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721. A NEW SPECIES OF *INOCERAMUS* (BIVALVIA) FROM THE UPPER CRETACEOUS OF HOKKAIDO*

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Abstract. In this paper a peculiar new species of *Inoceramus* is described on a set of specimens from the lower part of the Middle Turonian of the Obira area, northwestern Hokkaido. It belongs to the group of *I.* (*I.*) *lamarcki* PARKINSON and is somewhat allied to *I.* (*I.*) *paralamarcki* EFREMOVA, from the Ust. Yenisei depression (USSR), but is distinguished by its extremely high outline, extraordinary convexity, well developed and somewhat convex posterior wing and less inequivalveness.

The occurrence of this kind of inoceramid species is rather unusual in the Upper Cretaceous of Japan and its palaeobiogeographical and evolutionary implications are discussed in an Appendix by MATSUMOTO and NODA.

Introduction

In the course of restudying inoceramids from the Cretaceous of Japan, which one of us (M.N.) is undertaking, sometimes with T. MATSUMOTO or others, it is noticed that there occur occasionally several species which have been little known from the Japanese province. In this paper one of them is described under a new specific name.

This unexpected discovery came from our fossil hunting in the Obira area on August 10th, 1977, when only two valves of probably a single individual were obtained. Having been encouraged by Prof. T. MATSUMOTO, we reinvestigated there again in the summer of 1979, getting a few more specimens. One of us (K.M.) further continued the field work, with a result to obtain still more. These are the basic material of the present study. The holotype is registrated at Kyushu University (GK) and others at Mikasa Museum (MC).

As the specimens are very peculiar as compared with the better known species which occur commonly in the Upper Cretaceous of Japan, a biometric examination is added for careful comparison with the species home and abroad.

After the palaeontological description, some remarks are given on the phylogenetic relations and palaeobiogeographic implications as an appendix.

In this study NODA is mainly responsible for the palaeontological description, but as MURAMOTO has much co-operated in the field and laboratory works, the co-

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authorship is taken.

Before going further, we thank Emeritus Professor Tatsuro MATSUMOTO of Kyushu University for his cordial help and advice, including critical reading of the first draft. We are indebted to Mr. Kinichi KAMIZUMA and Mrs. Tomiko SUGAWARA for their help in the field work.

Furthermore, one of us (M. N.) is indebted to Prof. MATSUMOTO who has co-operated in the discussions of the phylogeny and palaeobiogeography.

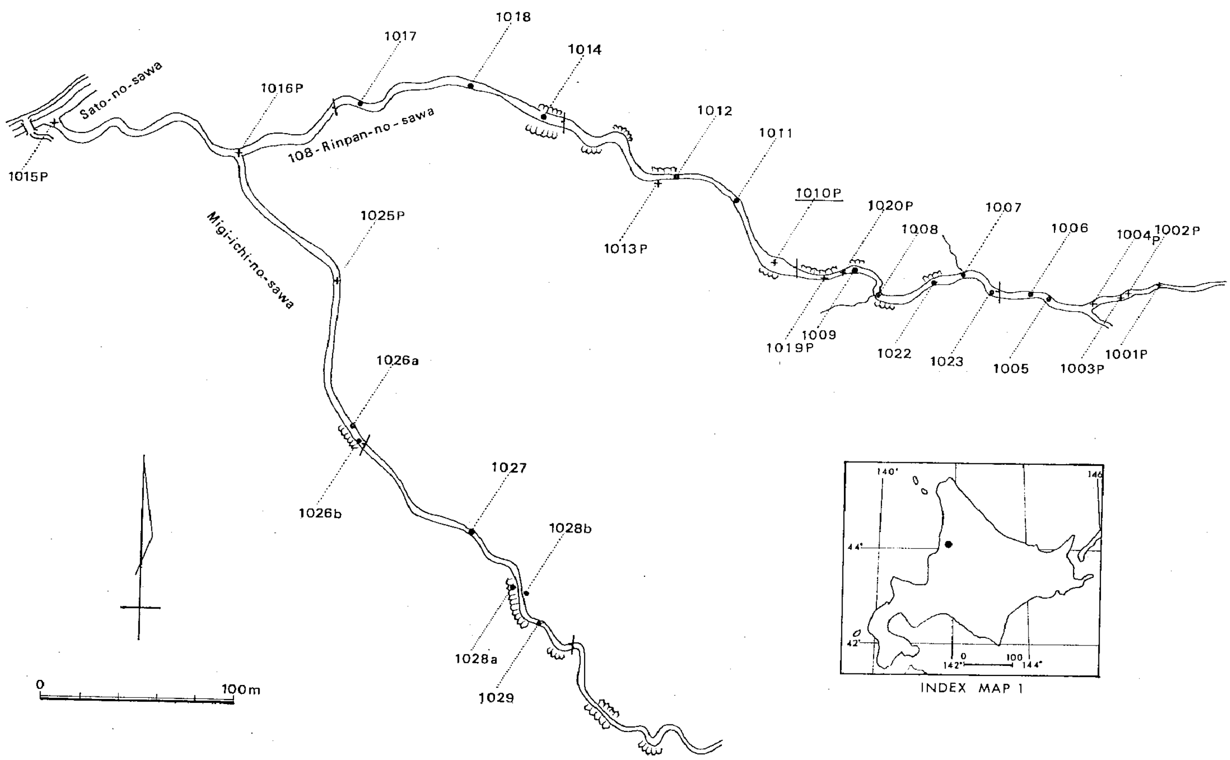
Notes on Stratigraphy

The Obira area in northwestern Hokkaido is famous for the well exposed Cretaceous sequences and occurrence of well preserved fossils. Aside from the classical works of JIMBO (1894) and YABE (1909), the Cretaceous stratigraphy of this area has been recently described by TANAKA (1963), MATSUMOTO et al. (1976-issued 1978) and TANABE et al. (1977) among others, with lists of fossils from the subdivided units. Geological maps by TSUSHIMA et al. (1958) and IGI et al. (1958) are also available.

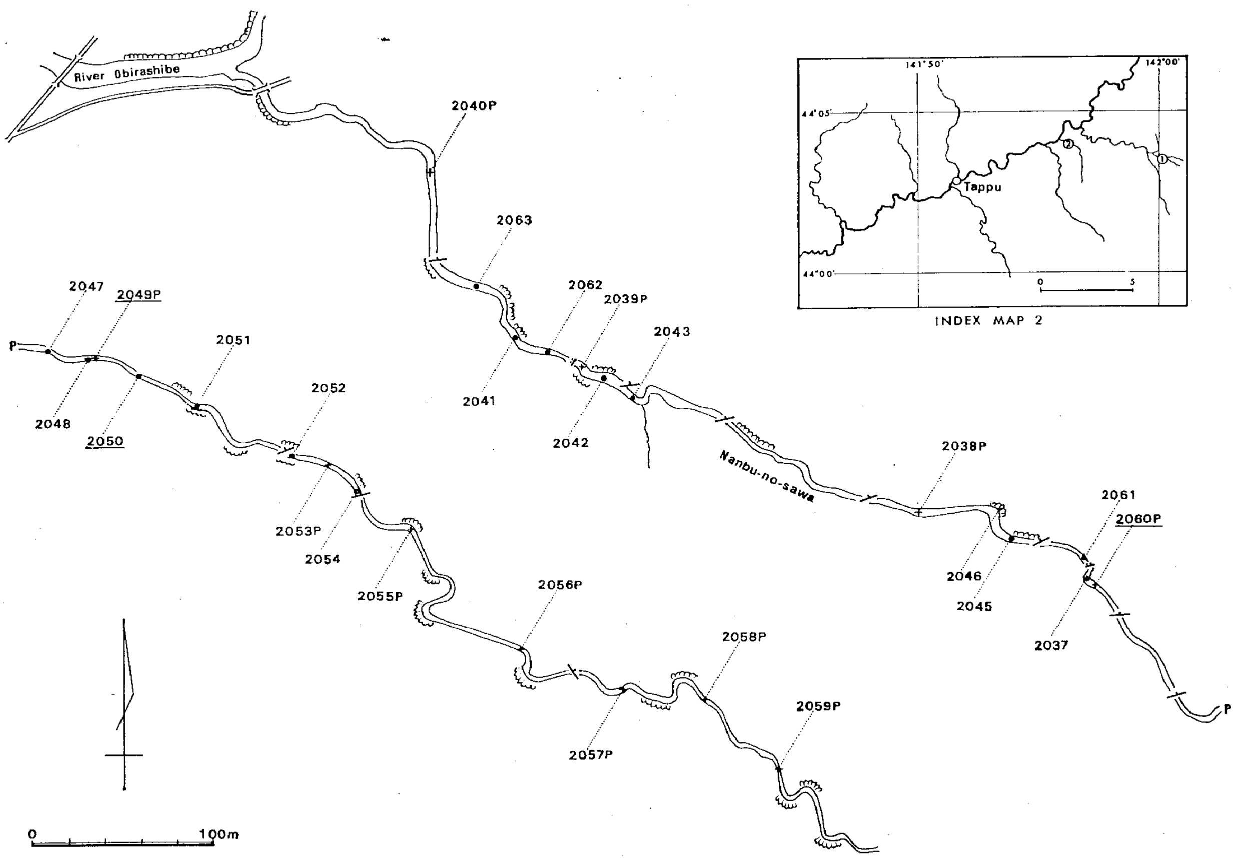
The present discovery of a new species happened to come from our hunting of fossils in the Zone of *Inoceramus* (*I.*) *hobetsensis* (Middle Turonian).

