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The early Cenomanian (Cretaceous) ammonite fauna from the Soeushinai area of Hokkaido, North Japan

(Studies of the Cretaceous ammonites from Hokkaido and Sakhalin-XCVII)

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Abstract: The ammonoid fauna from the main part of the Lower Cenomanian sedimentary series in the Soeushinai area of northwestern Hokkaido is prolific. It forms the assemblage of species here called the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone. It is situated above the basal Cenomanian *Graysonites wooldridgei* Zone and below the well traced *Mantelliceras saxbii* Zone. It, thus, represents the main part of the Lower Cenomanian Substage in the studied area. The correlation of this zone with otherwise defined zones, home and abroad, is discussed. Systematic descriptions are given for the zonal indices and several selected species.

Keywords: Ammonoid fauna, *Stoliczkaia* (*Lamnayella*), Cretaceous, Cenomanian, correlation, Hokkaido.

1. Introduction

The main part of the Lower Cenomanian Substage in Japan is represented by the *Mantelliceras japonicum* Assemblage Zone in the Ikushunbetsu Valley of the Mikasa district, central Hokkaido, as has been already described (Matsumoto *et al*., 1969). In the Soeushinai area of northwestern Hokkaido, the biostratigraphic unit correlated with the above zone is represented by another, dissimilar fauna. It is called here the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone.

In this paper the faunal constituents of this zone are explained and the correlation with otherwise named zones, home and abroad, is discussed. Also some variation within this area is mentioned.

The systematic descriptions are given to the zonal indices, *Stoliczkaia* (*Lamnayella*) *japonica* (Matsumoto, Kimura and Katto, 1952) and *S.* (*L.*) *sanctaecatherinae* Wright and Kennedy, 1978, and also certain other selected species. Many others have been already described.

2. *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone

Faunal constituents.—This zone is represented by *Stoliczkaia* (*Lamnayella*) *japonica* (Matsumoto, Kimura and Katto, 1952) and *S.* (*Lamnayella*) *sanctaecatherinae* Wright and Kennedy, 1978. In addition to them it contains *Stoliczkaia* (*Shumarinaia*) *asiatica* Matsumoto and Inoma, 1975, *S.* (*Shumarinaia*) *hashimotoi* Matsumoto and Inoma, 1975, *Marshallites kossmati* Matsumoto and Inoma, 1975, *M. rotundatus* Matsumoto and Takahashi, 1991, *Marshallites hayashii* sp. nov., *Eogunnarites unicus* (Yabe, 1904), *Sounnaites alaskaensis* (Matsumoto, 1959), *Zelandites inflatus* Matsumoto, 1959, *Z.* cf. *europea* Wright and Kennedy, 1984, *Gabbioceras yezoense* Shigeta, 1996, *Ficheuria pusilla* Matsumoto and Inoma, 1975, *Mariella* (*Mariella*) *oehlerti* (Pervinquière, 1910), *M.* (*M.*) *dorsetensis* (Spath, 1926), *M.* (*M.*) *pacifica* Matsumoto, Inoma and Kawashita, 1999, *M.* (*M.*) *gallieni* (Boule, Lemoine and Thevénin, 1907), *Anisoceras hashimotoi* Inoma, 1980, *Hamites japonicus* (Inoma, 1980), *Metaptychoceras pacificum* Inoma, 1980, *Sciponoceras matsumotoi* Inoma, 1980, *Scaphites japonicus* Inoma, 1980, and *Worthoceras pacificum* Matsumoto and Yokoi, 1987.

Some of the above species depended on the specimens in the transported nodules in the papers of Hashimoto *et al*. (1965), Matsumoto and Inoma (1975) and Inoma (1980). Subsequently the stratigraphic occurrences of the mega-fossils have been investigated more precisely by Nishida *et al*. (1996, 1997), Matsumoto *et al*. (1997), and also Matsumoto *et al*. (1999). Based on the further field works by Nishida and Matsumoto up to 2002, with the aid of Takashi Sakai, Jun Aizawa, Yoko Inoue and Toshio Shimanuki

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from time to time, it is now confirmed that almost all the species enumerated above are referable to the *S.* (*L.*) *japonica* Assemblage Zone.

Furthermore, the following species occur fairly commonly in the same zone, although they may range further upward and/or downward: *Phylloceras* (*Neophylloceras*) *seresitense* Pervinquière, 1907, *Partschiceras japonicum* (Matsumoto, 1942), *Desmoceras kossmati* Matsumoto, 1954, *Desmoceras japonicum* Yabe, 1904, *Anagaudryceras sacya* (Forbes, 1846), *A. whitneyi* (Gabb, 1869), *A. madraspatanum* (Stoliczka, 1865), *Gaudryceras yokoii* (Matsumoto, 1995), *Parajaubertella kawakitana* Matsumoto, 1942, *P. zizoh* Matsumoto, Yokoi and Kawashita, 1997, *Tetragonites* aff. *kitchini* (Krenkel, 1910), *T.* cf. *subtimotheanum* Wiedmann, 1962, *Marshallites cumshewaensis* (Whiteaves, 1884), *Mariella* (*M.*) *miliari*s (Pictet and Campiche, 1861), and *Mariella* (*M.*) cf. *carrancoi* (Böse, 1923). Especially, *Desmoceras kossmati* and *Marshallites cumshewaensis* occur abundantly in this zone, although they appeared already in the Upper Albian Substage.

The above enumerated species from the Soeushinai area were previously described by Matsumoto and Inoma (1975, 1991, 1999), Inoma (1980), Matsumoto and Yokoi (1987), Matsumoto and Kawashita (1995, 1998, 1999), and Matsumoto *et al.*, (1997, 1999). Moreover, several species of *Desmoceras* have been recently revised (Matsumoto and Nishida, 2004). We regard *D. poronaicum* Yabe, 1904 as a young form and junior synonym of *D. japonicum* Yabe, 1904 (page preference) and *D. kossmati* Matsumoto, 1954 as an independent species. Note that the result of the study on *Desmoceras* by Matsumoto and Nishida (2004) is different from that of Kawabe and Haggart (2003).

Type area.—The strata which are assigned to the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone are well traced in the meridional belt across the middle part of the main streams of the Nakamata-zawa, the Shumarinai River and a part of the Sanjussen-zawa. The main part of the Hotei-zawa and the upper reaches of the Sakin-zawa are included in this belt (Figs. 1-3).

The lower limit of this zone is immediately above the geochronologically measured tuff layer represented by the sample from Loc. R8943B, whereas *Graysonites wooldridgei* Young, 1958 and *Utaturiceras chrysanthemum* Matsumoto, Nishida and Toshimitsu, 2003 were obtained at Loc. R8943A immediately below R8943B (see Obradovich *et al.*, 2002; Matsumoto *et al.*, 2003). The upper limit of the *S.* (*Lamnayella*) *japonica* Assemblage Zone is demarcated by the biostratigraphic level characterized by the first occurrence of *Mantelliceras saxbii* (Sharpe). At this level there is another well traced layer of tuff. The radiometric ages of the samples from these two levels have been recently measured on the included sanidine by means of the ^{40}Ar-^{39}Ar layer fusion method, with the results 99.16 ± 0.37 Ma for the upper part of the *G. wooldridgei* Zone and 98.98 ± 0.38 Ma for the level of *M. saxbii*, respectively (Obradovich *et al.*, 2002). It follows that the time interval of the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone is slightly over 0.18 Ma, i.e., approximately 0.2 Ma.

It is amazing to know that in this geologically short time interval, there were some conditions which were favourable for many kinds of ammonoids to live somewhere within and around this area of deposition, and then some of their remains were transported for some distance and embedded in the sediments of the investigated area. Certain species of worldwide distribution may have migrated from a long distance.

Specimens in this zone are often incompletely preserved on account of the damage by predators or accidents during transportation, as well as the case of half ammonite preservation caused by a particular type of sedimentation in some part of the area under investigation. On the other hand, a considerable number of small, immature specimens of a single species are fairly well preserved within a single nodule (e.g., *Marshallites cumshewaensis* in a nodule of Loc. R449p in the Suribachi-zawa). In an extreme case, a nodule of moderate size contains a great number of tiny, very young specimens of a single species (e.g., *Desmoceras* sp. in a nodule (YKC101024p7) obtained by Y. Kawashita in the upper reaches of the Bishamon-zawa).

The above mentioned examples are concerned with ammonoid species belonging to the Desmoceratacеae. Anyhow, they suggest the mode of living in certain young stages not far from the hatching of this kind of ammonoids, although why they were killed at once and fossilized in a single nodule is another problem. The above is recorded here as one of the cases in the mode of ammonoid occurrence in this zone.

Additionally, it should be recorded that fragmentary pieces of terrestrial plants are sometimes intermingled with ammonoids in a nodule. On the other hand bivalves and gastropods are rather scanty in this zone, except for some particular kind of bivalves (unpublished, preliminary information by Masayuki Tashiro). Inoceramids are common.

Atypical part.—In the area along the middle course of the Sanjussen-zawa within the Soeushinai area, including its northern tributary Kaeru-no-sawa and southern one called the Yoshitaro-zawa, the faunal constituents of the *S.* (*L.*) *japonica* Assemblage Zone are somewhat different from those of the type area. In fact, *Stoliczkaia* (*Lamnayella*) *sanctaecatherinae* and *Gabbioceras yezoense* Shigeta were obtained by Kawashita and Egashira at about Loc. R3289 of this route, but there are some other species which have not yet been collected from the typical area of the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone.

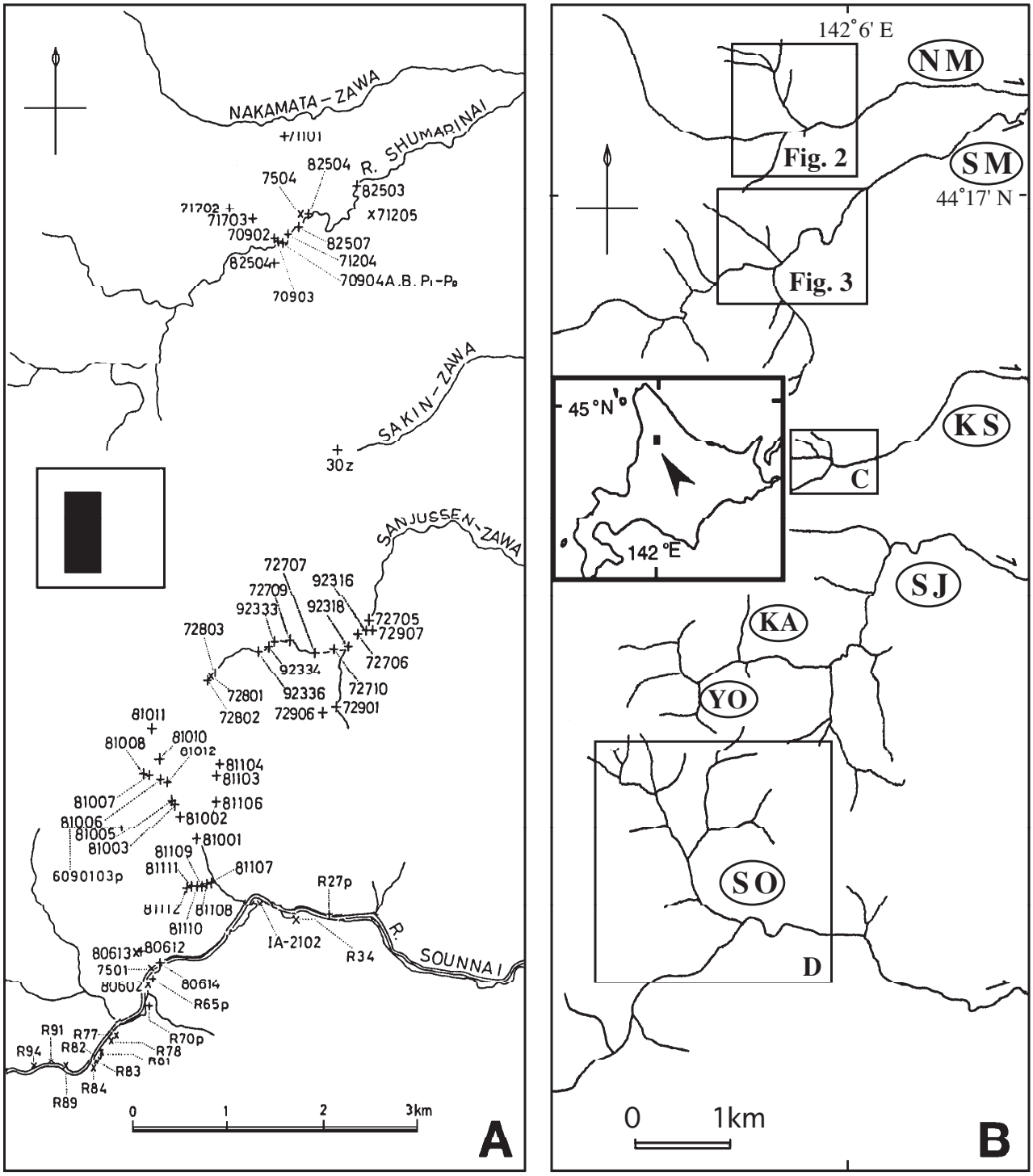


Fig. 1. Maps of the Soeushinai area, Hokkaido.

A. Map adopted from Matsumoto and Inoma, 1975, fig. 1 of *Mem. Fac. Sci., Kyushu Univ., ser. D*, **23**, by permission of the original authors and the Editor of the Memoir.

B. Index map showing the studied areas: Figs. 2 and 3 in this paper, C and D in Matsumoto *et al*., 2003, figs. 2 and 3. NM: Nakamata-zawa, SM: Shumarinai River, KS: Kyoei-Sakin-zawa, SJ: Sanjussen-zawa, KA: Kaeru-no-sawa, YO: Yoshitaro-zawa, SO: Sounnai River and its northern tributary Suribachi-zawa.
Latitude and longitude values are referred to the Japanese Terrestrial Reference Frame.

