Some Upper Cretaceous Desmoceratids from Hokkaido and Saghalien : Studies on the Cretaceous Ammonites from Hokkaido and Saghalien-VII

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Some Upper Cretaceous Desmoceratids from Hokkaido and Saghalien

(Studies on the Cretaceous Ammonites from Hokkaido and Saghalien-VII)

By

Tatsuro MATSUMOTO and Ikuwo OBATA

Foreword

In the previous papers of this series one of us (T.M.) has described selected leading species of the Desmoceratidae (*s.s.*) and also many species of the Puzosiidae from Hokkaido and Saghalien but several species have been still left untouched. In this paper we describe them and give some remarks on the genera concerned.

The material dealt with here belongs to the same collections which have been explained in the previous papers. The following abbreviations are used for the institutions to which the specimens belong:

GT. Geological Institute, University of Tokyo;

GK. Department of Geology, Kyushu University, Fukuoka;

BM. British Museum (Natural History), London;

GSM. Geological Survey and Museum of Great Britain, London;

NZ. GS. New Zealand Geological Survey, Wellington.

The rough draft of the manuscript and some photographs were arranged several years ago by T. MATSUMOTO and brought with him when he visited London in 1953-54 where he made some additional study. However the specimens had been mostly left in Japan at that time, so I. OBATA carried on further detailed study on the specimens in conjunction, by correspondence, with T. M.'s work in London. The final cooperative study has been done after T.M.'s return home.

Systematic Descriptions

Order Ammonoidea

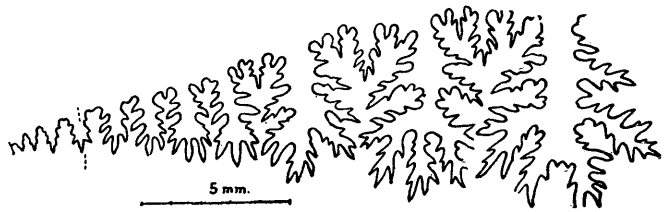
Family Desmoceratidae

Genus *Desmophyllites* SPATH, 1929

Synonym.– *Schlüteria* GROSSOUVRE, 1894, *non* FRITSCH & KAFKA, 1887.

Type species.– *Desmoceras larteti* SEUNES, 1891, designated by SPATH, 1921.

Generic diagnosis.– Shell is relatively small, being 100mm. or less in diameter, polygyral but very involute, with more or less compressed, oval to elliptical whorl-section in most growth stages and with very narrow and crater-like umbilicus. Constrictions are rather frequent, more or less well marked on the internal mould but often only weakly elevated on the shell, strongly flexuous to simply arcuate on the sides and projected on the venter. Suture is of typical *Desmoceras*-type consisting of numerous elements arranged regularly along a nearly straight radial line.



T.M. del.
Fig. 1. External suture-line of *Desmophyllites diphylloides* (FORBES). GT. I-3117 from Loc. T280, bed IIIe (zone of *Inoceramus schmidti*), Abeshinai Valley, Teshio Province, Hokkaido (T.M. Coll.).

Remarks.– Since the proposal by DE GROSSOUVRE (1894, p. 216) of *Schlüteria*, a name that was preoccupied and was replaced by *Desmophyllites* (SPATH, 1929, p. 270), the genus has been understood as analogous to *Phylloceras* (*s.l.*) in form and ornamentation but in suture more like *Desmoceras*. This might be held to suggest its direct derivation from Phylloceratid. Indeed this remains as a possible hypothesis but no passage form has been found. The high involution of whorls moreover is only a point of apparent similarity between the 'Senonian *Phylloceras*' (i.e. *Neophylloceras*) and *Desmophyllites*, because the latter is distinctly polygyral as compared with the former, as is illustrated by the longitudinal sections (see Pl. 30). *Desmophyllites diphylloides* (FORBES) and *Damesites damesi* (JIMBO) indeed resemble each other in this respect. However the difference between the two families varies by genera. *Phyllopachyceras ezoense* (YOKOYAMA), for instance, does not so much deviate in longitudinal section from *Desmophyllites diphylloides* (FORBES) or *Damesites damesi* (JIMBO) as *Neophylloceras subramosum* (SPATH), if it still belongs rather to the less polygyral group.

The Upper Cretaceous Phylloceratids, such as *Phylloceras*, *Neophylloceras* and *Phyllopachyceras*, have fine thread-like ribs which cross the venter almost straight radially, while *Desmophyllites* is nearly smooth or very weakly striate and those striae and the periodic constrictions show a prominent projection on the venter. *Neophylloceras* looses the phylloid character of the suture in later whorls but is clearly a member of the Phylloceratidae and is readily distinguishable in many respects from *Desmophyllites*. Some species however which have been referred to "*Schlüteria*" must be re-

moved to *Neophylloceras*, as, for instance, '*Schlüteria*' *bodei* MÜLLER & WOLLEMANN (1906, p. 13, pl. viii, figs. la, b, 2), '*S.*' *pergensis* GROSSOUVRE (1894, p. 217) (=*Ammonites velledae* SHARPE, 1854, p. 39, pl. xvii, fig. 7, BM. C. 3110) and '*S.*' *rouselli* GROSSOUVRE (1894, p. 217, pl. xxiv, fig. 2). Others, such as '*Schlüteria*' *rarawa* MARSHALL (1926, p. 192, pl. 19, fig. 10; pl. 32, figs. 7, 8), the original specimens of which one of us (T.M.) has examined, are nothing but immature shells of *Phyllopachyceras*.

On the other hand *Desmophyllites* is closely allied to other genera of Desmoceratidae. The immature whorls are essentially similar in *Desmoceras* (*s.s.*) (Albian-Cenomanian), *D.* (*Pseudouhligella*) (Cenomanian), *Tragodesmoceroides* (Turonian), *Damesites* (Cenomanian-Maestrichtian) and *Desmophyllites*, while the distinction among these genera only becomes clear in the outer whorls.

At first glance *Desmophyllites* resembles the compressed subgroup of *Desmoceras* (including *Pseudouhligella*). The differences lie in its narrower umbilicus*, stronger ventral projection of the constrictions, much stronger involution (even in the small immature shells) and generally more finely incised and more numerous sutural elements. However these differences are by no means great and it could be regarded as a subgenus of *Desmoceras* if there were Turonian and Lower Senonian forms which linked the Cenomanian form with the Upper Senonian one in a continuous lineage. Such forms have not yet been discovered but instead there are *Tragodesmoceroides* MATSUMOTO, 1942 in the Turonian and *Onitshoceras* REYMENT, 1954 in the Coniacian. The compressed *Desmoceras* and *Desmophyllites* are probably similar developments at separate ages in the same family Desmoceratidae (*s.s.*). *Desmophyllites* may have descended from *Tragodesmoceroides* by weakening of the ribs. As another possible interpretation the weakening or loss of the ribs and keel in the later *Damesites* might give rise to *Desmophyllites*, but the nearly smooth *Damesites sugata* (FORBES) and *D. hetonaiensis* MATSUMOTO in the Upper Senonian continue to have the keel.

Distribution.– World wide in the Upper Senonian (Campanian and probably also Maestrichtian). The forms of the Lower Senonian hitherto referred to *Desmophyllites* or *Schlüteria* are mostly doubtful or incorrect in generic assignment.

Among the recent authors KNECHTEL (1947) was correct in the explanation of the genus *Desmophyllites* but his species, *D. ellasworthi* (p. 128, pl. xlvii, figs. 1, 2, 3), from presumed Coniacian in Peru, is not referable to that genus because of the different suture and shell form which suggest rather some Puzosiid.

Desmophyllites diphylloides (FORBES)

Pl. 24, figs. 1a, b, 2a, b, 3a, b, 4a, b, 5a, b;
Pl. 30, fig. 1.

* *Pseudouhligella* has a vertical umbilical wall in the adult, while *Desmophyllites* has a crater-like umbilicus.

1846. *Ammonites diphylloides* FORBES, p. 105, pl. viii, fig. 8a, b, c.
1865. *Ammonites diphylloides*, STOLICZKA, p. 119, pl. lix, figs. 8, 8a, 9.
1898. *Desmoceras diphylloides* (FORBES), KOSSMAT, p. 108 (173), pl. xix (xxv), figs. 8a, b, c, 9a, b, c.
1907. *Puzosia* (*Latidorsella*) *diphylloides* (FORBES), PERVINQUIÈRE, p. 140, pl. vi, figs. 1a, b, 2a, b, and 7a–c.
1931. *Desmoceras diphylloides* (FORBES), BASSE, p. 23, pl. ii, figs. 3, 4.
1931. *Desmoceras* (*Latidorsella*) *diphylloides* (FORBES) var. *besairiei* COLLIGNON, p. 15, pl. ii, figs. 8, 8a, 8b, 9; pls. viii, figs. 5-8.
1942. *Schlüteria diphylloides* (FORBES), MATSUMOTO, p. 24.
1953. *Desmophyllites diphylloides* (FORBES), SPATH, p. 21 (footnote), pl. ii, fig. 5.

Material.– Lectotype is BM.C. 22682* from Valudayur, Pondicherry, India. There are in the British Museum (Nat. Hist.) three other syntypes of different sizes collected from the same area: BM.C. 22683, BM.C. 22684 and BM.C. 22685. The followings are the selected examples in our collections. In M. ISHIZAKI & K. SAKAKURA's Collection from Togushi area, Nishi-Notoro Peninsula, South Saghalien: GT. I–1477 a, b, c, GT. I–1478, GT. I–1479, GT. I–1480, GT I–1481, GT. I–1485, GT. I–1486, GT. I–1487 and GT. I–1488 from Loc. 823; GT. I–1482 from loc. 9·9; GT. I–1483 from loc. 17, GT. I–1484, GT. I–1489, GT. I–1490 and GT. I–986 b from loc. 825; GT. I–1491 from loc. 20; GT. I–1492 from loc. 9·8·4·6; GT. I–1494 from loc. 9·2. In M. KAWADA's Coll. from Naibuchi Valley, South Saghalien: GT. I–539a, b from Santangawa, Ryugase group. In T.M.'s Coll. from the same area: GT. I–2615 (from loc. N146, horizon Mh 6α, β), GT. I–2626 (N 165–166p, Mh 6), GT. I–2627 (N 166p, Mh 6), etc.; from the Abeshinai-Saku area, Teshio Province, Hokkaido: GT. I–3114 (loc. T 280, bed IIIe), GT. I–3115 (T 944d, IIIe), GT. I–3117 (T 280, IIIe), GT. I–3118 (T 313, IIIe), GT. I–3130 (T 8–9p, IIIe?), GT. I–3131 (T 522p, IIIe), GT. I–3133 (T579p, IIIe), etc; from Urakawa area, Hidaka Province, Hokkaido: GK. H3277 (loc. U238, bed Ur5β), GK. H3278 (U238, Ur5β), and GK. H3306 (U240 p, Ur4β). These are in good preservation; there are many other comparable specimens.

Dimensions–

Specimen	Diameter	Height	Breadth	(B/H)	Umbilicus (%)
BM. C.22682	20.0	11.0	9.0	(0.82)	1.4 (7.0)
BM. C.22683	22.0	12.0	9.1	(0.74)	1.6 (7.3)
GT. I-1478a	37.4	19.9	16.7	(0.84)	3.0 (8.0)
〃 b	25.4	13.7	11.7	(0.85)	2.1 (8.2)
〃 c	20.9	11.7	9.7	(0.82)	— —
〃 d	26.9	15.6	12.5	(0.80)	2.0 (7.4)
〃 f	19.0	11.6	9.5	(0.82)	1.5 (7.9)
GT. I-1479a	20.4	11.7	9.5	(0.81)	1.6 (7.8)
〃 b	15.5	9.3	6.9	(0.74)	1.5 (9.7)
〃 c	10.7	6.5	5.4	(0.83)	1.3 (12)
〃 d	8.0	4.4	4.3	(0.98)	1.0 (13)

* Since FORBES depended on several specimens this specimen should be lectotype, although it was called as holotype by SPATH (1953, p. 21, footnote).

〃 e	25.1	15.0	12.1	(0.81)	2.3 (9.2)
GT. I-1488b	30.1	16.0	13.7	(0.86)	2.9 (9.6)
〃 c	15.5	9.0	7.1	(0.79)	1.4 (9.7)
〃 d	19.2	11.2	10.0	(0.89)	1.4 (7.3)
〃 e	12.8	6.7	6.3	(0.94)	1.3 (10)
〃 f	8.0	4.1	4.3	(1.1)	1.0 (13)
〃 g	15.6	8.9	8.1	(0.91)	1.4 (8.9)
〃 h	19.6	10.8	9.3	(0.86)	1.5 (7.7)
GT. I-3114a	21.1	12.9	9.7	(0.74)	1.7 (8.1)
〃 〃	14.1	8.4	7.1	(0.85)	— —
〃 〃	9.9	5.2	5.2	(1.0)	— —
〃 〃	7.0	3.7	3.7	(1.0)	— —
〃 〃	5.1	2.7	2.7	(1.0)	— —
〃 〃	3.7	1.8	1.9	(1.1)	— —
〃 〃	2.5	1.3	1.4	(1.1)	— —
〃 〃	1.8	0.8	1.0	(1.3)	— —
GT. I-3117a	27.0	15.7	13.2	(0.83)	2.9 (10.7)
〃 b	19.1	11.2	9.2	(0.82)	1.9 (9.9)
GT. I-3118a	24.6	15.1	11.5	(0.76)	2.3 (9.3)
〃 b	23.1	13.2	11.1	(0.84)	2.3 (10.0)
〃 c	15.7	9.3	8.4	(0.90)	1.9 (12.1)
GT. I-3133	17.6	10.5	9.0	(0.86)	1.8 (10.3)

Specific diagnosis.– A species of *Desmophyllites* characterized by the moderately compressed, typically flat sided, slightly divergent whorls with broadly arched venter; its constrictions impressed on the internal mould are moderately strong and typically frequent, prorsiradiate and somewhat concave on the outer part of the whorl with or without a very slight biconvexity on the sides and forming a strong forward, tongue-like projection on the venter; on the surface of the shell the low ribs corresponding to the constrictions are hardly discernible except on the ventral area; very faint striae or riblets nearly parallel to the constrictions are found on the well-preserved shells.

Remarks.– FORBES' original material, which one of us (T.M.) has studied at the British Museum (Natural History), comprises four small specimens from the Valudayur group. Even if we exclude the slightly deformed last portion of the lectotype, BM. C. 22682, the four specimens show a certain variation in the thickness of whorls or in the proportion between height and breadth. Our numerous specimens from Hokkaido and Saghalien, and especially groups of specimens from the same bed, clearly indicate the same feature. The same species was reported from the Senonian of Tunisia by PERVINQUIÈRE (1907) who also recognized a wide range of variability.

The flattened flanks and the particular curvature of the constrictions are characteristic to the present species and we can distinguish it from the allied species, *D. phyllimorphum* (KOSSMAT), which has inflated flanks (but relatively small B/H) and regular and gentle biconvexity of the constrictions. However the constrictions generally vary in curvature, frequency and strength with growth, so the careful observation is necessary. Similarly the complexity, number of elements and other details in

the sutures change in some degree with growth and vary in individuals, although the general pattern is constant.