Four localities grouped into two are concerned with the basic material. Their locations are indicated in the route maps of Text-figs. 1 and 2 and also recorded as follows:

(1) Loc. Ob1010: Osarunaidake Quad. (Topographic Map 1:25000). Long. 142°0′22″E, Lat. 44°03′49″N. 108 Rinpan-no-sawa, about 400 m upperstream from the confluence with



Text-fig. 1. Locality map of *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. (108 Rinpan-no-sawa). For the index map refer together with that of the Text-fig. 2.



Text-fig. 2. Locality map of *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. (Nanbu-no-sawa). For the index map refer together with that of the Text-fig. 1.

Sato-no-sawa, a branch of Kamikinenbetsu-zawa, a tributary of the River Obirashibe, administratively in Kamikinenbetsu, Obira-Machi, Rumoi-gun, Hokkaido.

(2a) Loc. Ob2049: Takishita Quad. (Topographic Map 1:25000). Long. 141°56′39″E, Lat. 44°03′49″N. Nanbu-no-sawa, a tributary of the River Obirashibe, about 800 m upward from the confluence with the main stream of the Obira, along the course of stream.

(2b) Loc. Ob2050: Takishita Quad. (Topographic Map 1:25000). Long. 141°56′41″E, Lat. 44°03′49″N. Nanbu-no-sawa, about 50 m upperstream of Loc. Ob2040.

(2c) Loc. Ob2060: Takishita Quad. (Topographic Map 1:25000). Long. 141°56′32″E, Lat. 44°03′54″N. Nanbu-no-sawa, about 150 m downstream from Loc. Ob2049.

As has been described by aforementioned previous authors these localities are within the area of the Middle Yezo Group. This group in the Obira area is subdivided into 15 units, from Ma to Mo in ascending order.

(1) Loc. Ob1010 is situated within Unit Mj in the published geological map of TANAKA (1963, map 1), but according to MATSUMOTO (personal comm.), who investigated there with K. MURAMOTO on other days, there is a thrust at some distance on the west side of the locality, by which Unit Mk seems to reappear there. Unit Mk is characterized by the common occurrence of an inoceramid, which is temporarily called *I.* (*I.*) aff. *hobetsensis nonsulcatus* NAGAO et

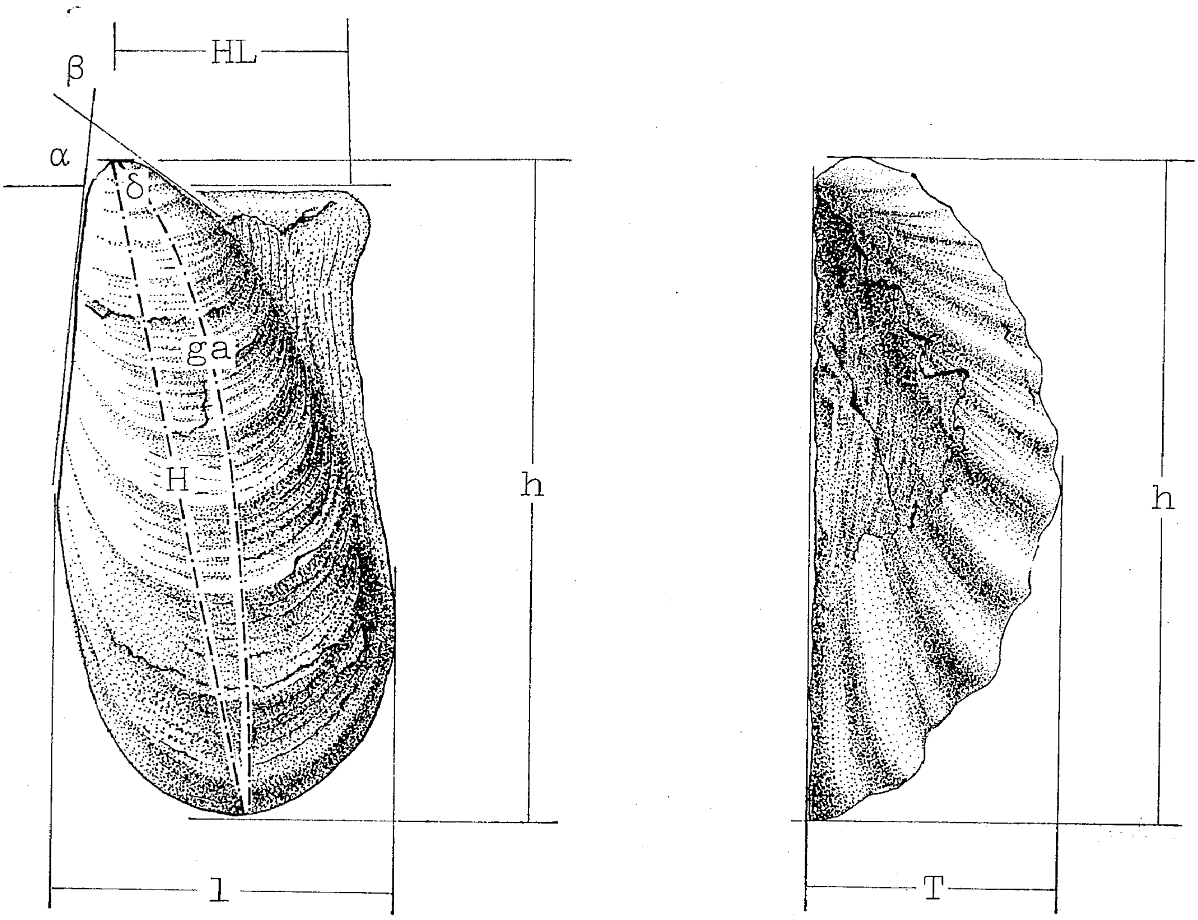
MATSUMOTO, and *Eubostrychoceras japonicum* (YABE) (emended by MATSUMOTO, 1977) and other heteromorph ammonoids. Lithologically clay is predominant in Mj, whereas sandy siltstone is so in Mk. It is highly possible that the inoceramid specimens obtained at Ob1010 came from Unit Mk, and accordingly lower part of the "Middle Turonian" [K4b$_2$ of MATSUMOTO, 1980 in press] on the Japanese scale.

(2) Locs. Ob2049, Ob2050 and Ob2060 are in the limited part of the lower course of the Nanbu-no-sawa, a tributary of the River Obirashibe, which Unit Mk, Ml and Mm are indicated in the pubished geological map of TANAKA (1963, map 1). Loc. Ob2050 is certainly within Unit Mk, but nodules at Locs. Ob2049 and Ob2060 are floats derived from some exposures in the upstream and their stratigraphic assignment to Unit Mk is presumed from the associated *I.* aff. *hobetsensis nonsulcatus* as well as their somewhat downstream position as compare with Loc. Ob2050.

Method of Examination

The basic morphology for measurements is shown in Text-fig. 3.

Calipers of JIS standard, 200 mm in



Text-fig. 3. Basic morphology for measurements. l: shell length, h: shell height, HL: hinge-line, T: thickness, ga: growth axis, H: maximum dimension from umbo to ventral extremity, α: angle between anterior margin and hinge-line, β: beak angle, δ: obliquity—angle between hinge-line and H, or at a certain growth stage of ga.

measurable extent and 1/20 mm in accuracy, and contact goniometer were used for measurements of length and angle respectively. A flexible gauge was applied for measurements of the vertical and cross sections of ontogeny. Measurements are made three times for the same part, and the mean values are shown.