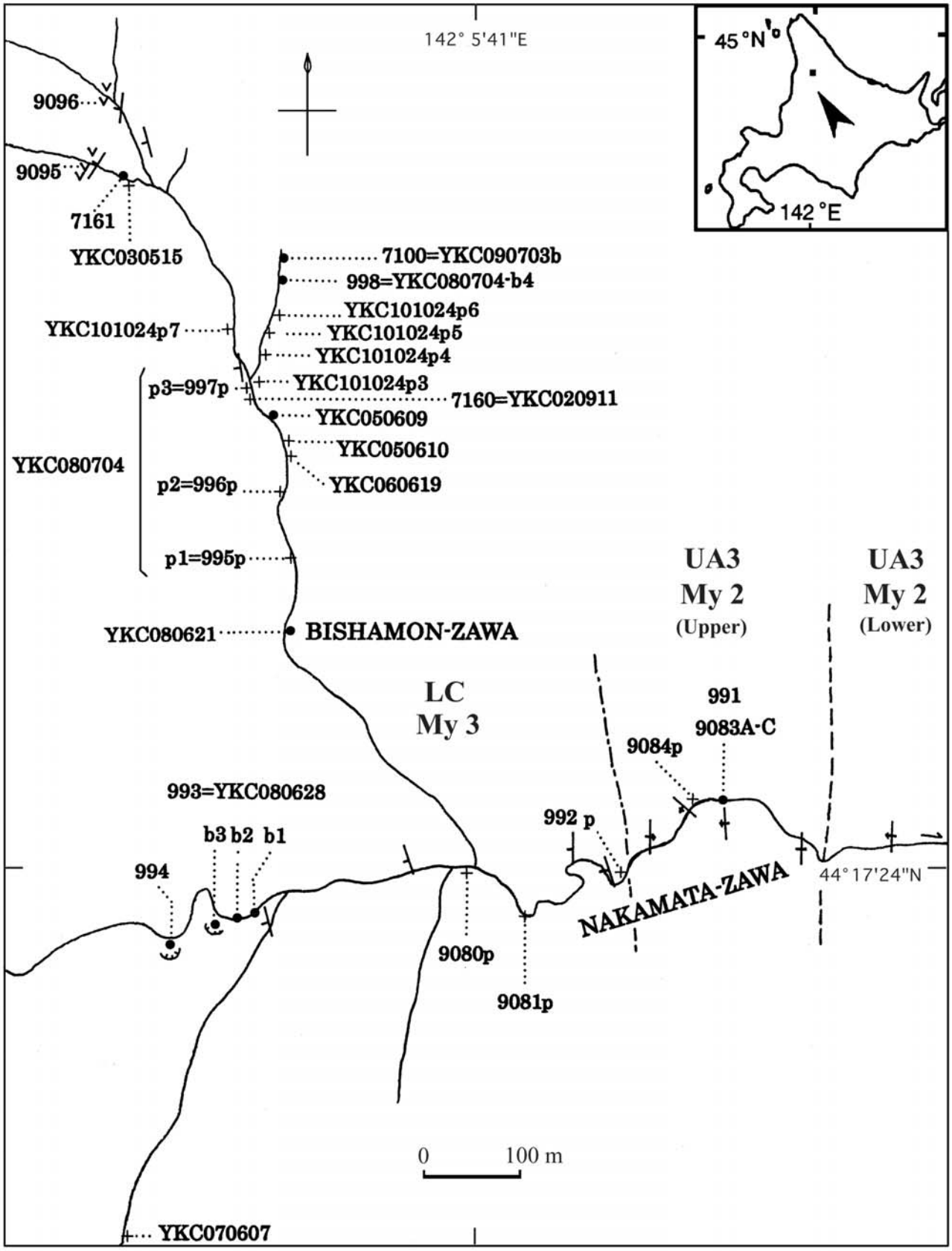


Fig. 2. Geological route map of the Nakamata-zawa (part) and its tributaries. See legend attached to Fig. 3. Latitude and longitude values are referred to the Japanese Terrestrial Reference Frame.

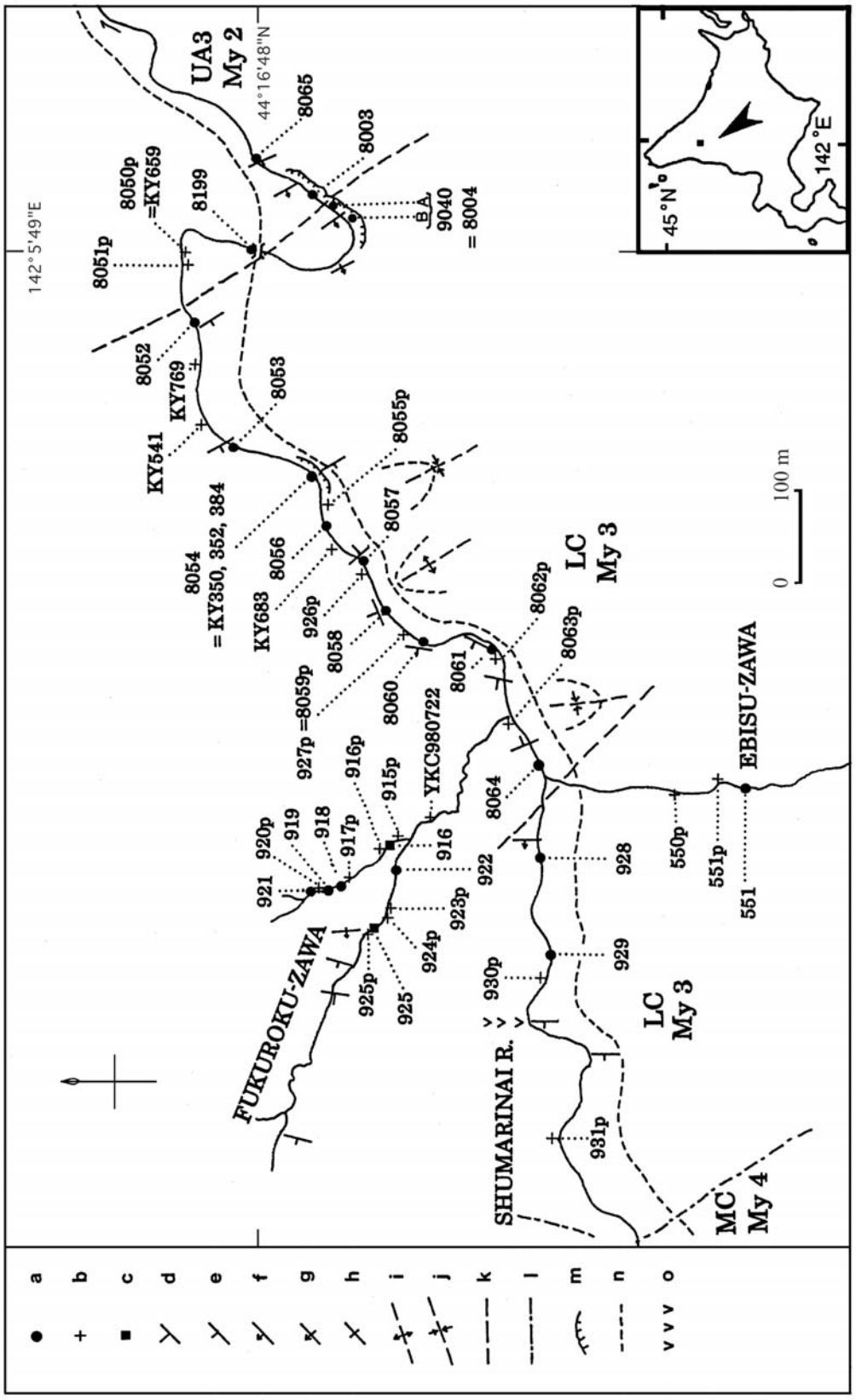


Fig. 3. Geological route map of the Shumarinai River (part) and its tributaries.
Legend (for Figs. 2 and 3).
a: (mega-) fossil sample (in situ); b: ditto (fallen or transported); c: rock sample; d-h: general attitude of strata, in which dip angle is low (d), moderate (e), fairly high (f), very high (g), and vertical (h); i: anticline; j: syncline; k: inferred fault; l: boundary of members; m: cliff; n: jeepable road; o: tuff.
My2 = the second member of the Middle Yezo Group in ascending order, which is referred to the third one of the tripart units of the Upper Albian Substage, briefly marked as UA3. My3 and My4 = the third and fourth members of the Middle Yezo Group, which are referred to the Lower and Middle Cenomanian (LC and MC) Substages.
Latitude and longitude values are referred to the Japanese Terrestrial Reference Frame.

What we call the species of atypical fauna are *Mesoturrilites boerssumensis* (Schlüter, 1876) (see Matsumoto and Inoma, 1999, p. 38, figs. 2, 3), *Sharpeiceras mocambiquense* (Choffat, 1903) (Fig. 19), *Sharpeiceras* cf. *kongo* Matsumoto, Muramoto and Takahashi, 1969 (Fig. 20), *Mantelliceras lymense* (Spath, 1926) (Fig. 18), *Euhystrichoceras nicaisei* (Coquand, 1862) and *Algericeras* cf. *proratum* (Coquand, 1880). They have not yet been found in the typical area of the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone, although they are probably contemporary with the latter. It should be noted that they consist of cosmopolitan elements. This means that the fauna may represent an offshore open sea environment in comparison with the typical fauna of the *S.* (*L.*) *japonica* Assemblage Zone. Incidentally, the last two Coquand's species from the Sanjussen-zawa route are to be described later by another authorship.

3. Correlation

The upper limit of the *S.* (*L.*) *japonica* Assemblage Zone is demarcated by *Mantelliceras saxbii*, which forms so far a particular zonule in the upper part of the lower Cenomanian sequence of strata in Hokkaido. For instance, *M. saxbii* is found in the Ikushunbetsu Valley of the Mikasa district, where it demarcates the upper limit of the *Mantelliceras japonicum* Assemblage Zone (Matsumoto *et al.*, 1969), which represents the main part of the lower Cenomanian in that classical area.

Below the *S.* (*L.*) *japonica* Assemblage Zone in the Soeushinai area, there is some thickness of the basal Cenomanian sediments which are assigned to the *Utaturiceras vicinale-Graysonites wooldridgei* Zone, as has been recently reported (Matsumoto *et al.*, 2003). In the Mikasa district there is a unit (about 40 m) of sandy siltstone above the late Albian sandstone and mudstone of turbidite facies. From this unit, which contains *Desmoceras kossmati* Matsumoto, poorly preserved specimens of *Graysonites* and *Utaturiceras* have been occasionally found.

The *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone in the Soeushinai area of northwestern Hokkaido is, thus, correlated with the *Mantelliceras japonicum* Assemblage Zone in the Mikasa district of central Hokkaido. The difference in the faunas between the two areas is mainly due to the environmental conditions. Namely, the Mikasa Formation is generally sediments of shallower, near shore environments, although some ammonites of offshore environments may have been transported there.

As to the correlation with northwest Europe, we should take into consideration not only the species of *Stoliczkaia* (*Lamnayella*) but also other constituents of the assemblage zone. For some reasons few species of *Mantelliceras* are available, but several species of *Mariella* occur fairly frequently in this zone and are useful for the interregional correlation. They have been already described (Matsumoto and Kawashita, 1999; Matsumoto *et al.*, 1999). On these grounds the *S.* (*L.*) *japonica* Assemblage Zone is correlated with the main part of the *Neostlingoceras carcitanensis* Zone and the succeeding *Sharpeiceras schlueteri* Zone (Kennedy *in* Gale *et al.*, 1996) of NW Europe, provided that the basal Cenomanian *Graysonites wooldridgei* Zone is lacking or hardly recognized in NW Europe for some paleobiogeographic, environmental and/or sedimentological reasons (see Matsumoto *et al.*, 2003, p. 155).

4. Conventions

Repositories.—The specimens treated in this paper are registered at the following institutions with abbreviated headings: GK = The Kyushu University Museum, 6-10-1 Hakozaki, Fukuoka, 812-8581; GS = Geological Collections, Faculty of Culture and Education, Saga University, 1 Honjo-machi, Saga 840-8502; TKD = Institute of Geoscience, the University of Tsukuba, 1-1-1 Tennodai, Tsukuba 305-8571; GSJ = Geological Museum of the Geological Survey of Japan, AIST, 1-1-1 Higashi, Tsukuba 305-8567; MCM = Mikasa City Museum, 1-212-1, Ikushunbetsu Nishiki-cho, Mikasa 068-2111. Furthermore, the collections of the late Katsujo Yokoi [abbreviated as KY], are to be donated to the Nakagawa Museum of Natural History [abbreviated NM], 28-9 Yasukawa, Nakagawa-machi, Hokkaido 098-2626, except for certain specimens which had been already presented to the Kyushu University Museum. In both cases the specimens are listed, together with K. Yokoi's original numbers. Likewise, the collections of the late Yoshitaro Kawashita are to be donated to the National Science Museum, 3-23-1 Hyakunin-cho, Shinjuku-ku, 169-0073 Tokyo, but in this paper the specimens are numbered under YKC (Y. Kawashita's Collections), together with the numbers under GS (Saga University), where the specimens have been studied by us. The specimens with the register number under GS in this paper are to be removed to and kept at the Kyusyu University Museum before T.Nishida's retirement from Saga University.

Measurements.—The following abbreviations are used in the table of measurements and also in the text. M = measured position; A = apertural end; E = preserved end at some distance from A; LS = last septum (i.e., the end of phragmocone); D = diameter of shell; U = diameter of umbilicus; H = whorl height; B = whorl breadth; R+r = number of primary and that of secondary ribs in the last half whorl. It should be noted that a measured value is based on the actual specimen, even if the specimen is secondary deformed to some extent.