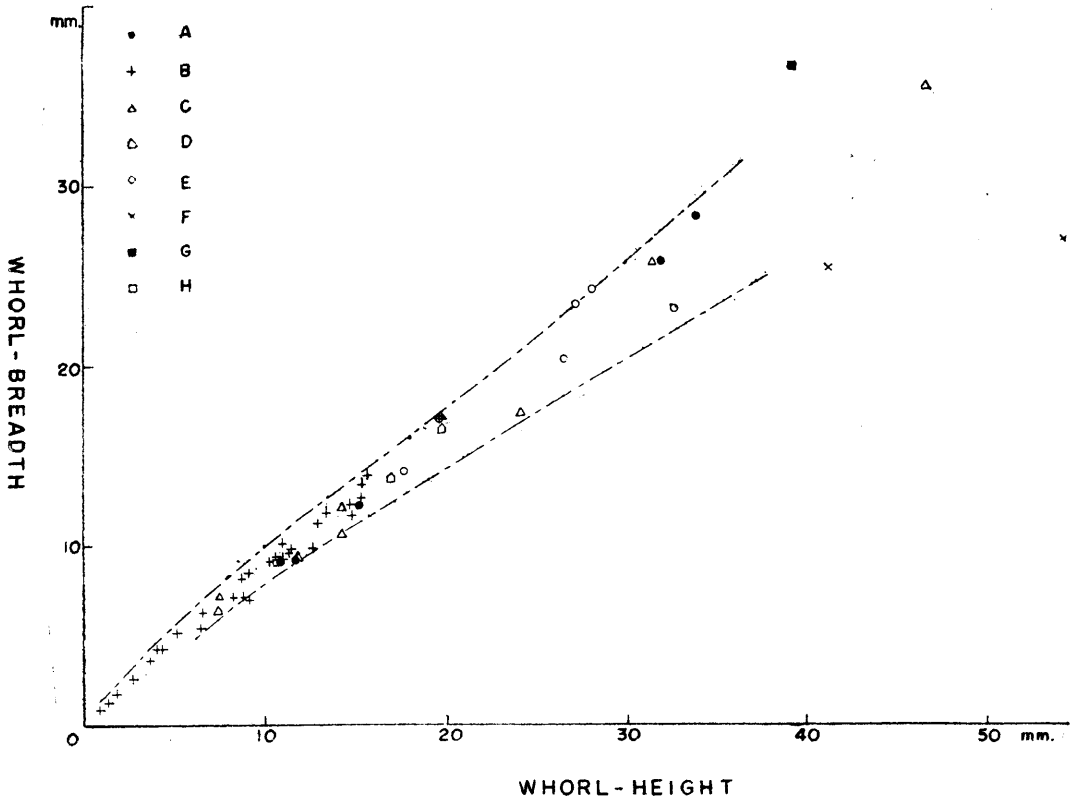


Fig. 2. Diagram showing the proportion between breadth and height of whorls in *Desmophyllites diphylloides* (FORBES) and related forms. A. *D. diphylloides* from India (FORBES, 1846; KOSSMAT, 1898) and Madagascar (BASSE, 1931). B. *D. diphylloides* from Hokkaido and Saghalien. C. "*Desmoceras simplex* v. HOEPEN". D. "*Desmoceras crassum* v. HOEPEN". E. "*Desmoceras selwynianus* (WHITEAVES)". F. *Desmophyllites larteti* (SEUNES) from Europe. G. "*Desmoceras*" *pyrenaicum* (GROSSOUVRE), holotype. H. "*Desmoceras pyrenaicum* GROSSOUVRE", paratype. ------ Limit of variation in *Desmophyllites diphylloides* (FORBES) emended in this paper.

Thus *Desmoceras simplex* v. HOEPEN from South Africa (1921, p. 19, pl. iii, figs. 11–16; text fig. 10) is probably identical with the present species and *D. woodsi* (SPATH) (1921a, p. 45, pl. vii, fig. 1; 1922, p. 129) may also be an inflated form of the Indian species, although without seeing the specimen we cannot decide whether SPATH's form is *diphylloides* or *phyllimorphum*. *Desmoceras crassum* v. HOEPEN (1921, p. 20, pl. iv, figs. 3, 4; text fig. 11) may very possibly fall within the thick variety of the present species. In fact Dr. SPATH recently reported the occurrence of *D. diphylloides* from Angola in Africa, illustrating an example with relatively thick whorls (1953, p. 26 footnote, pl. ii, fig. 6a–c) (see Measurements). We agree with COLLIGNON (1931) in regarding

the form from Madagascar as a variety of the present species.

The Canadian form, '*Ammonites selwynianus* WHITEAVES' (1879, p. 104, pl. 13, fig. 1, 1a; USHER, 1952, p. 63, pl. v, figs. 3, 4; pl. vi, figs. 1–3; pl. xxxi, fig. 20) from the "Upper Campanian" of Queen Charlotte Island is again very similar to *Desmophyllites diphylloides* (FORBES)*. The dimensions of the Canadian specimens measured by USHER (1952) show some variation in shell form which is as a whole quite similar to those of *D. diphylloides*. If we consider the change of characters with growth, the Canadian form is as narrowly umbilicate as the Indian and Japanese forms and there is also no essential difference in the ventral projection of the constrictions among the three forms, so that they may well be grouped in one and the same species.

In short *Amm. selwynianus* WHITEAVES, *Desmoceras simplex* v. HOEPEN and *D. crassum* v. HOEPEN are probably synonymous with *D. diphylloides* (FORBES) and thus the species has a world wide distribution in the Upper Senonian, although a final conclusion should await study of the Canadian and African specimens. Anyhow the Japanese form is specifically identical with the Indian form represented by FORBES' original specimens.

Among the European forms *Desmophyllites larteti* (SEUNES) (1890, p. 19, pl. iv (xiii), figs. 2a, b, 3; pl. iii (xii), fig. 2) (also GROSSOUVRE, 1894, p. 216, pl. xxxiv, figs. 2a, b) is a distinct species on account of its much compressed whorl with the maximum breadth at the mid-height, narrowly arched venter, and well marked constrictions which are strongly sigmoidal on the sides and show very acute ventral projection. '*Desmoceras*' *pyrenaicum* GROSSOUVRE seems to be a composite species, as was suggested by PERVINQUIÈRE (1907) (p. 140), who studied the original specimens.

The holotype of *pyrenaicum* (GROSSOUVRE, 1894, p. 168, pl. xxv, fig. 2) is round whorled and shows, as PERVINQUIÈRE mentioned, a different curvature of the constriction as compared with the "paratype" (*Ibid*, pl. xxxvii, fig. 9). The latter is flat sided, somewhat compressed and slightly divergent in section and in every respects very similar to *D. diphylloides* (FORBES), as KOSSMAT has already pointed out. This form, which came from the Upper Senonian ('Upper Campanian' of GROSSOUVRE, 1902) is probably referable to *D. diphylloides* (FORBES) itself. On the other hand the species (*pyrenaicum*) represented by the holotype, which came from the Lower Santonian, cannot for several reasons be referred to *Desmophyllites*, although it may have some connection with the origin of that genus.

Occurrence.– In Hokkaido and Saghalien the species is characteristic of the Infrahetonaian and Paleohetonaian, the approximate equivalent of the Lower and Upper Campanian. The occurrence of the species outside the Japanese province has been mentioned just above.

* The ventral view of KOSSMAT's figure of larger specimen (1898, pl. xix, fig. 8b) seems to be incongruent with his description, the ventral projection of the constrictions having been too gently drawn, although we have had no opportunity of studying that specimen.

Genus *Damesites* MATSUMOTO

The definition of the genus has already been given (T.M., 1942, T.M., 1954 *in* T.M. (Editor)) and doubtful points of nomenclature have also been discussed (WRIGHT & MATSUMOTO, 1954).

Of the four Senonian species from Hokkaido and Saghalien, *D. damesi* (JIMBO) and *D. hetonaiensis* MATSUMOTO were described in detail in 1954. *D. semicostatus* (YABE MS.) MATSUMOTO and *D. sugata* (FORBES) are here described in more detail. Besides them there is an Upper Cenomanian form, the description of which is now under preparation by R. SAITO & T. MATSUMOTO (in press). Therefore the genus ranges from Upper Cenomanian to Maestrichtian.

Damesites semicostatus (YABE MS.) MATSUMOTO

Pl. 25, figs. 1a–d, 2a–c, 3a, b, 4a, b, 5a, b;
Pl. 26, figs. 1a–c, 2a, b, 3a, b; Pl. 30, fig. 6.

1909. *Desmoceras semicostatus* YABE (MS.), *nom. nud.*, p. 443.
1942. *Damesites semicostatus* (YABE MS.) MATSUMOTO, p. 27, fig. 1h.

Material.– In the concise original description (T.M. 1942) the holotype was not designated. Here GT. I–3104 from loc. T592b, bed IIIa, Abeshinai Valley, Teshio Province (T.M. Coll.) is designated as lectotype. Other examples in T.M.'s Collection from the same valley: GT. I–3105 (T592h, IIIa) and GT. I–3388 (T593a, IIIa). In H. YABE's Collection from the Ikushumbets Valley, Ishikari Province, Hokkaido: GT. I–361, GT. I–362 and GT. I–363, "*Pachydiscus* bed" ≒ *Anapachydiscus* zone; from Saushi-sanushibe, Iburi Province, Hokkaido: GK. H4107, GK. H4109 and GK. H4110; from Opirashibets* Valley, Teshio Province, Hokkaido: GK. H4108 and GK. H4111. In K. TANAKA and E. INOUYE's Collection from the same valley: GK. H4102, GK. H4103, GK. H4104 (loc. NH137) and GK. H4105 (loc. NH35). In T.M.'s Collection from the Urakawa area, Hidaka Province, Hokkaido: GK. H3312 (loc. U141 p7) and GK. H3313 (loc. U164 p2). In M. ISHIZAKI & K. SAKAKURA's Collection from Togushi area, Nishi-Notoro Peninsula, South Saghalien: GT. I–1416, GT. I–1473a–d, GT. I–1474, GT. I–1475 and GT. I–1476, all from loc. Togushi-35, "Togushi shale" (≒Upper part of Miho group). Several specimens from the Opirashibets Valley (without precise record of collection) somewhat deviate from the typical form but are included in the present species: GK. H4112, GK. H4113, GK. H4114 and GK. H4115.

Dimensions.–

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* Opirashibets is sometimes written as Obirashibets or as Obirashibetsu. In this paper the first spelling is adopted following Dr. YABE's label.

Specimen	Diameter	Height	Breadth	(B/H)	Umbilicus	(%)
GT. I-3104	37.7	23.3	18.9	(0.81)	3.0	(8.0)
GT. I- 361	33.9	20.4	17.0	(0.83)	3.3	(9.7)
GT. I- 362	—	32.3	24.3	(0.75)	4.6	—
GT. I- 363	46.3	26.4	20.8	(0.79)	3.3	(7.1)
GT. I-1473a	41.0	24.6	19.4	(0.79)	3.4	(8.3)
GT. I-1473b	35.6	22.3	18.4	(0.83)	3.0	(8.4)
GT. I-1475	36.6	21.2	17.4	(0.82)	3.4	(9.3)
GK. H4102	51.2	32.5	21.7	(0.67)*	3.6	(7.0)
GK. H4103	36.9	21.5	17.7	(0.82)	3.3	(8.9)
GK. H4108	—	29.7	23.7	(0.80)	—	—
GK. H4111	37.5	22.2	—	—	3.5	(9.3)
GK. H4113	61.2	35.6	27.1	(0.76)	5.1	(8.3)
GK. H4114a	76.7	46.3	29.3	(0.63)	—	—

Specific diagnosis.– Very involute with very narrow and crater-like umbilicus; of fairly small or moderate size, with much compressed whorls in later growth stages; flanks nearly flat and parallel in middle age but slightly inflated in the adult; venter carinate or carinati-sulcate in later whorls; the keel being rather low at first and high in the adult, while the furrows kept indistinct. Constrictions are rather frequent but sometimes variable in number and distinctness, very sigmoidal on the sides and strongly projected on the venter, forming acute chevrons. Those on the full-grown body whorl are generally obsolete, if not completely lost.

The outer whorls are ornamented with numerous, flexiradiate, fine and narrow subcostae which are nearly obsolete on the inner half of the flanks and distinct on the outer half with a projection on the venter in parallel to the constrictions. Branching and unification of the subcostae are sometimes found near the ventrolateral part. The subcostae become fine and dense near the keel, but the sharper ones indent the keel as they cross.

Remarks.– The present species is allied to *Damesites damesi* (JIMBO) in size, form and general features of ornamentation as well as in sutures. The distinction is in the costae; the ribs are much elevated, sharper and more regular in this species than in *D. damesi*. The dentation of the keel is better developed in this species. Carefully examined the proportion of height and breadth of whorls is different between the two species in the corresponding size; *D. semicostatus* is somewhat more compressed than *D. damesi* (see text fig. 4).

There are some variations in the sharpness of the subcostae, dentation and height of the keel and the distinctness of the furrows, so that certain specimens (e.g. GK. H4114b, GK. H4113, etc.) approach to *D. damesi*, although they are rather referable to the present species. In the unornamented immature shells the two species are hardly distinguished. Although the two species are nearly contemporary, so far as

* deformed

we know, they are not usually associated with each other at one and the same locality.

Occurrence.– Urakawan, both in its lower and upper parts, approximately Coniacian and Santonian; possibly Upper Gyliakian, though not ascertained in situ.

Damesites sugata (FORBES)

Pl. 26, figs. 4a, b, 5a, b; Pl. 27, figs. 3a, b, 4a–d.

1845. *Ammonites sugata* FORBES, p. 113, pl. x, fig. 2.
1865. *Ammonites sugata* FORBES, STOLICZKA, p. 60, pl. xxxii, figs. 4-6; pl. xxxiii, figs. 1, 2.
1890. *Desmoceras sugata* (FORBES), YOKOYAMA, p. 185, pl. xx, fig. 11a-c.
1898. *Desmoceras sugata* (FORBES), KOSSMAT, p. 111 [176], pls. xix (xxv), fig. 1a, b; xviii (xxiv), fig. 11.
1921. *Hauericeras ? sugata* (FORBES), SPATH, p. 46, pl. vi, fig. 3a, b.
1942. *Damesites sugata* (FORBES), MATSUMOTO, p. 27, text fig. 1f.

Material.– A number of specimens in good preservation are before us. Following is a list of selected examples. GT. I–1471 from loc. Togushi–32; GT. I–1469, GT. I–1470 and GT. I–1472 from loc. Togushi–9·7; GT. I–1467 and GT. I–1468 from loc. Togushi–96·217, all in "Togushi shale", the equivalent of the upper part of the Miho group, Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.). GT. I–2593 from locality N22z, zone Mh6β; GT. I–2588 from N401e2, Mh6β; GT. I–2585 and GT. I–2590 from N401c6, Mh6β; GT. I–2589 from N401g3, Mh6β; GT. I–2578 and GT. I–2582 from N391, Mh6; GK. H2408 from N143p2, Mh6α_2; GK. H2407 from N22z from Mh6β, all in the Naibuchi Valley, South Saghalien (T.M. Coll.). GT. I–3119 from locality T310b, bed IIId, Abeshinai Valley, Teshio Province, Hokkaido (T. M. Coll.). GK. H3270 from loc. U595, bed Ur1β; GK. H3272 from loc. U600C13, bed Ur2β'; GK. H3273 from U143p2, Ur1β; GK. H3275 from U513, Ur2β'; GK. H3319, U141p2, Ur1β, all in the Urakawa area, Hidaka Province, Hokkaido (T.M. Coll.). GT. I–359a, b, c, from Shisanushibe and GT. I–360 from Soushisanushibe, "*Pachydiscus* beds" (≒ *Anapachydiscus* zone), Iburi Province, Hokkaido (H. YABE Coll.). GT. I–358a from Urakawa (H. YABE Coll.). GK. H5124, GK. H5129, GK. H5130, GK. H5131 and GK. H5132 in S. NAGAOKA's Coll., record uncertain, South Saghalien.