The process of the numerical analyses and calculations are omitted. For details readers may refer to HAYAMI (1969), and HAYAMI and MATSUKUMA (1971).

Palaeontological Description

Family Inoceramidae GIEBEL, 1852

Genus *Inoceramus* SOWERBY, 1814

Subgenus *Inoceramus* SOWERBY, 1814

Inoceramus (*Inoceramus*) *obiraensis* NODA et MURAMOTO, sp. nov.

Pls. 46–49

Material.—Holotype. GK. H10107, separate valves of a single individual, which must have been articulated originally, from Loc. Ob1010, probably Unit Mk of the Middle Yezo Group (obtained by M. NODA and K. MURAMOTO, 1977). Paratypes. MC540827, left valve from Loc. Ob2049: presumably middle or upper part of Unit Mk (obtained by K. MURAMOTO, 1979), MC540728, right valve from Loc. Ob2050: middle part of Unit Mk (obtained by joint field work of M. NODA, K. MURAMOTO, K. KAMIZUMA and T. SUGAWARA, 1979) and MC540729, left valve from Loc. Ob2060, middle or upper part of Unit Mk of the same group (obtained by M. NODA, K. MURAMOTO, K. KAMIZUMA and T. SUGAWARA, 1979).

Diagnosis.—Shell of medium size, inequivalve, extremely strongly convex antero-posteriorly and also dorso-ventrally. Umbo terminal, less conspicuous, projected beyond the hinge-line, and curved inwards and a little forwards. Anterior side very broad and concave to the valve plane, posterior one also steep or truncated and demarcated clearly from the posterior wing, which is considerably wide and inflated dorso-ventrally. Right valve less convex than left, but its wing is more inflated than that of left valve. Anterior margin straight or slightly concave, antero-ventral one broadly round, ventral margin narrowly rounded, passing into broadly arcuate postero-dorsal margin. Hinge-line somewhat shorter than two thirds of shell length.

Surface ornamented with concentric ribs and rings in combination. The concentric ribs coarse, round-topped, regular in strength and size in the middle stage, then becoming irregular and separated by somewhat wider and concave interspaces. The concentric rings cover the ribs and interspaces. The ribs much weakened on the anterior part and also on the posterior wing where only concentric rings are discernible. Hinge-structure unknown.

Measurements.—See Table 1.

Ontogeny.—The individual relative growth of the holotype is examined separately for the left and the right valves. The three variables, height (h), length (l), and thickness (T) of each valve are examined.

Plotting l and T in the ordinate and h in the abscissa on logarithmic graph paper, and the reduced major axes are calculated (for the calculation refer to HAYAMI and MATSUKUMA, 1971). The relative growth of l and h, and l and T are shown in Text-fig. 4. For comparison, those of *I.* (*I.*) *hobetsensis nonsulcatus* collected from the same area are shown.

The ontogenetic changes of characters are also illustrated in Text-figs. 5A, B

Table 1. Measurements. linear dimension in mm.

Specimen	l	h	T	HL	β	$\delta_{H=60\,mm}$
GK.H10107 RV	73.3+	137.7	58.0	44.5+	72	80
GK.H10107 LV	59.1+	107.3+	64.6	—	68	86
MC540728 RV	39.4	65.5	26.9	24.6	74	82
MC540729 LV	31.9+	60.0	25.4	—	59	—
MC540827 LV	—	100.3	47.2	—	64	—

Specimen	l/h	l/h=60 mm	T/h	HL/h	h/l	T/l	HL/l
GK.H10107 RV	0.53+	0.76	0.42	0.32+	1.88−	0.79−	0.61
GK.H10107 LV	0.55	0.64	0.60−	—	1.82	1.09−	—
MC540728 RV	0.60	0.64	0.41	0.38	1.73	0.68	0.62
MC540729 LV	0.53+	0.53+	0.42	—	1.88−	0.80−	—
MC540827 LV	—	—	0.47	—	—	—	—

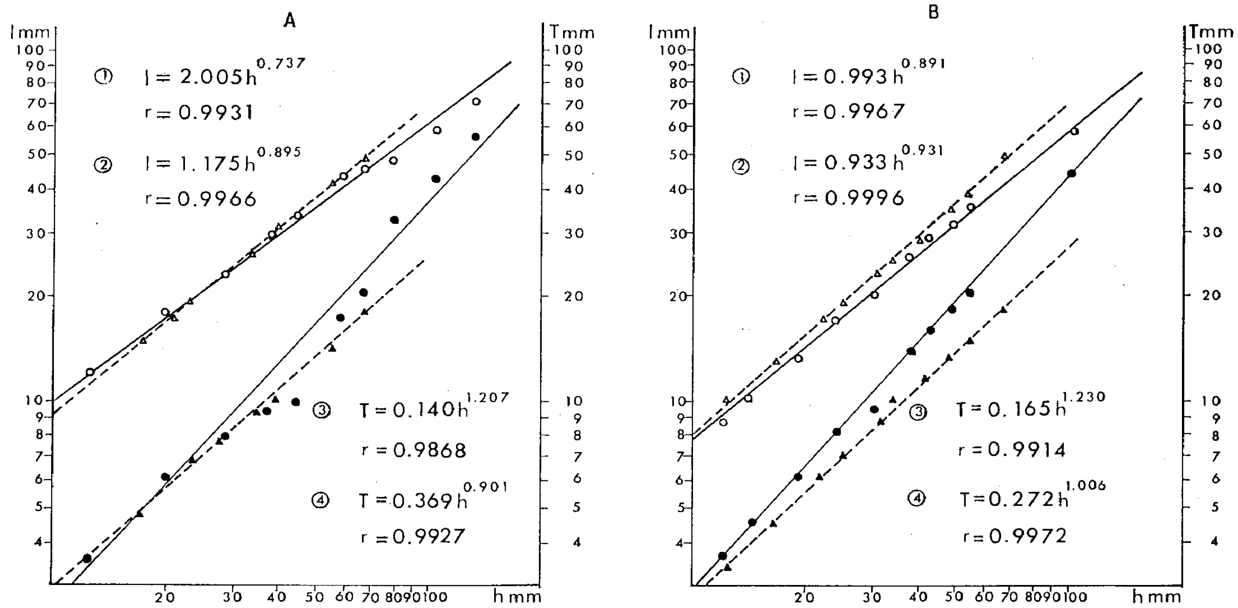
reference. l: shell length. h: shell height. T: thickness. HL: hinge-line. β: beak angle. $\delta_{H=60\,mm}$: angle between hinge-line and H, at a growth stage of 60 mm in H. GK: specimens of Kyushu University. MC: specimens of Mikasa Museum. LV: left valve. RV: right valve.

and 6A, B. As are clearly shown in Text-figs. 4 and 6, in the juvenile stages the specimens closely resemble those of *I.* (*I.*) *hobetsuensis nonsulcatus* but are much more inflated antero-posteriorly and also along the growth axis, and considerably elongate along the growth axis.

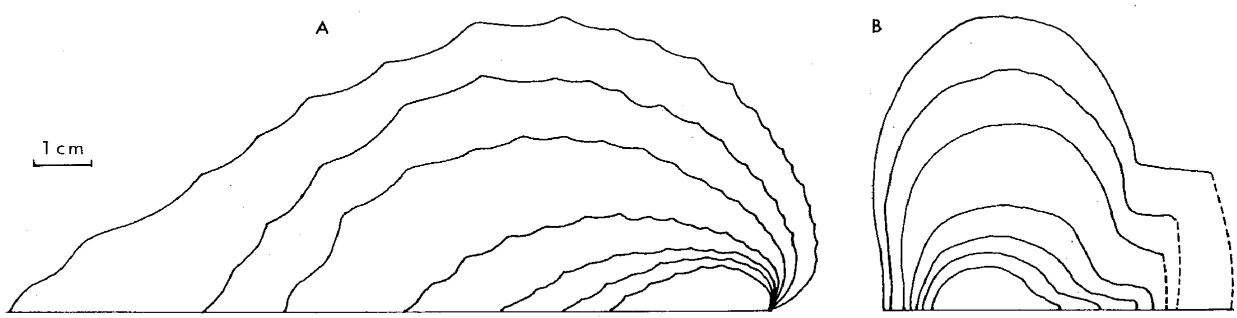
Descriptive remarks.—In the holotype, a portion of the posterior wing is eroded out at the marginal part, thus the simple ratios of l/h and HL/h of each valve may be slightly larger than the value shown in Table 1. The left valve of the holotype is also somewhat eroded out from the flank to the venter and the hinge part, the values of T/h and T/l, therefore, may be somewhat smaller than those shown in Table 1. MC540729 is deficient in the posterior half and hinge part and MC540827 is so at the umbo and wing. The test, which remained on MC540728 and MC540827, is fairly thick near the umbo, where the surface sculpture is precisely observed. On the surface of the internal mould, faint radial striae are discernible in the anterior part, where concentric ornaments disappear. The beak angle and the shell convexity vary among individuals. For example, MC540827 has much stronger convexity than other specimens, although it is impossible to express numerically.