Selection of the species to be described.—In the next chapter of systematic paleontology, the two zonal in-

dices of *Stoliczkaia* (*Lamnayella*) are described. Among the atypical elements, one species of *Mantelliceras* and two species of *Sharpeiceras* are illustrated with short remarks. In addition, a new species of *Marshallites* is established, and three gaudryceratid species are revised.

5. Systematic paleontology

Order Ammonoidea Zittel, 1884
Superfamily Acanthocerataceae Grossouvre, 1894
Family Lyelliceratidae Spath, 1921
Genus ***Stoliczkaia*** Neumayr, 1875
Subgenus ***Stoliczkaia* (*Lamnayella*)** Wright and Kennedy, 1978

Type species.—*Stoliczkaia* (*Lamnayella*) *juigneti* Wright and Kennedy, 1978 (p. 398, pl. 37, figs. 1-10, pl. 38, figs. 1-12), by original designation.

Diagnosis.—Shell dimorphic, small or medium-sized even at maturity of macroconch, with fastigiate and feebly trituberculate venter in youth and evenly rounded later. Ribs weakly flexed, rather crowded, long and short alternated and/or branched at least in early growth stage, with umbilical bullae on the primaries, becoming distant and moderately strong when mature, tending to have less frequent or no secondaries (modified from Wright and Kennedy, 1978, p. 394).

Occurrence.—Several species of this subgenus have been reported from the lower part of the Cenomanian Stage in England, France, Romania, southern India, Japan, Texas and Mexico.

Remarks.—Two species occur in Japan, *S.* (*L.*) *japonica* (Matsumoto, Kimura and Katto, 1952) and *S.* (*L.*) *sanctaecatherinae* Wright and Kennedy, 1978. The former is a senior synonym of *S.* (*Stoliczkaia*) *amanoi* Matsumoto and Inoma, 1975, as explained below.

Stoliczkaia* (*Lamnayella*) *japonica (Matsumoto, Kimura and Katto, 1952)

(Figures 4—12)

Synonymy.—

Kazanskyella(?) *japonica* Matsumoto, Kimura and Katto, 1952, p. 182, pl. 13, fig. 2; *Stoliczkaia* (*Stoliczkaia*) *amanoi* Matsumoto and Inoma, 1975, p. 271, pl. 38, figs. 2-4; *Stoliczkaia* (*Stoliczkaia*) cf. *clavigera* Neumayr; Matsumoto and Inoma, 1975, p. 267, pl. 38, fig. 1; text-fig. 4; *Stoliczkaia* (*Lamnayella*) *amanoi* Matsumoto and Inoma; Nishida *et al.*, 1996, pl. 17, figs. 3, 4 (without description).

Material.—Holotype GK.H4022 (Fig. 4) from the Susaki Formation (Katto, 1952), southern Shikoku. For its location see Matsumoto *et al.*, 1952, fig. 1. GK.H4214 (Fig. 5), holotype of *S.* (*L.*) *amanoi*, collected by M. Amano from Member IIe of the Goshonoura Group, Shishi-jima, southwestern Kyushu.

In addition to the three specimens treated previously by Matsumoto and Inoma (1975, p. 271, pl. 38, figs. 2-4), the following specimens from the Soeushinai area are referred to this species: KY384 [to be preserved at NM, and its plaster cast kept at GSJ F16088] (Fig. 6) collected by K. Yokoi at Loc. R8054, right bank of the Shumarinai River; GK.H8623 [= KY681; its plaster cast kept at GSJ F16089] (Fig. 7) collected by K. Yokoi from the upper reaches of the Ebisu-zawa; GS.G282 (Fig. 8) collected by T.N. and T.M. with the aid of Y. Kawashita and T. Shimanuki at Loc. R9040 of the Shumarinai River; TKD30596 (Fig. 9) collected by W. Hashimoto from Loc. 82507p of the Shumarinai River; previously described under *Stoliczkaia* (*Stoliczkaia*) cf. *clavigera* Neumayr by Matsumoto and Inoma (1975, p. 267, pl. 38, fig. 1; text-fig. 4). KY556 [to be preserved at NM] (Fig. 10) collected by K. Yokoi from the upper reaches of the Suribachi-zawa; GK.H8406 [= KY790; its plaster cast kept at GSJ F14895] (Fig. 11) collected by K. Yokoi at Loc. R505 of the Suribachi-zawa as a fallen block. Its ventral part of the body chamber is severely eroded away, but the external suture (Fig. 12) is well shown near the end of phragmocone. GS.G276 collected by T.N. and T.M. at Loc. R8071 of the Hotei-zawa. Also GK.H8517 collected by T.M. at Loc. Y534Ep1, Tengu-zawa of the Shuparo area, Yubari Mountains.

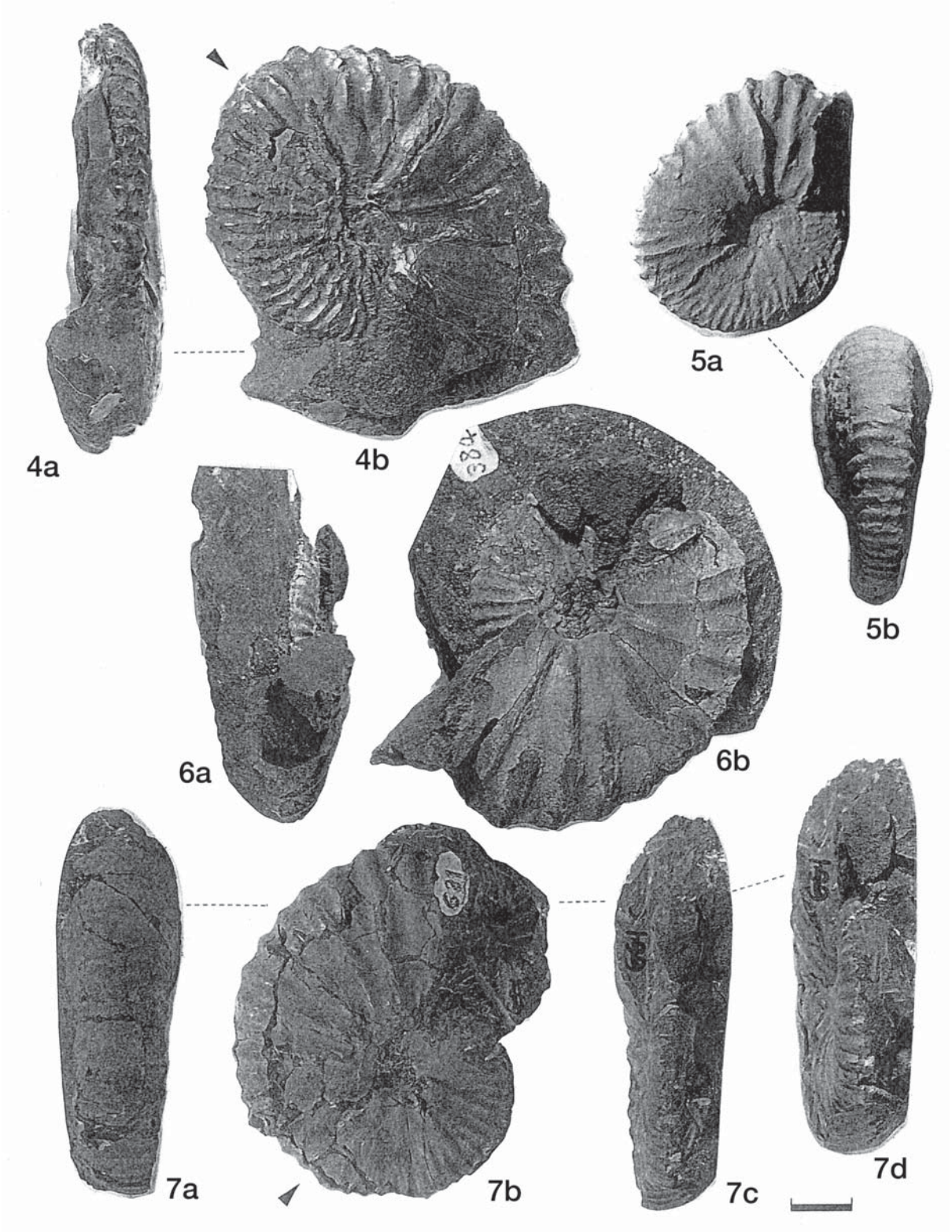
Diagnosis.—Dimorphic. Microconch about 60 mm in diameter, with narrow umbilicus; whorls higher than broad; ribs fairly crowded and of unequal length on phragmocone, with umbilical tubercle on each major one; ventral part trituberculate in youth. Ribs on the adult body chamber coarsen and less crowded but still alternately long and short.

Macroconch about 90 mm in diameter, tending to become fairly broadly umbilicate in the late growth stage. Ribs on the adult body chamber much coarsen but still alternately long and short. They may weaken in the last portion.

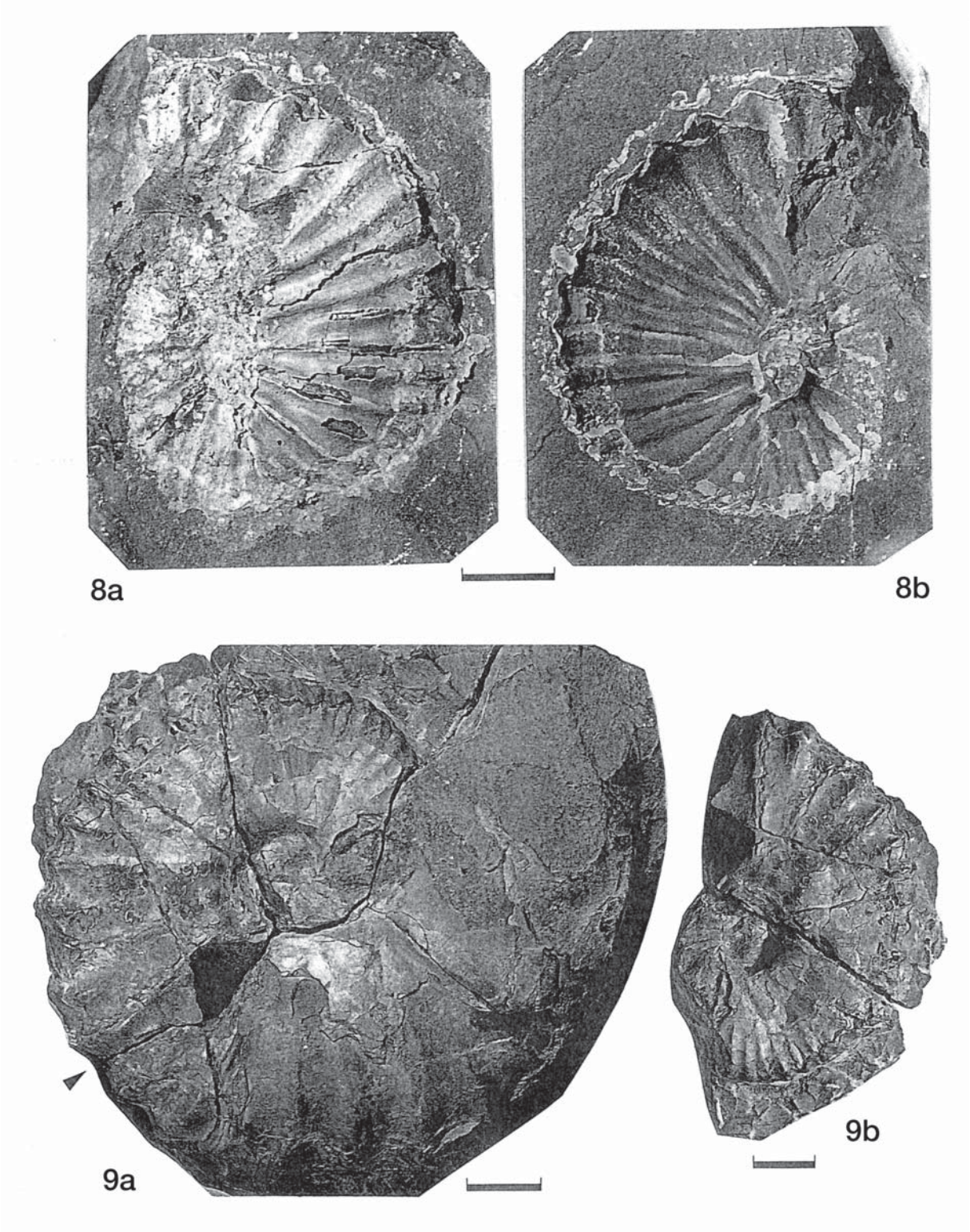
Suture moderately incised in the late growth stage (Fig. 12; also Matsumoto and Inoma, 1975, fig. 4).

Dimensions.—See Table 1.