Dimensions.–

Specimen	Diameter	Height	Breadth	(B/H)	Umbilicus (%)
YOKOYAMA, 1890 from fig.	44.5	26.5	18.(?)	(0.68)	4.5 (10.1)
GT. I-359a	40.0	22.4	16.5	(0.74)	4.8 (12.0)
GT. I-1467	63.0	34.1	—	—	8.3 (13.2)
GT. I-1469	65.5	35.5	20.5	(0.58)	9.5 (14.5)
at each half volution	46.8	24.0	17.3	(0.72)	6.5 (13.9)
〃	31.5	16.4	12.5	(0.76)	4.3 (13.8)
〃	22.0	12.0	9.2	(0.76)	2.5 (11.4)
GT. I-1470	24.0	13.6	9.0	(0.66)	3.0 (12.5)
GT. I-2582	24.5	13.6	11.2	(0.82)	2.5 (10.2)

GT. I-2589	33.5	19.8	14.3	(0.72)	4.1 (12.2)
GT. I-2593	—	25.3	19.5	(0.77)	6.9 (—)
GT. I-3119	35.5	17.8	13.1	(0.73)	4.5 (12.7)
GK. H2407	15.2	8.5	6.3	(0.74)	1.9 (12.5)
GK. H2408	23.4	12.9	10.2	(0.79)	2.8 (12.0)
GK. H3270	54.0	28.0	21.2	(0.76)	7.8 (14.4)
GK. H5124	46.8	26.2	17.2	(0.66)	6.3 (13.5)
GK. H5129	37.0	20.8	15.4	(0.74)	5.0 (13.5)
GK. H5130	38.0	21.3	15.3	(0.72)	5.1 (13.4)
GK. H5131	33.7	19.2	13.6	(0.71)	4.4 (13.1)

Specific diagnosis.– A species of *Damesites* characterized by much compressed whorls with parallel and flattened flanks, somewhat wider umbilicus than in other species (being 10–15 % of diameters), surrounded by steeply sloping umbilical wall and subrounded to subangular umbilical shoulder; constrictions are infrequent in the immature shell, frequent in the adult, prorsiradiate and gently arcuate, showing a strong projection and chevrons on the ventral area. Ventral keel is rather obtuse, without accompanying furrows on its sides. The internal mould is smooth, but sometimes the surface of the shell has faint raised lines, besides the constrictions and keel. Sutures are similar to those of *Damesites damesi* and have seven pairs of auxiliaries besides E, L, U2, U1 and I.

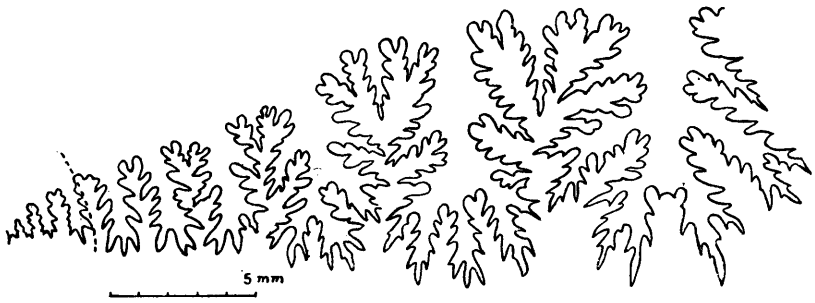

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Fig. 3. External suture-line of *Damesites sugata* (FORBES). GT. I-1469 from loc. Togushi 9·7, Togushi shale, Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.).

Remarks.– The holotype of *Ammonites sugata* FORBES from India, BM. C. 22674, is a relatively small shell of poor preservation. STOLICZKA (1865) and KOSSMAT (1898) described larger specimens of better preservation from the same area and have given a better definition.

The specimens from Hokkaido and Saghalien are sufficient in number and mode of preservation to justify the specific identity with the Indian form and, at the same time, to show the extent of variation within the species.

From *Damesites damesi* (JIMBO) the present species is clearly distinguished by its

more compressed and laterally flattened whorls (cf. figures of B/H of both species at successive growth-stages), somewhat wider umbilicus (slightly exceeding 10% of diameter at later growth-stages), subrounded to subangular umbilical margin, oblique

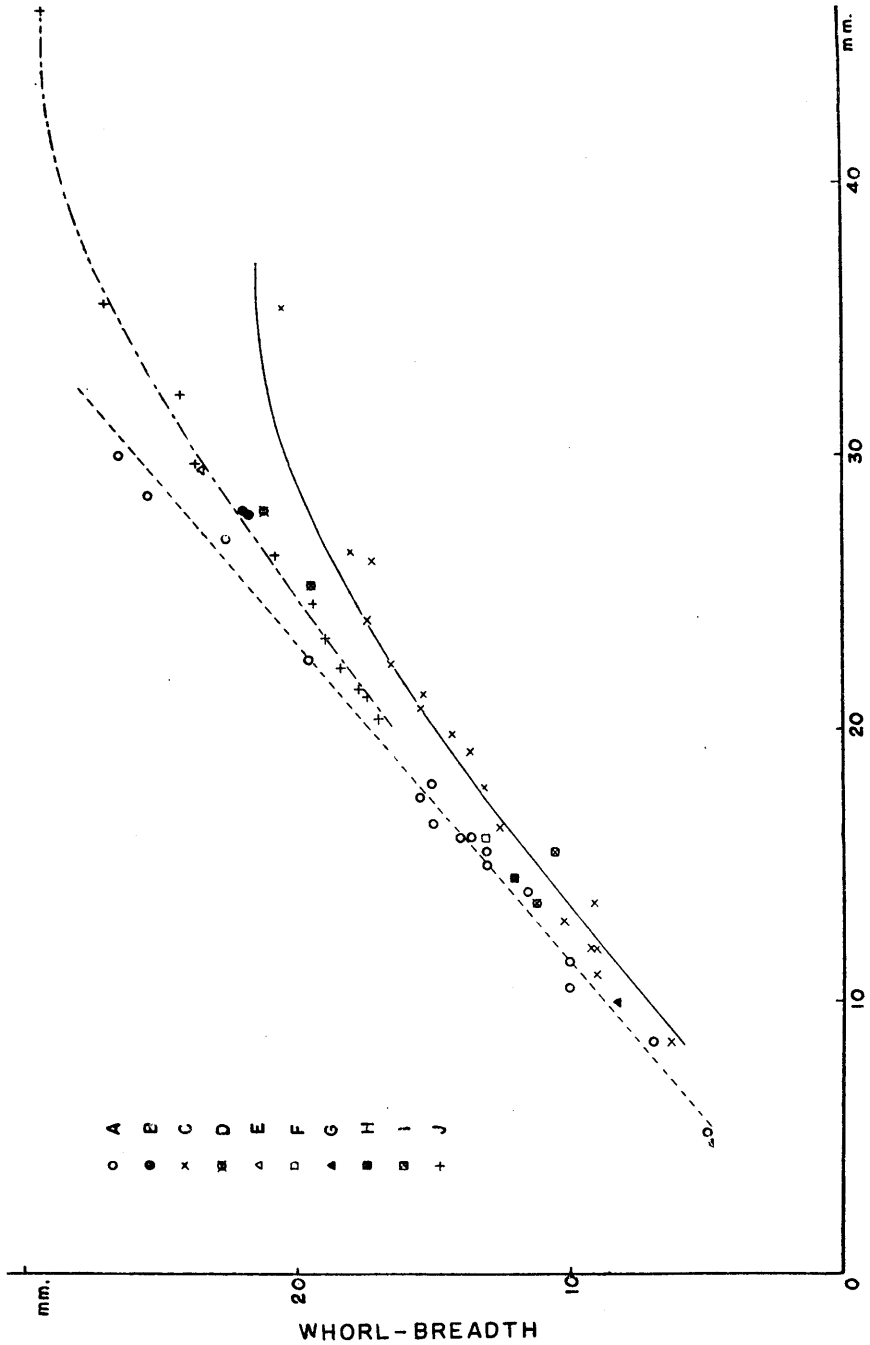

Fig. 4. Diagram showing the proportion between breadth and height of whorls in three species of *Damesites* and related forms. A. *Damesites damesi* (JIMBO) from Hokkaido and Saghalien. B. *D. damesi intermedius* MATSUMOTO. C. *Damesites sugata* (FORBES) from India, Hokkaido and Saghalien. D. *D. sugata* (FORBES), relatively thick forms referred in this paper (GK.H3270, GT. I-2582 and GT. I-2593). E. "*Desmoceras sugata*" from Madagascar in BASSE, 1931. F. "*Hauericeras ? sugata*" from Pondoland in SPATH, 1921. G. "*Desmoceras compacta*" from Pondoland in v. HOEPEN, 1921. H. "*Desmoceras sugatum*" from California in ANDERSON, 1902. I. "*Desmoceras obscurus*" from Germany in SCHLÜTER, 1872. J. *Damesites semicostatus* (YABE MS.) MATSUMOTO.

(instead of biconvex) constrictions, frequent in the outer whorl, and absence of subcostae, consequent absence of crenulation of the keel, and also absence of furrows along the ventral keel. Thus YOKOYAMA's *sugata* (1890, p. 185, pl. xx, fig. 11) from Ibui near Urakawa, Hokkaido is a real *sugata* and not *damesi*.

There are, however, a few peculiar forms which seem to be intermediate between the two species in question. An example is GK. H3270 (from bed Ur1β, Urakawa area, Hokkaido), in which the whorl is thicker than the normal form of *sugata*, being still thicker than the "thick specimen" of STOLICZKA (1865, pl. xxxii, figs. 4, 5), but has good characters of *sugata* in other respects. This can be included as a variety of the present species. Considering the change of characters with growth, STOLICZKA's thick example is not far from the average of the species, while his compressed example (pl. xxxii, fig. 6) may be an extreme example just opposite to the Japanese one mentioned above.

Another, still more peculiar, form is represented by several specimens (quite rare in our rich collection). It is quite similar in shell form to the typical form of *Damesites damesi*, but it has weaker subcostae, weaker keel, shallower furrows and less sigmoidal and more prorsiradiate constrictions than the typical *damesi*, thus closely approaching *sugata*.

Although the two species in question have a long stratigraphical range, in the Province of Hokkaido and Saghalien, *D. damesi* appears earlier than *D. sugata*. Therefore we are inclined to regard the peculiar form here mentioned as having a subspecific significance, justifying

Damesites damesi intermedius MATSUMOTO, 1954

with holotype, GK. H3269 from locality U513, bed Ur2β', Urakawa (T.M. 1954a, pl. vi (xxii), fig. 4a, b, here reillustrated in Pl. 27, fig. 2a, b). GT. I–2604 (Pl. 27, fig. 1) (from a pebble of the Juhachi-rinpan-Ichino-sawa, a tributary of the Naibuchi, probably derived from zone Mh4, south Saghalien, T.M. Coll.) is another example, although it was previously listed under *Damesites damesi* (JIMBO) (T.M. 1954, p. 268). The age of the subspecies is Paleourakawan (Coniacian) and Neourakawan (Santonian).

In spite of the presence of the intermediate form the plentiful material demonstrates that *Damesites sugata* is distinct from *D. damesi* and KOSSMAT's proposal (1898) to *D. damesi* (JIMBO) as a synonym of *D. sugata* (FORBES) is not warranted.

Damesites hetonaiensis MATSUMOTO is fairly similar to the present species in the nearly smooth shell, simply arcuate constrictions and the proportion between height and breadth of whorls, but has distinctly narrower and crater-like umbilicus. The keel seems narrower and sharper in *D. hetonaiensis* than in *D. sugata* and the constrictions seems weaker. However these two characters are often modified by the condition of preservation.

"*Desmoceras sugata* (FORBES)" from Madagascar (BASSE, 1931, p. 21, pl. ii, figs. 19, 20) seems to us more similar to *D. hetonaiensis* than to *D. sugata*, but it is somewhat

thicker than the type of *D. hetonaiensis*. The fact may be ignored as a minor difference within the variation of that species. As another possibility the form might correspond to *D. damesi intermedius* mentioned above.

In immature specimens of *Damesites* below 30mm. in diameter the specific distinction is not necessarily well exemplified, so that species created on such material are hardly justified. *Desmoceras compacta* v. HOEPEN (1921, p. 21, pl. iv, figs. 5–7, text fig. 12) unfortunately is such a case. This might be a thick variety of *D. sugata* or of *D. hetonaiensis*, but its close resemblance to immature *D. damesi* is undeniable. Similarly *D. sugata* from California (ANDERSON, 1902, p. 98, pl. iii, figs. 98, 99), which is said to have been obtained with *Metaplacenticeras californicum*, *M. pacificus* and other "Lower Chico" species* could either be a young *Damesites damesi* or *D. sugata*, though hardly determinable in the absence of specimens of better preservation.

Constrictions are usually virtually absent or infrequent in the inner whorls but become increasingly frequent and well marked with growth. The feature however varies in individuals. The holotype, which is obviously immature, seems free from the well marked constrictions, although its preservation is not good. KOSSMAT's illustrated specimen (pl. xix, fig. 1), which is nearly as large as one of STOLICZKA's smooth ones (pl. xxxii, fig. 6) already has frequent constrictions. A similar feature is found also in our specimens. One rather unusual specimen, GT. I–1470, from the same locality as typical *sugata* (e.g. GT. I–1469), in spite of its small size has several prorsiradiate and arcuate constrictions and is, moreover, much compressed and laterally flattened as in the adult of the typical form. In other words the adult character seems to have appeared ontogenetically earlier in this specimen as compared with the normal form of *sugata*. We have to call it provisionally *Damesites* sp. aff. *D. sugata* (FORBES).

Ammonites obscurus SCHLÜTER (1872, p. 70, pl. 22, fig. 9, 10) from the Senonian of North Germany apparently resembles immature shells of the present species but is indeed obscure, as the author mentioned, as its suture is not clearly shown. The specific name is found under the genus *Pachydiscus* in GROSSOUVRE's list (1901, p. 283) of the species from the British *Marsupites* zone, without any reason of the generic assignment.

Someone might suppose that *Damesites* was derived from a certain *Desmophyllites*.** KOSSMAT pointed out the resemblance between *D. sugata* (FORBES) and *Desmophyllites phyllimorphum* (KOSSMAT) in several respects, but in India the latter is known only from the Ariyalur group while the former begins to appear earlier. It is still difficult to

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* The record of the occurrence of *Metaplacenticeras* in California is quite questionable. ANDERSON in his more recent paper (1931, p. 125) mentioned the occurrence of the two species above the 'Middle Chico' horizon of *'Fagesia' siskiyouensis* ANDERSON.

** The derivation of *Damesites* straight from *Desmoceras* is now more probable on account of the discovery of Cenomanian forms (R. SAITO & T. MATSUMOTO, in press).

prove precisely the origin of *Damesites sugata*. However the discovery of *Damesites damesi intermedius* suggests that *D. sugata* may be a derivative from *D. damesi* or have a common ancestor with that species.

Occurrence.– The locality of FORBES' original specimen is recorded as Verdachellum, India, presumably Trichinopoly group. STOLICZKA reported the species from the Trichinopoly and Ariyalur groups and KOSSMAT stated that its range in India was from the Upper Trichinopoly group to the Lower Ariyalur group. All the specimens illustrated by the two authors are Trichinopoly ones and we are not certain whether the Ariyalur specimens actually belong to the present species or to other species. In Hokkaido and South Saghalien it is common in the Neourakawan, approximately corresponding to the Santonian.

Genus *Hauericeras* de GROSSOUVRE, 1894

Type species.– *Ammonites pseudogardèni* SCHLÜTER, 1872.

Diagnosis.– Very compressed, discoidal and polygyral shell, with a sagittate and then keeled venter and subangular umbilical shoulder in more or less later growth stages. The coiling is fairly involute or fairly evolute and accordingly the umbilicus is fairly narrow or fairly wide. Constrictions, generally well marked on the internal mould of outer whorls, are more or less sigmoidal or simply arcuate on the flanks, showing on the outer whorl a strong forward bend at the periphery usually without cutting the keel. Surface of the shell is nearly smooth or very faintly ornamented with the striae and or riblets which are flexiradiate on the flanks and show a prominent projection on the venter. Suture of the *Desmoceras*-type or sometimes rather of the *Puzosia*-type, with broad E, subsymmetrically trifid and somewhat longer L, slightly recurved U2, strongly or gently descending auxiliaries and subsymmetrically or asymmetrically bifid saddles.

Distribution.– Senonian (*s.l.*) (mainly from Santonian to Maestrichtian, but rarely in Coniacian), world wide.

Remarks.– The genus has been believed to be well defined since it was proposed by DE GROSSOUVRE (1894, p. 219). However, from considerations of the origin of the genus and of the taxonomic necessity we propose here division into two subgenera:

Subgenus *Hauericeras* (*s.s.*)

Type species.–*Ammonites pseudogardeni* SCHLÜTER, 1872.