Comparison

I. (*I.*) *lamarcki* PARKINSON, a widespread species of the Middle to Upper Turonian, is considerably variable in outline and shell convexity (WOODS, 1912a; TRÖGER, 1967). Some specimens of that species somewhat resemble the present specimens in the elongate outline along the growth

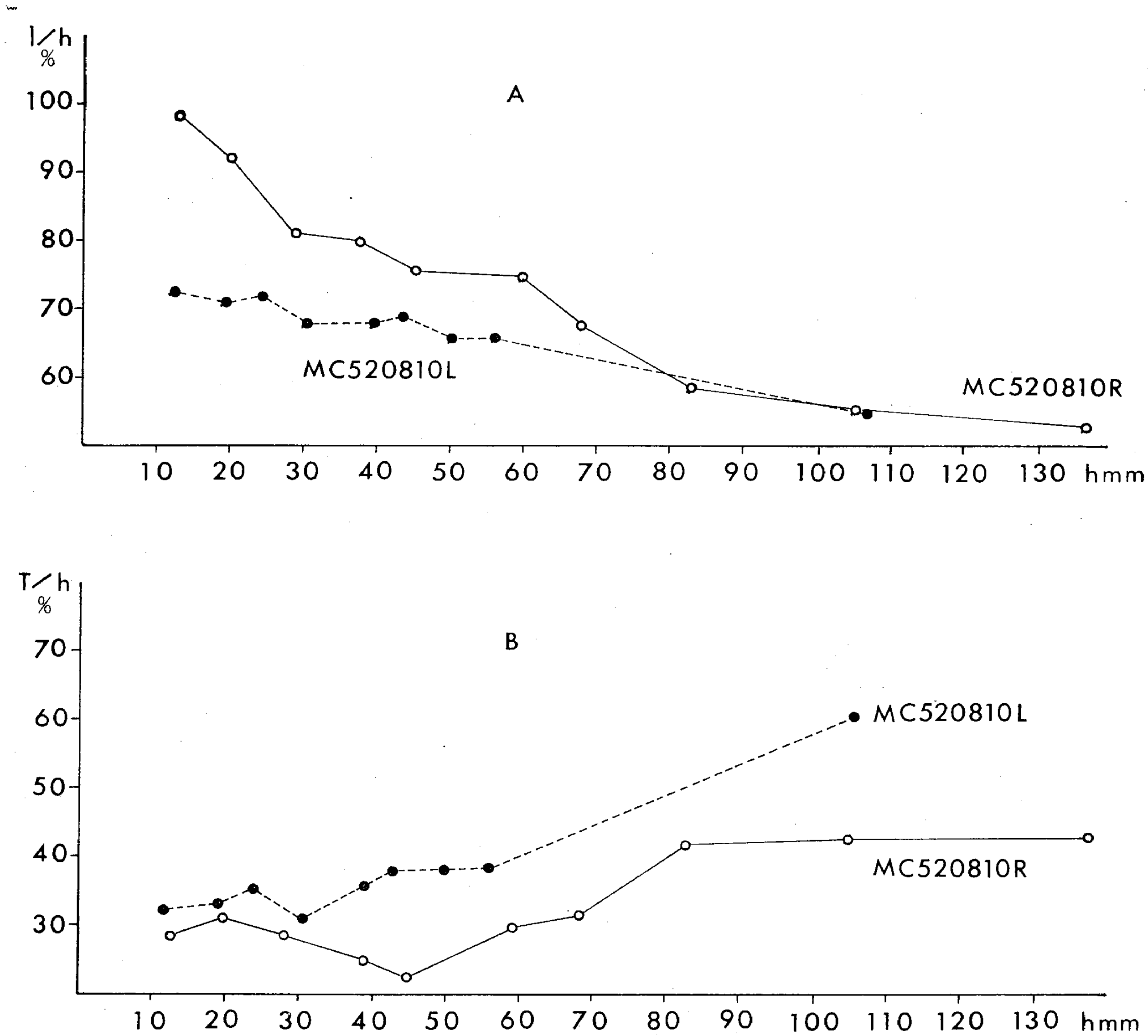


Text-fig. 4. Diagram showing the individual relative growth. A : right valve, B : left valve 1, 3 : *I.* (*I.*) *obiraensis*, solid line, 2, 4 : *I.* (*I.*) *hobetsensis nonsulcatus*, broken line.



Text-fig. 5. Ontogenetic change of shell convexity. A : anterior view, B : dorsal view.

axis and well developed wing. Judging from the illustrations and a plaster cast (GK. H9586) of WOODS (1912a, pl. 213, fig. 66, BM4753; 1912b, p. 8, figs. 34-36), a well inflated specimen has a smaller proportion of h/l, and other specimens with an elongate form are highly inequivalve. Our specimens are still more elongated and more convex and less inequivalve than any illustrated examples of *I.* (*I.*) *lamarcki*. TRÖGER (1967) examined biometrically some characters of *I.* (*I.*) *lamarcki lamarcki* from the Middle Turonian of Sachsen and Harzvorland, East Germany, showing them in p. 189, text-fig. 16a, b, for the left and the right valves respectively. As is clear from Text-fig. 6a, the ontogenetic change of the simple ratio l/h of the holotype of our species agrees well with that of *I.* (*I.*) *lamarcki lamarcki* var. I in the right valve, but never in the left valve. TRÖGER did not demonstrate the ontogenetic change of T/h, which should be more effective to



Text-fig. 6A. Diagram showing the ontogenetic change of simple ratio l/h. 6B. Diagram showing the ontogenetic change of simple ratio T/h.

compare the two species. The shell convexity of the TRÖGER's specimens is also considerably strong in both valves, so far as his illustration (p. 61, fig. 16) is concerned.

As has been kindly suggested by MATSUMOTO (personal comm.), the holotype of *I.* (*I.*) *paralamarcki* EFREMOVA (1978, p. 82, pl. 1, fig. 1), from the lower part of the Nasonovsk Formation (Zone of *I. lamarcki*) of the Ust-Yenisei depression, resembles the present species in obliquity, shell convexity and sharply demarcated posterior wing. But the former is discriminated from the latter in its more remarkable inequivalveness, smaller proportion of h/l, shorter and less inflated wing and much weaker concentric ornamentation.

As has been also suggested by MATSU-

MOTO (personal comm.), *I.* (*I.*) *najdini* IVANNIKOV (1979) from the Upper Turonian of the Donets Basin looks similar to the present species, so far as his photograph (IVANNIKOV, 1979, pl. 21, figs. 2, 3) is observed, but distinct from the latter in the equivalve shell, smaller proportions of T/l and h/l and also a smaller triangular wing.

Appendix

Notes on Phylogeny and Palaeobiogeography

by

Tatsuro MATSUMOTO* and
Masayuki NODA

To evalute the present discovery of a peculiar *Inoceramus* species of the *lamarcki* group from the Turonian of Hokkaido, let us discuss the phylogeny and palaeobiogeography on the basis of the available data.

The present species occurred in association with an undescribed form which is provisionally called *Inoceramus* (*Inoceramus*) aff. *hobetsensis nonsulcatus* and they agree well in shell-form and ornamentation in their early growth stage. This suggests some phylogenetic relation between them, but we found no transitional form which could link the two species in Hokkaido. The stratigraphic position of these species is in a relatively lower part of $K4b_2$ of the Japanese scale (MATSUMOTO, 1977), i.e. the lower part of the Zone of *Inoceramus hobetsensis*. This zone is correlated with the Middle Turonian in terms of the international scale, because it contains *Collignoniceras woollgari* (MANTELL). Strictly speaking, however, the boundary of the Lower and the Middle Turonian is not yet precisely defined even in France and England (see HANCOCK et al., 1977). Be that as it may, the origin of the present species is more reasonably ascribed to the migration from elsewhere than to the sympatric speciation within Hokkaido.