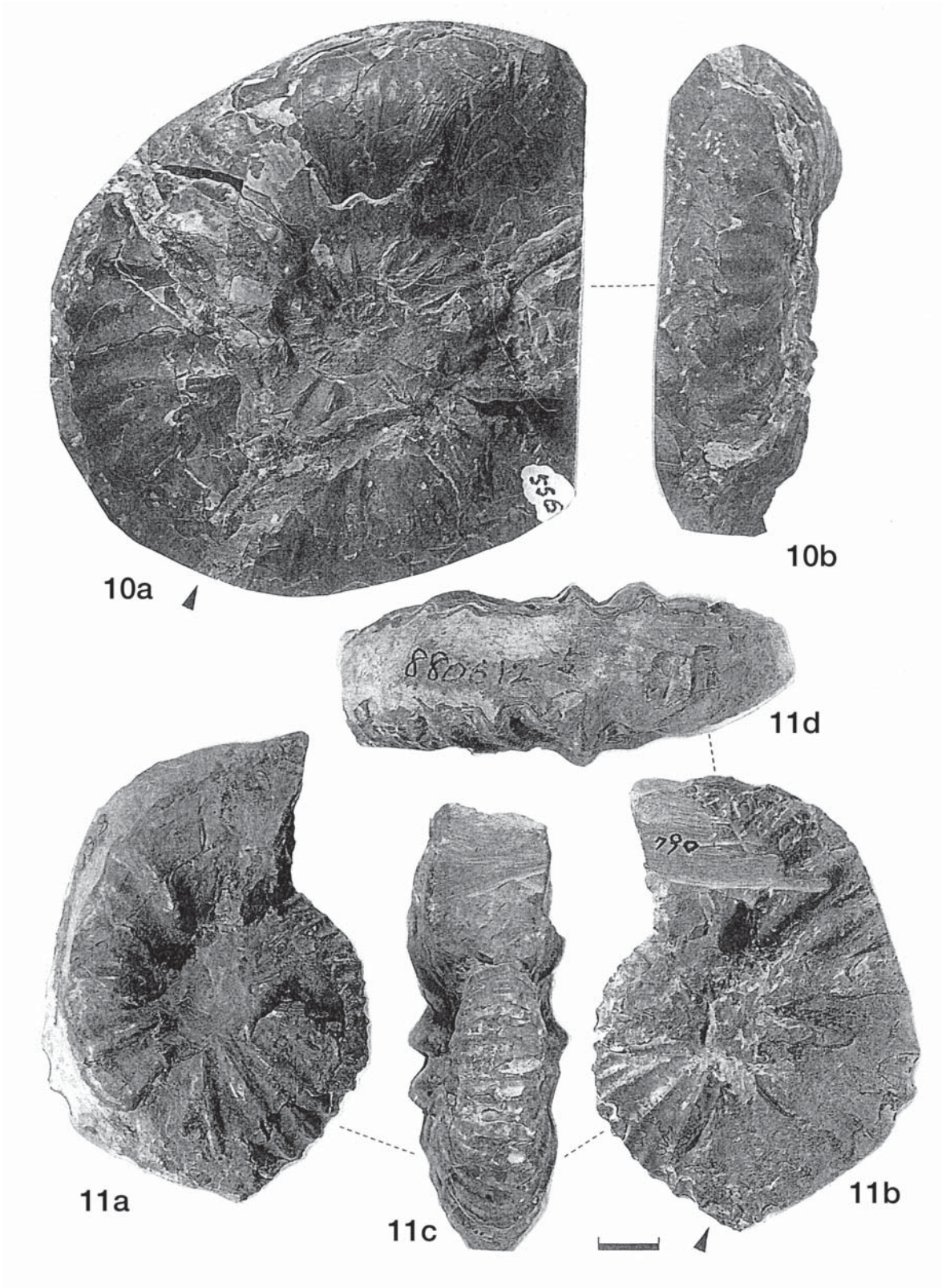
Description.—The previous description of *Stoliczkaia* (*Stoliczkaia*) *amanoi* Matsumoto and Inoma (1975, p. 271) is available for the microconch of the present species and that of *S.* (*S.*) cf. *clavigera* Neumayr in the same paper (Matsumoto and Inoma, 1975, p. 267, pl. 38, fig. 1; text-fig.4) is so for the macroconch, although in both cases the three rows of tiny tubercles on the ventral part of the septate stage were overlooked. Carefully reexamined, they do exist and the species should be referred to *Stoliczkaia* (*Lamnayella*) Wright and Kennedy, 1978.



Figs. 4-7. *Stoliczkaia* (*Lamnayella*) *japonica* (Matsumoto, Kimura and Katto).
Examples of microconchs. 4: GK.H4022, holotype from Shikoku, in the state of half ammonite preservation. Ventral (a) and left lateral (b) views. 5: GK.H4214, from Kyushu. Left lateral (a) and ventral (b) views. This was the holotype of *Stoliczkaia amanoi* Matsumoto and Inoma, 1975. 6: KY384 [to be preserved at NM], from Loc. KY350 [= Loc. R8054], south bank of the Shumarinai River. Ventral view of the phragmocone (a) and left lateral view (b) of the whole specimen in the state of half ammonite preservation. 7: GK.H8623 [= KY681] from a transported nodule in the upper reaches of the Ebisu-zawa. Ventral (a), left lateral (b), early apertural (c) and late apertural (d) views. Scale bar = 10 mm. Arrow: end of phragmocone. Photos courtesy of M. Noda.



Figs. 8-9. *Stoliczkaia* (*Lamnayella*) *japonica* (Matsumoto, Kimura and Katto).
8: GK.H8627 [= GS.G282] from Loc. R9040 of the Shumarinai River. Right side of the actual specimen (a) and its external mold (b) of an enlarged microconch. 9: TKD 30596, from Loc. 82507p (A. Inoma) of the Shumarinai River. Right side of the entire shell (a), and isolated part of the phragmocone (b). Scale bars = 10 mm. Photos by T.N. (8) and M. Noda (9).



Figs. 10-11. *Stoliczkaia* (*Lamnayella*) *japonica* (Matsumoto, Kimura and Katto).
Examples of macroconch. 10: KY556 [to be preserved at NM], from the upper reaches of the Suribachi-zawa, left side (a) and ventral (b) views. 11: GK.H8406 [= KY790] collected by K. Yokoi at Loc. R505 of the Suribachi-zawa, left lateral(a), right lateral (b), apertural (c) and ventral (d) views; ventral part is highly eroded. Scale bar = 10 mm.

Table 1. Measurements of *Stoliczkaia* (*Lamnayella*) *japonica* (Matsumoto, Kimura and Katto).

Specimen	M	D	U	U/D	H	B	B/H	R+r
GK.H4022	A-20°	68.0	13.0	.19	32.5	14+α	>.43	8+6
〃	A-200°	48.0	—	—	27.0	12+α	>.44	11+10
GK.H8623	A	62.0	10.5	.17	31.0	19.0	.61	7+7
〃	A-180°	38.0	6.0	.16	20.0	14.0	.70	6+17
TKD30596	A	84.0	23.0	.27	35.0	—	—	6+6
〃	A-180°	60.0	13.0	.22	28	16+α	>.57	8+12

Dimorphic pair is evident in the previously described species of *S.* (*Lamnayella*) from Europe and Texas, as Wright and Kennedy (1978) demonstrated. This can be applied also to the material from Japan. The holotype of *S.* (*L.*) *japonica* is a microconch. The larger specimens, which have similar characters with the smaller ones in youth but show somewhat modified features at the late growth stage, are regarded as macroconchs.

The specimens illustrated in Figs. 4-8 are examples of microconchs and those in Figs. 9-10 are regarded as macroconchs. GK.H8406 [= KY790] (Fig. 11) is questionable, for it is much distorted and its outer whorl is deficient. It could be, however, regarded as a somewhat smaller macroconch.

Discussion.—The holotype of this species was referred to the genus *Kazanskyella* Stoyanow, 1949, with a query (Matsumoto *et al.*, 1952, p. 182), but *Kazanskyella* should have prorsiradiate, rigid ribs and poorly incised, shallow L in the suture. Moreover, the three rows of tiny tubercles on the ventral part of the immature whorl were overlooked in the original description.

On the ground of diagnostic characters, the specific identity between the holotype from Shikoku and more numerous specimens from Hokkaido and S.W. Kyushu, recently called *Stoliczkaia* (*Lamnayella*) *amanoi* (Matsumoto and Inoma, 1975) (see Nishida *et al.*, 1996, pl. 17, figs. 3, 4) is undoubted. Thus, the correct specific name should be *Stoliczkaia* (*Lamnayella*) *japonica* (Matsumoto, Kimura and Katto, 1952).

Comparison.—The microconch of this species resembles that of *S.* (*L.*) *juigneti* Wright and Kennedy (1978, p. 398, pl. 37, figs. 5, 6; pl. 38, figs. 1-12), from the Lower Cenomanian Substage of the Anglo-Paris basin, but the former is more involute, with its whorl height increasing more rapidly, and provided with denser ribs on the phragmocone.

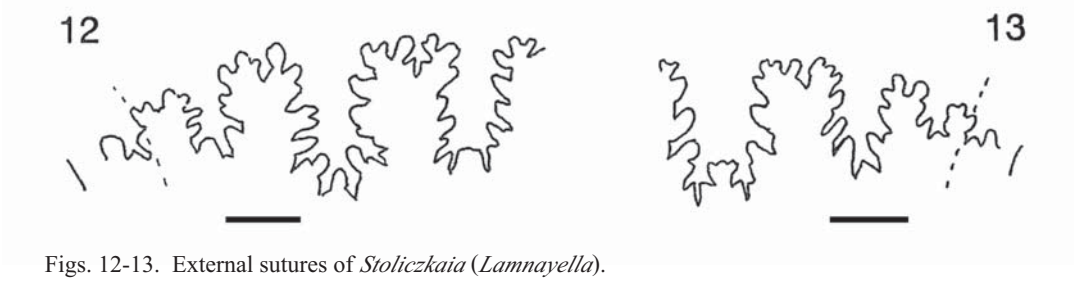
The macroconch of this species is somewhat larger than that of *S.* (*L.*) *juigneti* Wright and Kennedy (1978, p. 398, pl. 37, figs. 1-4; 7-10) and its ribs are denser on the phragmocone and continue to be alternately long and short even on the adult body chamber.

Occurrence.—The described specimens were collected from the main part of the lower Cenomanian Member My3 in the Soeushinai area, N.W. Hokkaido. Some others from the correlatable part in the Shuparo area, central Hokkaido; also in Shikoku and Kyushu, S. W. Japan.

Stoliczkaia* (*Lamnayella*) *sanctaecatherinae Wright and Kennedy, 1978

(Figures 13-17)

Synonymy.—*Stoliczkaia* (*Lamnayella*) *sanctaecatherinae* Wright and Kennedy, 1978, p. 402, pl. 38, figs. 13-16, 22, 23; pl. 39, figs. 9-11; text-fig. 4a-c; Wright and Kennedy, 1984, p. 78, pl. 10, figs. 12, 14, 15; text-fig. 11B; Nishida *et al.*, 1996, pl. 17,



Figs. 12-13. External sutures of *Stoliczkaia* (*Lamnayella*).
12: *S.* (*L.*) *japonica*, near the end of phragmocone of KY790. 13: *S.* (*L.*) *sanctaecatherinae*, last suture of GK.H8407 [= KY350]. Scale bars = 10 mm. Drawing by T.M.

figs. 1, 2 (without description).

Material.—GK.H8407 [= KY350; its plaster cast kept at GSJ F14893] (Figs. 13 and 14) collected by K. Yokoi at Loc. R8054, right bank of the Shumarinai River; GS.G103 [= YKC 060617] (Fig. 15) collected by Y. Kawashita *in situ* at a locality near R7239p in the upper reaches of the Sanjussen-zawa; GS.G275 [= YKC 050610] (Fig. 16) collected by Y. Kawashita at Loc. R997p in the Bishamon-zawa, northern branch of the Nakamata-zawa; GS.G274 [= YKC 030515] collected by Y. Kawashita from the Bishamon-zawa; GS.G273 [= YKC 040805p; its plaster cast kept at GSJ F16095], collected by Y. Kawashita at Loc. R520 of the Suribachi-zawa; GK.H8408 [= KY768; its plaster cast kept at GSJ F14889] (Fig. 17) collected by K. Yokoi at Loc. R8926p of the Kyoei-Sakin-zawa, GS.G301 collected by T.N. at Loc. R8944 of the Kyoei-Sakin-zawa.

Diagnosis.—See Wright and Kennedy, 1978, p. 402.

Dimensions.—See Table 2.

Description.—Fairly numerous specimens from the Soeushinai area are available. They are mostly referable to microconchs, of which GK.H8407 (Fig. 14) is a well preserved phragmocone plus a posterior position of the body chamber. GS.G103 (Fig. 15) can be regarded as an example of macroconch.

The external suture, as shown in GK.H8407 (Fig. 13) is essentially similar to that of *S.* (*L.*) *japonica* (Fig. 12).

Occurrence.—The specimens obtained *in situ* are from the *S.* (*L.*) *japonica* Assemblage Zone, main part of the Lower Cenomanian Substage in the Soeushinai area of northwestern Hokkaido. Some others in the fallen or transported nodules are interpreted to have been derived from the same zone on the evidence of associated species.

Family Acanthoceratidae Grossouvre, 1894

Genus ***Mantelliceras*** Hyatt, 1903

Type species.—*Ammonites mantelli* J. Sowerby, 1814, by original designation (Hyatt, 1903, p. 113).

Diagnosis.—See Wright and Kennedy, 1984, p. 97.

Occurrence.—Specimens of *Mantelliceras* are rather rare in the typical part of the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone. Above this zone, in the upper part of the Lower Cenomanian Substage, the specimens referable to *M. saxbii* (Sharpe, 1857) occurs commonly, but the specimens are often deficient. In the presumably lower or possibly lowest part of the Cenomanian Stage a specimen referable to *M. lymense* (Spath, 1926) occurred. It is described here, although it may not be a member of the *S.* (*L.*) *japonica* Assemblage Zone.

Mantelliceras lymense (Spath, 1926)

(Figure 18)

Lectotype.—*Acanthoceras martimpreyi* Coquand; Pervinquière, 1907, p. 289, pl. 16, fig. 16, as designated by Wright and Kennedy, 1984, p. 102, text-fig. 24A, B.

Material.—GS.G210 from Loc. R8411p, eastern branch of the upper reaches of the Yoshitaro-zawa, a southern tributary of the upper course of the Sanjussen-zawa.

Description.—About 65 mm in diameter at the end of the better preserved part; succeeding last part of about a quarter whorl is much destroyed. Whorls are subrounded in section, nearly as high as broad, with rounded venter.