Subgeneric diagnosis.– Fairly involute and fairly narrowly umbilicate subgroup of *Hauericeras* with suture of rather *Desmoceras*-type, characterized by the large E, subsymmetrically trifid L, which is a little shallower, or as deep as E, and very gradually descending, numerous auxiliary elements. Surface is nearly smooth, sometimes with falciform striae or riblets and in some case weak, peripheral nodes or

node-like riblets.

Distribution.– Lower Senonian (mainly Santonian).

Subgenus ***Gardeniceras***, nov.

Type species.– *Ammonites gardeni* BAILY, 1855.

Subgeneric diagnosis.– Fairly evolute and fairly widely umbilicate subgroup of *Hauericeras* with the suture of rather *Puzosia*-type, characterized by the subsymmetrically trifid L, which is somewhat deeper than E, asymmetrically bifid saddles, recurved U2 and the strongly descending subdivisions of U3 (=S).

Distribution.– Senonian (*s.l.*) (mainly Santonian-Maestrichtian).

Some minor features in the suture may sometimes be correlated with the shell form–for example the degree of descending character in the auxiliaries and their number with the length of the flanks from the venter to the umbilical margin, but, as one of us (T.M.) has demonstrated in the previous paper, the inflated Puzosiids (e.g. *Pachydesmoceras* and *Jimboiceras*) have the same type of suture as the compressed Puzosiids and, again, the high whorled Pachydiscids have the same pattern of suture as the depressed or round whorled Pachydiscids. In the case of *Hauericeras* the distinction defined above is clearly more than specific and has good significance in taxonomy and probably in phylogeny.

GROSSOUVRE's diagnosis of *Hauericeras* (1894, p. 219) was based largely on *Ammonites gardeni* BAILY and related forms from France. However he designated *Ammonites pseudogardeni* SCHLÜTER as type species, regardless of the disharmony between his generic diagnosis and the character of the type species.

To the subgroup of *Ammonites pseudogardeni*, here defined as subgenus *Hauericeras* (*s.s.*), belongs another German species: *Hauericeras nodotum* (SCHLÜTER) [=*Amm. pseudogardeni* var. *nodotus* SCHLÜTER (1899, p. 411)=*Hauericeras pseudogardeni* MÜLLER & WOLLEMANN, 1906, p. 14, pl. iv, figs. 1–4; pl. viii, fig. 3)=*Hauericeras buszii* WEGNER, 1905, incl. varieties *nodata* and *costata* (p. 208, pl. viii, figs. 1a, b)]. This species is very interesting because of its close resemblance to the inner whorls of the contemporary or slightly earlier *Tragodesmoceras clypeale* (SCHLÜTER) in the involute, narrowly umbilicate, compressed and sagittate shell form, the flexuous constrictions and the general pattern of the suture. The peripheral costae or small radial nodes in this species may be relics of or a parallel development to the ribs in *Tragodesmoceras*. The horizon of *H. nodotum* (SCHLÜTER) is interpreted mainly as Santonian ("Granulatenkreide", Münsterland of WEGNER, 1905; "Untersenon" of MÜLLER & WOLLEMANN, 1906, who reported also Upper Santonian species, *Parapuzosia daubrei*, *Eupachydiscus isculensis*, *Scaphites binodosus*, *Diplacmoceras bidorsatum*, etc). From the same formation ("Granulatenkreide") WEGNER* (1905) reported the occurrence of *Hauericeras pseudogardeni* itself, which ranges down

to the upper part of "Emscher-Mergel"–that means probably the Lowest Santonian– and *Tragodesmoceras clypeale* (SCHLÜTER), which is said to occur in the Coniacian. SCHLÜTER (1872) described *Trag. clypeale* from the "Lower Senonian sandy rock", north of the Harz, regarding it as allied to *Amm. pseudogardeni* in Westphalia.

Thus the German material strongly suggests the derivation of *Hauericeras* (*s. s.*) from *Tragodesmoceras* or some similar form, by reduction of the ornament and the acquisition of a keel on the sagittate venter. Several species of *Tragodesmoceras* are known in North America, among which *T. bassi* MORROW (1935, p. 468, pl. 52, figs. 1a-c; pl. 53, figs. 3–5, text figs. 1–3) is very weakly ribbed in its outer whorl and fairly similar to *Hauericeras*.

H. (*Gardeniceras*) is possibly either a direct derivative or parallel development of *Hauericras* (*s. s.*). Indeed *H. welschi* GROSSOUVRE (1894, p. 222, pl. xxxv, fig. 9, text fig. 82) from the Lower Santonian is rather intermediate in its coiling between *H.* (*s. s.*) *pseudogardeni* and *H.* (*G.*) *gardeni*, but its suture is unknown.

A possible interpretation is that *Gardeniceras* might be a derivative from some compressed Puzosiid. For instance, *Puzosia compressa* KOSSMAT (1898, p. 119 (184), pl. xviii (xxiv), fig. 4 = *Ammonites durga* p.p. STOLICZKA, 1865, p. 143, pl. 1xxi, fig. 6, 7) is apparently similar to *Gardeniceras* and in fact STOLICZKA combined his larger specimen with the smaller specimen (1865, pl. 1xxi, fig. 5) of *Ammonites durga* FORBES, the latter of which is specifically identical with *H.* (*G.*) *rembda* (FORBES) described below. The disappearance of the weak ventral ribs from *Puzosia compressa* with acquisition of the sagittate and keeled venter might give rise to *H.* (*Gardeniceras*), and then (?) *Hauericeras* (*s. s.*). However in our present knowledge there is no intermediate form between the Lower Utatur (lower Cenomanian or Uppermost Albian) *Puzosia compressa* and Senonian *Hauericeras* (*s.s.*) whereas, as one of us has recently shown (T.M., 1954, Puzosiidae), relatively strongly ornamented Puzosiids, such as *Mesopuzosia*, *Neopuzosia*, *Austiniceras* and *Parapuzosia*, are generally common in the Turonian and Senonian. Furthermore *P. compressa* has the suture of typical *Puzosia* type (see KOSSMAT, 1898, pl. xviii, fig. 4) with very large and asymmetric L, and much further apart from the *Desmoceras* type than that of *Hauericeras*.

Another species which should be considered is "*Puzosia*" *angusta* MARSHALL (1926, p. 180, pl. 41, figs. 1, 2; pl. 22, fig. 5) from New Zealand. It is fairly similar to *H.* (*Gardeniceras*) but has no keel and a narrowly arched venter, which ribs cross with a forward projection. That species, which belongs to a Campanian fauna, is probably a specialized Puzosiid related to *Kitchinites* (?) *darwini* PHILIPPI from Chile. Unfortunately in the original specimens of *angusta* (MARSHALL's illustrated one and another, NZ. GS. Ce. 826) ventral portion of the constricted part is not preserved, so that the oblique

* WEGNER was by no means far from perfect in putting *clypeale* in *Hauericeras* (1905, p. 207) with a remark on its intimate relation with *H. pseudogardeni*.

cutting of ribs by the constriction has not yet been clearly confirmed. Its suture is similar to that of *Kitchinites brevicostatus* (MARSHALL), being much more complicated than that of *Hauericeras*.

In short, according to our present knowledge, *Hauericeras* seems to have no direct connexion with *Puzosia* and the resemblance between the two may be a case of parallel development.

There occurs rarely in the Turonian of Japan a peculiar Desmoceratid. It is a small, very thin, much compressed discoidal shell with a very narrowly arched venter. The suture, constrictions and the faint striae are of *Desmoceras* type. It is probably a specialized descendant from the Cenomanian *Desmoceras* (*Pseudouhligella*) *ezoanum* MATSUMOTO and perhaps requires a new specific name, which we do not propose here because the material is still insufficient (Pl. 30, fig. 7). We notice that the form foreshadows well the tendency of *Hauericeras*-like shell, although it may not be a direct ancestor.

Another form which should be compared with *Hauericeras* (*s.l.*) is *Oiophyllites* SPATH, 1953. The type species, *O. decipiens* SPATH from the Upper Senonian of Antarctica, is indeed a distinct form, though represented only by a few small specimens. Having fortunately studied those specimens (BM. C. 41348, C. 41343, C. 41403, C. 41404), one of us (T.M.) noticed the striking similarity between them and the inner whorls of *Hauericeras*. To demonstrate the similarity we illustrate here *O. decipiens* and early immature examples of *Hauericeras angustum* of the corresponding size (Text figs. 5, 6).

Oiophyllites is narrowly umbilicate and has sigmoidal (biconvex) striae as in *Hauericeras nodatum*. The suture is also similar in general pattern between the two genera.

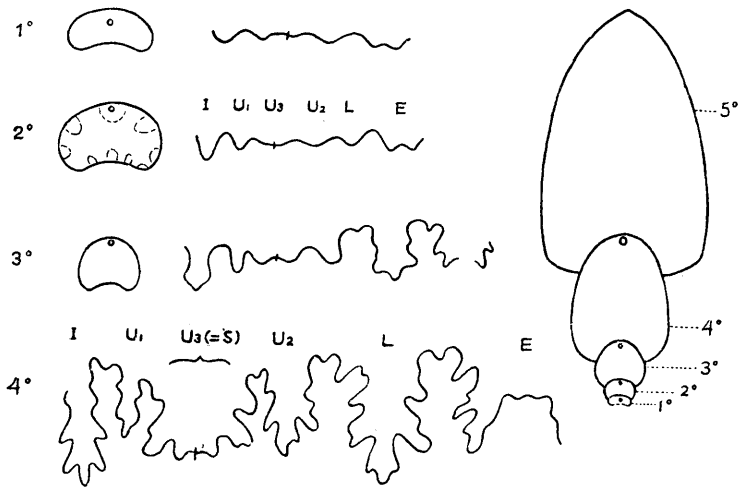

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Fig. 5. *Hauericeras* (*Gardeniceras*) *angustum* YABE in very young growth-stages, showing sutures and whorl-sections. 1°, 2°, ··· 5°: First, second, ··· and fifth whorls. The fifth whorl is 16mm in diameter. GK. H 3334a from loc. U505, bed Urlβ (zone of *Inoceramus naumanni*), Urakawa area, Hidaka Province, Hokkaio (T. M. Coll.).

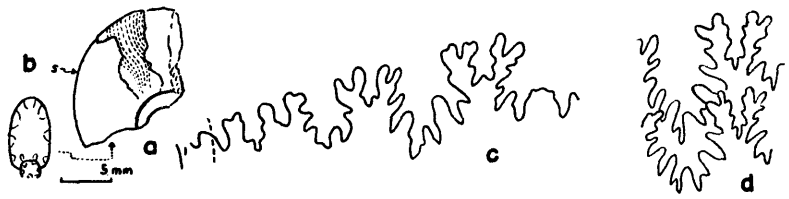


Fig. 6. *Oiophyllites decipiens* SPATH. Lateral view (a), whorl-section (b) and suture (c) (at s) of holotype, BM.C. 41348 and partial suture-line (d) of another specimen, BM.C. 41343, Lecham Crags, South, James Ross Island, Graham Land. T.M. del. by kind permission of Keeper of Geology, British Museum (Natural History).

Oiophyllites is characterized by a somewhat phylloid outline of suture but this is not more marked than in certain young *Hauericeras* and many other immature Desmoceratids. In fact the phylloid character in the suture of one of the paratypes is not so distinct as in the holotype. The character seems to be variable as is often the case in reduced forms.

Thus the genus is closely allied to *Hauericeras*. In fact *Oiophyllites angolaensis* SPATH seems to be nothing but an internal mould of an immature *Hauericeras*. However the genus is in our opinion distinct, because the type species has no keel even in the larger paratype at a whorl-height of 13mm. on which the test is preserved. *Oiophyllites* may be a special offshoot from *Hauericeras* (*s.s.*) or from a main Desmoceratid stock, like *Desmophyllites*, in parallel with *Hauericeras*. Its suture has some reducing tendency and there is no direct connexion between it and *Neophylloceras* or *Phyllopachyceras*.

In the flattening of the flanks and very narrow venter *Oiophyllites* is somewhat similar to *Kitchinites*. However *Kitchinites* has complicated sutures and numerous ribs which are cut by oblique constrictions. In our opinion there is probably no direct connexion between the two.

Although there are still unsettled points as to the evolution of *Hauericeras*, the genus represents a special offshoot perhaps derived from the main stock of the Upper Cretaceous Desmoceratidae. It is not a typical member of Desmoceratidae (*s.s.*) nor of Puzosiidae, so that the subfamily **Hauericeratinae**, which was provisionally introduced in the list of the ammonites from the Naibuchi Valley (T. MATSUMOTO, 1938), should be used for it and for *Oiophyllites*.

Hauericeras (*Gardeniceras*) *angustum* YABE

Pl. 24, fig. 6 ; Pl. 28, figs. 1a, b, 2 ; Pl. 29, figs. 1a, b, 2a, b, 3a, b, 4a, b, 5 ; Text figs. 5, 7.

1865. *Ammonites gardeni* BAILY, STOLICZKA, p. 61, pl. xxviii, fig. 4.
1890. *Desmoceras gardeni* (BAILY), YOKOYAMA, p. 184, pl. xx, fig. 10.
1898. *Desmoceras* (*Hauericeras*) *gardeni* (BAILY), KOSSMAT, p. 123, pl. xviii, figs. 7a, b, 8, 10.
1904. *Hauericeras gardeni* (BAILY), YABE, p. 32.
1904. *Hauericeras angustum* YABE, p. 33, pl. v, figs. 5, 6.

1942. *Hauericeras gardeni* (BAILY), MATSUMOTO, p. 25.
1952. *Hauericeras gardeni* (BAILY), USHER, p. 61, pl. v, figs. 1, 2 (in which specimens of WHITEAVES (1879, 1895, 1903) are included).

Material.– We have examined numerous specimens. The followings are the selected examples.

GT. I-259, holotype, from "Upper Ammonite bed" in Urakawa, Hidaka Province, Hokkaido (K. JIMBO Coll.?). In YABE's Collection, mostly described as *Hauericeras gardeni* (BAILY), GT. I-256, GT. I-257, and GT. I-269 from Kikume-zawa, Ishikari Province; GT. I-258 and GT. I-267 from Sanushibe and GT. I-264 from Popets, a tributary of Popets, Iburi Province; GT. I-266 from Shikuraki, Ishikari Prov.; GT. I-263, GT. I-265 and GT. I-274 from Urakawa; GT. I-268a, b from Orowembets, Teshio Province; all "*Pachydiscus* beds" (≒*Anapachydiscus* zone) in Hokkaido. In M. KAWADA's Collection from the Upper part of the Miho group, Naibuchi Valley, South Saghalien: GT. I-554, GT. I-555 and GT. I-556. In T.M's Collection: GT. I-2594 (loc. N143p, zone Mh6), GT. I-2595 (N210, Mh6β), GT. I-2596 (N183, Mh6β), GT. I-2597 (N401i, Mh6β), GT. I-2598 (N401e, Mh6β), GT. I-2599 (N401e7, Mh6β), GT. I-2600 (N147p, Mh6), GT. I-2601 (N199a, Mh6α2) and GT. I-3852 (N401g4, Mh6β), Naibuchi Valley, South Saghalien; GT. I-3134 (loc. T739r, Bed IIId), GT. I-3135 (T739r, IIId), GT. I-3136 (T472p, IIId or e ?), GT. I-3137 (T277c, IIId), GT. I-3139 (T276b, IIIc), GT. I-3140 (T277b, IIId), GT. I-3389 (T730p, III), GT. I-3418 (T211, IIId), Abeshinai-Saku area, Teshio Province, Hokkaido; GK. H3836 from loc. H5c, GK. H3837 and GK. H3838 from loc. H5b, upper part of Upper Yezo group, Hetonai area, Iburi Province, Hokkaido; GK. H3322 (loc. U141 p3, bed Ur1β), GK. H3323 (U141p3, Ur1β), GK. H3328 (U150p6, Ur2β), GK. H3834 (U505, Ur1β), Urakawa area, Hidaka Province, Hokkaido. In S. NAGAOKA's Collection GK. H5138, GK. H5139, GK. H5140, GK. H5141 and GK. H5213 from South Saghalien; in U. TANAKA's Collection GK. H5209 from Abeshinai, Teshio Province, Hokkaido. Other specimens from the upper part of the Upper Yezo group in Yubari-Shiyubari area, Ishikari Province, in Opirashibets area, Ishikari Province have been examined too. YOKOYAMA's specimen is preserved in Germany and not at our disposal.

