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On a leading ammonite species *Pachydiscus kobayashii* from the Hobetsu district, Hokkaido

(Studies of the Cretaceous ammonites from Hokkaido–LXXII)

by

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Abstract –*Pachydiscus (Pachydiscus) kobayashii* was described by MATSUMOTO and MOROZUMI(1980) on the material from the Upper Cretaceous Izumi Group of Southwest Jappn. In 1990 a large collection of fossils was made from an enlarged cutting of the Fukaushi Sandstone (a menber of the Hakobuchi Group) on the occasion of repair works of a road in the Hobetsu district. In that collection held by the Hobetsu Museum there are five species of ammonites, of which *P. (Neodesmoceras) gracilis* MATSUMOTO predominates over others. *P. (P.) kobayashii* is represented there omly by two specimens, which, howere, record its first occurrence in Hokkaido and have stimulated us to restudy this species. As a result *P. (P.) kobayashii* is more similar to *P. (P.) neubergicus* (HAUER) than to *P. (P.) egertoni* (FORBES) in having fairly compressed whorls and rather straight ribs on the main flank, but it is much larger and shows merely a tendency toward the differentiation of ornament into the primaries with umbilical bullae and numerous outer ribs in a limited period of the late septate stage of fairly large size. The origin of *P. (P.) kobayashii* may possibly be in such a species as *P. (P.) perfidus* DE GROSSOUVER rather than in *P. (P.) preegertoni* COLLIGNON. Since the Fukaushi Sandstone overlies the Zone of *P. (Neodesmoceras) japonicus–Inoceramus (Endocostea) shikotanensis* of the Lower Sandy Siltstone, *P. (P.) kobayashii* is Maastrichtian in age. The Zone of *P. (P.) kobayashii–Eubaculites regina* in the Azenotani Formation of the Izumi Group is referred to the Lower Maastrichtian. The Fukaushi Sandstone is probably an upper part of the Lower Maastrichtian.

Key words – *Pachydiscus (P.) kobayashii, P. (P.) neubergicus.* Maastrichtian, Hakobuchi Group, Izumi Group.

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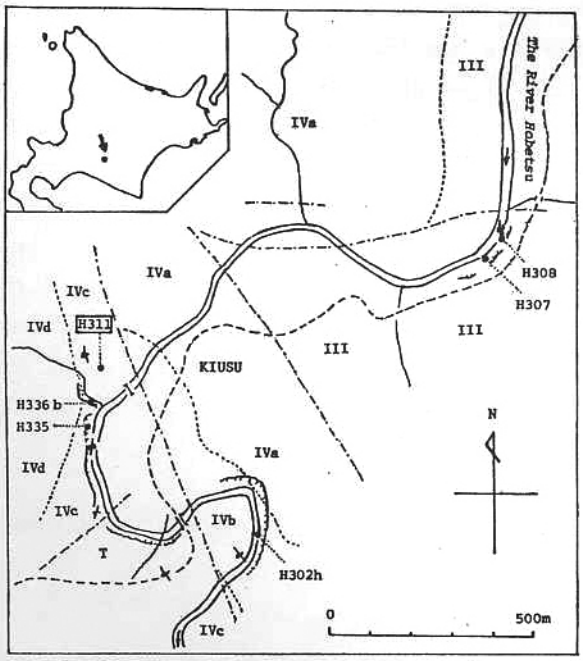
I Introduction

A fine achievement was carried out by the Hobetsu Museum in collecting all the fossils from a cutting on the occasion of the repair works of a road called the Sekiyu-zawa route in 1990 under the administration of Hobetsu Township.

The rock exposed on that cutting is the light greenish silty fine-grained sandstone, about 15m in thickness,which is referred to the Fukaushi〔Hukaushi〕Formation of the Upper Cretaceous Hakobuchi Group. This outcrop before the repair works was numbered H311,as indicated by MATSUMOTO *(in* MATSUMOTO *et al.* , 1979, fig.7)(See also Text-fig.1 in this paper) and the Fukaushi Format ion was marked as Unit IVc. H311 is used in this paper to show the location, although the outcrop was somewhat enlarged by the repair works. At present the cutting is protected by an artificial cover.

A bivalve species *Sphenoceramus hetonaianus* (MATSUMOTO) occurred there most abundantly and should be described on another occasion. We have identified five ammnoite species, of which *Pachydiscus (Neodesmoceras) gracilis* MATSUMOTO predominates over others. We describe in this paper *Pachydiscus (Pachydiscus) kobayashii* (SHIMIZU) because it has not been hitherto reported from Hokkaido and it is useful for regional correlation.



Text-fig. 1. Geological map of a part of the Hobetsu district, showing ammonite localities (small solid circles). H311 is the location of the cutting where studied a mmonites occurred. III: Upper Yezo Group(mainly Coniacian-Santonian and lowest Campanian), IV: Hakobuchi Group (Campanian and Maastrichtian), IVa: Lower Hakobuchi, IVb: Lower Sandy Siltstone, IVc: Fukaushi Sandstone, IVd: Upper Sandy Siltstone, T: Palaeogene, chain: fault, broken line: highway (adapted from MATSUMOTO *in* MATSUMOTO *et al.* , 1979 by permission).

II Palaeontological description

Family Pachydiscidae SPATH, 1922
Genus *Pachydiscus* ZITTEL, 1884

Synonym.—*Parapachydiscus* HYATT, 1900(see SPATH, 1939).

