865. SOME INOCERAMIDS (BIVALVIA) FROM THE CENOMANIAN (CRETACEOUS) OF JAPAN – IV
AN INTERESTING NEW SPECIES FROM HOKKAIDO*

TATSURO MATSUMOTO

c/o Department of Geology, Kyushu University 33, Fukuoka 812

and

KEISAKU TANAKA

Nakayama, 3-62-10, 1200-109, Hachioji, Tokyo 192-03

Abstract. A specimen obtained by K. T. from his Member Te (=Ilc of T. M.), i.e. the middle part of the Mikasa Formation in the Ikushumbets Valley, was labelled as Inoceramus cf. etheridgei Woods and is held in the Geological Museum of the Geological Survey of Japan. This is restudied by us together with other relevant specimens from the Upper Cenomanian strata in the Ikushumbets and Oyubari areas, central Hokkaido. They represent a new species which is allied to I. scalprum Böhn (=I. etheridgei Woods, currently included in I. virgatus Schlüter as a variety or a subsp. by some authors), but characterized by regular concentric ribs in addition to fine concentric lirae. This species resembles I. atlanticus (Heinz) but is distinguished by a dissimilar outline of the shell caused by its anteriorly concave growth axis instead of the nearly straight to weakly convex one of that species. We interpret that this species may have evolved from the scalprum-like form of the variable species I. virgatus, with development of distinct ribs. There seems to be a reduction in size at higher levels than the type locality. Some of the specimens previously reported under I. tenustriatus Nagao et Matsumoto from the Cenomanian strata in various regions of the world may be preferably transferred to this species.

Introduction

One of us (Tanaka, 1985) listed some fossil specimens from the Cretaceous System of Japan, hold in the Geological Museum of the Geological Survey of Japan (GSJ), Tsukuba, which he obtained, sometimes with coworkers, during the field works to prepare geological maps on scale 1:50,000 in various areas of Japan. The other of us (T. M.) has recently visited the Museum to look at several specimens selected from the list. One of them, GSJ. F8275 from Ikushumbets, central Hokkaido, listed as Inoceramus cf. etheridgei Woods, was particularly interesting to him, because it did give him a hint to solve an entangled problem (to be discussed below) in which palaeontologists specializing in the inoceramids have been involved.

We have investigated this particular specimen together with other relevant ones, mostly those collected by T. M., sometimes with his colleagues, through field works in the Oyubari area (adjacent to the south of the Ikushumbets area), now kept in the Geological Collections, Kyushu University (GK) and partly those from the Ikushumbets area, deposited in the Institute of Geology and Palaeontology, Tohoku University. Sendai (IGPS). As a result a new species is established in this paper, giving remarks

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on its implications in the taxonomy of the Inoceramidae.

This paper is added as Part IV of the serial papers under the above indicated major title, which was intended at the beginning to consist of three parts (Matsumoto and Noda, 1986, p. 410).

Systematic description

Genus *Inoceramus* Sowerby, 1814

*Type species:* — *Inoceramus cuvierii* Sowerby, 1814.

*Remarks:* — In this paper the genus *Inoceramus* is used in a broad sense as in Matsumoto et al. (1987, p. 148). As to the technical terms and their abbreviations we follow those in Matsumoto and Noda (1986, P. 410).

*Inoceramus nodai* sp. nov.

Figures 1—3, 5—13

1966 *Inoceramus tenusiistratus* (? ) Nagao et Matsumoto; Pergament, p. 47, pl. 13, figs. 2—4; pl. 14, figs. 2—4.

? 1977 *Inoceramus tenusiistratus* ? Nagao and Matsumoto; Kauffman and Powell, p. 67, pl. 2, fig. 5; pl. 3, figs. 7, 9, 10.

1982 *Inoceramus tenusiistratus* Nagao & Matsumoto; Keller, p. 62, pl. 1, figs. 3a, b.

1985 *Inoceramus cf. etheridgei* Woods; Tanaka, p. 57.