Dimensions.–

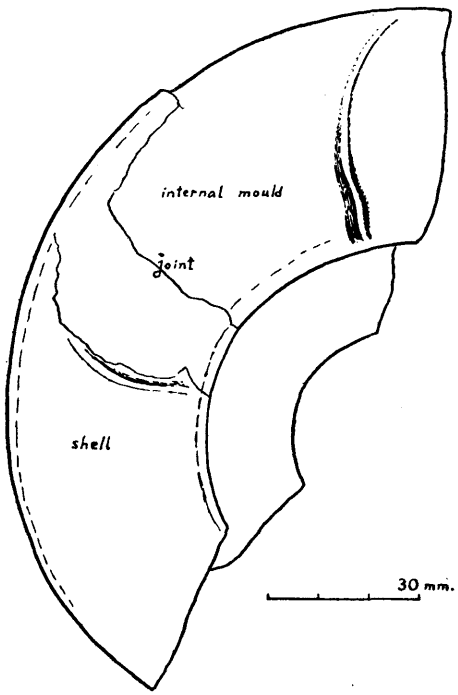
Specimen	Diameter	Height	Breadth	(B/H)	Umbilicus (%)
GT. I-259	33	14	7	(0.5)	11 (33)
GT. I-257	34	13	8(–)	(0.6)	12.5 (37)
GT. I-274	83	31	14	(0.45)	31 (37)
〃	44	17	8	(0.5)	15 (34)
〃	20.5	9	4.5	(0.5)	6.5 (32)
〃	9	3.7	2.8	(0.75)	— —
GT. I-554	123.5	42.3	—	—	51.2 (41.4)
〃	92.5	32.5	16.5	(0.50)	38.3 (41.4)
GT. I-3852	41.3	15.5	8.7	(0.55)	15.5 (37.5)
〃	20.2	8.0	5.0	(0.63)	7.5 (37)

GT. I-2594	53	21	9.5	(0.45)	18 (34)
GK. H3322	123.4	42.8	23.2	(0.54)	51.0 (41.3)
GK. H3323	24.2	11.0	6.0	(0.55)	8.0 (33)
GK. H3326	60.6	25.0	11.5	(0.46)	20.5 (33.8)
GK. H3328	38.3	14.0	8.0(?)	(0.57)	14.6 (38.1)
GK. H3334a	27.8	11.3	6.3	(0.56)	10.4 (37.4)
GK. H3334b	22.8	9.9	5.3	(0.54)	8.0 (35)
GK. H3335	138	—	—	—	Ca 60 (43)
GK. H3336	—	44.3	23.3	(0.55)	— —
GK. H3836	140.0	47.0	—	—	60.4 (43.1)
GK. H5138	46.6	18.1	9.4	(0.52)	17.4 (37.3)
GK. H5139	39.7	16.7	8.6	(0.51)	13.7 (34.5)
GK. H5140	47.6	18.9	11.0	(0.58)	17.4 (36.6)
GK. H5141	—	34.3	17.3	(0.50)	36.9 —
GK. H5209	126.2	43.1	—	—	51.2 (40.6)
GK. H5213	139.6	46.7	25.0	(0.54)	60.0 (43.0)

Specific diagnosis.– Discoidal, evolute, polygyral shell of moderate size, usually about 150mm. and occasionally over 170mm. in diameter when full-grown, consisting of much compressed whorls, keeled in the later stages, rather flattened on flanks and gently convergent in section, with the maximum breadth near the umbilical margin. The umbilicus is fairly wide and is surrounded by a steep but low wall and subangular shoulder.

Surface of the shell is nearly smooth, with only faint, irregular fine riblets or striae, which are better developed on the inner half of the flanks and weakened towards the venter showing gentle flexuosity on the sides and prominent projection on the venter. Constrictions are very faint or hardly discernible in the inner whorls and occasionally better marked but infrequent in the outer whorl. They run nearly parallel to the striae, with only slight flexuosity on the sides.

Suture-line, consisting of E, L, U2, U3 (=S), U1, I, is similar to that of *Puzosia* in general pattern, especially in the strongly descending auxiliaries and the asymmetrically divided saddles, but has broad and fairly deep E and rather subsymmetrical L, which is slightly or somewhat longer than E, even in the adult.



T.M. del.

Fig. 7. *Hauericeras* (*Gardeniceras*) cf. *angustum* YABE. Lateral view of a fragmentary body whorl. GT. I-3389 from loc. T730p2, Upper Yezo group, Abeshinai-Saku area, Teshio Province, Hokkaido (T. M. Coll.).

Remarks.– The present species is closely allied to *Hauericeras gardeni* (BAILY) (1855, p. 456, pl. xi, figs. 3 a–c; SPATH, 1921, p. 238, text fig. A; SPATH, 1922, p. 129) from South Africa. Indeed even the proposer of *H. angustum* misreferred some of its specimens to that species (YABE, 1904, p. 32) and one of us (T.M., 1942) once regarded *angustum* as a variety of *gardeni*. However from careful comparison of specimens (including BAILY's originals deposited in the British Museum (Natural History)), we have found criteria sufficient for justification of the specific distinction. The main difference is in the constriction and in the proportion between height and breadth of whorls.

In the adult whorl of the African species the constriction becomes suddenly well marked, especially on the internal mould,* and fairly frequent, showing an anteriorly

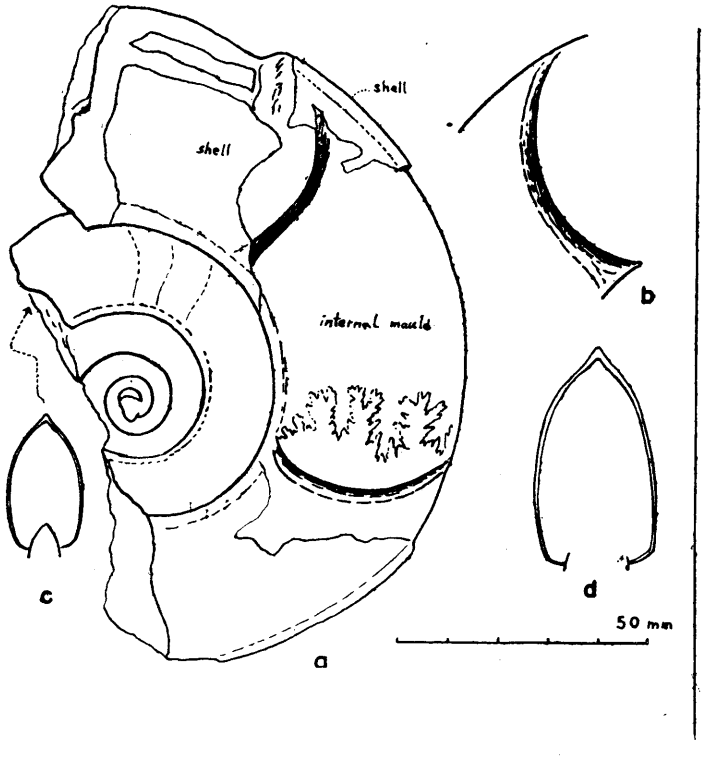


Fig. 8. *Hauericeras* (*Gardeniceras*) *gardeni* (BAILY). Lateral view (a), part of the opposite side (b), showing concave constrictions, and whorl-sections (c, d). One of BAILY's syntypes, BM. C. 35622 [= R 11371] from White-Men's House, coast near Umzumbani River, South Africa. (T. M. del. by kind permission of Keeper of Geology, British Museum (Natural History)).

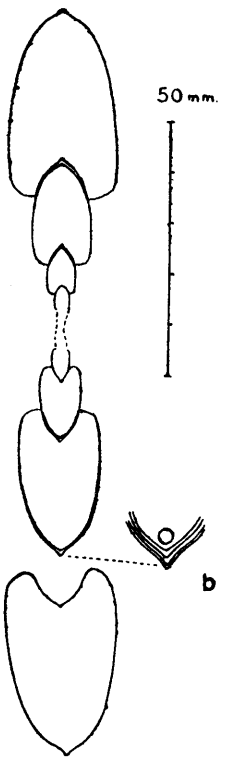


Fig. 9. Whorl-section of *Hauericeras* (*Gardeniceras*) *gardeni* (BAILY), with an enlarged section of a keel (b). BM. C. 18520, referred by SPATH, 1922, p.130. Shell is partly preserved. T.M. del. by kind permission of Keeper of Geology, British Museum (Natural History)).

* The elevation of the shell corresponding to the constriction is very blunt (low and broad) on the main part of the flanks and further reduces its strength near the umbilical margin and also on the venter, so that the characteristic concavity is not well manifested on the shell.

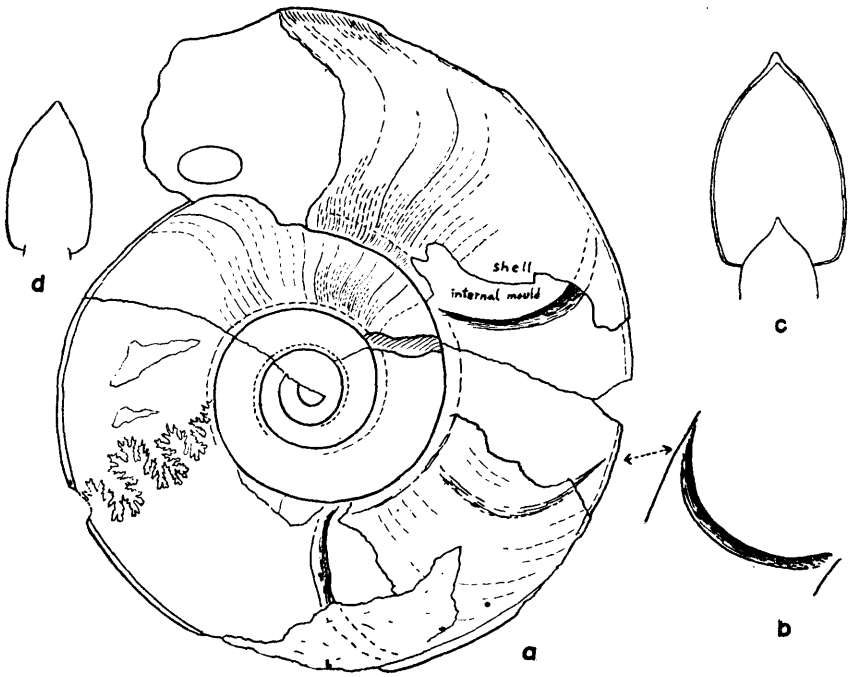


Fig. 10. *Hauericeras* (*Gardeniceras*) *gardeni* (BAILY). Lateral view (a), showing the last suture, striae or riblets on the shell and concave constrictions on the internal mould; a portion of the opposite side (b) showing a concave constriction; whorl-sections of the body chamber (c), which is relatively thick, and of the septate whorl (d), which is much compressed. BM.C.18518, referred by SPATH, 1922, p.130. T.M. del. with kind permission of Keeper of Geology, British Museum (Natural History), ×2/3.

concave curvature, with forward bend both at the umbilical and ventrolateral edges. Its curvature is, therefore, different from that of the striae or fine riblets on the sides (text figs. 8, 10). In the adult whorl of the Japanese species it is infrequent and relatively indistinct, showing a curvature parallel to the striae or riblets. The above observation depends on the examination of numerous specimens of both provinces, so that the difference is not a variation within one and the same species. However in the immature individuals below 80mm. in diameter, constrictions are as a rule hardly discernible, especially when the shell is preserved, but in some cases can be seen on well preserved internal moulds, though weak and infrequent; they are slightly flexuous on the sides and moderately projected at the ventrolateral edge, forming chevrons on the venter. Accordingly it can be said that the Japanese species retains the character of the immature stage even in the adult and that the African species has apparently acquired a new character in the adult.

Regarding the proportion between height and breadth of whorls, the Japanese species is, as a rule, somewhat more compressed than the African one. The fact is clear-

ly shown by a graph (text fig. 11), in which two curves are illustrated. Again the difference is very slight or almost indiscernible in the early immature stage, but that in the middle and later stages is so distinct as to justify specific difference. Of cource there is some variation even in the adult. In this respect there is an interesting specimen (BM. C. 18518, SPATH's "relatively thickest example" in the South African species, text fig. 10), in which the body whorl is distinctly broader and inflated than others, but the septate part is not much different from the usual African form. That example may be a case of sexual dimorphism, as known in recent *Nautilus*, the somewhat inflated form being the female.

Unfortunately an immature specimen (GT. I–259) was originally designated as a type of *H. angustum* YABE and the illustrated specimen of *H. gardeni* (BAILY) (1855, pl. xi, fig. 3a, b) (BM. R. 11370) is again a nucleus of larger individual. Therefore the specific distinction is not so well revealed between the two specimens. However they are reasonably regarded as an immature of the Japanese and African species respectively, because they occur in the respective provinces together with a number of better preserved adult specimens, in which unmistakable characters are shown. Furthermore YABE (1904) has already pointed out that *H. angustum* has higher whorls than *H. gar-*

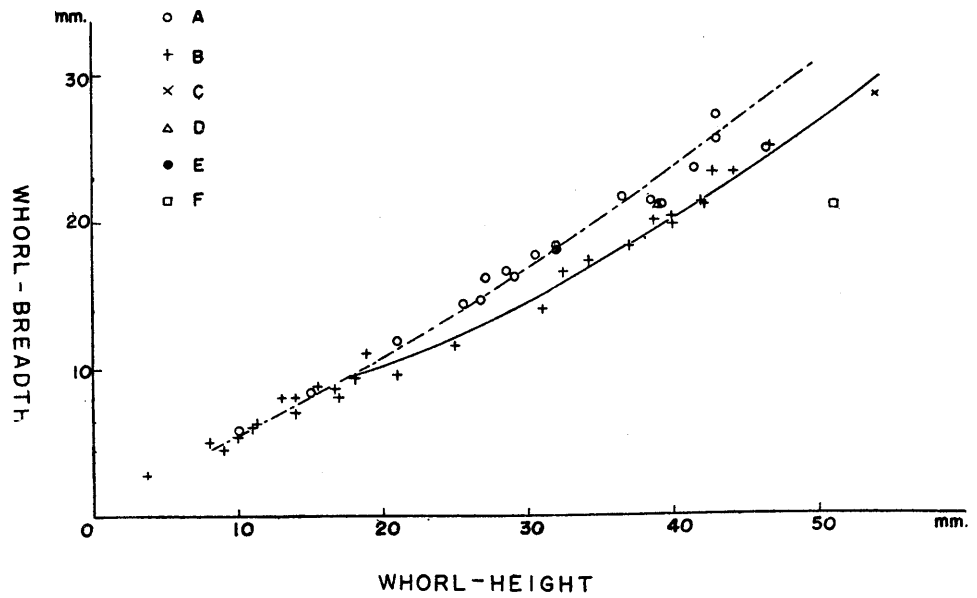


Fig. 11. Diagram showing the proportion between breadth and height of whorls in *Hauericeras* (*Gardeniceras*) *angustum* YABE, *H.* (*G.*) *gardeni* (BAILY) and related forms. A. *H.* (*G.*) *gardeni* from Africa in BAILY, 1855 and SPATH, 1921. B. *H.* (*G.*) *angustum* YABE from Hokkaido and Saghalien. C. "*Ammonites gardeni* BAILY" from India in STOLICZKA, 1865. D. "*H. gardeni* (BAILY)" from Canada in USHER, 1952. E. "*H. gardeni* (BAILY)" from Madagascar in BASSE, 1931. F. "*Ammonites gardeni* BAILY" in FAVRE, 1869.

deni. BAILY's illustration of the suture (BAILY 1855, pl. xi, fig. 3c) depended on an adult specimen (BM. C. 35622=R11371).