Turning to the regions outside the Japanese province, we notice *I.* (*I.*) *paralamarcki* EFREMOVA, from the Nasonovsk Formation of the Ust-Yenisei depression, as one of the closely allied species to ours. In the same formation of the Ust-Yenisei depression that species is associated with *I.* (*I.*) *pogrebovi* EFREMOVA, *I.* (*I.*) *schulginoae* EFREMOVA and *I.* (*I.*) *kolokolcevoae* EFREMOVA. These species are all ascribed to the group of *I.* (*I.*) *lamarcki* and occur in the Zone of *Inoceramus lamarcki*, that is "Upper Turonian" of her concept (EFREMOVA, 1978), which may include the Middle Turonian of others.

I. (*I.*) *pogrebovi* among others, looks similar to *I.* (*I.*) *hobetsensis nonsulcatus* in outline and surface ornamentation. In her paper, however, the right umbo is described as being more projected beyond the hinge-line than the left. This seems

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Explanation of Plate 46

Fig. 1a–c. *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. natural size. Holotype, rg. GK.H10107, right valve. Loc. Ob1010, 108 Rinpan-no-sawa, Kamikinenbetsu, Obira machi, Rumoi gun, Hokkaido. Str. position: middle part of the Unit Mk of the Middle Yezo Group. (coll. M. NODA and K. MURAMOTO, 1977). a: lateral view, b: anterior view, c: dorsal view.

1b

1c

1a

exceptional for the normal inoceramids: otherwise the valves may have been displaced secondarily along the valve plane. *I. (I.) kolokolcevoae* is characterized by a very long hinge-line (as long as the shell length) and an extremely large posterior wing. A similar form is occasionally found as a variety of an associate form of *I. (I.) hobetsensis* (s.l.) from Unit Mk of the Obira area. In short, it is interesting to note that the assemblage of the above species in the Nasonovsk Formation is in harmony with that of *I. (I.) obiraensis*, *I. (I.)* aff. *hobetsensis nonsulcatus* and *I. (I.) hobetsensis* (s.l.) in Unit Mk of the Obira area.

The group of *Inoceramus lamarcki* is defined typically by TRÖGER (1967). We follow him, but take the group in a broad sense, in which both the sulcate and nonsulcate forms are included. We do not regard the sulcate species as a single lineage (e.g., *I. lamarcki* lineage of KAUFFMAN, 1977, p. 177), but sulcate forms developed probably from nonsulcate ones in several parallel lineages of the *lamarcki* group (s.l.).

Now, going westward, MOSKVINA (1959) recorded *I. (I.) seitzi* from the "Upper Turonian" (upper half of Turonian, probably including the Middle Turonian) of the northern Caucasus. It resembles *I. (I.) obiraensis* in the degree of inequivalveness, elongate outline, strongly involved umbo and broad anterior part, but differs in its less convexity and smaller triangular posterior wing. TRÖGER (1967, p. 60) did not identify it with true *I. (I.) seitzi* ANDERT (1934), from the "Oberturon $\alpha \cdot \beta$", that is basal Coniacian, of central Europe, but has assigned it to *I. (I.) lamarcki lamarcki* with a query.

I. (I.) najdini IVANNIKOV, from the "Upper Turonian" of the Donets Basin, Ukraine, is somewhat similar to *I. (I.) obiraensis*, as has been discussed in the preceding page. In "Turkestan" of the USSR central Asia, ARCHANGUELSKY (1916, p. 16, pl. 2, figs. 4–6; pl. 3, fig. 1) described two forms of the *lamarcki* group, one of which (1916, pl. 2, fig. 6) is seemingly similar to *I. (I.) obiraensis*, but the precise comparison is difficult because of the deficiency of its posterior wing and the absence of the right valve.

On the material from central Europe, TRÖGER (1967) discriminated three subspecies and two varieties of *I. (I.) lamarcki*, that is *I. (I.) lamarcki lamarcki* var. I, *I. (I.) lamarcki lamarcki* var. II, *I. (I.) lamarcki geinitzi* TRÖGER and *I. (I.) lamarcki stümckei* HEINZ. As to the phylogenetic relations, TRÖGER (1967, p. 134; 1976) remarked that the lineage would be *I. (I.) lamarcki* var. I—var. II—*I. (I.) lamarcki stümckei*, which were decreasing gradually in shell convexity. He has shown that these subspecies occur successively one after another with considerable overlapping.

As to the British Middle to Upper Turonian species of the *lamarcki* group (s.l.), KAUFFMAN (1978) preliminarily reported the ascending succession as follows: (1) *I. (I.) cuvieri cuvieri* SOWERBY, (2) *I. (I.) cuvieri* subsp. nov, (3) *I. (I.) flaccidus* WHITE with early *I. (I.) lamarcki*, (4) *I. (I.) costellatus* WOODS with early *I. (I.) lamarcki* (s.l.) and early *I. apicalis* WOODS and (5) *I. (I.) lamarcki* "plexus" with *I. apicalis*. No species comparable with *I. (I.) obiraensis* is known in this area.

In the Turonian of the North American Interior province, there are several species belonging to the *lamarcki* group, such as *I. (I.) flaccidus* and "*I. (I.)* sp. nov. aff. *I. (I.) flaccidus* and *I. (I.) lamarcki*" (KAUFFMAN, 1977b, pl. 8, figs. 11, 16). *I. (I.) flaccidus* resembles in some respects *I. (I.) hobetsensis hobetsensis*, as NAGAO and MATSUMOTO (1939, p. 285) and MATSU-

MOTO (1959, p. 85) have already pointed out and more recently KAUFFMAN (1977, p. 177) has remarked. We have noticed, however, no species among the described ones from this province which is closely allied to *I.* (*I.*) *obiraensis*.

One of us (MATSUMOTO, 1978) has shown a reconstructed palaeogeographic map of the world for the Early Turonian, showing the distribution of certain vascoceratid ammonites of the Tethyan affinity. In this paper, we show in Text-fig. 7 a tentative palaeogeographic map of the world for the Middle to Late Turonian. As compared with the Early Turonian, the epicontinental seas retreated extensively from various areas in the Middle to Upper Turonian time and the tropical Tethys Sea became narrower and less continuous. Probably for this and other reasons the ammonites of the Tissotiidae, Coilopoceratidae and other Tethys Sea elements are almost absent in the Japanese province. The inoceramids show also a remarkable change. For instance, world wide species of the *Mytiloides labiatus* group occur fairly commonly in the Lower Turonian of Japan, whereas an apparently endemic *Mytiloides teraokai* MATSUMOTO et NODA remained as a descendant in the Middle Turonian. *Inoceramus* species of the *lamarcki* group, such as *I.* (*I.*) *hobetsensis* (s. l.) and *I.* (*I.*) *iburiensis* NAGAO et MATSUMOTO, occur extensively and abundantly in the Middle Turonian of the Japanese province and its extension. A possible ancestor of *I.* (*I.*) *hobetsensis* or that of *I.* (*I.*) aff. *hobetsensis* has not yet been found from the Lower Turonian of Japan.