*Material:* — Holotype, GSJ, F8275A (Fig. 1), BV, in a calcareous nodule collected by K. Tanaka at loc. lw32 (= T. M.'s loc. lk1043) from the siltstone in the main part of K. T.'s Member Tc (= T. M.'s Member IIc), Middle Member of the Mikasa Formation exposed across the main stream of the River Ikushumbetsu, central Hokkaido.

Paratypes, 36 specimens enumerated as follows: (1) GSJ. F8275B, RV, partly cropping out from the same nodule as the holotype; (2—4) small, probably juveniles, IGPS. 86187B (Fig. 2), C (Fig. 3) (both RV) and D (LV) in a calcareous nodule of sandy siltstone, Member IIc of the Mikasa Formation on the River Ikushumbetsu, without record of collector; (5, 6) GK. H8259A, B (Fig. 5) (RV and LV) in a nodule collected by T. Matsumoto with Y. Kawashita from the mudstone at loc. Y511165; (7—12) GK. H8260A (Fig. 6) B, C, D (these four LV) and E, F (RV) collected by T. M. at loc. Y511164 from the same bed as (5, 6), i.e. in the uppermost part of the probable extension of Member IIb (Matsumoto, 1942, p. 230), Taki-no-sawa route, Oyubari area, central Hokkaido; (13) GK. H8269A (RV) (Fig. 7) and (14, 15) GK. H8270A (RV) and B (RV) from loc. Y5111; (16, 17) GK. H8272A (LV) (Fig. 8) and B (RV) from loc. Y5112; (18—24) GK. H8273A (Fig. 13), B (Fig. 10), D, F (Fig. 12), G (Fig. 9) (all these five LV) and C (RV) (Fig. 11) and H (RV) from loc. Y5113; (25—29) GK. H8274A, B (LV) and C, D, E (RV) from loc. Y5113; (30—36) GK. H8275A, B (RV) and C, D, E, F, G (LV) from loc. Y5111; 13—36 developed or separated by T. M. from the calcareous nodules obtained through the field work (in 1969) by T. M. and H. Okada from sandy siltstone beds in the unit of alternating sandstone and siltstone, probable extension of Member IIb.

The above enumerated specimens are mostly internal moulds or composite internal moulds, with partly attached inner shell layer. External moulds are available for GK. H8259, GK. H8269 and GK. H8272B.

*Etymology:* — This species is dedicated to Dr. Masayuki Noda who has contributed much to the taxonomy and biostratigraphy of the Inoceramidae.

*Diagnosis:* — Shell medium to small sized, sub-ovate and inequilateral. Valves gently convex in general, but for moderately convex umbonal part. Beak at the anterior end, small, pointed and not much exceeding the hinge line even in the left valve. Anterior hinge angle (= apical angle, \( \alpha \)) 95° to 110°. Axis of growth nearly straight in young shell and gradually curved forward with growth, forming anteriorly concave curvature. Anterior margin nearly straight or gently concave and abruptly bent at the antero-ventral edge to the asymmetrically subcircular ventral margin, which passes to the longly arcuate posterior margin. Hinge line of moderate length (s/l=2/3 in the holotype), forming obtuse angle (125°—
140°) with the posterior margin. Postero-dorsal wing-like part narrow, to which the main part of the disk gradually inclines. The maximum inflation of valve immediately in front of the growth-axis; anterior side nearly vertical or overhanging.

Surface of shell ornamented with fine and dense concentric lirae and fairly regular concentric ribs of low to moderate intensity. Concentric rings may be discernible on some part of the internal mould, corresponding to the sharper lirae on the shell surface.

Dimensions:—See Table 1.

Observation:—The holotype consists of both
Table 1. Measurements of *I. nodai* on selected specimens

<table>
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<tr>
<th>Specimen</th>
<th>V</th>
<th>h</th>
<th>l</th>
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<th>H</th>
<th>L</th>
<th>L/H</th>
<th>b</th>
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<td>–</td>
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<td>.32</td>
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<td>.71</td>
<td>95°</td>
<td>80°</td>
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Figure 1. *Inoceramus nodai* sp. nov.