Ribs are rather crowded, nearly radial without flexuosity; long and short ones are alternated; occasionally two shorter ones intercalated. Long ribs start from the bullate umbilical tubercles. On the outer whorl lateral and inner ventrolateral tubercles are undeveloped; only outer ventrolateral tubercles are discernible. Inner ventrolateral tubercles may be faintly observable on the small whorl of the young stage (see Fig. 18d).

Remarks.—Although the right side of the outer whorl is incompletely preserved, this specimen is well comparable with such specimen of *M. lymense* as shown by Wright and Kennedy, 1984, pl. 22, fig. 5a-c and the small inner whorl is comparable with another one illustrated in the same plate (pl. 22, fig. 4a-c).

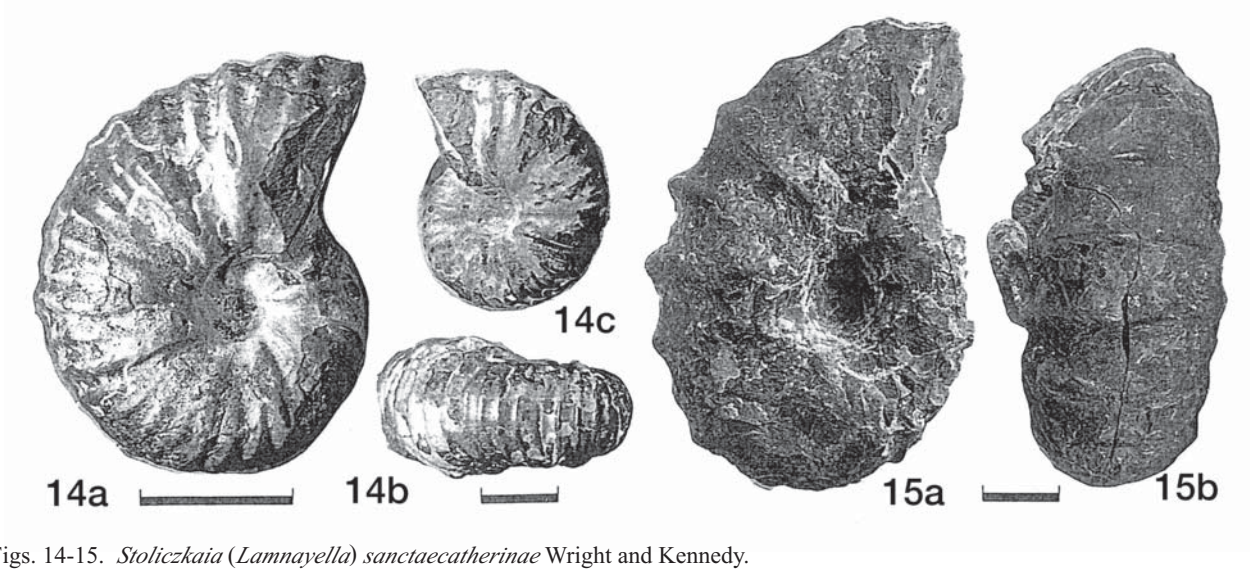
Our specimen is comparable in size with an example figured by Wright and Kennedy, 1984, pl. 22, fig. 5, which was regarded as an example of microconch.

Occurrence.—The described specimen did not occurred *in situ* from the exposed rock. It was in a fallen or transported nodule in which a small specimen of *Desmoceras kossmati* is contained. At another locality near this point *Graysonites adkinsi* Young, 1958 was found, although it was again in a fallen or transported nodule. Anyhow, it is highly possible that these specimens may have derived from the basal part of the Cenomanian Stage as in the case of the preceding paper (Matsumoto *et al.*, 2003). As an addition to that paper this is recorded here.

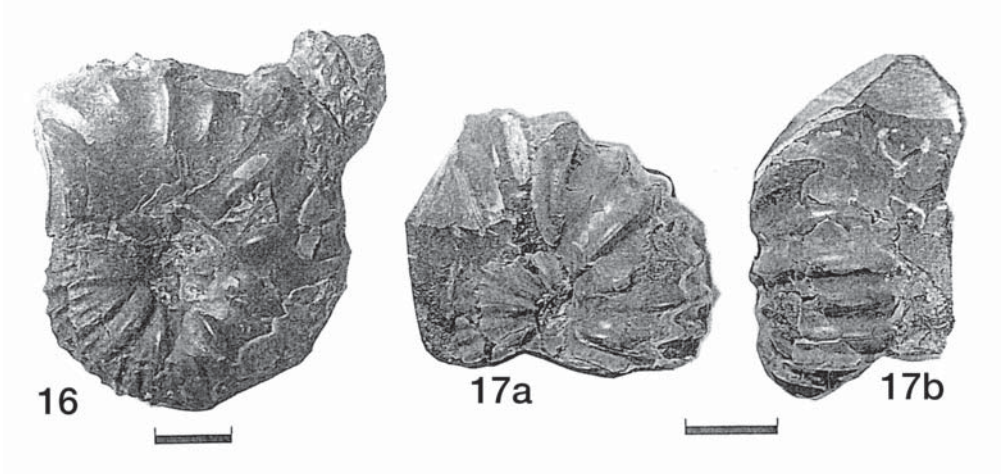
Genus ***Sharpeiceras*** Hyatt, 1903

Type species.—*Ammonites laticlavius* Sharpe, 1855 (p. 31, pl. 14, fig. 1) by original designation of Hyatt (1903, p. 111).

Remarks.—For the generic diagnosis, see Wright and Kennedy (1984, p. 126) and Wright *in* Wright, with Callomon and Howarth (1996, p. 154).



Figs. 14-15. *Stoliczkaia* (*Lamnayella*) *sanctaecatherinae* Wright and Kennedy.
14: GK.H8407 [= KY350] from Loc. R8054, south bank of the Shumarinai River. a: left lateral view (enlarged); b and c: right lateral and ventral views. 15: GS.G103 [= YKC060617] *in situ* near Loc. R7239p, upper reaches of the Sanjussen-zawa. Left lateral (a) and dorsal (b) views of a macroconch. Scale bars = 10 mm. Photos by N. Egashira.



Figs.16-17. *Stoliczkaia* (*Lamnayella*) *sanctaecatherinae* Wright and Kennedy.
16: GS.G275 [= YKC050610] from a point 80 m south of Loc. R997p, Bishamon-zawa, northern tributary of the Nakamata-zawa. Fragmentary piece of *Mariella* (*M.*) *lewesiensis* is attached; 17: GK.H8408 [= KY768] from Loc. R8926p, upper reaches of the Kyoei-Sakin-zawa, left lateral (a) and ventral (b) views. Scale bar = 10 mm. Photos by N. Egashira.

Table 2. Measurements of *Stoliczkaia* (*Lamnayella*) *sanctaecatherinae* (Wright and Kennedy).

Specimen	M	D	U	U/D	H	B	B/H	R+r
Holotype	E	47.7	12.9	.27	18.8	20.3	1.08	
GK.H8407	E	30.0	5.5	.18	15.0	16.5	1.10	6+9
GS.G103	E	60.0	15.0	.25	25.0	27.0	1.08	5+4

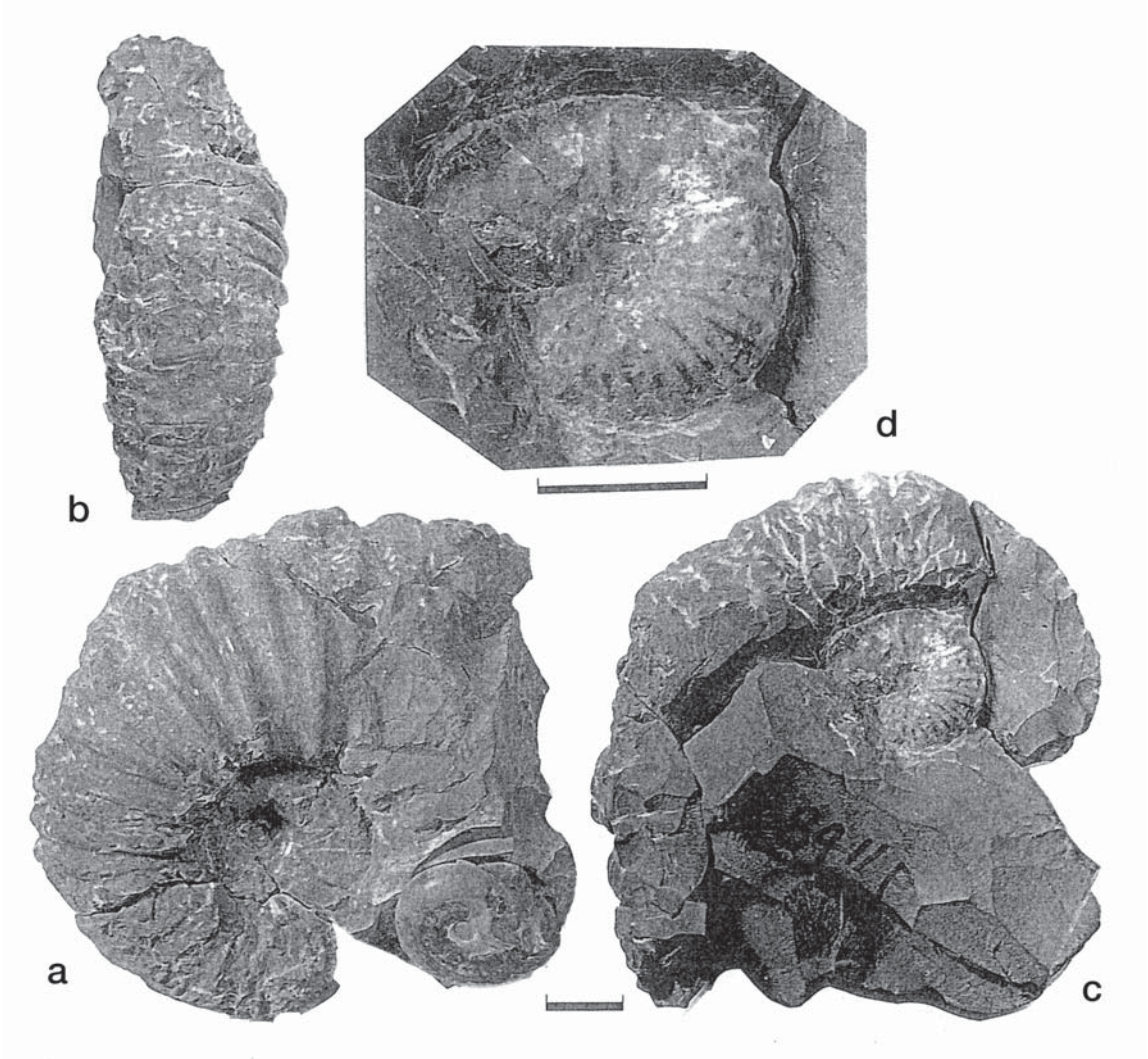


Fig. 18. *Mantelliceras lymense* (Spath).
Left lateral (a) and ventral (b) views of the outer whorl; right lateral view of the inner whorl (c, d). GS.G210, from Loc. R8411p. A young shell of *Desmoceras* (*Pseudouhligella*) *kossmati* Matsumoto is obliquely shown at the lower right corner of the nodule. Scale bar = 10 mm.

Sharpeiceras mocambiquense (Choffat, 1903)

(Figure 19)

Synonymy.—

Acanthoceras laticlavium Sharpe var. *mocambiquensis* Choffat, 1903, p. 25, pl. 4, fig. 3a, b and pl. 7, fig. 1a, b; *Sharpeiceras* aff. *S. vohipalense* Collignon; Matsumoto and Suekane, 1987, p. 3, pl. 1, figs. 1-3; *Sharpeiceras mocambiquense* (Choffat, 1903); Matsumoto and Toshimitsu, 1998, p. 624, pls. 2, 3.

Holotype.—The original specimen described and illustrated by Choffat (1903, *vide supra*), from Conducia, northeastern Mozambique.

Material.—GS.G296 collected by T.N. and others at Loc. R8602p, Kaeru-no-sawa, a northern tributary of the Sanjussen-zawa.

Description.—This is a gigantic specimen, 495 mm in costal diameter at the end of the phragmocone. On the assumption that its lost body chamber is half a whorl, the entire shell diameter is estimated at nearly 600 mm. The specimen is in the state of half-ammonite preservation; but its whorl is somewhat higher than broad and subrectangular in costal section and subelliptical in intercostal section. The umbilical ratio (U/D) is 0.31～0.32.