Type species.—*Ammonites neubergicus* HAUER, 1858 by the subsequent disignation of DE GROSSOUVRE (1894, p. 177).

Remarks.—This genus is divided into the subgenera *Pachydiscus(Pachydiscus)* ZITTEL,1884 and *Pachydiscus (Neodesmoceras)* MATSUMOTO,1947. For the general account of this genus, including the diagnosis and affinities of the two subgenera, readers may refer to MATSUMOTO *in* MATSUMOTO *et al.* (1979, p.50) and also KENNEDY and SUMMESBERGER(1986, p.188).

Pachydiscus (Pachydiscus) kobayashii (SHIMIZU,1935)
Plates I—III; Text—figs. 2—4

Parapachydiscus aff. *egertoni* (FORBES); KOBAYASHI, 1931,pl.11.

Parapachydiscus kobayashii SHIMIZU, 1935 ,p.208

Parapachydiscus aff. *egertoni* (FORBES)KOBAYASHI; MATSUMOTO, 1936,p.262,pl.30,fig.1; pl.31,fig.1; text—figs.1a,2b,3a,b.

Pachydiscus (Pachydiscus) kobayashii (SHIMIZU); MATSUMOTO and MOROZUMI, 1980, p.8, pl.3,fig.4,; pl.4,fig.1.

Remarks.—There may be a nomenclatural doubt about the validity of *"Parapachydiscus kobayashii"* SHIMIZU (1935, p.208). because he merely indicated *"Parapachydicus kobayashii* nom. nov. (=*P. egertoni* in KOBAYASHI, 1931, pl.11) which differs from *P. egertoni* (FORBES, 1846) in having a somewhat different ornamentation", without explanation and description of characteristics. In this paper, however, we follow MATSUMOTO and MOROZUMI (1980, p.2) in calling the present species at least provisionally *Pachydiscus (Pachydiscus) kobayashii* (SHIMIZU).

Material.—Two large specimens, HMG—901(P1.I; Text—fig.2) and HMG—902 (P1.II; Text—fig.3)from loc. H311, Hobetsu district, south-central Hokkaido (see Text—fig 1).

Description.—The tow specimens are very large; HMG—901 is about 250㎜ in diameter at the last septum, with its body-chamber incompletely(less than 90°) preserved. The trace of the umbilical seam of the lost body-chamber ends

at U=80mm, which enable us to estimate the original diameter at least 400mm. HMG−902 is more incomplete and wholly septate. This suggests a similarly large size of the original shell.

At the late septate stage the involution is about 2/3 and the width of umbilicus nearly or slightly less than 20%. The rate of whorl expansion is fairly high, as indicated by H/h=1.56 in HMG−901.

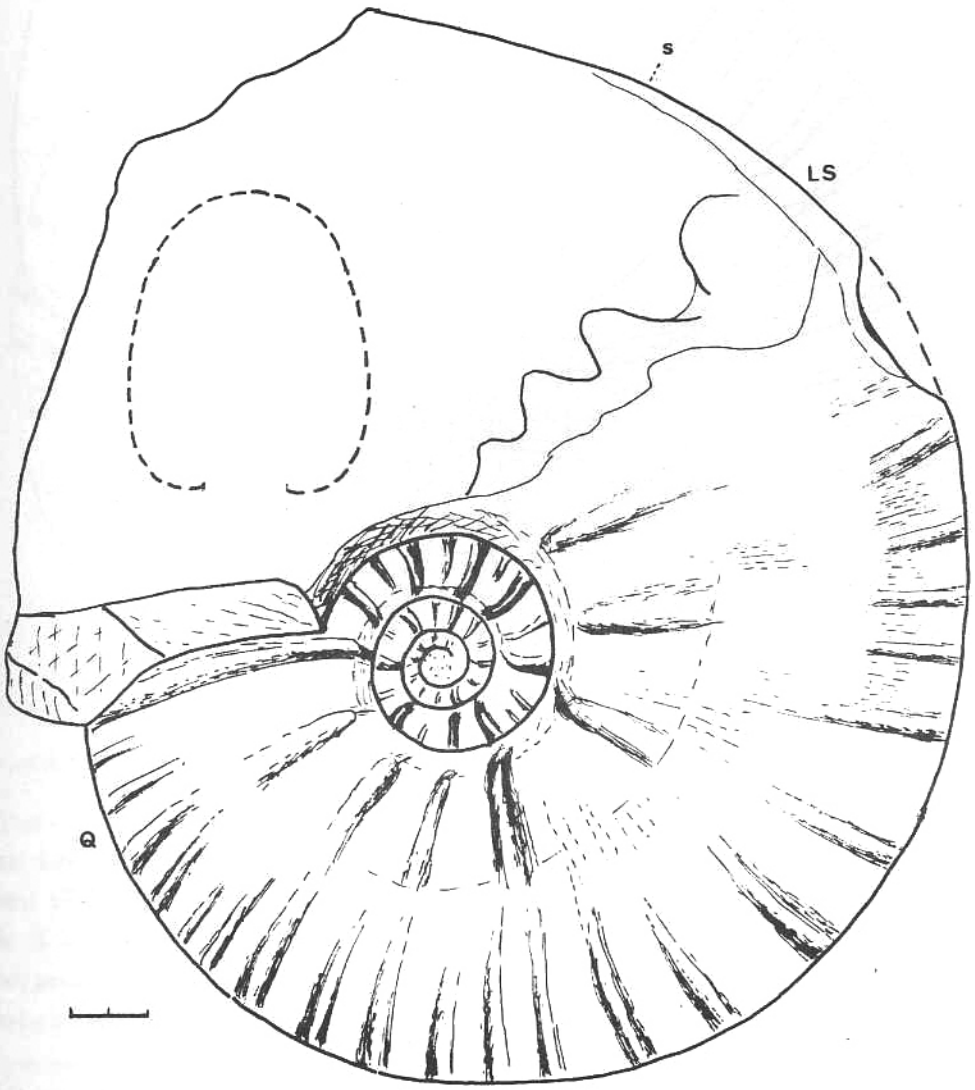
The whorl is higher than broad,with B/H slightly less than 0.75 in the late part of the phragmocone, suboval to sublliptical in cross−section, with a moderately rounded venter, gently convex flanks, abruptly bent but subrounded umbilical edge and nearly vertical or slightly overhanging wall. It is broadest below (i.e. dorsad of) the mid - height.