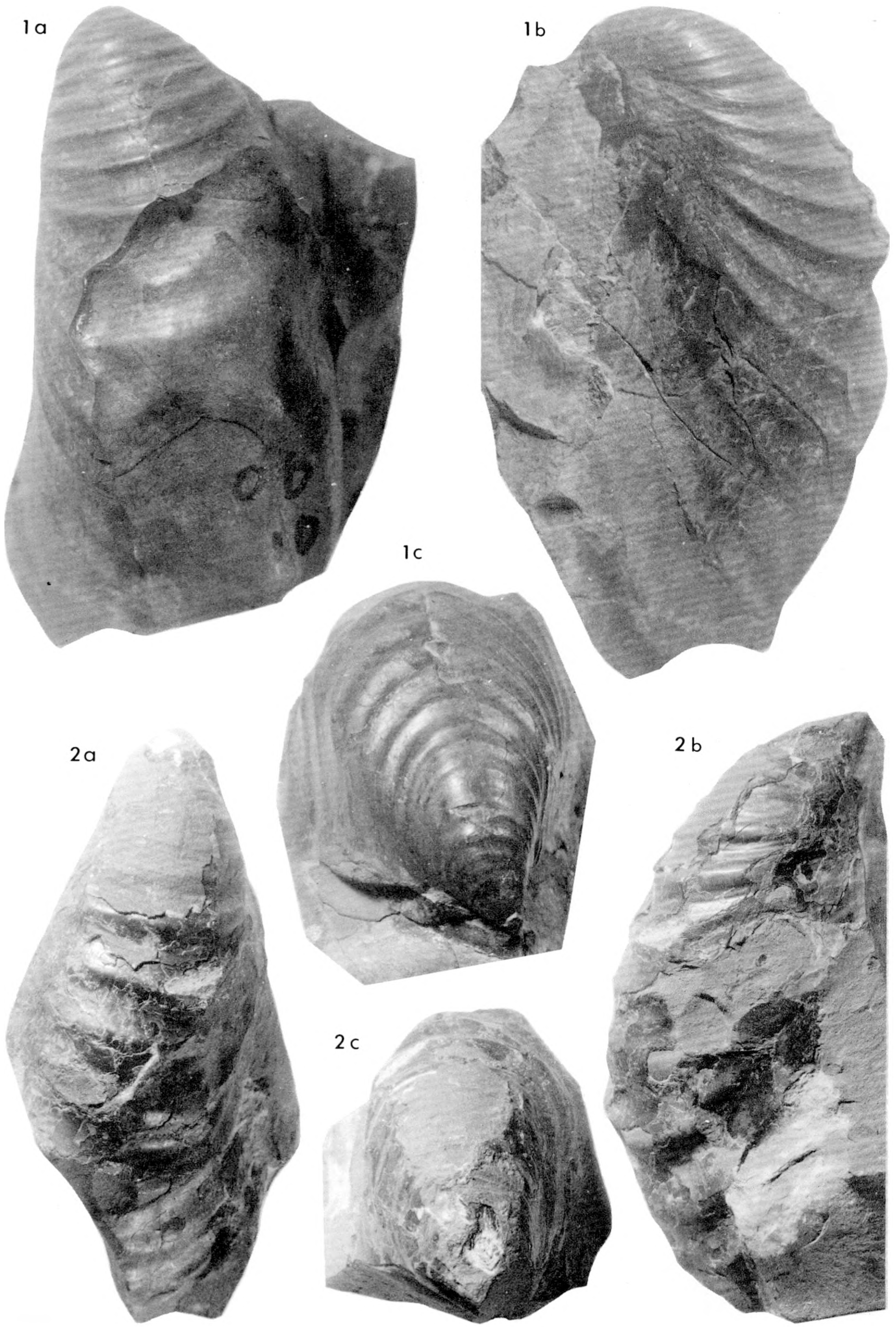
In Text-fig. 7, we show the main areas where the species of the *I.* (*I.*) *lamarcki* group have been reported with clear records. As is evident from this map, their distribution is limited to the North Temperate Realm (as defined by KAUFFMAN, 1973). In that realm the North European Province (1a in Text-fig. 7) is extended eastward to the North Central Asia Subprovince (1b) and the West Siberia Province (4) should better be defined to include the Ust-Yenisei depression. The latter province has already been indicated by TRÖGER (1976a) as a representative of the Boreal Realm in his Early Turonian faunal palaeogeographic map. In the North Temperate Realm, the North American Interior Province (2) and the North Pacific Province (3) are also included, the latter of which are subdivided into the Northeast Pacific (3a) and the Japanese-East Asian (3b) subprovinces.

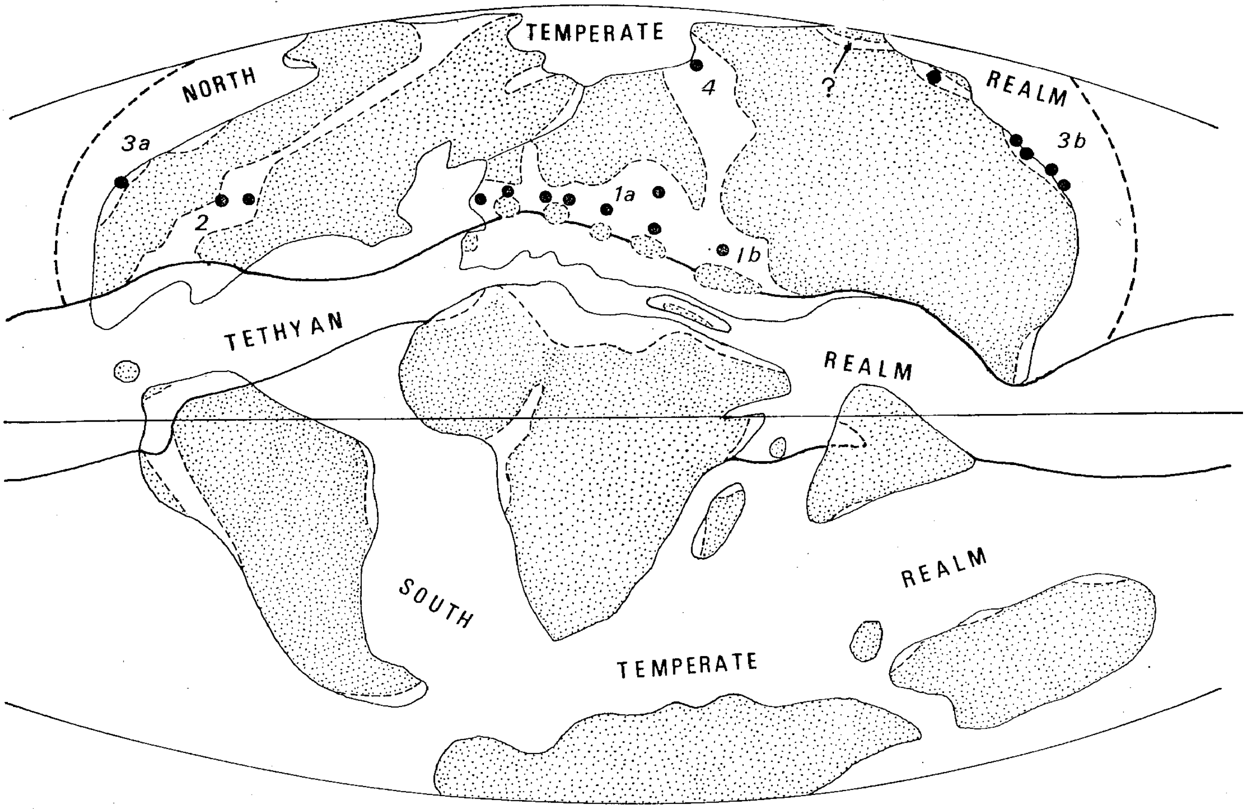
As KAUFFMAN (1973) has generally stated, some of the species in the North Temperate Realm may suggest possible migration routes and patterns. It can be presumed that the group of *I.* (*I.*) *lamarcki*

Explanation of Plate 47

Fig. 1a–c. *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. natural size. Holotype, rg. GK.H10107, left valve. Loc. Ob1010, 108 Rinpan-no-sawa, Kamikinenbetsu, Obira machi, Rumoi gun, Hokkaido. Str. position: middle part of the Unit Mj of the Middle Yezo Group (coll. M. NODA and K. MURAMOTO, 1977). a: lateral view, b: anterior view, c: dorsal view.

Fig. 2a–c. *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. natural size. Paratype, rg. MC540827, left valve. Loc. Ob2049, Nanbu-no-sawa, Obira machi, Rumoi gun, Hokkaido. Str. Position: middle to upper part of the Unit Mk of the Middle Yezo Group (coll. K. MURAMOTO, 1979). a: lateral view, b: anterior view, c: dorsal view.


1a
1b
1c
2a
2b
2c



Text-fig. 7. Palaeogeographic map of the Middle to Late Turonian, showing the distribution of the group of *I.* (*I.*) *lamarcki*. (reconstruction after DIETZ and HOLDEN, 1970). 1a: North European Province (proper). 1b: North Central Asian subprovince. 2: North America Interior Province. 3a: Northeast Pacific subprovince. 3b: Japanese East Asian subprovince. 4: West Siberian Province.

was dispersed by way of the circum-polar seas rather than the tropical Tethys Sea. A question, however, remains unsettled as to the ancestor of this group. TRÖGER (1976b) has left blank for the Early Turonian below the phylogenetic tree of the *lamarcki* group and above that of the group of *I. tenuis—I. pictus.*

Another question is whether the migration took place from the North Pacific Province via the circum-polar seas to the North European Province or *vice versa* or from the Arctic Sea to the North Europe and North Pacific Provinces simultaneously. To solve this problem more careful comparison of the species, further collecting better fossils and more precise correlation are necessary between the regions concerned.

