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A MONOGRAPH OF THE CRETACEOUS
INOCERAMUS OF JAPAN

By

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With 34 Plates

(Contribution from the Department of Geology and Mineralogy,
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Sapporo; No. 248)

PART II.¹⁾

With 22 Plates

CONTENTS

VII. Description of species (continued)

The group of <i>Inoceramus yabei</i>
The group of <i>Inoceramus ezoensis</i> and <i>Endocostea</i>
The group of <i>Inoceramus naumanni</i>
Incertae sedis

The Group of *Inoceramus yabei*

Inoceramus yabei NAGAO et MATUMOTO sp. nov.

Pt. I, Pl. XXXIV (XII), figs. 5-7; Pt. II, Pl. I, figs. 1-6; Pl. II, fig. 8 (?).

Shell moderate in size, subequivalve, a little inequilateral and roughly of a scalene triangle in marginal outline; usually as long as high²⁾ or only a little higher than long; very inflated³⁾ in general

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1) Part I of this article is contained in Vol. IV, Nos. 3-4 of this Journal.

2) Usually the left valve is slightly higher than long.

3) The convexity of valve is very variable among the individuals, probably due to the state of preservation to a great extent.

with a considerable curvature along the axis of growth, and less convex antero-posteriorly, except in the umbonal region. Antero-dorsal margin long, nearly straight or slightly excavated, the posterodorsal also long, straight or weakly arched, sloping rapidly backwards and downwards; anterior margin rather evenly rounded, the posterior somewhat more narrowly so and the ventral broadly convex, except in young stage. Hinge-line of moderate length, beak angle more or less obtuse. Beak pointed, prominent, more prominent in left valve, curved anteriorly, apical angle usually acute, sometimes of a right angle. Antero-dorsal marginal part flattened, nearly perpendicular to the plane of valve. Posterior wing¹⁾ rather small, and obtusely triangular in outline.

Surface sculptured with concentric ridges and rings; the ridges rather inconspicuous on the umbonal region, elevated in the main part of valve, asymmetrically wavy in cross-section, with a rounded or sometimes subangular summit and relatively irregular in distance, breadth and height. Concentric rings present on the ridges as well as the interspaces, usually low and irregular in breadth.²⁾

Remarks:

- 1) This species seems to be highly variable in outline of the shell. Numerous specimens have been examined, but are very often ill-preserved and deformed, making it difficult to determine the extent of variation. However, the following forms are distinguished among them, all of which excepting the typical one are provisionally included in this species.

a) Typical form:

Sp. rg. no. 7276 (Hk) from the upper part of the *Trigonia* Sandstone exposed near Yûbari. An internal mould of both valves (Pt. I, pl. XII, fig. 5).

Sp. rg. no. 22685 (Sd) from the *Trigonia* Sandstone of the Ikusyunbetu district (Pt. I, pl. XII, fig. 6).

The proportion of height and length decreases with age. In the earlier stage, the shell is much higher than long, and its ventral margin more rounded than in the adult

1) The wing, though not preserved in many specimens, seems to be rather distinct from the flank.

2) The concentric rings are partly impressed on internal moulds.

stage. In mature specimens, the left valve is only a little higher than long, while the right one is as high as long. In this form the convexity of valve along the axis is great.

b) Longer form:

Sp. rg. nos. 22812 (Sd) and I-745 (Tk) from the Lower Hutaba beds; nos. I-734 (Tk) and I-738a (Tk) from the Ônogawa Cretaceous (pl. I, fig. 5).

Slightly longer than high, even in the young stage; ventral margin more broadly rounded than in the typical form. Convexity near the beak rather great, with a very large beak angle. However, there seems no distinct difference between the type and this form; the difference may be due to deformation. There are some specimens, (e.g. no. 57824, Sd) on the other hand, which are possibly provided with a sculpture different from that of the typical one.

c) Genuiculated form, represented by the specimens enumerated below.

Great convexity along the axis of valve, hence the ventral portion almost perpendicular to the dorsal, is one of the characteristic features of this form.

This bending of the valve is variable among the specimens.

- a) Those which are globose or gibbous, due to even bending (e.g. no. I-749, Tk).
- β) Those which bend in the later stage of growth (e.g. nos. I-750, I-769, Tk). (Pt. I, pl. XII, fig. 7).
- γ) Those which bend in the earlier stage (e.g. no. I-754, Tk).