In the middle - aged stage, i.e. on the inner whorl of a large shell, the umbilical tubercles are moderately strong, bullate and fairly distant, numbering 6 or 7 per half whorl. The primary ribs extend from the bullae, showing a concave curve across the umbilical edge but are almost rectiradiate or occasionally slightly flexuous on the flank. There are secondary ribs, one or two or occasionally three on each interspaces, some of which may be fairly long, arising on the inner flank, but nodeless.

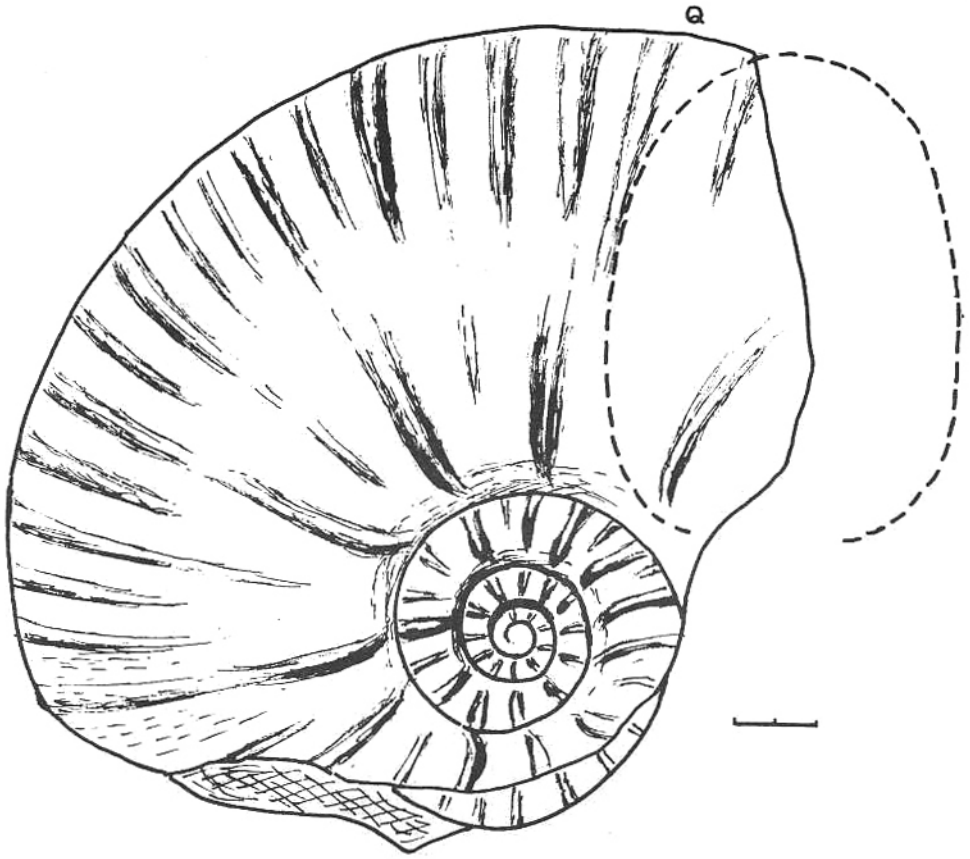
On the late part of the septate whorl, with H over 70mm or 80mm, the primary ribs are of nearly the same frequency as those of the preceding stage, extending from the umbilical bullae straight outward on the flank. The bullae are weaker than in the preceding stage, thick or thin and straight or somewhat concave. A long but nodeless rib may occur rarely. This stage is characterized by numerous short ribs or riblets developed on the ventrolateral part. Some of them are on the extension of the primary or long ribs. They are weak and inclined slightly forward. They are mostly extended to cross the venter nearly at right angles with the siphonal line. The ventrolateral ribs are about 3 times as numerous as the umbilical bullae, *viz.* 18 to 21 per half whorl. Some of the primary ribs are much weakened or almost obsolete on the middle of flank. There is thus a tendency to the differentiation of the ornament into the umbilical or inner lateral and the ventral or ventrolateral, although this occurs in a rather limited extent on a large and last part of the septate whorl.

On account of the incomplete preservation, the ornament on the body - chamber is not precisely known, but it seems to be generally blunt or faint and the outer part of the whorl looks nearly smooth.

Very fine growth - lines or striae are discernible where outer shell layer is preserved.