The shell is ornamented by slightly prorsiradiate ribs which are separated by wider interspaces. The ribs number 9 or 10 per half whorl. The tubercles on the ribs are in five rows: peri-umbilical, inner and outer lateral, and also inner and outer ventrolateral. Some of the lateral tubercles are weaker than others. The umbilical tubercles are bullate; the inner ventrolateral

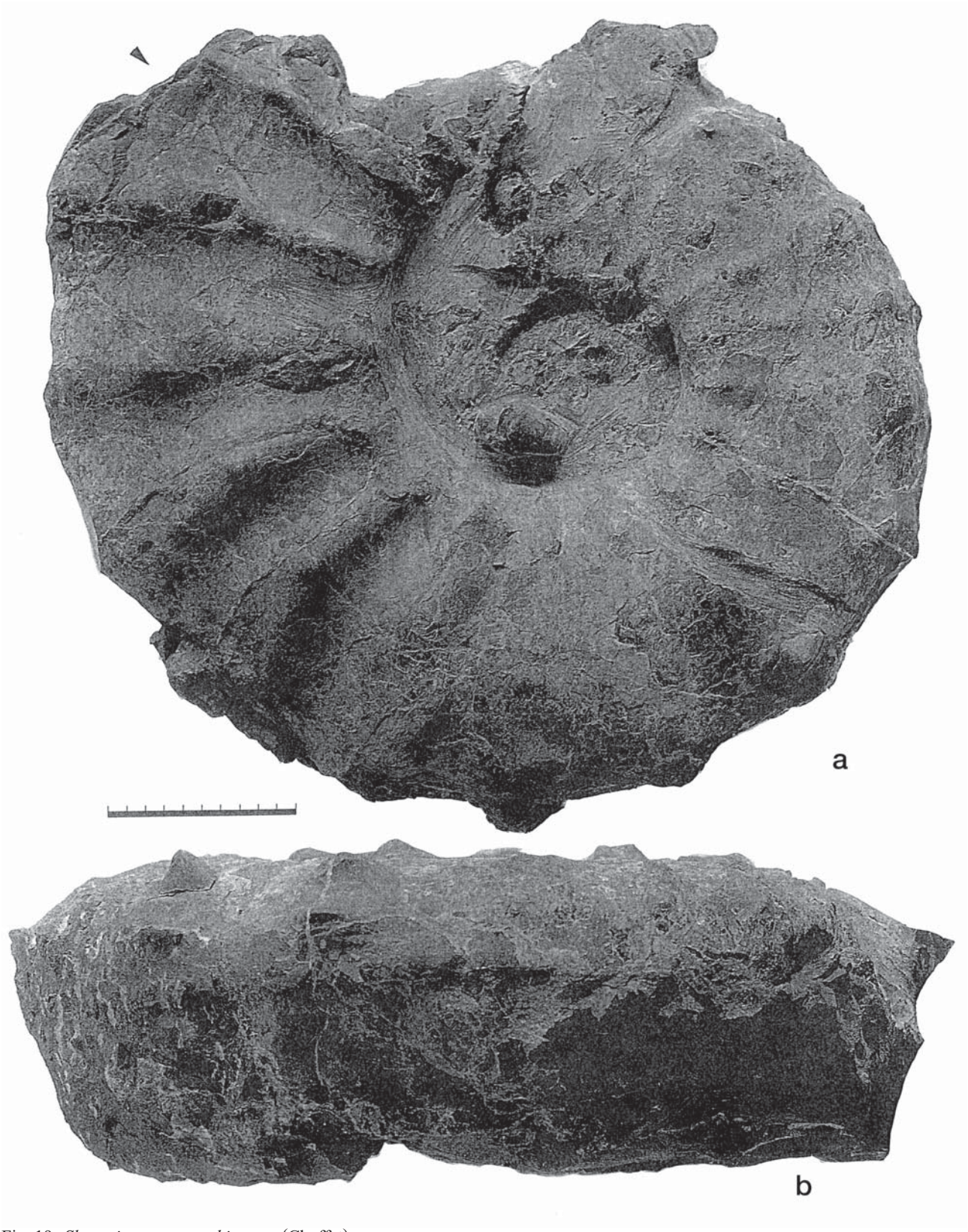


Fig. 19. *Sharpeiceras mocambiquense* (Choffat).
Lateral (a) and ventral (b) views of GS.G296, from Loc. R8602p, Kaeru-no-sawa, northern tributary of the Sanjussen-zawa. Scale bar = 10 cm. Photos courtesy of K. Shinohara.

tubercles pointed sideways; the outer ventrolateral tubercles are clavate. Generally the ornamentation tends to strengthen and broaden with growth, although that of the adult body chamber is not preserved.

Regrettably, characters of the inner whorls are not well shown in this specimen.

Remarks.—The holotype of *Sharpeiceras mocambiquense* (Choffat, 1903) was originally described under *Acanthoceras laticlavium* var. *mocambiquensis* Choffat, 1903 (p. 25, pl. 4, fig. 3; pl. 7, fig. 1). Much later, Wright and Kennedy (1987, p. 129) put Choffat's above named specimen in the synonymy list of *Sharpeiceras schlueteri* Hyatt, 1903. They did point out that Choffat's paper was published several months earlier than Hyatt's (1903), but they disregarded Choffat's *mocambiquense*.

Despite some deficiency in the state of preservation, the Choffat's specimen from Mozambique shows its own distinct characters, and the same diagnoses are confirmed in the specimens from Japan, which include the present one as well as those already described by Matsumoto and Toshimitsu (1998, p. 624, pls. 2, 3). The narrow umbilicus, with U/D about 0.3 (0.29～0.33), fairly widely separated and slightly prorsiradiate ribs, numbering only 9 on the last half whorl of the phragmocone, are the characters which enable us to distinguish this species from *Sharpeiceras schlueteri* Hyatt (see Amédro *et al*., 2002, pl. 5 as its gigantic example, which shows 12 ribs on the last half whorl and U/D 0.41). Somewhat younger whorl of *S. schlueteri* has more numerous ribs, as is clearly shown by Bayle's typical specimen (see Wright and Kennedy, 1987, text-fig. 33).

In the same respects, what was called *Sharpeiceras kikuae* Matsumoto and Kawashita (1995, p. 186, pl. 5, figs. 1, 2; 1998, p. 92, figs. 3, 4), from the lower Cenomanian part of the Yubari Mountains, is now suppressed as a synonym of *S. schlueteri*. As *S. mocambiquense* was obtained by T. Suekane from the same member (see Matsumoto and Toshimitsu, 1998, p. 624, pl. 3), the two species under consideration are contemporary, although *S. mocambiquense* is found more commonly in Japan.

Occurrence.—As for material. The specimen here described was in a transported or fallen nodule, but the derivation from the main part of the lower Cenomanian sediments is supported by the nearby occurrences of *Sharpeiceras* cf. *kongo* and *Inoceramus virgatus* Schlüter.

Sharpeiceras cf. ***kongo*** Matsumoto, Muramoto and Takahashi, 1969

(Figure 20)

Material.—GS.G297 collected by T.N. and others at Loc. R8604p, Kaeru-no-sawa, a northern tributary of the Sanjussen-zawa.

Description.—This is a piece of body whorl, for about 130°, with the maximum costal section, H = 196 mm, B = 130 mm, B/H = 0.66; and intercostal section, h = 152 mm, b = 100 mm, b/h = 0.66. There are six major ribs at wide intervals in the main part. In the last portion two weaker ribs are discernible. Every major rib is provided with bullate tubercle at the umbilical shoulder, midlateral tubercle, and inner and outer ventrolateral tubercles, of which the outer one stretches markedly upward.

Remarks.—The specimen is quite similar in size, shell form and ornamentation to the body whorl of the nearly completely preserved holotype of *Sharpeiceras kongo* Matsumoto, Muramoto and Takahashi, 1969 (p. 261, pl. 29, fig. 1; pl. 30, fig. 1; text-figs. 3-4), from the lower Cenomanian Member IIa of the Mikasa Formation in the Ikushunbetsu Valley (see Matsumoto *et al*., 1969, p. 287). As GS.G297 is fragmentary, it is described under open nomenclature.

Occurrence.—Although this specimen was in a fallen or transported nodule, it suggests the main part of the lower Cenomanian sediments of the original outcrop.

Family Kossmaticeratidae Spath, 1922
Subfamily Marshallitinae Matsumoto, 1955

Genus ***Marshallites*** Matsumoto, 1955

Type species.—*Marshallites compressus* Matsumoto, 1955 by original designation (Matsumoto, 1955, p. 119).

Marshallites hayashii sp. nov.

(Figures 21-23)

Synonymy.—

Marshallites aff. *hendersoni* Matsumoto and Takahashi; Matsumoto and Inoma, 1991, p. 109, pl. 28, figs. 2, 3; Nishida *et al*., 1997, pl. 5, figs. 1-3 (without description).

Material.—Holotype: GK.H8404 (Fig. 22; its plaster cast kept at GSJ F14890), collected by M. Hayashi from Loc. H21 in the source area of the Kyoei-Sakinzawa. Paratype (1): GK.H8405 (Fig. 21; its plaster cast kept at GSJ F14892), collected by K. Yokoi as a boulder at his Loc. KY667, about 1000 m downstream (i.e., eastward) from H21, in the Cretaceous outlier surrounded by the Tertiary strata (the location indicated in the map by Nishida *et al*., 1996, fig. 7). Paratype (2): YKC050711 (Fig. 23), collected by Y. Kawashita at Loc. R851 on the lower course of the Daikoku-zawa, a tributary of the Sounnai River (the point indicated in text-fig. 4 of Nishida *et al*., 1997, p. 246). YKC080622,

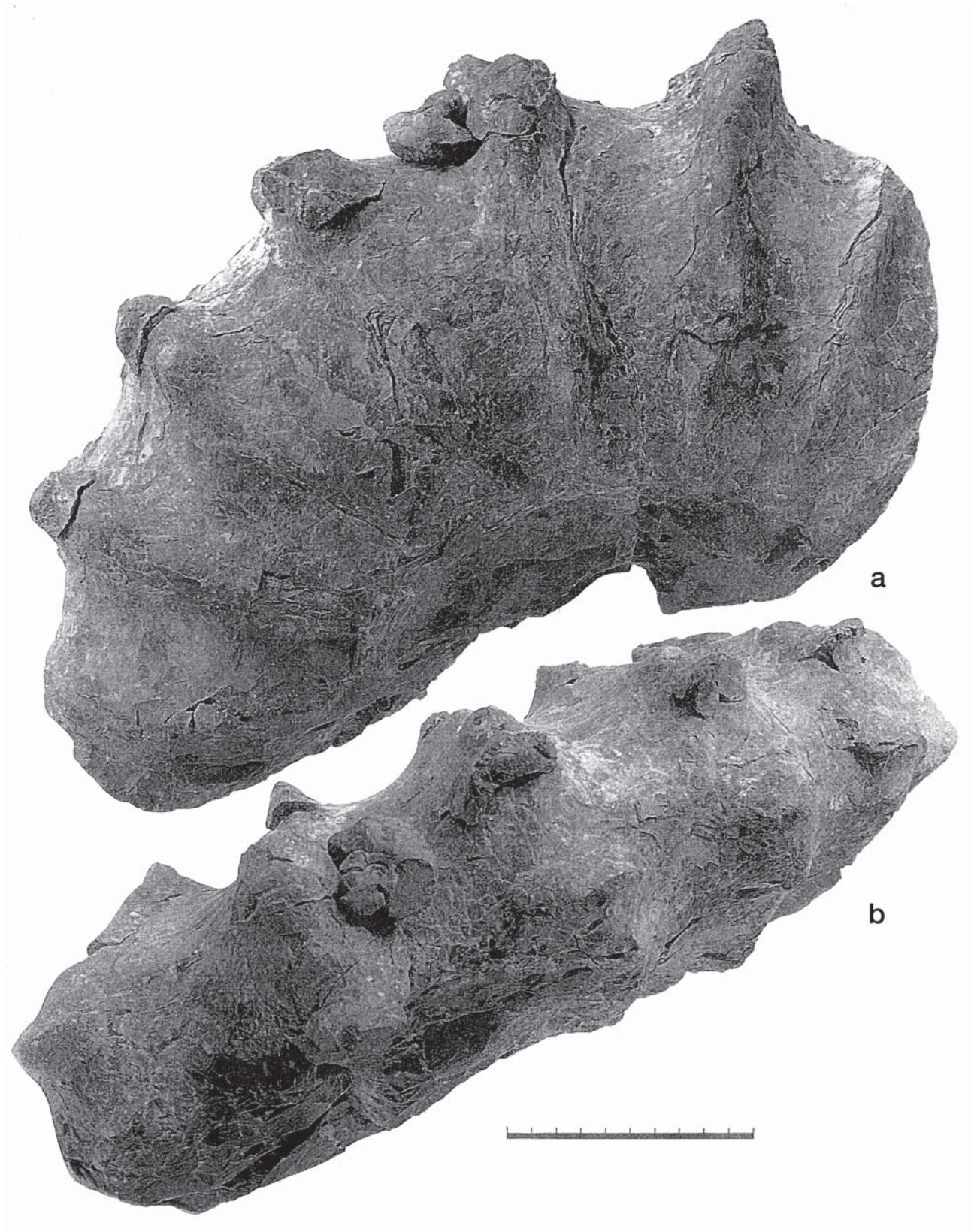
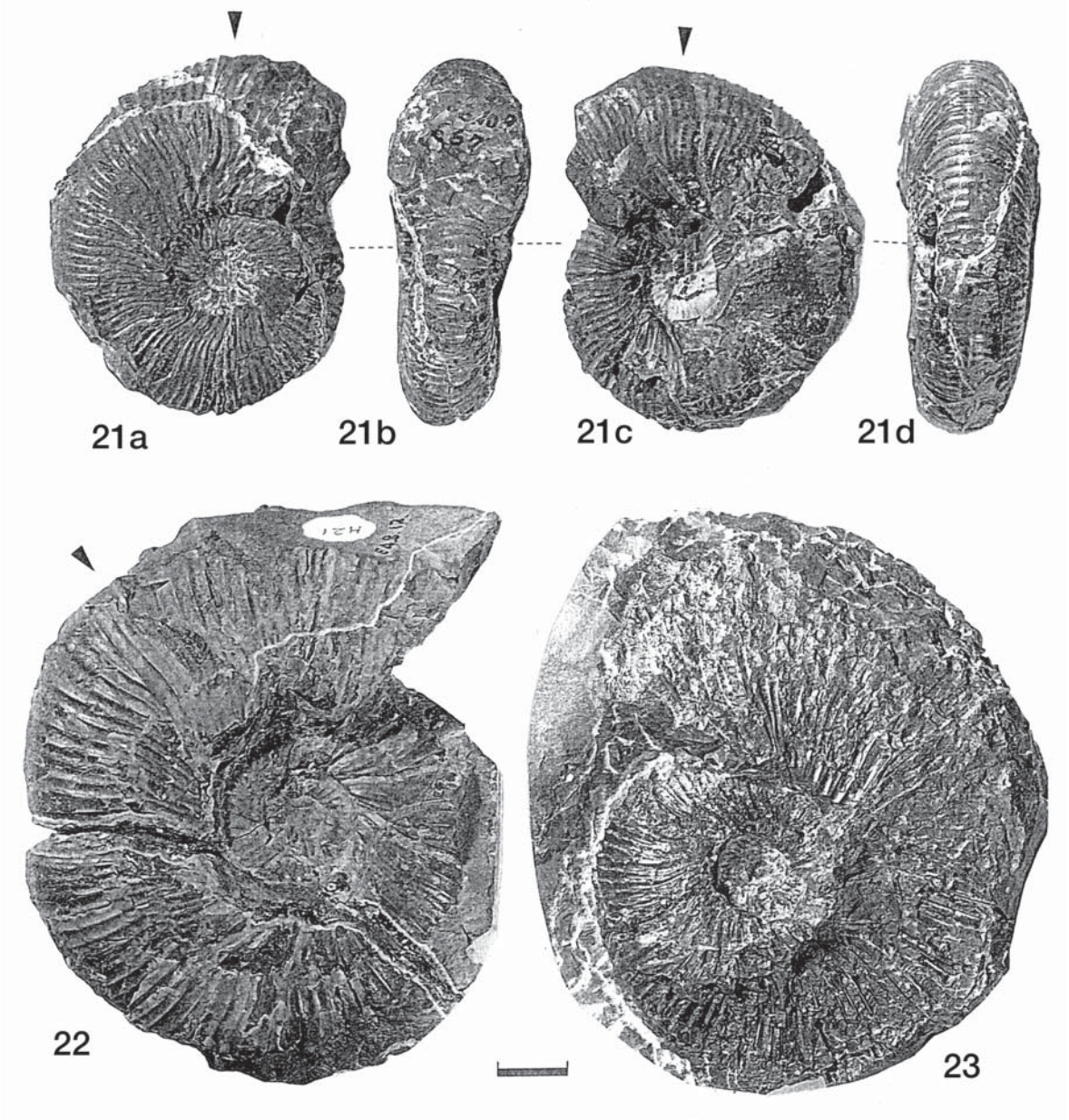