Holotype, GSJ. F8275A (BV), from loc. lw32 (= lk1043) of the River Ikushumbets, lower part of Member Tc (= Ic), Mikasa Formation (K. Tanaka Coll.). A: lateral view of RV, with a ventral portion of a paratype, GSJ. F8275B at the bottom; B: anterior view of RV and half exposed LV, with a posterior view of GSJ. F8275B at the bottom; C: dorsal view of BV (umbro of LV deficient); D: RV in particular view, showing its umbonal part better than A; all in natural size (x 1).

Photos (Figs. 1–15) by courtesy of Dr. Masayuki Noda.
valves, of which the left valve is deficient in lacking the umbonal part and only half exposed. We had to stop trimming the concealed posterior half, otherwise the better preserved right valve would be destroyed, because the specimen is too fragile. The right valve is a composite internal mould for the major part and the inner shell layer is attached to the posterodorsal part and some other portions, where fine concentric lirae are discernible in addition to the regular ribs. The ribs are low but rather sharp at their summit. So far as the visible part is concerned, the difference in the convexity or breadth (b) of the valve is slight between the left and right valves of the holotype.

Another right valve (paratype 1), which crops out from the same nodule as the holotype, has somewhat coarser and rather rounded ribs as compared with those of the holotype, although the difference is by no means great.

Other paratypes (2 to 36), which came from comparatively higher parts of the Upper Cenomanian, are smaller than the holotype. Some of them may be juveniles. The largest of them is 35 mm in H and may be adult. Others may be at least middle-aged (see remarks below). Those from locs. Y5111, Y5112 and Y5113 are often embedded in school, but left and right valves are mostly separated. As far as the well preserved specimens are concerned, the beak of the left valve is slightly projected beyond the hinge line.

Of the paratypes 2 to 36, the figured 12 specimens are better preserved in showing both the shell-form and ornamentation. Even in the unillustrated specimens with deficient outline, the ornament may be well shown. In the normal cases of this small form, the ribs are distinct and rather sharply headed (e.g. GK. H8259A; GK. H8273A, C; GK. H8274A, B). In the less convex valves, which may be originally so in some cases but due to secondary compression in other cases, the major ribs are low, but fine and dense, concentric lirae may be well shown (e.g. GK. H8269A, B; GK. H8272A, B; GK. H8275A, B, C, D).

The major ribs are normally regular in the gradual increase in strength and interval, but the irregularity by bifurcation or intercalation may sometimes occur. The ribs begin to develop distinctly at the stage with H=15 mm in the holotype. In the smaller paratypes from locs. Y5111–Y5113, the ribs begin to be discernible at H=8 to 11 mm and in the case of very small IGPS. 86187C and B, probably from the higher bed than the holotype in the Ikushumbets route, there are 4 and 6 ribs at their H=10 mm and 15 mm respectively. Generally the intervals of the ribs are narrower and the ribs look to be more crowded in many, if not all, of the small paratypes as compared with those of the holotype. The above facts suggest that there is variation in size and that many of the small specimens from the higher part of the Upper Cenomanian may be already middle-aged and the largest one (H=35 mm) may be adult.

There is also some extent of variation in shell-form. For example, GK. H8269A and IGPS. 86187B represent a comparatively higher form with a smaller ratio of L/H or l/h than that of the normal form. They are contained in the same nodule as some examples of the normal form and the difference in the value of L/H or l/h is not great (see Table 1). The convexity of the valves varies to some extent. The ratio b/h, which may reflect the convexity, ranges from 0.24 to 0.33 in the measured specimens.

Comparison and discussion:—With respect to the regular concentric ribs combined with fine and dense concentric lirae, this species is similar to _Inoceramus atlanticus_ (Heinz). The latter species was proposed by Heinz (1936, p. 96), under the genus _Camptoceramus_ Heinz, 1932 (nom. nud.) for the two illustrated specimens of _I. crippsi_ var. _reachensis_ in Woods (1911, p. 278, pl. 48, fig. 5 and pl. 49, fig. 1), from the Zone of _Holaster subglobosus_ (Lower Chalk, Cenomanian) of England. Later Woods' pl. 48 fig. 5 was designated as the lectotype by Pergament (1966, p. 58) prior to Keller's (1982, p. 58) too late designation of the other specimen.