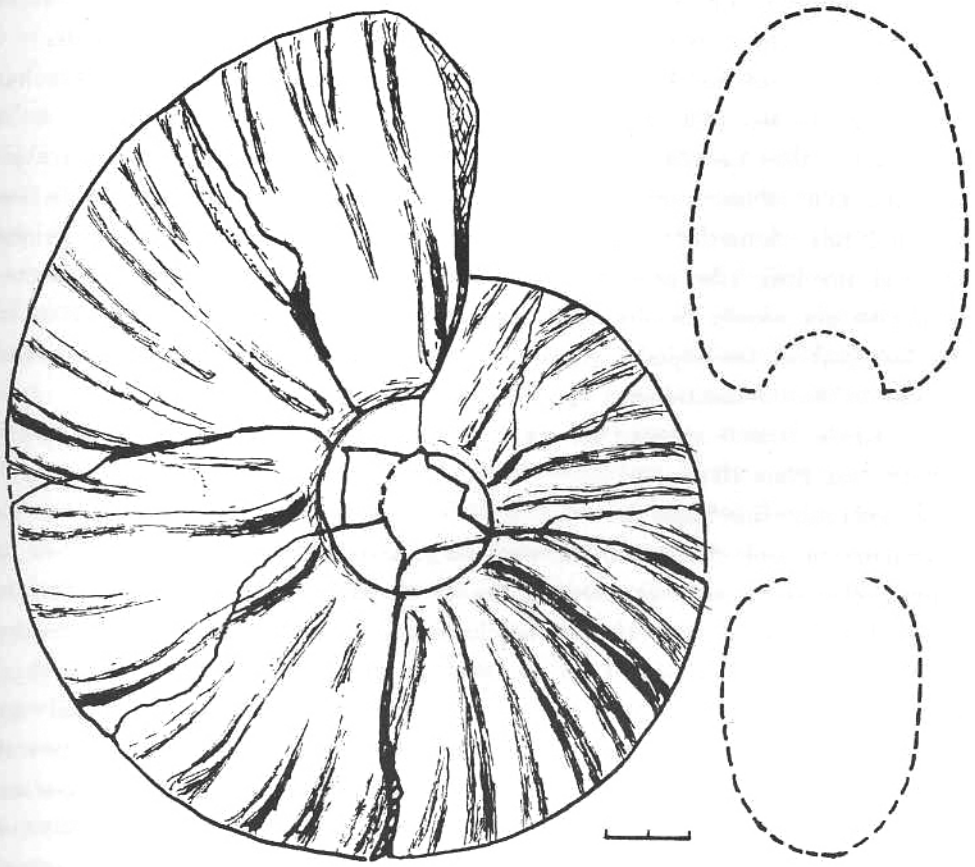
Text-fig. 2 .*Pachydiscus (Pachydiscus) kobayashii.*
Diagramatic sketch of HMG-901. Right lateral view and whorl-section at Q.
LS: last septum, s: end of siphuncle. Scale bar: 20mm. (T.M. *delin.*)



Text-fig. 3. *Pachydiscus (Pachydiscus) kobayashii.*
Diagramatic sketch of HMG-902. Left lateral view and whorl-section at Q.
Scale bar: 20mm. (T.M.*delin.*)

The suture-line is exposed only partly where shell layer is stripped and its *Pachydiscus* pattern cannot be traced entirely. HMG-901 shows the eroded last septum and the siphuncle runs for about 50mm further from the bottom of E of the preserved last septum. Such an extra-siphuncle is occasionally found in some other ammonites. We interpret that the next septum may have been under formation but not completed and destroyed away later.

Note on the holotype.-The holotype(Pl.III; Text-fig.4) consists of the wholly septate outer whorl and badly damaged fractions of inner whorls. Its outer whorl preserves partly the shelly material which is, however, somewhat weathered. Its shell-form is quite similar to that of the Hobetsu specimens described above, showing suboval to subelliptical whorl-sections and nearly the same rates of B/H, which decrease with growth from 0.77 to 0.70.



Text-fig. 4. *Pachydiscus (Pachydiscus) kobayashii.*
Diagramatic sketc of the holotype, UMUT. MM7720. Left lareral view and whorl-sections. Scale bar: 20㎜. (T.M.*delin*.)

Table 1. Measurements (in ㎜) of *P. (Pachydiscus) kobayashii.*

Specimen	D	U	U/D	H	B	B/H	h	H/h	Ribs(180°)
HMG-901	231	44	0.19	114	84	0.74	73	1.56	6/18
HMG-902		54		110	80	0.73			6/21
Holotype	207	48	0.23	97	69	0.70	62	1.56	7/19

Measured point of HMG-901 is at 40° adaptical from the last suture. That of HMG-902 is at Q in Text-fig.3.
D=diameter, U=width of umbilicus, H=whorl-height, B=whorl-breadth, h=whorl-height at 180° adaptical from H.
Ribs(180°)=number of primary ribs/that of all the ventrolateral ribs in half whorl.

On the early 210° of this whorl there are eight or nine primary ribs, which arise from the umbilical bullae, and on each interspace one to three secondaries, some of which are fairly long but nodeless and others shorter.

On the preserved last 150° of this whorl the primaries somewhat broaden but lower and the secondaries more or less shorten and much weaken; also some weak riblets may be added on the outer part. Where preservation is favourable, the ribs and riblets run across the venter almost at right angles with the siphonal line. Somewhat outside the mid-flank there is a spiral zone where some of the long ribs are interrupted or disposed en echelon and the shorter faint ribs are mostly on the outer part and slightly inclined forward. Thus in the last part of the septate whorl,the ornament of the holotype is essentially similar to that of the Hobetsu specimens.