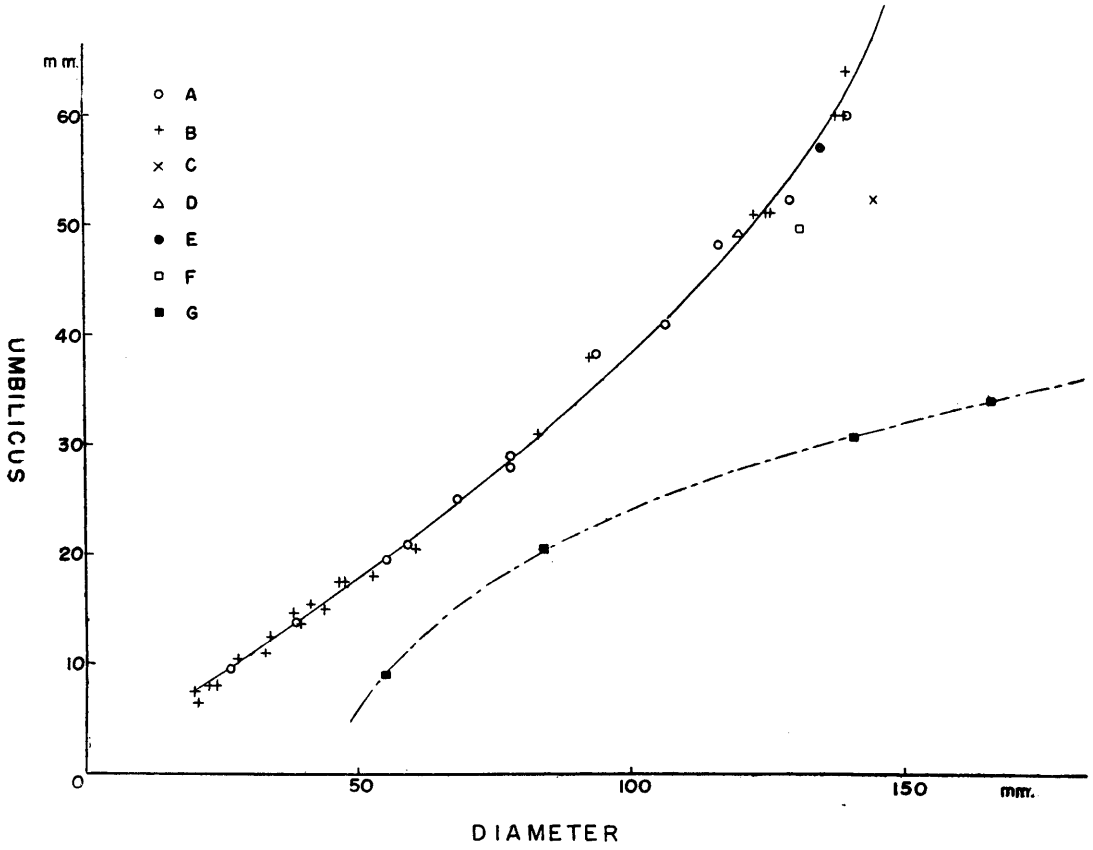


Fig. 12. Diagram showing the proportion between the width of umbilicus and diameter in *Hauericeras* (*Gardeniceras*) *angustum* YABE, *H.* (*G.*) *gardeni* (BAILY) and *H.* (*H.*) *pseudogardeni* (SCHLÜTER). A—F same as in Fig. 11. G. *Hauericeras* (*Hauericeras*) *pseudogardeni* (SCHLÜTER) from Europe.

Another character which was stated by YABE as a specific criterion is the width of umbilicus. Although the whorl seems to grow rather slowly with a gradual change of character, it does change with growth. Therefore the mere mention of figures of, for instance, the width of umbilicus in proportion to the diameter is not sufficient for specific distinction without consideration of the growth stages. The fact is best illustrated if we plot the measurements on a graph, which shows a curved line (text fig. 12). Thus there is not essential difference between the two species in question, so far as the proportion of umbilicus to diameter is concerned.

Shortly *Hauericeras* (*Gardeniceras*) *angustum* YABE is closely allied but specifically separated from *Hauericeras* (*Gardeniceras*) *gardeni* (BAILY). Thus all the specimens from

Hokkaido and Saghalien which were identified to the latter are better removed to the former.

Besides the South African and Japanese specimens discussed above, there are several forms which were refered to *H. gardeni* (BAILY). The Indian form represented by STOLICZKA's large specimen (1865, pl. xxviii, fig. 4) and the one from the Nanaimo group of Vancouver Island which was illustrated by USHER (1952, p. 61, pl. v, figs. 1, 2; pl. xxxi, fig. 10) seem to belong to *H. (G.) angustum*, while the Malgash specimens illustrated by BASSE (1931, p. 23, pl. iv, figs. 2–4) and COLLIGNON (1932, p. 17, pl. iii, fig. 3, 3a) clearly belong to *H. (G.) gardeni*.

The European form from the Upper Senonian of Lemberg described by FAVRE (1869, p. 12, pl. iv, fig. 1) and KNER (1850, p. 8, pl. i, fig. 3) is similar to the Japanese and Indian forms in the curvature of constriction, but its constriction is more frequent and much stronger, and its whorl is much compressed (B/H being 0.41 at a diameter of 131mm.), with the maximum breadth at mid-height. If that shell form is not the effect of the secondary deformation the European form should be separated as a distinct species, to which KNER's name (*H. (G.) sulcatum*) should be applied. It is rather allied to *H. (G.) rembda* (FORBES) but is much more compressed and its constriction does not show biconvexity.

Another character which is to be remarked here is the keel. In both *H. (G.) angustum* and *H. (G.) gardeni* the keel develops with growth and the "hollow-keel" (SPATH, 1921, p. 240 and text fig. A–8) is not applicable in the strict sense of the word (see text fig. 9). In the very young shell, below 10mm. in diameter, the whorl is depressed, rounded and then elliptical in section without a keel; in the next stage, up to 70–80mm. in diameter, the internal mould (cast) has no keel but is only gently sagittate in its later substage, but when the shell is preserved it is keeled, the keel becoming increasingly distinct with growth; the layers of the shell are thickened to form the base and apex of the compact keel. After that and in the body chamber the internal mould also shows a blunt keel and the layers of the shell are distinctly thickened to form a solid and prominent keel. However no specimens, so far examined, show such a peculiar, polygonal keel as that found in some example of *H. (G.) rembda* (FORBES) (see below).

Occurrence.– Fairly common in the Neourakawan (approximately Santonian), occasionally in the Infrahetonaian (Lower Campanian) and doubtfully in the Paleourakawan (Coniacian) in Hokkaido and South Saghalien.

Hauericeras (Gardeniceras) cf. rembda (FORBES)

Pl. 29, figs. 6, 7a, b.

Cf. 1846. *Ammonites rembda* FORBES, p. 111, pl. vii, fig. 3a, b.
1846. *Ammonites durga* FORBES, p. 104, pl. vii, fig. 11a, b.
1865. *Ammonites rembda* FORBES, STOLICZKA, p. 63, pl. xxxiii, fig. 5; pl. lxxi, fig. 9 (?).

1865. *Ammonites durga* FORBES, STOLICZKA, p. 143, pl. lxxi, fig. 5, 5a only.
1871. *Ammonites rembda* FORBES, GRIESBACH, p. 63, pl. iii, figs. 2, 3.
1898. *Hauericeras rembda* (FORBES), KOSSMAT, p. 124 (189), pl. xviii (xxiv), fig. 9.

Material.– In Hokkaido there are a few specimens which are comparable with the FORBES' species: GK. H3828 and others from locality H12b, bed IVb, Hetonai area, Iburi Province, Hokkaido. They are small specimens mostly represented by the internal moulds.

Dimensions.

Specimen	Diameter	Height	Breadth	(B/H)	Umbilicus (%)
GK. H3828	32.0	—	—	—	— —
(incomplete outer half whorl omitted)	22.2	9.2	6.2	(0.67)	8.7 (39)

Description.– The specimens are quite similar to *H.* (*G.*) *rembda* (FORBES) in rather evolute and fairly widely umbilicate whorls, somewhat inflated flanks with the maximum breadth of the whorl near mid-height, very low umbilical wall, distinct but distant constrictions (three per whorl) which are gently biconvex and cross the venter on the internal mould. As they are internal moulds the peculiar keel with a pentagonal section cannot be confirmed. A precisely similar keel appears, apparently irregularly, in certain Albian Dipoloceratidae, for example *Manuaniceras manuaense* (SPATH) (1921b, p. 281, pl. xxv, fig. 1). It is probably of a little diagnostic importance.

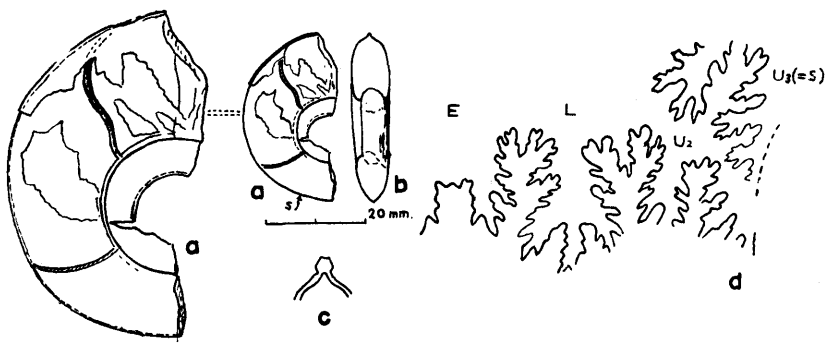


Fig. 13. *Hauericeras* (*Gardeniceras*) *rembda* (FORBES). Lectotype, BM. R. 10483 from Pondicherry, Valudayur group, India. Lateral (a, a') and apertural (b) views, enlarged section of keel (c) and suture-line at s (d). T.M. del. by kind permission of Keeper of Geology, British Museum (Natural History).

The lectotype of FORBES' species, which is unfortunately a small incomplete specimen (BM. R. 10483) (Text fig. 13), has on its preserved half whorl two distant, slightly prorsiradiate constrictions, the anterior one of which is more distinctly biconvex than the posterior one. STOLICZKA's fragmentary whorl, which is slightly larger than the FORBES', shows still more distinct biconvexity of the constriction. Thus the curvature of the constriction is proved to vary with growth. Therefore the Japanese speci-

mens in question probably correspond to the inner whorls of the Indian species, while *Hauericeras fayoli* GROSSOUVRE (1894, p. 220, pl. xxvii, fig. 3a, b) from the Upper Senonian of France may represent an outer whorl of the same species, although, as KOSSMAT pointed out, the absence of the shell (and accordingly the keel) makes us hesitate in leading a definite conclusion.

Occurrence.– Lower Sandy Siltstone of the Hakobuchi group in Iburi Province, Hokkaido. The species occurs outside Hokkaido, in the Shimonada Sandy Siltstone, the highest ammonite-bearing member of the Izumi group in Southwest Japan, together with *Neophylloceras hetonaiense*, *Pachydiscus subcompressus*, etc. Thus in Japan its age is Neohetonaian, approximately Maestrichtian. The Indian specimens came from the Valudayur beds at Pondicherry, which is most probably Maestrichtian. The allied (or possibly identical) form in France is known in the zone of *Pachydiscus neubergicus*.

Conclusive Remarks

As a summarized result we list here in tabular form the species of Desmoceratidae (*s.s.*), with their ranges in the Cretaceous of Hokkaido and Saghalien, which have been described above and also in other papers (YOKOYAMA 1890, JIMBO 1894, YABE 1904, MATSUMOTO 1942, 1954a, SAITO & MATSUMOTO in press) (Table I).

The geological ranges of the species have been concluded from the stratigraphic works, to which one of us (T.M. 1942–43, T.M. (Editor) 1954) is mainly responsible. There are several specimens whose precise locality and horizon are uncertain or whose specific identification is doubtful. Among several questions it should be particularly noted that we have not yet complete records of the history of *Damesites* inspite of its abundance in our province. We should search for better material especially from Gyliakian (Cenomanian-Turonian) and also from Paleohetonaian (Campanian).

Desmoceratidae in this paper is of narrow sense. The definition has already been given in a previous paper in comparison with Puzosiidae (*s.s.*) (MATSUMOTO, 1954b, p. 105). In the same paper one of us (T.M.) presented a table showing the supposed trends of evolution in both families. So far as the Upper Cretaceous Desmoceratids are concerned we can now revise in some way that table, although we are still far from perfect conclusion. We present here, though tentatively, a corrected chart (Table II).

One of the corrections is about the origin of *Damesites*; the subject is to be discussed fully in another paper (SAITO & MATSUMOTO, in press). The available material strongly suggests that *Damesites*, *Tragodesmoceroides* and *Tragodesmoceras* are probably developed in parallel and almost simultaneously from *Desmoceras* in Cenomanian. However better Cenomanian representatives of the three genera are wanted.

Desmophyllites is proved to have no direct connection with Phylloceratids, but its precise origin is still uncertain chiefly because of the insufficient material from Coniacian. In that age *Onitshoceras* was recently discovered by REYMENT (1954). We regard

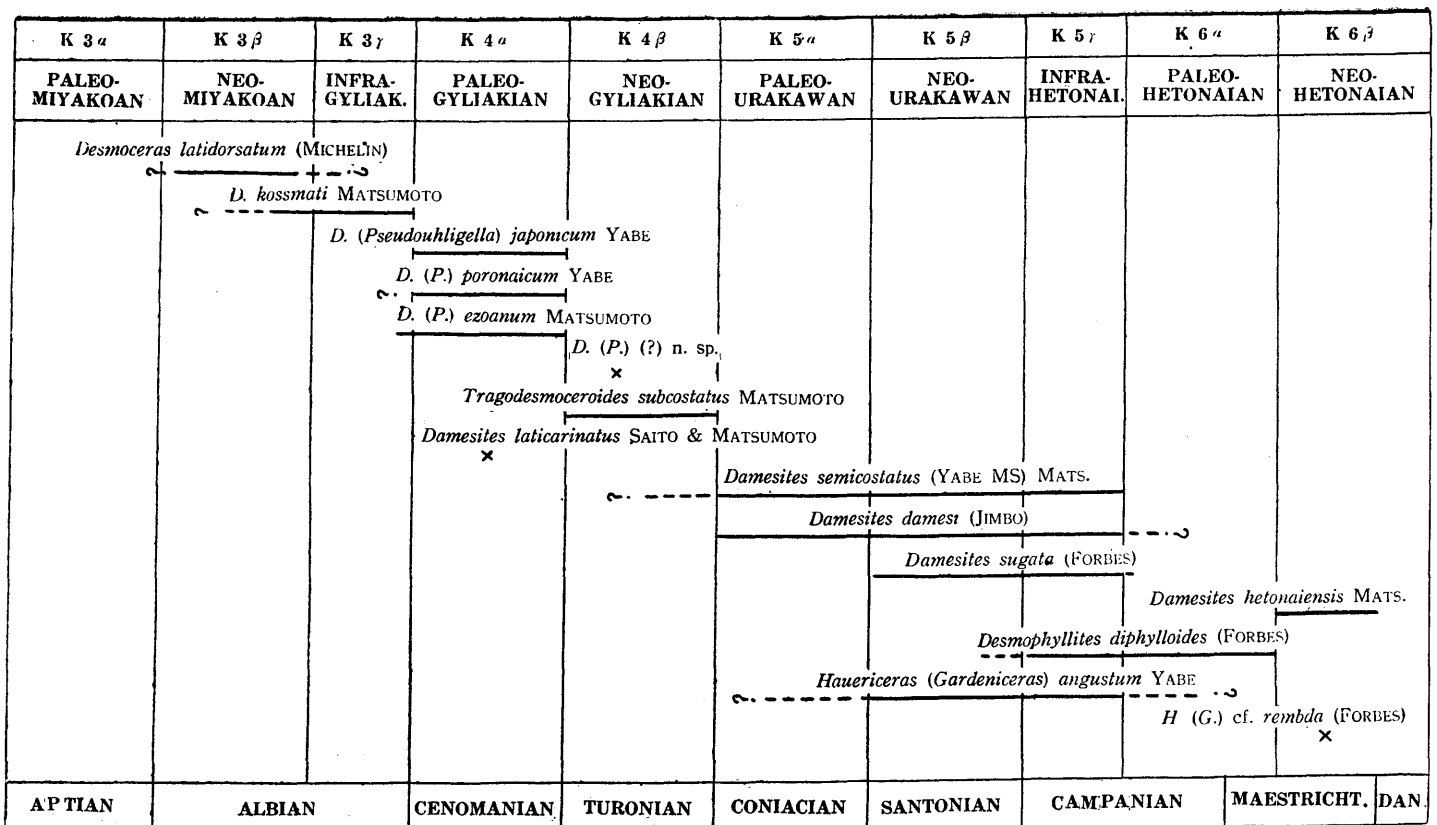


Table I. Geological range of the species belonging to the Desmoceratidae in the Yezo-Saghalien Province.