Fig. 20. *Sharpeiceras* cf. *kongo* Matsumoto, Muramoto and Takahashi.
Lateral (a) and ventral (b) views of GS.G297, from Loc. R8604p, Kaeru-no-sawa, northern tributary of the Sanjussen-zawa. A smaller specimen on the venter is *Anagaudryceras* sp. Scale bar = 10 cm. Photos courtesy of K. Shinohara.



Figs. 21-23. *Marshallites hayashii* sp. nov.
21: Left lateral (a), frontal (b), right lateral (c) and ventral (d) views of GK.H8405 from Loc. KY667 of the Kyoei-Sakin-zawa. 22: Left lateral view of the holotype, GK.H8404 from Loc. H21 of the Kyoei-Sakin-zawa. 23: YKC050711 from Loc. R851 of the Daikoku-zawa. Scale bar = 10 mm. Photos courtesy of M. Noda.

collected by Y. Kawashita at Loc. R918 of the Fukuroku-zawa, a tributary of the Shumarinai River (the location indicated in Fig. 3 of this paper) and other smaller or poorly preserved specimens, including those treated by Matsumoto and Inoma, 1991 (*in* Matsumoto, compiled, 1991) and GS.G278 from Loc. R8071p of the Hotei-zawa may be referred to this species.

Diagnosis.—Moderately involute whorl, with less inflated flanks, ornamented by bi- or trifurcated, somewhat flexuous ribs arising from umbilical bullae. Constrictions frequent and gently flexuous, cutting two to several ribs behind.

Dimensions.—See Table 3.

Description.—Shell is medium size at the adult stage. The whorl expands with moderate rate, overlapping about half or more of the preceding one. The umbilicus is rather narrow (U/D = 0.28) and shallow, surrounded by vertical wall. Whorl is higher than broad and suboval in section, with weakly convex flanks, which converge gradually to moderately arched venter.

Constrictions are fairly frequent, 6 to 8 per whorl, prorsiradiate around the umbilical margin, and somewhat flexuous outward, cutting two to several ribs

Table 3. Measurements of *Marshallites hayashii* sp. nov.

Specimen	M	D	U	U/D	H	B	B/H	R'+r'
GK.H8405	LS	53.0	15.0	.28	24.5	19.5	.79	8+20
GK.H8404	LS	75.0	21.0	.28	33.0	26.0	.79	8+19

R'+r' = number of primary and secondary ribs within 1/6 whorl (60°)

behind. Ribs are numerous, fairly dense, and variably flexed on the flank, passing to rather weak ventral projection. They are normally bifurcate at each umbilical bulla and have additional branching or intercalation on the flank.

Suture is as for the genus.

Observation.—There are two forms of dissimilar size. The larger one, represented by the holotype, is about 75 mm diameter at the end of phragmocone, whereas the smaller one, exemplified by the paratype (1), is about 50 mm. Whether there is a dimorphic pair or not cannot be decided, without examining more specimens, especially those completely preserved up to the apertural end.

Comparison and discussion.—This species resembles *M. hendersoni* Matsumoto and Takahashi, 1991 (*in* Matsumoto, compiled, 1991, p. 30, pl. 3, figs. 4, 5), from the middle Cenomanian strata of the Mikasa and Nakagawa districts, but is distinguished by its more involute whorl, more arched, instead of broadly rounded or flatter venter, and more flexuous ribs and constrictions.

It is somewhat similar to *M. compressus* Matsumoto, 1955 (see Matsumoto, compiled, 1991, p. 24, pl. 1, figs. 1-4; pl. 2, figs. 1-7; pl. 3, figs. 1-3; text-figs. 5, 6), from the middle Cenomanian beds of the Nakagawa and Mikasa districts, but the whorl of the former is not so much compressed as that of the latter. The ornamentation is well shown from the early growth stage onward in the former, whereas it is weak or extremely faint in the early to middle growth stages of the latter.

Occurrence.—As for material. There are four species of *Marshallites* which occur in the Assemblage Zone of *Stoliczkaia* (*Lamnayella*) *japonica* in the Soeushinai area: namely, *M. cumshewaensis* (Whiteaves), *M. rotundatus* Matsumoto and Takahashi, *M. kossmati* Matsumoto and Inoma and *M. hayashii*. Among them *M. cumshewaensis* is the most common element and its juveniles are found abundantly, —for instance a great number of small, young shells contained in one nodule. It occurs also in the upper Albian and Cenomanian formations of British Columbia and southeastern Alaska (Whiteaves, 1884; Matsumoto, 1959, 1991; McLearn, 1972). In contrast to that species, *M. hayashii* has not been found so abundantly and its true range should be determined by further investigation.

Superfamily Tetragonitaceae Hyatt, 1900
Family Gaudryceratidae Spath, 1927

Genus ***Anagaudryceras*** Shimizu, 1934

Type species.—*Ammonites sacya* Forbes, 1846

Diagnosis.—See Wright with Callomon and Howarth, 1996, p. 3.

Anagaudryceras whitneyi (Gabb, 1869)

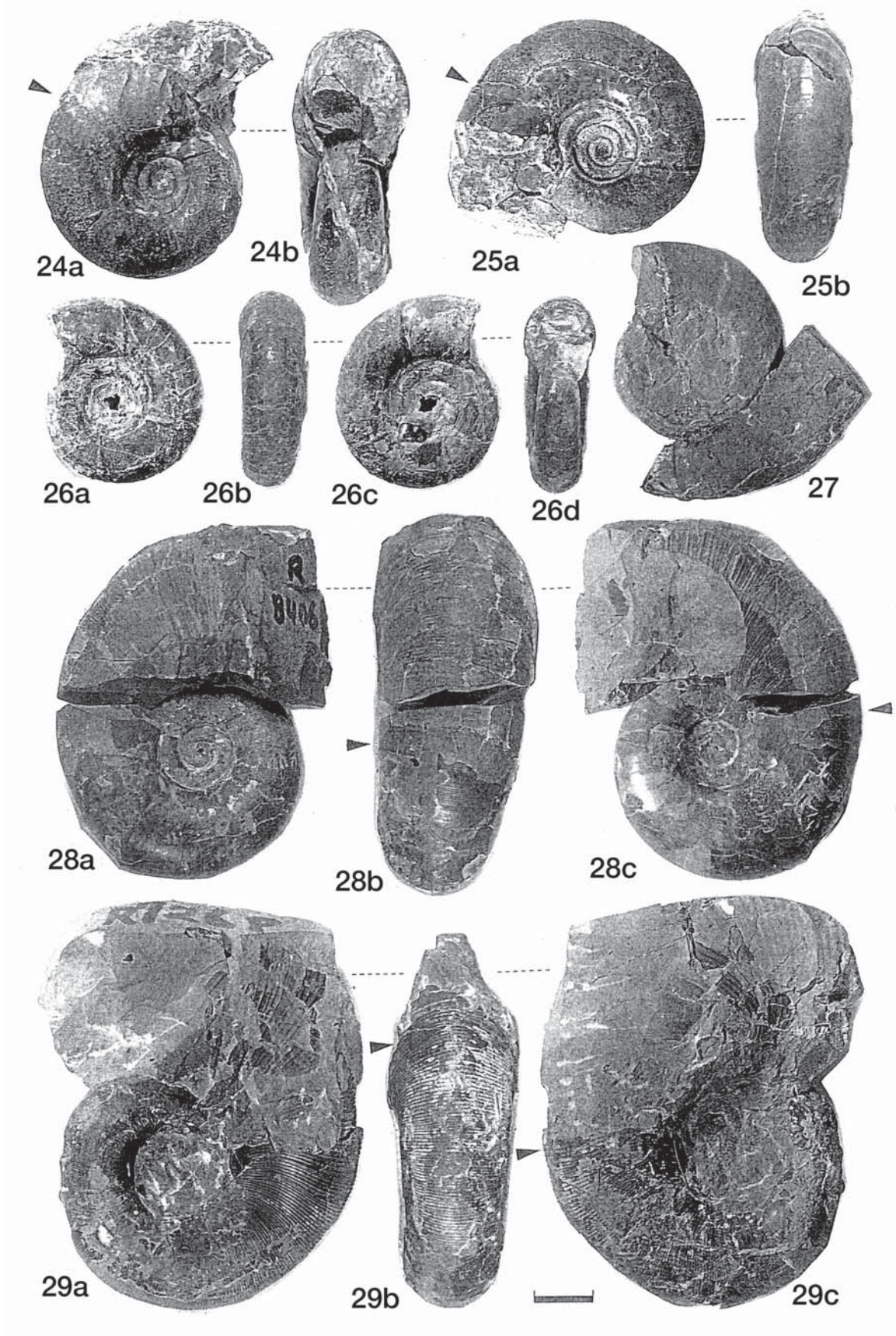
(Figures 24, 25)

Synonymy.—

Ammonites whitneyi Gabb, 1869, p. 134, pl. 22, figs. 14, 14a, 14b; *Lytoceras* (*Kossmatella*) *whitneyi* (Gabb); Anderson, 1938, p. 152, pl., 31, figs. 1, 2; *Anagaudryceras whitneyi* (Gabb); Murphy, 1967, p. 16, pl. 2, figs. 3, 5, 6; text-figs. 11-13; *Anagaudryceras* aff. *whitneyi* (Gabb); Matsumoto, 1995, p. 39, figs. 19A-C.

Material.—In addition to MCM.A250 (S. Uchida Coll.) (Matsumoto, 1995, fig. 19C) from the upper Albian bed of the Mikasa district, there are more specimens from the Soeushinai area. They are GK.H8414 (Matsumoto, 1995, fig. 19B) [= KY801; its plaster cast kept at GSJ F14896], GK.H8415 [= KY808] (Matsumoto, 1995, fig. 19A), TKD30029 (Fig. 25), from Loc. 81110, and TKD30030 (Fig. 24) from Loc. 81001, all in the area of the Suribachi-zawa. Also GS.G259 from Loc. R873p of Nishida *et al.* (1996), slightly upstream from the mouth of the Suribachi-zawa, where upper part of the Member My2 (Upper Albian) is exposed; TKD30518 from a nodule P5 (with early Cenomanian assemblage of species) on the Shumarinai River.

Remarks.—MCM.A250, collected by S. Uchida from the upper Albian part along the Ikushunbetsu River and described previously by Matsumoto (1995, p. 39, fig. 19C) is essentially similar to the holotype of *Anagaudryceras whitneyi* (Gabb, 1869; figured by Murphy, 1967, pl. 2, fig. 3). Two other specimens of KY collection reported by Matsumoto (1995, figs. 19A, B) are comparable with Murphy's (1967, pl. 2, fig. 6).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26a
26b
26c
26d
27
28a
28b
28c
29a
29b
29c

Table 4. Measurements of *Anagaudryceras whitneyi* (Gabb).

Specimen	M	D	U	U/D	H	B	B/H	H/h
MCM.A250	LS+120°	153.0	43.0	.28	66.0	56.0	.85	—
MCM.A250	LS+30°	122.0	36.0	.30	54.0	48.0	.89	1.69
GK.H8414	LS	37.5	12.3	.33	16.4	16.0	.98	1.86
TKD30029	LS	42.0	13.0	.31	17.7	16.8	.95	1.57
TKD30030	LS	43.3	12.8	.30	18.4	18.0	.96	1.52
TKD30518	LS	34.0	11.0	.32	14.3	14.1	.99	1.64
GS.G259	LS	41.3	12.0	.29	19.2	16.5	.86	1.90

In this table, h = whorl height at 180° (half whorl) earlier than H.