The suture is well-exposed on the holotype, showing the typical *Pachydiscus* pattern (see Plate III).

Dimensions.—See Table 1.

Comparison and discussion.—A very large size with estimated diameters of adult shells about or over 400㎜ is one of the diagnostic characters. This is demonstrated by the investigated specimens from both Izumi and Hokkaido. Such a large size has never been reported on any specimen of *P. (P.) egertoni* and *P. (P.) neubergicus*. The lectotype of *P. (P.) egertoni*, designated by MATSUMOTO (1959, p.42; before KENNEDY, 1986a, p.38), is wholly septate at D=105㎜ but shows already the adolescent type ornament and the numerous ventral ribs cease to develop at about 70㎜ diameter(see MATSUMOTO *in* MATSUMOTO *et al.*, 1986, text—fig.2). Even if the missing body-chamber is restored as long as 240°, its entire diameter would be about 180㎜ or at the most 200㎜.

The lectotype and several other specimens of *P. (P.) neubergicus* from Austria illustrated by KENNEDY and SUMMESBERGER(1986), which are mostly septate, show the middle-aged type ornament. Somewhat lager examples, which are represented by the one illustrated by them in pl.5, figs.4—5 and the holotype of *P. (P.) crishna*(FORBES,1846) from southern India,which is closely allied to *P. (P)neubergicus* (see HENDERSON and MCNAMARA,1985, p.74), but shows a concave curvature of ribs (MATSUMOTO *in* MATSUMOTO *et al.*, 1986, p.8), are about 120㎜ diameter and show the adolescent type ornament on the preserved last half whorl and the middle-aged type ornament stops to persist at about 90 ㎜ diameter.

In other words *P. (P.) neubergicus* seems to be nearly simlar in size to *P. (P.) egertoni* at the adult stage and is evidently smaller than *P. (P.) kobayashii*.

The three specimens from Crimea illustrated by NAIDIN and SHIMANSKII(*in* MOSKOVINA, 1959, p.186, pl.10, figs.1—3) are somewhat larger than the above

specimens. The diameters(D) estimated from the photographs and rates of reduction are roughly 220㎜(fig.1), 140㎜(fig.2) and 200㎜(fig.3) respectively. Th e smaller one (*loc. cit.*, fig.2) can be certainly referred to *P. (P.) neubergicus*, seeing that the differentiation of ornament is clearly shown on the earlier half of its outer whorl and that the outward weakening of primaries occur on the later half. The two larger ones (*loc. cit.*, figs.1,3) show nearly rectiradiate primaries of moderate intensity on the late part of the septate whorl. In this feature they resemble an unusual form of *P. (P.) kobayashii* from Izumi mentioned by MATSUMOTO and MOROZUMI (1980, p.10, pl.3, fig.1). Without examining the material from Crimea,however,we cannot decide whether these two specimens should be regarded as examples of *P. (P.) kobayashii* from Crimea or as representing merely a morphotype of *P. (P.) neubergicus* or otherwise.

As to the shell-form, *P. (P.) kobayashii* is more similar to *P. (P.) neubergicus* or *P. (P.) crishna* than to *P. (P.) egertoni* in the outline of whorl-section, showing a smaller value of B/H and less convergent flanks than those of *P. (P.) egertoni*. In correlation with the enlargement of shell the coiling is more involute, the whorl-expansion is of higher ratio and the umbilicus is narrower in *P. (P.) kobayashii* than in *P. (P.) neubergicus* or *P. (P.) crishna*.

As to the ornarment, the characteristic middle-aged type numerous ventrolateral ribs in contrast to fewer, distant primary ribs with bullate tubercles around the umbilicus occur in *P. (P.) neubergicus* and *P. (P.) crishna* on the whorl with diameters from about 50㎜ to 100㎜. In *P. (P.) kobayashii* the ornament similar to the above appears on the whorl with much larger diameters, say from 130㎜ to 230㎜, in the late part of the septate stage, where the ornament has already tended to weaken and its differentiation into the elongate umbilical bullae and the numerous ventrolateral ribs is not so distinct and does not persist for so long duration as in *P. (P.) neubergicus*. The holotype and some others of this species from the Izumi Group are more or less eroded, whereas the tow specimens from Hokkaido preserve shell layers and are not deformed secondarily, showing the specific characters better than the material from Izumi.

The unusual form of *P. (P.) kobayashii* from the Izumi Group noticed by MATSUMOTO and MOROZUMI(1980, p.10, pl.3, fig.1) is much different from *P. (P.) neubergicus* in that the primary ribs predominate on a whorl of large diameter. We expect that the numerous ventrolateral ribs may appear on its still later whorl and should like to regard it an extreme variant of *P. (P.) kobayashii*. (See also the foregoing remarks on some Crimean specimens.)

The holotype of *P. (P.) kobayashii* looks similar to that of *P. (P.) preegertoni* COLLIGNON,1952 (see 1955, p.61, pl.20, fig.1) in lateral view but has higher whorls and must have been much larger originally,as it is wholly septate. *P. (P.)*

preegertoni rather resembles *P. (P.) egertoni* (FORBES) in shell-form, size and concave curvature of ribs but the differentiation of ornament is not so distinctly developed as in the latter. It may be an ancestor of *P. (P.) egertoni* but unlikely that of *P. (P.) kobayashii.*

Another species which could be reckoned as an ancestral form is *Pachydiscus perfidus* DE GROSSOUVRE (1894, p.213, pl.34, fig.1)(also KENNEDY and SUMMESBERGER, 1984, p.160, pl.3; pl.6, fig.6), from the Upper Campanian of Europe. It shows the tendency toward the differentiation of the ornament into umbilical and ventrolateral one, and the ribs on the main part of flank are straight. In these points *P. kobayashii* is somewhat similar to *P. perfidus* but in the latter the ornament is stronger on the outer whorl, the umbilicus is broader and the venter is flattened.