Incidentally, Kauffman (1978, p. iv• 4) called Woods' pl. 48, fig. 5 _I. (Mytiloides ?) reachensis_ Etheridge and Woods' pl. 49, fig. 1 _I. (Mytiloides ?) reachensis_ n. subsp. A, without
giving comments on *I. atlanticus* (Heinz), and mentioned further that the former occurs in the *Neostringoceras carctitanense* Zone and the latter in the *Mantelliceras saxbii* Zone. On examining the above specimens in the British Museum (Natural History) and also their plaster casts in Kyushu University (GK. H9581 and GK. H9582), one of us (T. M.) considered that they could possibly be referred to the genus *Mytiloides*, because of the evenly very fine and dense concentric lirae on the very thin shell in addition to regular major ribs. In fact Matsumoto (1959, p. 85) and Matsumoto and Noda (1975) mentioned as a working hypothesis that *I.*

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**Figures 2, 3.** *Inoceramus nodai* sp. nov. Paratypes, IGPS. 86187B (2) and C (3) (RV, probably juveniles), from the Ikushumbets. 2, 3: x 1; 2 x, 3 x: enlarged, x 2.

**Figure 4.** *Tarrantoceras aff. stantonii* Stephenson. IGPS. 86187A, contained with B and C in one and the same nodule, Member IIC (presumably its uppermost part), Mikasa Formation. Right (a) and left (b) lateral, earlier (c) and later (d) ventral views of the outer whorl; external mould of inner whorls (e), x 1.
reachensis (of Woods) could belong to the ancestral root stock from which Mytiloides labiatus (Schlotheim) may have offshooted. Anyhow, the above view is a suggestion for the question to what genus belongs the species proposed in this paper. We should, however, reserve the final answer until reliable evidence is obtained.

Aside from the question of generic assignment, we should mention here as to the validity of I. atlanticus. One of us (T. M.) once (in 1954) studied the syntypes of Inoceramus latus var. reachensis Etheridge, 1881 in the Sedgwick Museum, Cambridge. They are SM. B7173, B7174 and B7175 from the Totternhoe Stone of Burwell, Cambridgeshire, and more or less secondarily deformed or compressed. One of them, SM. B7173, figured by Etheridge (1881, p. 142, pl. 1, fig. 3) was designated by Woods (1911, p. 278) as the type, i.e. lectotype. It is much more elongated along the more oblique growth-axis than the above mentioned specimens of Woods (see Table 2). Therefore, the separation of I. atlanticus from I. reachensis (s. str.) can be justified. The two nominal species are, however, so similar in showing evenly dense and very fine concentric lirae on the very thin shell in addition to regular major ribs that subspecific distinction may be preferable. Without inspecting more specimens from successive levels, it is difficult to draw a final conclusion. In this paper, we tentatively use the specific name I. atlanticus on the ground of the above difference in shell form.

I. atlanticus has been reported also from the Cenomanian of France (Sornay, 1978, pl. 1, fig. 4), Germany (Keller, 1982, p. 57, pl. 1, fig. 6) and probably Kamchatka (Pergament, 1966, p. 58, pl. 5, fig. 3 with cf.). In every figured example of I. atlanticus, the axis of growth is at first nearly straight and then slowly curved toward the posterior, forming a gently convex curvature to the anterior.

In this new species, the axis of growth is at first nearly straight but soon curved toward the anterior, forming distinctly an anteriorly concave line. This character is constantly kept in every specimen examined. On account of this difference, the outline of the shell is also dissimilar between the two species.

The fine and dense concentric lirae and the general shell-form as well as the stratigraphic occurrences suggest that the two species may have diverged from a variable species I. virgatus Schlüter (recently redefined by Matsumoto et al., 1987), acquiring the better developed major concentric ribs.