Other specimens listed above are well preserved phragmocones of 34 to 44 mm diameters, with only the beginning of the body chamber preserved. They are, however, well comparable with the phragmocone of the specimen (SOC.K173/1) figured by Murphy (1967, pl. 2, fig. 6) in size, fairly rapid increase of whorl height with growth, lower value of umbilical ratio (U/D) and especially the clearly prorsiradiate, periodic flares or constrictions. Although Murphy mentioned the tendency toward a subquadrate cross section, this may be due to secondary deformation (obviously expressed by the drawing by Murphy, 1967, fig. 12). Our specimens are well preserved in showing subcircular (B/H: 0.86～0.99) cross section at the end of the septate whorl.

Generally the ratio of whorl growth, as represented by H/h, varies with growth and also between individuals. This species shows relatively higher ratio of whorl growth with considerable overlap of outer whorl, resulting in a lower umbilical ratio (U/D) (see Table 4).

To sum up, our specimens indeed resemble the immature specimens of *Anagaudryceras whitneyi* (Gabb) from the Pacific side of North America, but no example of perfect mature shell is available in our collections from the Soeushinai area. There are, however, fragmentary body chambers provisionally called *Anagaudryceras* sp.

Occurrence.—GS.G259 is from the upper part of the Upper Albian strata along the Sounnai River. TKD30518 came from the lower part of the Cenomanian beds on the middle course of the Shumarinai River. Other specimens from the area of the Suribachi-zawa can be ascribed to the Member My3, i.e., lower part of the Cenomanian Stage, although the records of collection are not necessarily satisfactory.

Genus ***Gaudryceras*** Grossouvre, 1894

Type species.—*Ammonites mitis* Hauer, 1866 (by original designation).

Gaudryceras subcostatum Matsumoto, 1995

(Figures 26-27)

Synonymy.—

←

Figs. 24-25. *Anagaudryceras whitneyi* (Gabb).
24: TKD30030 from Loc. 81001, Suribachi-zawa, left lateral (a) and frontal (b) views; 25: TKD30029 from Loc. 81110, Suribachi-zawa, right lateral (a) and back (b) views.

Figs. 26-27. *Gaudryceras subcostatum* (Matsumoto).
26: GS.G302 from Loc. R745, Okufutamata-zawa, right lateral (a), back (b), left lateral (c) and frontal (d) views. Dark colored (originally brown) material at a point on the umbilical margin is amber; 27: GS.G303 from Loc. R974, Okufutamata-zawa, right lateral view of an incomplete specimen.

Figs. 28-29. *Gaudryceras yokoii* (Matsumoto).
28: GS.G212 from Loc. R8406p, Yoshitaro-zawa, left lateral (a), back (b) and right lateral (c) views; 29: GS.G304 from Loc. R726p, Okufutamata-zawa, right lateral (a), back (b) and left lateral (c) views. Scale bar = 10 mm. Photos courtesy of M. Noda.

Miogaudryceras sp. nov.(?); Matsumoto 1995, p. 33, figs. 17A-D; *Gaudryceras subcostatum* Matsumoto, 1995, p. 75, figs. 38A-E.

Holotype.—UMUT.MM19693 [= GT.I-3268a], by original designation, figured by Matsumoto, 1995, fig. 38A-C. It was collected, together with the paratype, from the Member IIb at Loc. T881b, Shibunnai of the Nakagawa district in the Teshio Mountains, northwestern Hokkaido (about 60 km north of the Soeushinai area).

Diagnosis.—This species is characterized by the lower ratio of whorl growth, little overlap of whorl, giving rise to a wide umbilicus, and rather widely subrounded whorl section. Periodic constrictions or flares run somewhat obliquely forward, if not so remarkably forward as in *Anagaudryceras whitneyi* (Gabb). Numerous fine lirae are discernible on the surface of the outer shell layer.

Remarks.—The specimens previously called *Miogaudryceras* sp. nov.(?) by Matsumoto (1995, p. 33, figs. 17A, C, D), from the upper Cenomanian of the Okufutamata-zawa in the southern part of the Soeushinai area, should be assigned to the present species. The larger fragment of the body chamber illustrated previously by Matsumoto (1995, fig. 17B) may be also referred to the present species, because it occurred together with the smaller ones. It has lirae of variable coarseness.

There are two smaller specimens, GS.G302 (Fig. 26) from Loc. R745 and GS.G303 (Fig. 27) from Loc. R974, collected by N.T. and others from the middle part of the Cenomanian on the route of the Okufutamata-zawa, a tributary of the Kotanbetsu River.

To sum up, this species occurs in the middle and upper parts of the Cenomanian Stage, that is obviously higher than the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone. It is, however, described here to revise the inadequate reference to *Miogaudryceras*.

Gaudryceras yokoii (Matsumoto, 1995)

(Figures 28-29)

Synonymy.—*Miogaudryceras yokoii* Matsumoto, 1995, p. 28, figs. 14-16.

Material.—In addition to the holotype, GK.H8411 (its plaster cast kept at GSJ F14891), and the paratype, GK.H8412 (its plaster cast kept at GSJ F14894), from the lower Cenomanian part of the Suribachi-zawa, and another paratype, GK.H8413 (its plaster cast kept at GSJ F14888) from the route of the Shumarinai River, the following three specimens have been subsequently obtained by T.N. and others: GS.G212 (Fig. 28) at Loc. R8406p of the Yoshitaro-zawa (a southern tributary of the Sanjussen-zawa), GS.G304 (Fig. 29) at Loc. R726p and also YKC.080911p27 at Loc.R985p, both on the route of the Okufutamata-zawa.

Based on the examination of the above material, a revised diagnosis is given below.

Diagnosis.—Whorls broadly rounded in section at young stage, subcircular in the late part of the phragmocone, and much higher than broad in the adult body chamber. The entire shell rather small for the genus (about 70 to 80 mm in diameter). Constrictions, with associated flares, of moderate frequency. Lirae of moderate intensity well shown on the surface of the outer shell layer, running radially on the main part of the whorl; they coarsen on the adult body chamber, with some irregularity in strength and frequency.

Remarks.—This species is similar to *Mesogaudryceras leptonema* (Sharpe, 1855) (see Wright and Kennedy, 1984, p. 51) in the general appearance of the shell, but does not show coarse lirae on the inner whorl, except for the frequent flares which generally occur in the initial whorl of the gaudryceratid genera. *Mesogaudryceras* is described as having compressed whorls even in immature stages. Based on these points a new genus *Miogaudryceras* was established by Matsumoto (1995, p. 27) to distinguish it from *Mesogaudryceras*.

There is, however, no significant difference from *Gaudryceras* in the general characters. In many species of *Gaudryceras* the whorl becomes higher than broad with growth, although there may be difference between species in the degree of change in B/H with growth. A relatively rapid increase of whorl height at the later growth in this species cannot be regarded as enough criterion for the generic separation. There is, thus, no reason to maintain the genus *Miogaudryceras*, which is now suppressed as a junior synonym of *Gaudryceras*.

Occurrence.—Depending on the additional material, this species occurs so far in the lower and middle parts of the Cenomanian Stage.

6. Summary of results

(1) The ammonite fauna in the main part of the Lower Cenomanian sediments of the Soeushinai area of northwest Hokkaido consists of characteristic species, which constitute the *Stoliczkaia* (*Lamnayella*) *japonica* Assemblage Zone. This zone is situated above the basal Cenomanian *Graysonites wooldridgei* Zone and below the well traced *Mantelliceras saxbii* Zone.

(2) The radiometric ages have been already measured on the tuff samples from the lower and upper boundary levels of this zone, with the results slightly less than 0.2 Ma for the zone interval.

(3) The assemblage of species which constitute this zone is shown. Additionally there are more species of longer ranges. The majority of the fauna have already been described in the previously published papers.

(4) This zone is correlated with the *Mantelliceras japonicum* Assemblage Zone in the Mikasa district of central Hokkaido and also with the main part of the *Hypoturrilites carcitanensis* Zone and the succeeding *Sharpeiceras schlueteri* Zone in northwestern Europe. Several species occur not only commonly in a number of areas in Hokkaido but also further abroad.

(5) Systematic descriptions are given at length to *S.* (*L.*) *japonica* (Matsumoto, Kimura and Katto, 1952) and briefly to several selected species. Furthermore, a new species, *Marshallites hayashii*, is established as an element of this zone and revised descriptions are added to some gaudryceratids, in which *Miogaudryceras* Matsumoto, 1995 is suppressed as a synonym of *Gaudryceras* Grossouvre, 1894.

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Appendix

The studied area is a part of the Soeushinai area, which corresponds to the officially published geological map in the scale 1:50,000 "Soeushinai". The Cretaceous rocks in this area are referred mainly to the Middle Yezo Group (Albian to Turonian) and partly to the Upper Yezo Group (Coniacian and the succeeding part). On lithostratigraphic grounds the Middle Yezo Group is subdivided into 8 units, from Member My1 to My8. My1 and My 2 are Albian in age, My3 to My5 are the lower, middle and upper Cenomanian, My6 to My8 are Turonian. This paper deals mainly with the ammonite fauna of the main part of the lower Cenomanian, that is the Member My3 (Fig. 30). The basal Cenomanian ammonite fauna was dealt with in the preceding paper entitled: Early Cenomanian (Cretaceous) ammonoids *Utaturiceras* and *Graysonites* from Hokkaido, North Japan (*Bull. Geol. Surv. Japan*, **54**, 131-159). The present paper can be regarded as being continued from the preceding one.

The ammonite fauna of the lower Cenomanian was described on that of the Ikushunbetsu [= Mikasa] area which represents the shallow sea nearshore environments. The fauna of the same age in the Soeushinai represents that of rather offshore environments (Fig. 30) and is worthwhile to be described to contribute not only to improve domestic but also worldwide knowledge. The lower Cenomanian ammonite faunas of the offshore facies have been rarely reported, except for that in S.E. France (Kennedy *in* Gale *et al.*, 1996).

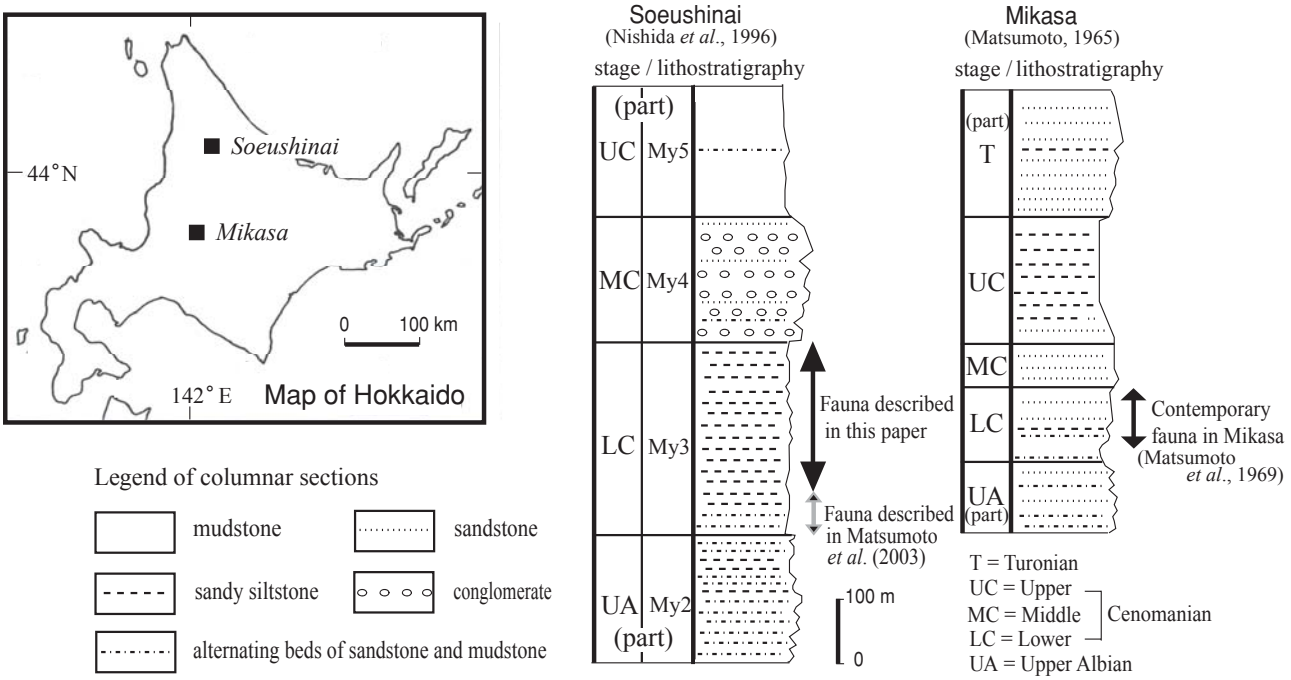

Fig. 30. Schematic columnar sections of the Cenomanian sediments (offshore facies in Soeushinai; nearshore shallow sea facies in Mikasa).

北海道添牛内地域産白亜紀セノマニアン初期の アンモナイト フォーナ

松本達郎・西田民雄・利光誠一

要　旨

北海道北西部の添牛内（そえうしない）地域の白亜系セノマニアン階下部の主要部には多数のアンモナイトが産出しており，独特のフォーナが認められる．このフォーナに基づき，*Stoliczkaia* (*Lamnayella*) *japonica* 群集帯を認定した．その構成種の中には既に数編の論文に記載された *Mariella* の特徴種を含んだ諸種があり，また帯の上下限をいくらか越えた生存期間のやや長い既知種も多数含まれる．本帯は既報のセノマニアン最下部の *Graysonites wooldridgei* 帯の上位にあり，上限は *Mantelliceras saxbii* 帯の直下で，それぞれ放射年代の測定された凝灰岩層で区切られている．本帯の分布範囲の中には幾分沖合相とみなされる部分もあり，構成種群にいくらかの変化がある．国内・海外の異名で呼ばれている帯との対比についても論述した．なお，*S.* (*Lamnayella*)の2種と更に若干の種を図示・記載し，その中で新種 *Marshallites hayashii* を設立した．