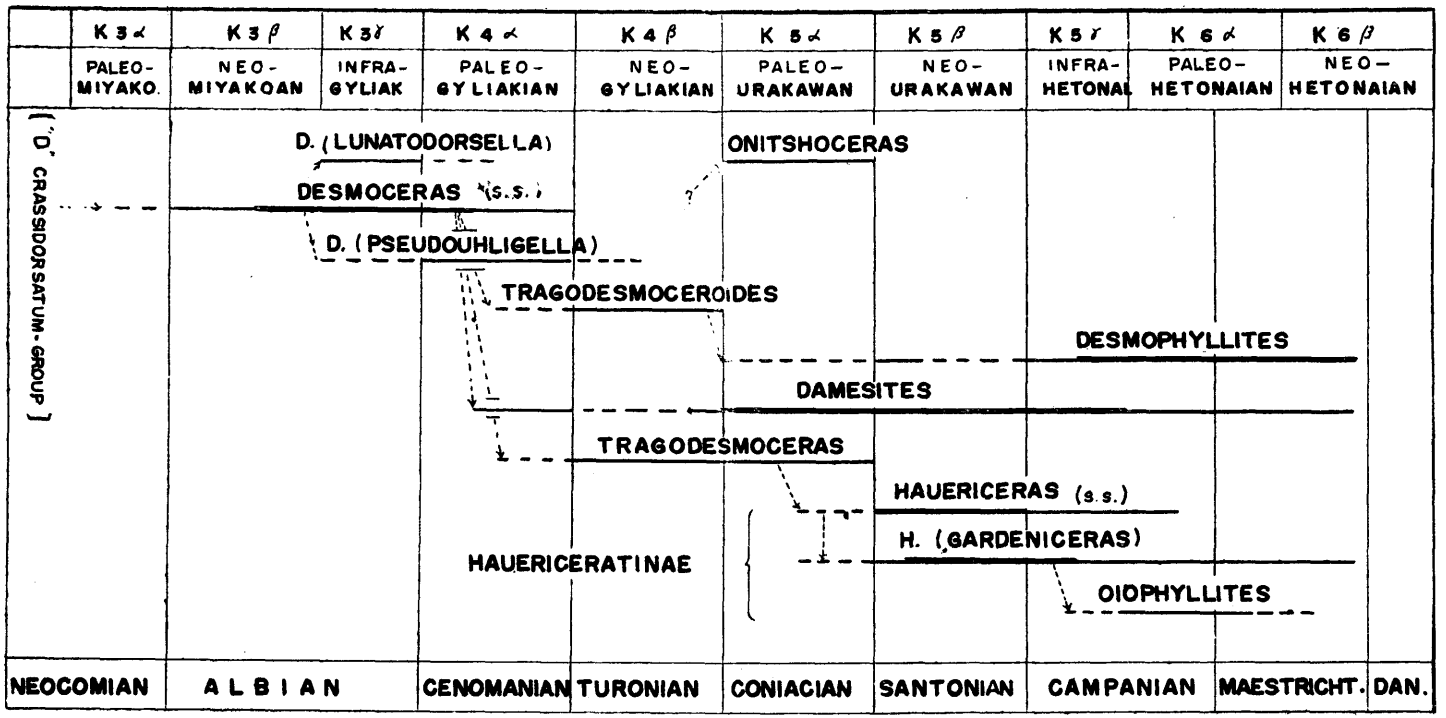


Table II. Evolution of Desmoceratidae.

the African genus as an offshoot which is much deviated from the main trend of Desmoceratids. The reason is in that its suture is somewhat different from typical *Desmoceras* pattern and in that its riblets show less prominent projection on the venter. The characters remind us certain Pachydiscids, but *Onitshoceras* has no umbilical tubercles and is narrowly umbilicate.

As has been discussed above, *Hauericeras* (with subgenera *Hauericeras s.s.* and *Gardeniceras*) has its probable origin in *Tragodesmoceras*, but is so specialized that it constitutes, together with *Oiophyllites*, a small branch, subfamily Hauericeratinae.

Acknowledgements

We wish to thank Mr. C. W. WRIGHT who has helped us in various ways and critically read through the typescript; Professor Emeritus H. YABE, Mr. M. KAWADA, Messrs. M. ISHIZAKI & K. SAKAKURA, Messrs. K. TANAKA & E. INOUYE and Mr. S. NAGAOKA who have provided us with their precious collections; Dr. C. A. FLEMING & Mr. A. P. MASON of New Zealand Geological Survey through whom one of us (T.M.) has had access to the New Zealand specimens; Mr. W. N. EDWARDS, Keeper of Geology, British Museum (Natural History), where one of us (T.M.) has been enabled to study through a British Council Scholarship, for facilities of that Museum; Dr. L. F. SPATH of the same Museum; Mr. R. A. REYMENT with whom one of us (T.M.) has freely discussed the taxonomy of *Onitshoceras*; Professor T. KOBAYASHI of Geological Institute, University of Tokyo, through whom we have borrowed valuable specimens of that Institute; Professor R. TORIYAMA who has particularly helped us in arranging this paper for publication by the Faculty of Science, Kyushu University; Mr. C. UEKI, Messrs. K. KANMERA & K. FUJII who kindly photographed for us some of the specimens figured in the plates; Miss Junko TAKAMIYA and Mr. H. TAKADA who have assisted in the preparation of the manuscript.

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T. Matsumoto and I. Obata

Some Upper Cretaceous Desmoceratids from Hokkaido and Saghalien

Plates

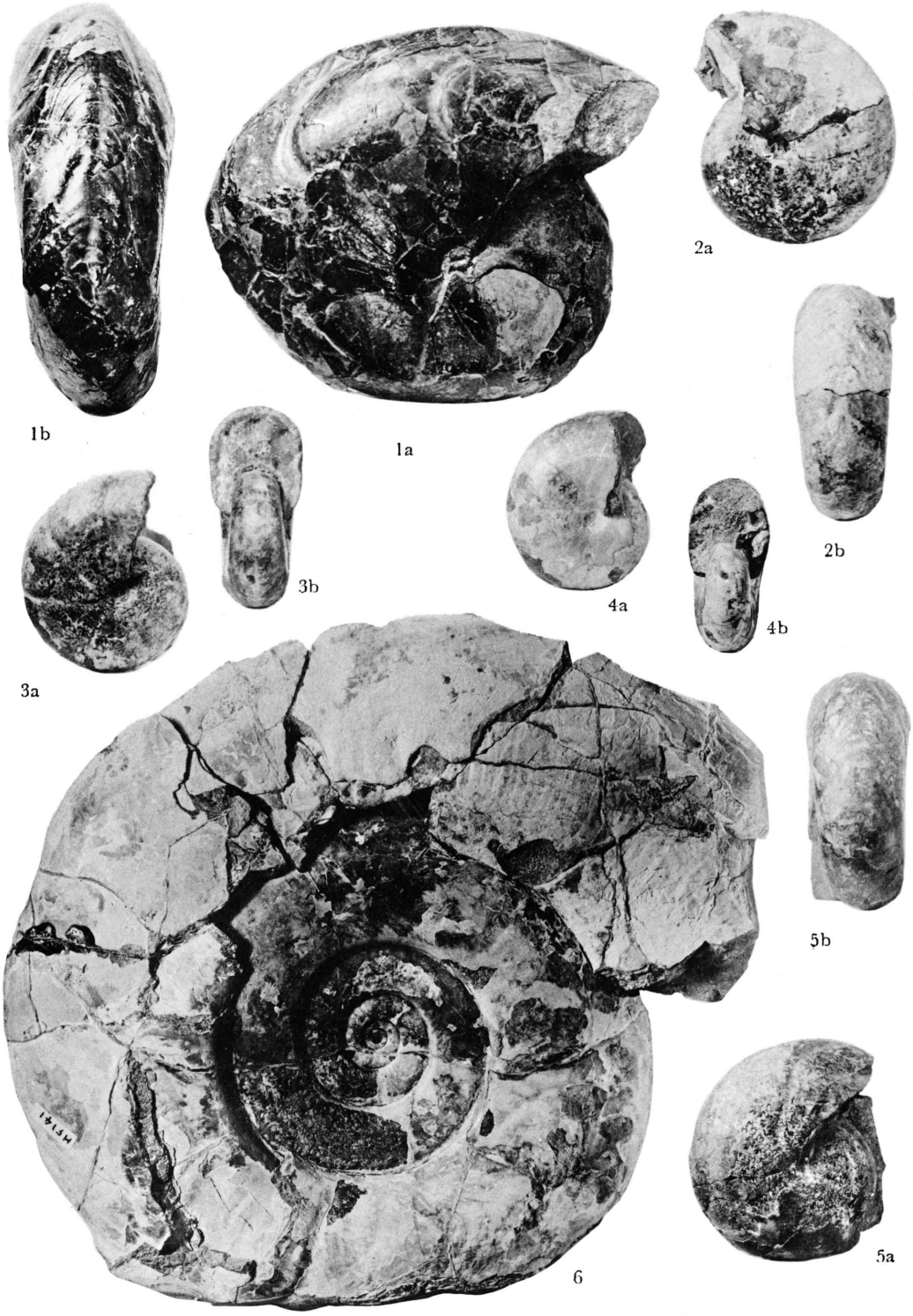
Plate 24

Figs. 1–5. *Desmophyllites diphylloides* (FORBES)..... Page 121

1. Lateral (a) and ventral (b) views, ×1. An example of the adult shell, GT. I-1491, locality 20, Togushi, "Togushi sandstone" (Lower Hetonaian), Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.).
2. Lateral (a) and ventral (b) views, ×1. Immature shell, GT. I-3117, locality T 280, bed IIIe (zone of *Inoceramus schmidti*), Abeshinai Valley, Teshio Province, Hokkaido (T. MATSUMOTO Coll.).
3. Lateral (a) and frontal (b) views, ×1. Somewhat earlier part of the same individual as above (GT. I-3117).
4. Lateral (a) and frontal (b) views, ×1. Immature shell, GT. I-3118, locality T 313, bed IIIe (zone of *Inoceramus schmidti*), Abeshinai Valley, Teshio Province, Hokkaido (T. MATSUMOTO Coll.).
5. Lateral (a) and Ventral (b) views, ×1. Immature shell, GT. I-1488, locality 823, Togushi, "Togushi sandstone", Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.).

Fig. 6. *Hauericeras* (*Gardeniceras*) *angustum* YABE ..... Page 137
Lateral view, ×2/3. An example of the adult shell, GK. H 5141, locality unrecorded in South Saghalien (purchased, S. NAGAOKA Coll.).

Photos by T. MATSUMOTO & I. OBATA.



T. Matsumoto & I. Obata: Upper Cretaceous Desmoceratids

Plate 25

Figs. 1–5. *Damesites semicostatus* (YABE MS.) MATSUMOTO .....Page 126

1. Lateral (a, b), ventral (c) and frontal (d) views, ×1. Lectotype, middle-aged, GT. I–3104, locality T 592b, bed IIIa (zone of *Inoceramus uwajimensis*), Abeshinai Valley, Teshio Province, Hokkaido (T. MATSUMOTO Coll.).

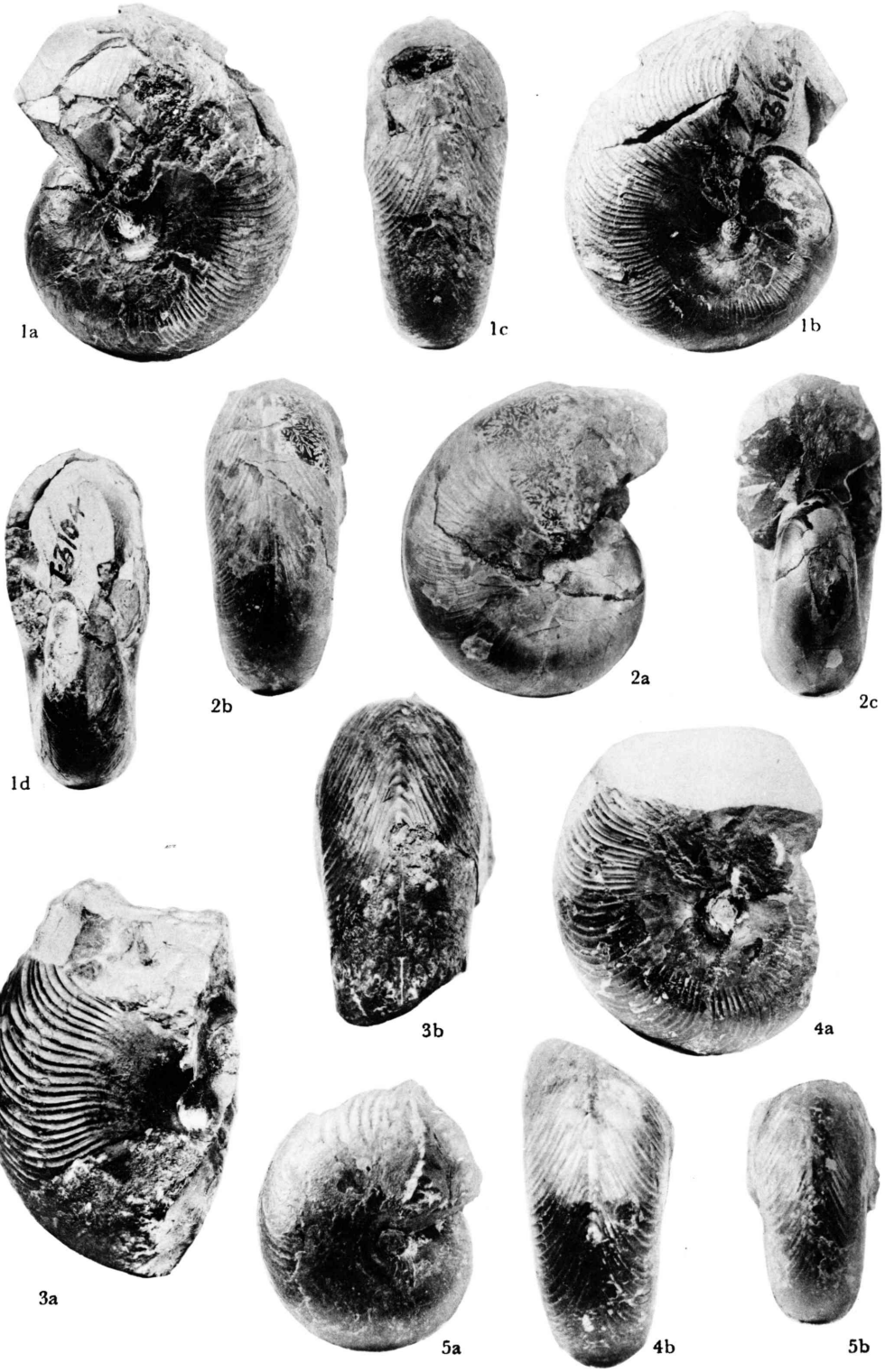
2. Lateral (a), ventral (b) and frontal (c) views, ×1. Middle-aged shell, GT. I–1473, locality 35, Togushi, "Togushi shale" (the equivalent of the upper part of the Miho group), Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.).