Should the subspecific definition by Keller (1982) be maintained, then the origin of I. nodai sp. nov. would be ascribed to I. virgatus scalarum Böhm and that of I. atlanticus could be so to I. virgatus virgatus Schlüter. Matsumoto et al. (1987) have denied the subspecific separation because of the presence of forms with mixed characters and the coexistence of various forms in the same province of the same geological age. However, in some late age of the Cenomanian, the divergence into two (or more) species my have taken place. Anyhow, the above interpretation would be dissonant with the aforementioned suggestion to refer I. atlanticus (=I. reachensis of Woods) to Mytiloides, unless I. virgatus is referable to Mytiloides.

Table 2. Measurements of the discussed species on selected specimens.

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<th>V</th>
<th>h</th>
<th>l</th>
<th>l/h</th>
<th>H</th>
<th>L</th>
<th>L/H</th>
<th>S</th>
<th>s/l</th>
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<td>95</td>
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<td>63</td>
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(1) I. atlanticus, lectotype; (2) I. atlanticus, paralectotype; (3) I. reachensis, lectotype; (4) I. aff. ginterensis
I. nodai sp. nov. is somewhat similar to I. tenuistratius Nagao et Matsumoto, 1939. We should recall here that Matsumoto (1959, p. 84) once mentioned that I. tenuistratius is somewhat allied to I. etheridgei Woods, 1911 (=I. virgatus scalprum Böhm, 1915) but is evidently later (Turonian) in age. Kauffman (1977, p. 178, 1978, p. iv—5) also regarded I. tenuistratius as a member of “the I. etheridgei lineage.”

I. tenuistratius was established on several syntypes from the celebrated exposures (loc. Ik2012—14) of the Upper Turonian strata on the River Pombets (see Matsumoto, 1984, fig. 3). It was defined fairly clearly and is now being restudied by Noda (1988) in parallel with this work. That species is constantly small and somewhat inequivalve, with more convex umbonal part which is steeply inclined to the postero-dorsal wing-like part. Its axis of growth is straight throughout, without showing such a curvature as that of I. nodai. It has fine and dense concentric lilae as those of this species but is devoid of such regular concentric ribs as those of I. nodai and I. atlanticus. Only weak concentric subcostae or undulations may occur irregularly in some specimens of I. tenuistratius.

Those forms which have been described or reported under I. tenuistratius, with or without a query, from the Cenomanian of various regions outside Japan by Pergament (1966), Kauffman and Powell (1977), Kauffman (1978, without fig.) and Keller (1982) (see above list of synonyms) are not referred to the named species. We are inclined to transfer them to I. nodai on the basis of their described and illustrated characters, although the final conclusion should be deferred until we examine the actual specimens or at least their replicas.

Although I. tenuistratius and I. nodai sp. nov. are distinguished, the two species might be genetically related. If the characters in the early growth-stage of I. nodai were retained and extended to a small-sized adult of the descendant, I. tenuistratius could be formed. To verify this hypothetical presumption of paedomorphosis, it is eagerly required to study the material from the lower part of the Turonian.

In this connexion it is interesting to see that the investigated specimens of I. nodai from the upper part of the Upper Cenomanian are small as compared with the typical form (holotype and others) from the lower part of the same substage in the sequence of Hokkaido.

A comparatively higher form among the population of I. nodai from higher levels, as represented by IGPS. 86187B (Fig. 2) and GK. H8269A (Fig. 7), is noteworthy in its similarity to a peculiar form said by Kauffman and Powell (1977, pl. 1, fig. 1) as “a young I. ginterensis Pergament showing abnormally close, regular juvenile rugae”, from the Hartland Member of Oklahoma. That North American form is indeed similar to I. ginterensis in the outline of shell, but such regular ribs do not appear on the young shell of typical I. ginterensis. It should be called I. aff. ginterensis (Table 2—4) or could be called I. aff. nodai.