It should be noted that the larger specimens of *P. neubergicus* by NAIDIN and SHIMANSKII (1959, pl.10, figs.1, 3) mentioned above seem to show a somewhat similar ornament to that of *P. perfidus.* KENNEDY (1986b, p.162) has suggested that the inner whorls of *P. perfidus* may foretell a paedomorphic origin for the *P. neubergicus* group.

Ⅲ Biostratigraphic correlation

Pachydiscus (Pachydiscus) kobayashii was established on the material from the Late Cretaceous Izumi Group of Southwest Japan. Examples of this species are now recorded to occur in the Fukaushi Sandstone of the Hakobuchi Group of Hokkaido.

As described in the precding chapter, *P. (P,) kobayashii* may have evolved from such species as *P. (P.) perfidus* with enlargement of shell, increase in ratio of whorl-expansion and tendency toward differentiation of ornament into the peri-umbilical, bullate primaries and numerous ventorolateral secondaries o n the late part of the phragmocone. It is hence fairly allied to *P. (P.) neubergicus,* but in the latter species, which is generally smaller than *P. (P.) kobayashii,* the differentiation of ornament is more distinct,appears earlier and persists for a longer duration.

The occurrence of *P. (P.) preegertoni* is known in the middle part of Campanian of Madagascar (COLLIGNON, 1955, p.63; 1970, p.38), Ariyalur Group (Campanian) of South India and the uppermost part of Campanian (above the Zone of *P. awajiensis*) in the Izumi Group of Awaji (MATSUMOTO *et al.*, 1986, p.5). *P. (P.) perfidus* occurs commonly in the Upper Campanian of Europe, whereas *P. (P.) neubergicus* is widespread in the Lower Maastrichtian of Europe and other regions, although the latter is occasionally recorded from the lower Upper Maastrichtian (KENNEDY and SUMMESBERGER, 1984, p.161; 1986, p.191).

The Hakobuchi Group in central to southern Hokkaido is divided into the lower and upper subgroups. The Upper Hakobuchi Subgroup consists of the following members in ascending order as originally proposed by OTATSUME(*in* UWATOKO and OTATSUME,1933):

A Lower Sandy Siltstone

B Fukaushi Sandstone

C Upper Sandy Siltstone

D Sanushibe 〔=Sanushupe〕

The Lower Sandy Siltstone is characterized by the fauna of the Zone of *P. (Neodesmoceras) japonicus-Inoceramus (Endocostea) shikotanensis*, which differs entirely from the Campanian fauna of the Lower Hakobuchi. *P. (N.) japonicus* MATSUMOTO,1947(see MATSUMOTO and SAITO, 1954, p.89, pl.9, fig.1; pl.10, fig.1; P1.11, figs.1,2; text-figs.1-3) is allied to *P. (N.) mokotibensis* (COLLIGNON, 1952) (see COLLIGNON, 1955, p.75, pl.28, fig.2; text-fig.21; 1971, p.32, pl.653, fig.2410) from the Lower Maastrichtian of Madagascar. Member A is thus referred to the lower part of the Maastrichtian.

Nostoceras hetonaiense MATSUMOTO, 1977 (p.322, pl.54, fig.2; pl.55, fig.1) is another element of the Zone of *P. (N.) japonicus-I. (E.) shikotanensis* in Hokkaido and also marks a zone in the Izumi Group of Awaji Island (MOROZUMI, 1985, p.41, pl.16, figs.1-5; pl.17, figs.5,6) together with *I. (E.) shikotanensis.* This zone in Awaji is regarded as representing the lowest part of Lower Maastrichtian (MOROZUMI, 1985, text-fig.3).

On account of the interruption by the Naruto Straits, it may be difficult to correlate the subdivisions of the Izumi Group in Awaji Island with those of the Izumi Mountains in the east. In the latter at least two zones are distinguished, the Zone of *P. (P.) kobayashii* as represented by Horizon A2 (Azenotani and nearby localities) below and the Zone of *P. (P.)* aff. *flexuosus* as represented by Horizon B5 (Sobura and neighbourhoods) above (MATSUMOTO and MOROZUMI, 1980; 1988) . *Baculites* 〔?*Eubaculites*〕 *regina* OBATA and MATSUMOTO, 1963 and *Nostoceras* aff. *hetonaiense,* among others, are important associates in the former.

On the ground of palaeontological and biostratigraphic facts mentioned above, we are inclined to conclude, though tentatively, as fllows:

(1) *P. (P.) kobayashii* is an index of Lower Maastrichtian,

(2) Zone of *P. (P.) kobayashii* or Horizon A2 in the Izumi Mountains is referred to Lower Maastrichtian, as suggested by MOROZUMI (1985, fig.13) , instead of Uppermost Campanian, as a possibility mentioned by MATSUMOTO and MOROZUMI (1980, p.27) .

(3) The Fukaushi Sandstone of the Upper Hakobuchi Subgroup is probably upper Lower Maastrichtian.