Still another question is to find a definite route of migration among the postulated "circum polar seas".

In view of the recent results of palaeotectonic studies (e.g. MONGER et al., 1972; FUJITA, 1978; DICKINSON, 1978), which show general development of the mountain systems around the North Pacific from Jurassic to Cretaceous period, it seems fairly difficult to point out the actual position of the Turonian seaway for the inoceramids to migrate between North Europe or West Siberia and the North Pacific through the Arctic Sea. In Text-fig. 7, a possible route is suggested through a postulated channel along the Yuzhno-Anyuy suture (between the massifs of Kolyma and Chukotka), which then turned to the Penzhina trough and extended southward to the trough of Saghalien-Hokkaido. We have, however, no positive evidence of the marine Middle Turonian in the Yuzhno-Anyuy area. The migration of a group of *Inoceramus* if ever occurred, must have been occasional. And such an occasional migration may indeed have given rise to a rare and unusual species in the subprovince of Hokkaido.

As a working hypothesis we can expect the ancestral species of the *I.* (*I.*) *lamarcki* group in a region of relatively uniform (i.e. less variable) conditions, which could be sought in an oceanic area. Various species of the *I.* (*I.*) *lamarcki* group inhabited in respective niches of several provinces where they may have evolved in parallel, adapting themselves to some different environments. *I.* (*I.*) *obiraensis* may have been derived from that unknown common ancestor directly or undirectly. Its too much convexity of the valves may be an extreme specialization and the species may have disappeared without giving rise to a successor.

To sum up, the phylogenetic position can be presumed to be a dead end offshoot derived from the main stock of the *I.* (*I.*) *lamarcki* group in comparatively early stage of the evolutionary history of that group.

References

ANDERT, H. (1934): Die Kreideablagerungen Zachsen Elbe und Jascken. Teil III: Die Fauna der obersten Kreide in Sachsen, Böhmen und Schlesien. *Abh. Preu. Geol. Landesanstalt, N.F.* vol. 159, p. 1-477, pls. 1-19.

ARCHANGUELSKY, A.D. (1916): Mollusques du Crétacé supérieur de Turkestan. *Mém. Com. Géol. Petrograd,* [N.S.] livr, 152, i-vi, p. 1-57, pls. 1-8.

DICKINSON, W.R. (1978): Plate tectonic evolution of north Pacific rim. *Jour. Phys. Earth,* vol. 26, Suppl., p. 1-19.

DIETZ, R.S. and HOLDEN, J.C. (1970): Reconstruction of Pangea: Break up and dispersion of continents, Permian to Recent. *Jour. Geophys. Res.* vol. 75, p. 4939-4958.

EFREMOVA, V.I. (1978): *Inoceramus* of Turonian deposits of the Ust-Yenisei depression. *In* PERGAMENT, M.A. (ed.): *Jurassic and Cretaceous Inoceramus and their Stratigraphic Importance.* Geol. Inst. Acad. Sci. USSR, p. 82-98, pls. 1-5 (in Russian).

FUJITA, K. (1978): Pre-Cenozoic tectonic evolution of northeast Siberia. *Jour. Geol.,* vol. 86, p. 159-173.

HANCOCK, J.M., KENNEDY, W.J. and WRIGHT, C.W. (1977): Towards a correlation of the Turonian sequence of Japan with those of North-west Europe. *Palaeont. Soc. Japan, Special Paper,* no. 21, p. 151-168.

Explanation of Plate 48

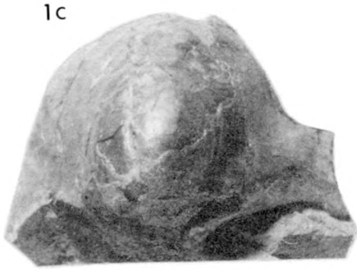
Fig. 1a-c. *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. ×1.1. Paratype, rg. MC540728, right valve. Loc. Ob2050, Nanbu-no-sawa, Obira machi, Rumoi gun, Hokkaido. Str. position: middle part of the Unit Mj-k of the Middle Yezo Group (coll. M. NODA, K. MURAMOTO, K. KAMIZUMA and T. SUGAWARA). a: lateral view, b: anterior view, c: dorsal view.

Fig. 2a-c. *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. ×1.2. Paratype, rg. MC530729, left valve, Loc. Ob2060, Nanbu-no-sawa, Obira machi, Rumoi gun, Hokkaido. Str. position: middle to upper part of the Middle Yezo Group (coll. M. NODA, K. MURAMOTO, K. KAMIZUMA and T. SUGAWARA, 1979).

Fig. 3. *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. ×0.93. Reconstruction of the holotype by the plaster model. dorsal view.

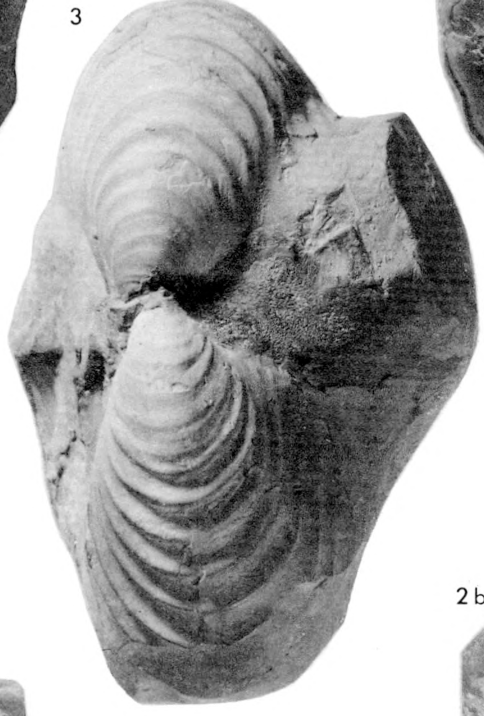
1a

1c



1b

3



2a

2b

2c

HAYAMI, I. (1969) : Mensuration of fossils and statistics. An example of palaeontological exercise. *Sci. Repts. Dept. Geol. Kyushu Univ.*, vol. 10, no. 2, p. 67-90 (in Japanese with English abstract).

HAYAMI, I. and MATSUKUMA, A. (1971) : Mensuration of fossils and statistics—Analysis of allometry and variation. *Ibid.*, vol. 10, no. 3, p. 135-160 (in Japanese with English abstract).

IGI, S., TANAKA, K., HATA, M. and SATO, H. (1958) : *Explanatory text of the geological map of Japan*, 1:50000. Horokanai (Asahikawa-39). Geol. Surv. Japan, 55+9pp (in Japanese with English abstract).

IVANNIKOV, A.V. (1979) : *Inoceramid species from the Upper Cretaceous of the Southwest in the East European Platform.* Akad. Sci. Ukraina SSR, 102p., 32pls. (in Russian).

JIMBO, K. (1894) : Beiträge zur Kenntnis der Fauna der Kreideformation von Hokkaido. *Palaeontl. Abh.* [*N.F.*], vol. 2, no. 3, p. 1-48, pls. 1-9.

KAUFFMAN, E.G. (1973) : Cretaceous Bivalvia. In HALLAM, A. (ed.) : *Atlas of Palaeobiogeography*, p. 353-383. Elsevier Scientific Publishing Company. Amsterdam, London, New York.

—— (1977a) : Systematic Biostratigraphic and Biogeographic relationships between Middle Cretaceous Euramerican and north Pacific Inoceramidae. *Palaeont. Soc. Japan, Special Paper*, no. 21, p. 169-212.

—— (1977b) : Illustrated guide to biostratigraphically important Cretaceous macrofossils, Western Interior Basin, U.S.A. *The Mountain Geologist*, vol. 14, p. 225-274.

—— (1978) : British middle Cretaceous inoceramid biostratigraphy. *In* REYMENT, R.A. and THOMEL, G. (ed.) : Mid-Cretaceous Events, Uppsala 1975-Nice 1976 Report, *Ann. Mus. d'Hist. Nat. Nice*, vol. 4 (for 1974), p. N1-N12.