We should mention here that there is another peculiar form represented by GK. H8269B (Fig. 14) and GK. H8271A (Fig. 15), which were intermingled with some specimens of I. nodai. It differs from the latter species in its obliquely elongated outline with straight growth-axis, smaller apical angle and narrowly raised, regular ribs of stronger curvature. Although the two specimens are immature or middle-aged, they resemble the holotype and other examples of Inoceramus schoendorfi (Heinz) from the Upper Cenomanian of Germany (near Hanover) and Denmark and Upper and Middle Cenomanian of France (see Sornay, 1980, p. 2, pl. 1, figs. 1—5). I. schoendorfi may be allied to but is clearly distinct from I. nodai by the above characteristics. We call the above mentioned form from Hokkaido tentatively I. cf. schoendorfi.

Occurrence:—The nodule, which contains the holotype and the paratype 1, was obtained by K.T. from his loc. Iw32, i.e. T. M.’s loc. Ik1043. It is on the main course of the River Ikushumbets, about 530 m downstream from the Katsurarazawa dam and slightly upstream from the entrance of a small branch stream called the Suido-no-sawa. The nodule was in dark grey siltstone which belongs to the lower part of the Middle Member.
of the Mikasa Formation, marked Tc by K. T. (in Matsuno et al., 1964, p. 28) or IIc by T. M. For the location on the route map and stratigraphic section see figs. 2 and 4 in Matsumoto (1965) and for the general stratigraphy of the Ikushumbets Valley see Matsumoto et al. (1978, p.

**Figures 5–13.** *Inoceramus nodai* sp. nov. Paratypes. 5: GK. H8259A (RV) and B (LV. oblique view of anterolateral part) from loc. Y5111e5 (T. Matsumoto Coll.), × 1. 5 x: Ditto, enlarged, × 2. 6: GK. H8260A (LV) from loc. Y5111e4 (T. M. Coll.), × 1.5. 7: GK. H8269A (RV) from loc. Y5111 (T. M. & H. Okada Coll.), × 1.5. 8: GK. H8272A (LV) from loc. Y5112 (T. M. & H. O. Coll.), × 1.5. 8p: Ditto, posterior view, × 1.5. 9, 9a: GK. H8273G (LV); 10, 10a: GK. H8273B (LV); 11: GK. H8273C (RV); 12, 12a: GK. H8273F (LV); 13: GK. H8273A (LV), these five in the same nodule from loc. Y8213 (T. M. & H. O. Coll.); 9a, 10a and 12a are anterior views of 9, 10 and 12; all × 1.5. 5–13 on the Taki-no-sawa route, extension of Member IIm (of the Shiyubari, Matsumoto, 1942), Oyubari area.
Figures 14, 15. Inoceramus cf. schoendorfi (Heinz). 14: GK. H8269B (RV), probably juvenile, contained with GK. H8269A (Figs. 7) in the same nodule. 15: GK. H8271A (RV), probably middle aged, contained with GK. H8270A, B (I. nodai, no fig.) in one and the same nodule. Both from loc. Y5111, Taki-no-sawa route, extension of Member II, Oyubari area (T. M. & H. O. Coll.). x 1.5.

xxxiii-3—5, figs. 6—8). From the main part of Member IIc occur Eucalycoceras pentagonum (Jukes-Browne) and Calycoceras cf. naviculare (Mantell) (see Matsumoto, 1975), indicating the lower part of the Upper Cenomanian.

IGPS. 86187B—D, i.e. paratypes 3—5, are in a dark grey calcareous nodule from Member IIc of the Ikushumbets Valley. The nodule contains Tarrantoceras aff. stantoni Stephenson (IGPS. 86187A) (Fig. 4) and numerous, drifted vegetable fragments, suggesting its derivation from the uppermost part of Member IIc, i.e. the Zone of Euomphaloceras (Kanibiceras) septemseriatum, next higher zone than the Pentagonum Zone.