In the Campanian and Maastrichtian ages of the Late Cretaceous there is a

considerable differentiation of faunas from province to province. Pachydiscidae shows however a world-wide distribution. At the level of species *P. (P.) neubergicus* and *P. (P.) gollevillensis* (D'ORBIGNY), for instance, are distributed commonly over several biogeographic provinces, whereas some others seem to be confined to a particular region. Even in the latter case, if their affinities and stratigraphic occurrences are carefully investigated, they are usful for the age correlation. *P. (P.) kobayashii* dealt with in this paper is such an example.

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Awaji (淡路), Azenotani (畦の谷), Fukaushi (深牛), Hakobuchi (函淵), Hobetsu (穂別), Hokkaido (北海道), Izumi (和泉), Mikasa (三笠), Naruto (鳴門), Oita (大分), Sanushibe (サヌシベ), Sekiyu-zawa (石油沢), Sobura (蕎原), Tokushima (徳島)

北海道穂別産の示準アンモナイト種 *Pachydiscus kobayashii* について

松本達郎・利光誠一

（和文要旨）

穂別町の町道（石油沢路線）修復工事の際に函淵層群の深牛砂岩層から産した化石は町立博物館に保管されている．その中に5種のアンモナイトが認められる．標記の種は従来西南日本の和泉層群産の材料に基づきMATSUMOTO & MOROZUMI(1980)が記載したが，北海道からは報告されていなかった．上記産出標本中に少数個体だがあり，保存状態も和泉のと異なるので，本種の特徴を従来より明確に記すことができた．*P. kobayashii*は*P. egertoni*よりもむしろ*P. neubergicus*と類似点が強く，祖先型としては*P. preegertoni*よりも*P. perfidus*かそれに近縁のものの可能性が強い．いずれにせよ著しく大型化している．時代は*P. egertoni*, *P. neubergicus*と同様マストリヒチアン前期であろう．深牛砂岩層は下部マストリヒチアンの上部とする方が妥当であり，他方和泉層群畦の谷層中の本種を産した層位を下部マストリヒチアンとしたMOROZUMI(1985)の対比図は正しかったと言える．

Explanation of plate I

Pachydiscus (Pachydiscus) kobayashii (SHIMIZU).
Right lateral(A) and ventral(B) views of HMG−901.
Scale bar: 20mm. (Photos by M. NODA)

Explanation of plate II

Pachydiscus (Pachydiscus) kobayashii (SHIMIZU).
Left(A) and right(B) lateral and ventral(C) views of HMG−902.
Scale bar: 20mm. (Photos by M. NODA)

Explanation of plate III

Pachydiscus (Pachydiscus) kobayashii (SHIMIZU).
Left(A) and right(B) lateral and vent ral(C) views of the wholly septate holotype(UMUT.MM7720). Reproduced from MATSUMOTO, 1936, pl.31, fig.1 [for A] and KOBAYASHI, 1931, pl.11 [for B and C] by permission. Scale bar: 30mm.

Plate I (MATSUMOTO & TOSHIMITSU)