3. Lateral (a) and ventral (b) views, ×1. GT. I–362, locality Yoshiashi-zawa, a tributary of the Ikushumbets, Upper Yezo group, Ishikari Province, Hokkaido (H. YABE Coll.).

4. Lateral (a) and ventral (b) views, ×1. Middle-aged, GT. I–363, locality and bed same as above (H. YABE Coll.).

5. Lateral (a) and ventral (b) views of an immature shell, ×1. GT. I–361, locality and bed same as above (H. YABE Coll.).

Photos by T. MATSUMOTO & I. OBATA.



T. Matsumoto & I. Obata: Upper Cretaceous Desmoceratids

Plate 26

Figs. 1–3. *Damesites semicostatus* (YABE MS.) MATSUMOTO ..... Page 126

1. Lateral (a), ventral (b) and frontal (c) views, ×1. GK. H 4103 from a pebble of the Opirashibets, Teshio Province, Hokkaido (K. TANAKA & E. INOUYE Coll.).

2. Lateral (a) and frontal (b) views of an adult shell, ×1. GK. H 4114a, middle course of the Opirashibets, Teshio Province, Hokkaido (H. YABE Coll.).

3. Lateral (a) and frontal (b) views of another adult shell, ×1. GK. H 4114b from the same locality as above (H. YABE Coll.).

Fig. 4. *Damesites sugata* (FORBES) ..... Page 128

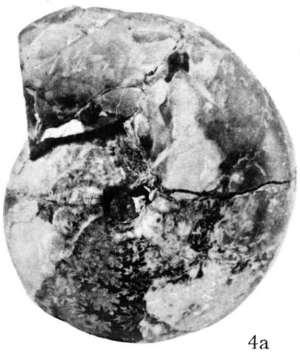
Lateral (a) and ventral (b) views, ×1. Middle-aged shell, GT. I–3119, loc. T310b, bed IIId (zone of *Inoceramus naumanni*), Abeshinai Valley, Teshio Province, Hokkaido (T. MATSUMOTO Coll.).

Fig. 5. *Damesites* aff. *sugata* (FORBES) ..... Page 132

Lateral (a) and ventral (b) views, ×1. GT. I–1470, loc. 97, Togushi, "Togushi shale" (=upper part of the Miho group), Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.).

Photos by T. MATSUMOTO & I. OBATA.

1a



4a

4b

1b

1c

3b

2b

2a

3a

5b

5a

T. Matsumoto & I. Obata: Upper Cretaceous Desmoceratids

Plate 27

Figs. 1, 2. *Damesites damesi intermedius* MATSUMOTO ..... Page 131

1. Lateral view, ×1. An example of the adult shell, GT. I-2604 from a pebble of the Juhachi-rinpan-Ichino-sawa, probably derived from zone Mh4, Naibuchi Valley, South Saghalien (T. MATSUMOTO Coll.).

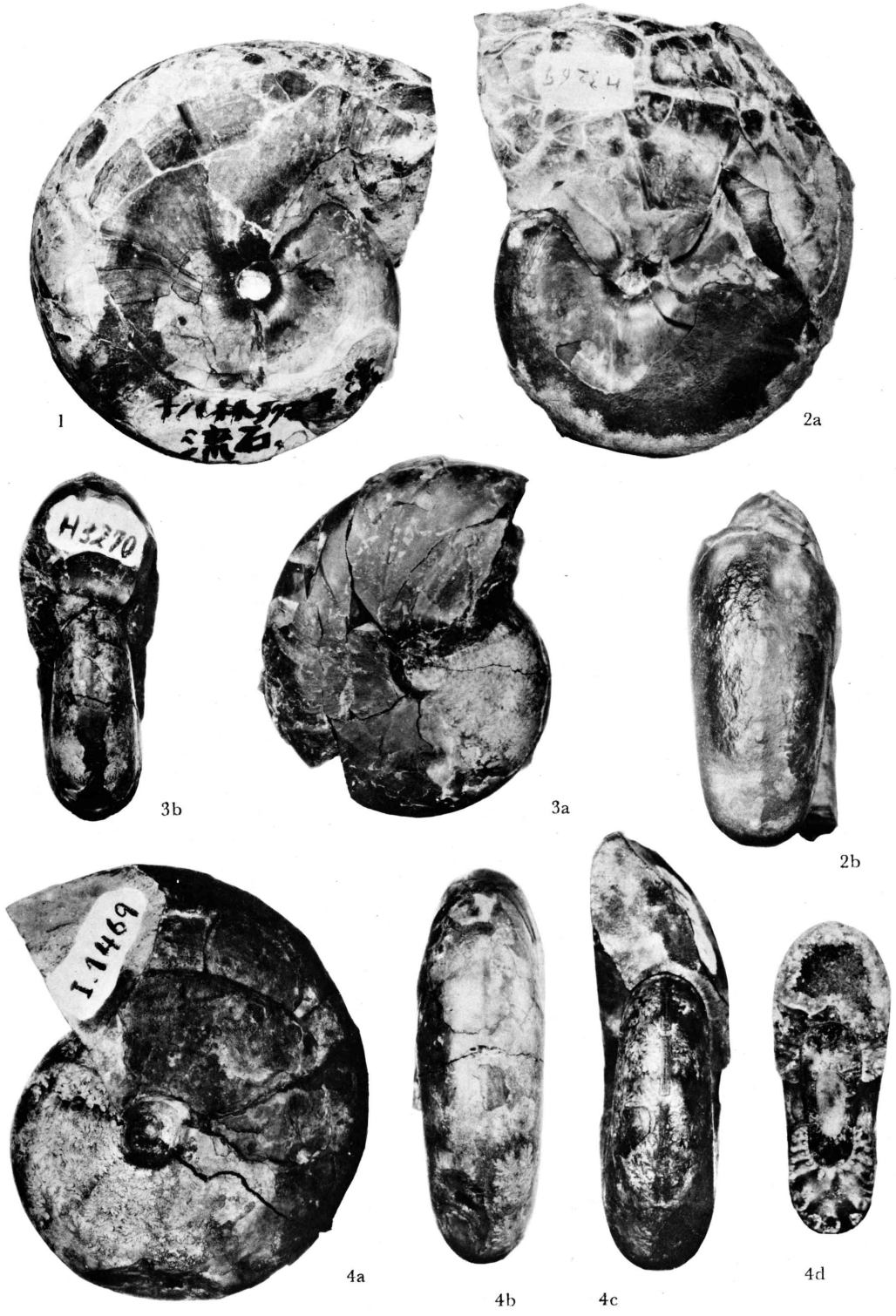
2. Lateral (a) and ventral (b) views, ×1. Holotype, adult, GK. H3269, locality U513, Ikandai, bed Ur2β', Upper Yezo group, Urakawa area, Hidaka Province, Hokkaido (T. MATSUMOTO Coll.) (reproduced from T. M. 1954a, pl. vi (xxii), fig. 4a, b).

Figs. 3, 4. *Damesites sugata* (FORBES) ..... Page 128

3. Lateral (a) and frontal (b) views, ×1. A form fairly similar to *Damesites damesi intermedius* MATSUMOTO, middle aged, GK. H 3270, loc. U595, bed Ur1β (zone of *Inoceramus naumanni*), Urakawa area, Hidaka Province, Hokkaido (T. MATSUMOTO Coll.).

4. Lateral (a), ventral (b) and frontal (c) views and whorl section (d), ×1. Adult, GT. I-1469, loc. 97, Togushi, "Togushi shale", Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.).

Photos by K. KANMERA & K. FUJII.



T. Matsumoto & I. Obata: Upper Cretaceous Desmoceratids

Plate 28

Figs. 1, 2. *Hauericeras* (*Gardeniceras*) *angustum* YABE .....Page 137

1. Lateral (a) and ventral (b) views, ×1. Adult, GK. H 3322, from loc. U141p3, bed Ur1β (zone of *Inoceramus naumanni*), Urakawa area, Hidaka Province, Hokkaido (T. MATSUMOTO Coll.).

2. Lateral view, ×2/3. Adult, GK. H5213, locality unrecorded in South Saghalien (purchased, S. NAGAOKA Coll.).

Photos by T. MATSUMOTO & I. OBATA.

2

1b

1a

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Plate 29

Figs. 1–5. *Hauericeras* (*Gardeniceras*) *angustum* YABE .....Page 137

1. Lateral view (a) and whorl section (b), ×1. One of *Hauericeras gardeni*, YABE 1904. GT. I–274, Urakawa area, Hidaka Province, Hokkaido.

2. Lateral (a) and frontal (b) views, ×1. Immature, reillustration of YABE's holotype (=YABE, 1904, pl. v, fig. 5.), GT. I–259, Ikandai near Urakawa, Upper Yezo group, Hidaka province, Hokkaido (H. YABE Coll.).

3. Lateral view (a) and whorl section (b), ×1. Immature shell, GT. I–3852 from loc. N401g4, zone Mh6β, Miho group, Naibuchi Valley, South Saghalien (T. MATSUMOTO Coll.).

4. Lateral (a) and ventral (b) views, ×1. Immature shell, GK. H3334b from loc. U 505, Ikandai, bed Urlβ (zone of *Inoceramus naumanni*), Urakawa area, Hidaka Province, Hokkaido (T. MATSUMOTO Coll.).

5. Lateral view, ×1. Immature shell, GK. H 3323 from loc. U141p3, bed Urlβ Urakawa area, Hidaka Province, Hokkaido (T. MATSUMOTO Coll.).

Figs. 6, 7. *Hauericeras* (*Gardeniceras*) cfr. *rembda* (FORBES) .....Page 145

6. Lateral view, ×1. Immature shell, GK. H 3828, locality H 12b, bed IVb, Lower Sandy Siltstone of the Hakobuchi group, Hetonai area, Iburi Province, Hokkaido (T. MATSUMOTO Coll.).

7. Lateral (a) and ventral (b) views, ×1. Inner whorls of the same individual as above (GK. H 3828).

Photos by C. UEKI (1–3) and T.MATSUMOTO & I. OBATA (4–7).

1a

1b

2b

3b

5

2a

3a

4b

4a

6

7a

7b

T. Matsumoto & I. Obata: Upper Cretaceous Desmoceratids

Plate 30

Fig. 1. *Desmophyllites diphylloides* (FORBES) ..... Page 120
Longitudinal section, ×3/2. Adult shell, GT. I-1479, locality 823•101', Togushi, "Togushi shale", Nishi-Notoro Peninsula, South Saghalien (M. ISHIZAKI & K. SAKAKURA Coll.).

Fig. 2. *Damesites damesi* (JIMBO) ..... Page 120
Longitudinal section, ×3/2. Middle-aged shell, GK. H 4193, the middle course of the Opirashibets, Teshio Province, Hokkaido.

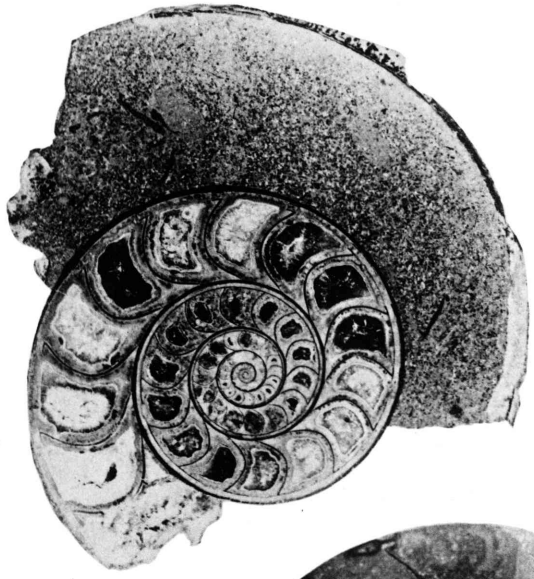
Fig. 3. *Phyllopachyceras ezoense* (YOKOYAMA) ..... Page 120
Longitudinal section, ×3/2. Middle-aged shell, GK. H 2055, locality N182f, zone Mh6β, Naibuchi Valley, South Saghalien (T. MATSUMOTO Coll.).

Fig. 4, 5. *Neophylloceras subramosum* SPATH ..... Page 120
4. Longitudinal section, ×3/2. Middle-aged shell, GK. H 5214, locality unrecorded in South Saghalien (purchased, S. NAGAOKA Coll.).
5. Longitudinal section, ×3/2. Middle-aged shell, GK. H 5215, locality unrecorded in South Saghalien (purchased, S. NAGAOKA Coll.).

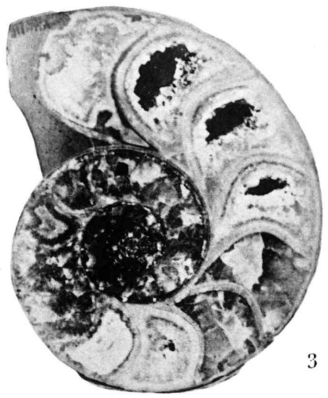
Fig. 6. *Damesites* cf. *semicostatus* (YABE MS.) MATSUMOTO ..... Page 126
Lateral view, ×1. Fragmentary body whorl of probably old growth-stage, GT. I-3388, locality T 593a, bed IIIa (zone of *Inoceramus uwajimensis*), Abeshinai Valley, Teshio Province, Hokkaido (T. MATSUMOTO Coll.).

Fig. 7. *Desmoceras* (*Pseudouhligella*) (?) n. sp. ..... Page 136
Lateral view, ×3/2. Immature shell, GT. I-3101, locality T 890p, bed IId (γ) 1, Saku formation, Abeshinai Valley, Teshio Province, Hokkaido (T. MATSUMOTO Coll.).

Photos by T. MATSUMOTO, K. FUJII and I. OBATA.



1



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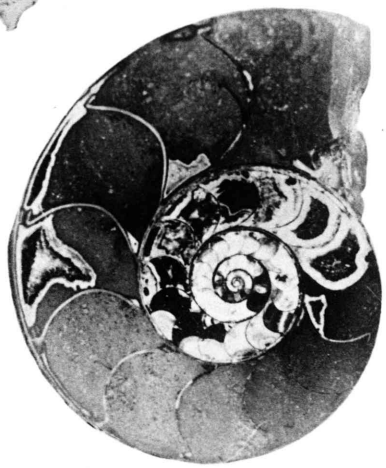
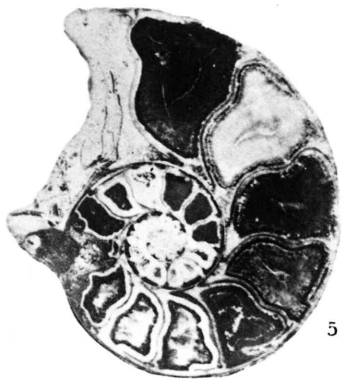


2



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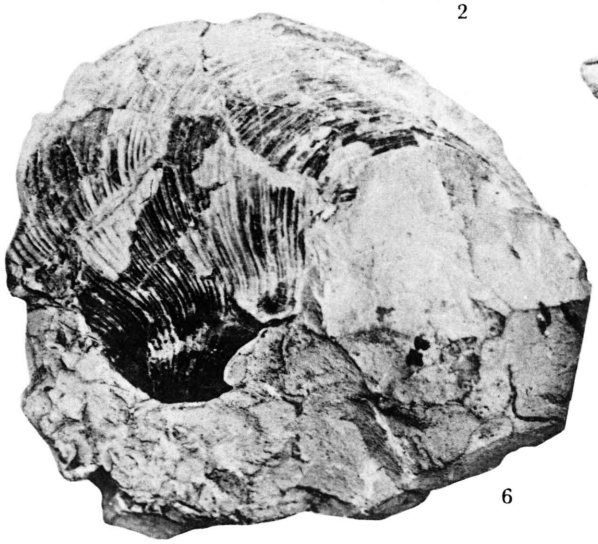

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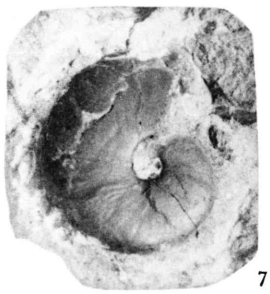

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