MATSUMOTO, T. (1959) : Zonation of the Upper Cretaceous in Japan. *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 9, no. 2, p. 54-93, pls. 6-11.

—— (1977) : Some heteromorph ammonoids from the Upper Cretaceous of Hokkaido. *Ibid.*, [D], vol. 23, no. 3, p. 303-366, pls. 43-61.

—— (1978) : *Atlas of Japanese fossils*, no. 50, 295-300, Tsukiji-Shokan, Tokyo (in Japanese).

—— (1980 in press) : Biostratigraphic subdivision of the Cretaceous system in the Japanese-East Asian Province—Definition and interregional correlation—*In* KAUFFMAN, E.G. and HATTIN, D.E. (ed.) : *The North Temperate Cretaceous.* Dowden, Hutchinson & Ross, Inc.

——, OKADA, H., HIRANO, H. and TANABE, K. (1976) : Mid-Cretaceous biostratigraphic succession in Hokkaido. *Ann. Mus. d'Hist. Nat. Nice*, vol. 4, (issued 1978), chapt. 33, 1-6; 10-18.

MONGER, J.W.H., SOUTHER, J.G. and GABRIELSE, H. (1972) : Evolution of the Canadian Cordillera: A plate tectonic model. *Amer. Jour. Sci.*, vol. 272, p. 577-602.

MOSKVINA, M.M. (ed.) (1959) : *Atlas of the Upper Cretaceous Fauna from the North Caucasus and Crimea.* 304pp., 91pls. Natin. Sci.-Tect. Press, Moscow (in Russian).

TANABE, K., HIRANO, H., MATSUMOTO, T. and MIYATA, Y. (1977) : Stratigraphy of the Upper Cretaceous deposits in the Obira area northwestern Hokkaido. *Sci. Repts. Dept. Geol., Kyushu Univ.*, vol. 12, no. 3, p. 181-202 (in Japanese with English abstract).

TANAKA, K. (1963) : A study of the Cretaceous sedimentation in Hokkaido, Japan. *Rept. Geol. Surv. Japan*, no. 197, 122pp., 2 maps, 3pls.

TRÖGER, K.A. (1967) : Zur Paläontologie, Biostratigraphie und faziellen Ausbildung der unteren Oberkreide (Cenoman bis Turon). Teil I: Paläontologie und Biostratigraphie der Inoceramen des Cenomans bis Turons. *Abh. Staatl. Mus. Mineral Geol.*, vol. 12, p. 13-207, pls. 1-14.

—— (1976a) : Zu einigen Problemen der Alb-Cenoman-Unter-Turon Transgression. *Ibid.*, vol. 25, p. 49-59.

—— (1976b) : Evolutionary trends of Upper Cretaceous *Inoceramus*. *Evolutionary Biol.*, Praha, p. 193-203.

TSUSHIMA, K., TANAKA, K., MASUNO, K. and YAMAGUCHI, S. (1958): *Explanatory text of the geological map of Japan.* 1:50000. Tappu (Asahikawa-38), Geol. Surv, Japan 66+8 pp. (in Japanese with English abstract).

WOODS, H. (1912a): A Monograph of the Cretaceous Lamellibranchia of England. 2, part 8, *Inoceramus.* p. 285-340, pls. 51-54. *Palaeontogr. Soc. London.*

—— (1912b): The evolution of *Inoceramus* in the Cretaceous Period. *Q.J.G.S. London,* vol. 68, p. 1-20.

YABE, H. (1909): Zur Stratigraphie und Paläontologie der oberen Kreide von Hokkaido und Sachalien. *Zeitschr. deutsch. Geol. Gesell.,* vol. 61, p. 402-444.

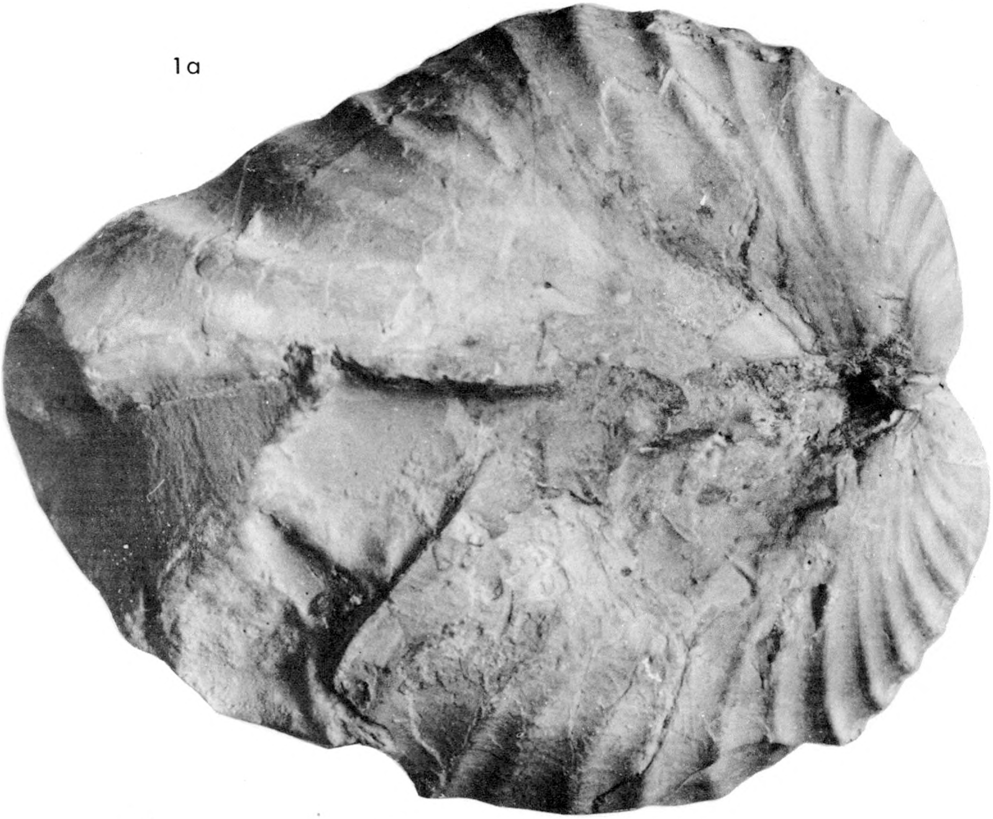
Asahikawa 旭川, Horokanai 幌加内, Kamikinenbetsu-zawa 上記念別沢, Migiichi-no-sawa 右一の沢, Mikasa 三笠, Nanbu 南部, Nanbu-no-sawa 南部の沢, Obira-machi 小平町, Obirashibe 小平蘂, Osarunaidake 長留内岳, Rinpan-no-sawa 林班の沢, Rumoi-gun 留萌郡, Sato-no-sawa 佐藤の沢, Takishita 滝下, Tappu 達布, Wasadahigashi 稙田東

北海道上部白亜系から発見されたイノセラムスの新種について：北海道の北西部を東西に流れる小平蘂川の中上流には上部白亜系チュロニアンの地層が広く露出しているが，この地域から採集された特異な形態をもつ *Inoceramus* について述べる。本種は，世界的に広く分布し，チュロニアン中部を代表する *I.* (*I.*) *lamarcki* に類似する点があり，とくに北シベリア Yenisei 河口低地の Nasonovsk 層 (*I. lamarcki* 帯) から産出した *I.* (*I.*) *paralamarcki* に似た点が多い。しかし，その不等殻性がそれほどいちじるしくなく，両殻ともに成長軸の方向に極端に長くのびている点や，膨らみがすこぶる大きく，さらに強く膨らんだ広い翼や強い装飾など相違する点が多いので，ここに新種として *Inoceramus* (*Inoceramus*) *obiraensis* の名のもとに記載した。研究にあたって，従来の記載や研究の方法に加えて，数量的に表わせる形質については補助的な手段として統計的な検討も試みた。この特異な種の日本での産出は珍しいので，近縁種の分布などを手がかりとして，チュロニアン中期の古地理や，本種の系統発生などについて若干の考察を付録で試みた。本論文：野田雅之・村本喜久雄，付録：松本達郎・野田雅之

Explanation of Plate 49

Fig. 1a, b. *Inoceramus* (*Inoceramus*) *obiraensis* n. sp. ×0.93. Reconstruction of the holotype by the plaster model. a: posterior view showing the convexity of the wing. b: anterior view showing the radial striae on the surface of internal mould.

1a



1b