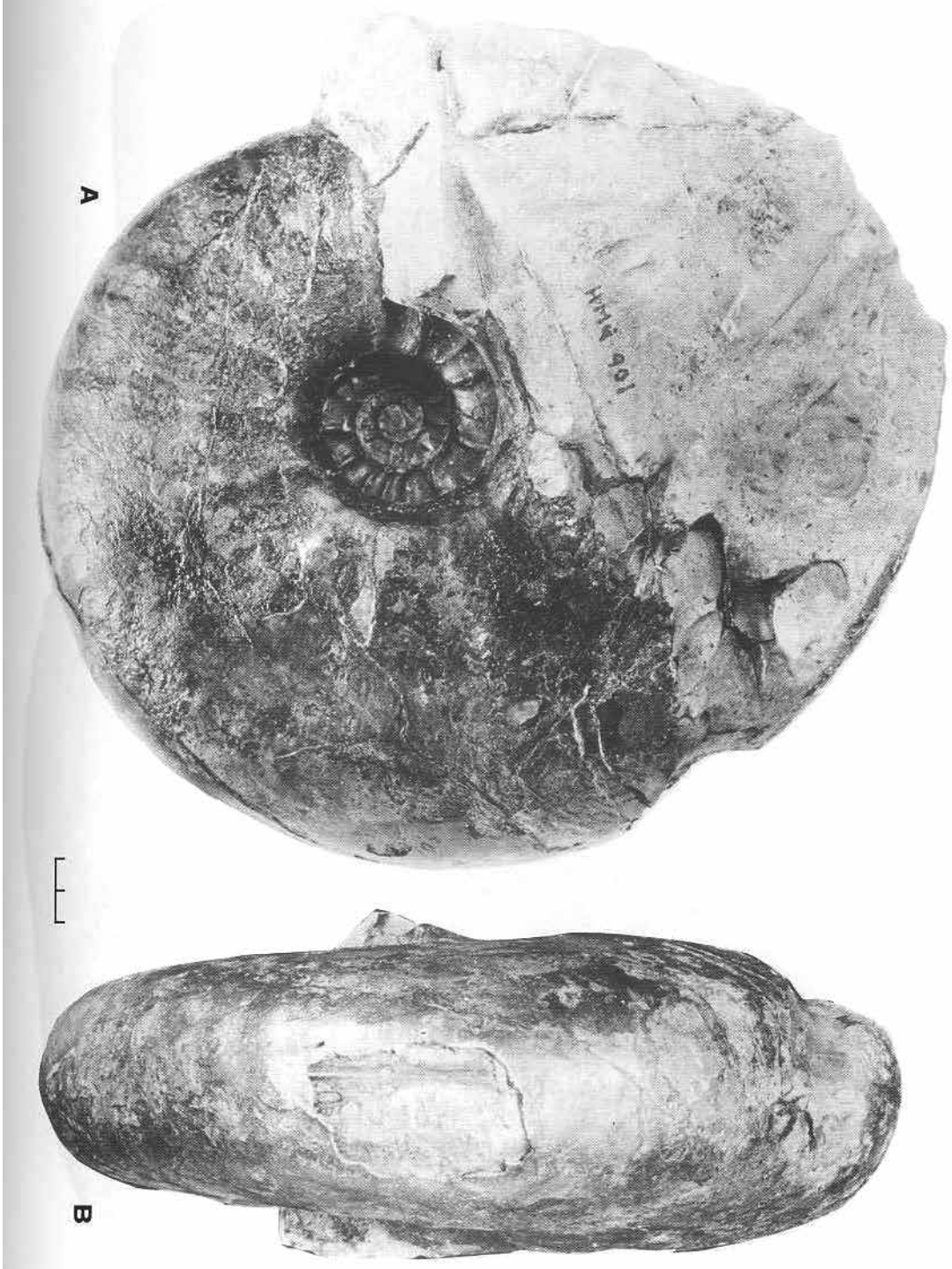

Plate II (MATSUMOTO & TOSHIMITSU)

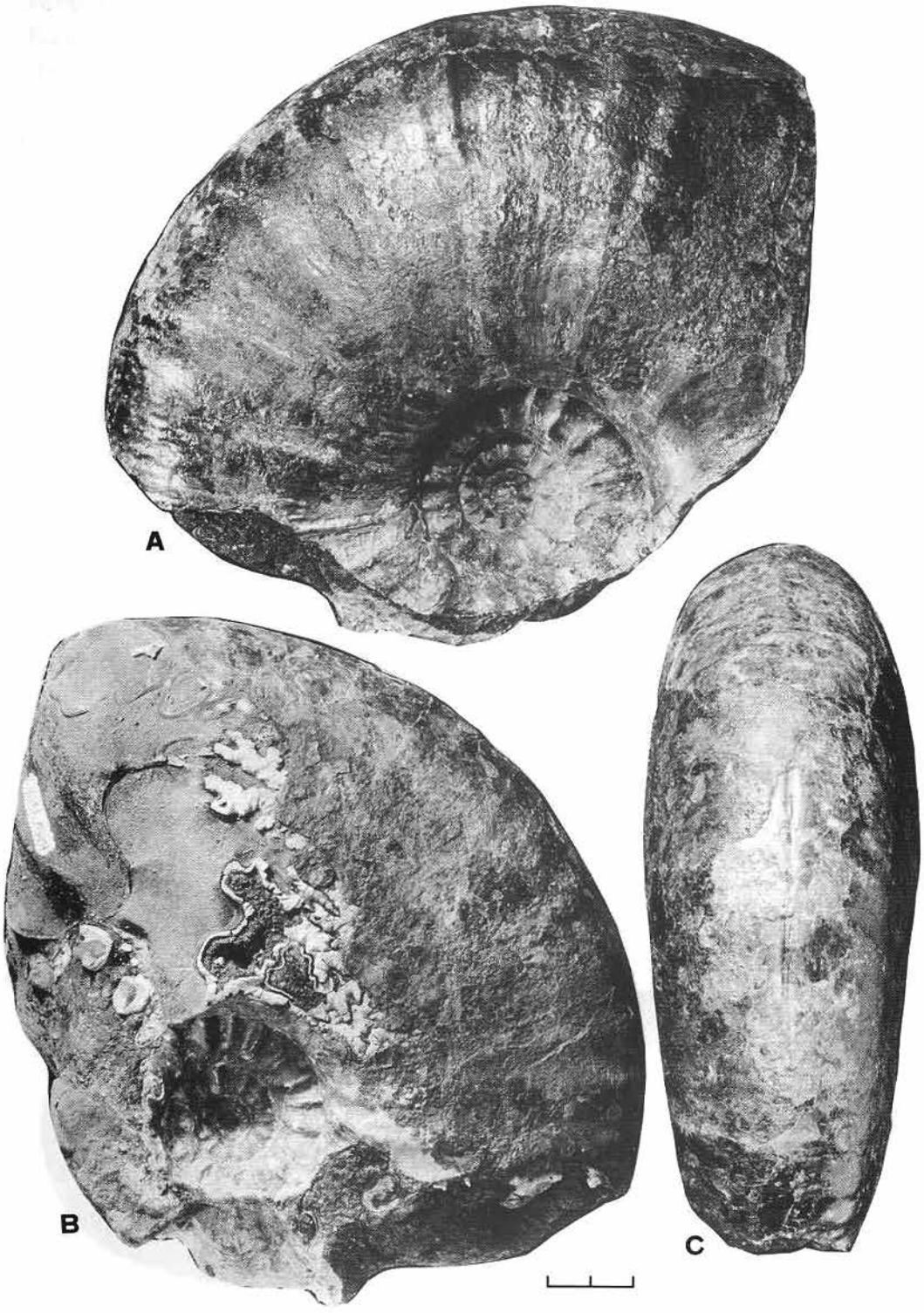

Plate Ⅲ (MATSUMOTO & TOSHIMITSU)