Numerous specimens from locs. Y5111, S112 and 5113 are in calcareous nodules contained in mudstone layers of a member of alternating sandstone and shale in the section along the stream Taki-no-sawa, Oyubari area. This member corresponds to Member II of Matsumoto (1942) of the Shiyubari area, adjacent to the northeast of the Oyubari area. It is referred to the Upper Cenomanian because it contains Damesites cf. laticarinatus Saito et Matsumoto and Marshallites compressus Matsumoto and because it is immediately below the bed with Pachydesmooceras kossmati Matsumoto and Pseudaspidoceras flexuosum Powell, the latter of which is an index of the Basal Turonian (Kennedy et al., 1987). This bed is followed above by a unit of mudstone characterized by Mytiloides mytiloides (Mantell) in the main part with intercalated key beds of tuff and tuffite. This unit certainly corresponds to Member II of the Shiyubari area (Matsumoto, 1942) and referred to the Lower Turonian.

This new species has been established on the material from the Upper Cenomanian of the Ikushumbets and Oyubari sections, but its true range has yet to be worked out by further investigations of other sections.

Probable examples of this species outside Japan illustrated under I. tenuistratiatus (with or without a query) are from the Zone of Dunveganoceras albertense and that of Sciponoceras gracile-E. (Kanibiceras) septemseriatum in the Upper Cenomanian of Oklahoma (Kauffman et al., 1977), also the Middle Cenomanian of the Sack-Mulde, Germany (Keller, 1982) and the Upper Cenomanian of the Koryak-Kamchatka region (Pergament, 1966).

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References cited


--- (1980): *Inoceramus schnöndorfi* Heinz, une espèce
松本達郎・田中啓策

Fukuoka 福岡、Hachioji 八王子、Hokkaido 北海道、Ikushumbets (ikushunbetsu) 鶴岡別、Iwamizawa 岩見沢、Katsurazawa 桂沢、Kyushu 九州、Mikasa 三笠、Nakayama 中山、Oyabaku 大沢、Ponbetsu (Ponbetsu) 奔別、Sendai 仙台、Shiroyama (Shiroyama) 朧山、Suido-no-sawa 水道の沢、Takino-sawa 青の沢、Tohoku 東北、Tokyo 東京、Tsukuba 提携。

本邦白亜系セノマニアン階産イノセラムスー IV。興味のある北海道産 1 新種：地質調査所地質標本室に保管の標本で、かって田中が鶴岡別の三笠層中部（セノマニアン上部）から得た GSJ F8275 を松木が見て、かねてからの疑問を解く鍵となると直観し、同じく鶴岡別産の東北大標本、大沢層のظ の II m 相当部層（セノマニアン下部）産の多数の九大標本と併せて共同研究した。その結果これらは田中が予見したように、"Inoceramus etheridgei Woods"（後に I. scalprum Böhm と改名、最近は I. virgatus Schlöter の亜種または 1 変異型とされる）と類似するが、同心細輪（irlae）に加えて、中間部の長さの規則正しい主筋が発達する。従って I. atlanticus (Heinz) に類似するが、殻の成長形が常に前方に凹の曲線を描き、それに伴って殻の輪郭も I. atlanticus と異なる。よって上記 GSJ 標本をホロタイプ、その他をパラタイプとして、新種 I. nodai を設立し、図示・記載した。

なお I. reachens Etheridge, 1881 のホロタイプは Woods (1911, pl. 48, fig. 5; pl. 49, fig. 1) が図示した "I. reachens" とは区別できる（英国で原標本を松木が検討）から、後者に基づき Heinz (1936) が提唱した I. atlanticus は採用してよい。

I. virgatus はセノマニアン下部（下部層外）に産する。今回採った I. nodai の標本は同階上部に産するが、最上部では小柄である。その小柄のものでも、チューロニアン上部産の I. tenuistratus Nagao et Matsumoto との差異は明確である。（本研究を平行して後者が田中が研究し1988年本号に記載。）ところが海外で複数の著者がセノマニアン産の "I. tenuistratus" を報告している。実物を見ていないから断言は控えるが、図示・記述のもの（同階上部、時に中部産）に関しては、その同定は誤で、I. nodai とした方がよいと思われる。この判断が正しいとするならば、I. nodai はセノマニアン上部産の示差化石として重要となるであろう。