Near or below the level of abrupt bending, the concentric ridges are strong, rather sharp-topped forming step-like appearance in cross-section. The marginal outline of valve is nearly equilateral, triangular above and semicircular below. There is at hand a specimen which links this form with the type one, although, again, it can not be denied that this feature may be due to deformation (e.g. no. I-737, Tk, pl. I, fig. 2).

- 2) Concentric ridges are somewhat variable in height, distance and outline, but the true variation is with difficulty distinguished from the result of secondary deformation.
- 3) Size of the shell: Usually 5 or 6 cm., but a specimen from the *Trigonia* Sandstone along the Ikusyunbetu attains 15 cm. in height. Since this large specimen has been derived from a contemporaneous rock, and is quite identical in many features, with the type form, it is thought to be conspecific.

4) *Measurements*: (mm.)

Specimens	H	L	Th
7276 (Hk) (left valve)	46	41	20
do. (right valve)	43	41	18
22685 (Sd) (left valve) (somewhat deformed)	56	49	17±
do. (right valve)	52	49	13?
do. (left valve) (juvenile stage)	23	18	
I-759 (left valve) (somewhat deformed)	72	ca. 80	
I-749 (Tk)	45	50	ca. 20
I-734 (Tk) (left valve)	37	40	
I-738a (Tk) (left valve)	57	66	

- 5) *Inoceramus angulosus* JIMBO¹⁾ (rg. no. I-150, Tk) based upon an imperfect internal mould, agrees with some specimens of the present species (no. I-759, Tk) from the same locality, but a more precise comparison is impossible at present owing to the bad state of preservation of the specimens at hand. However, some minor differences are observable, viz., larger size of valve and more regular ribbing.
- 6) *Affinities with some foreign species*:

Some species belonging to the group of *I. inconstans* WOODS seem to be allied to the present form. According to ANDERT who recently redescribed *I. inconstans*, the abrupt bending of the valve is always observable in this foreign species in the later stage of growth.²⁾ The convexity in the Japanese form is usually rather gradual and uniform. The classification of *I. inconstans*

1) K. JIMBO, 1894, p. 43, pl. VIII, fig. 6.

2) SIMIONESCU (1889) described gradual and uniform convexity of valve in *I. transsylvanicus*. HEINTZ pointed out that *I. inconstans* WOODS may be identical or bears a close relation with this last species.

and its allies is complicated at present; this seems also to be the case in the Japanese species under consideration.

I. inconstans WOODS em. HEINTZ or ANDERT is very different from the new species in having less equilateral outline and a long hinge line. *I. weisei* ANDERT from the Upper Turonian and Emscherian of Europe, is closely similar to some specimens of *I. yabei*, for it is rather more equilateral among the group of *I. inconstans*.¹⁾

I. protractus SCUPIN seems to be somewhat similar to the Japanese species. But the former²⁾ is more inflated and has more distinct antero- and postero-ventral angles than the latter.

No closely allied species has been reported from Asia and the Pacific Coast of North America; *I. rumphii* BÖHM is distinct in being inequilateral and more inflated, with a somewhat different sculpture. *I. aduncatus* ANDERSON is also quite different.

Occurrences:

- 1) Naibuti district, South Saghalin; horizon unknown.
- 2) Obirasibe district, prov. Tesio; *Scaphites* bed.
- 3) Along the Ikusyunbetu-gawa, prov. Isikari; Div. II-IV; common in the lower part.
- 4) Bibai and Yûbari, prov. Isikari; *Trigonia* Sandstone (upper part).
- 5) Ôyûbari, prov. Isikari; horizon unknown.
- 6) Hobetu district, prov. Ihuri; lowest part of the Upper Ammonite bed. (2-6, all in Hokkaidô).
- 7) Hutaba district, prov. Iwaki; lower Hutaba beds.
- 8) Uwazima district, prov. Iyo; horizon uncertain.
- 9) Ônogawa district, prov. Bungo; abundant in zones 0₁ and 0_{1'}, but known also from 0_{2'}, 0₃(?), 0₇, 0₈, and 0₉(?).

The typical form is fairly common in the epochs G and GU. However, similar specimens are not absent also from the epoch U (U₁-U_m) which are unfortunately very imperfect, and difficult to be distinguished from the typical specimens of *I. yabei*. They are included provisionally in the present species for the time being.

1) Less oblique, relatively higher and more inequivalve, with a less convex umbo and a more rounded ventral margin.

2) This species is excluded by ANDERT from the *inconstans*-group *s. str.* and considered to be possibly included within the variation of *I. walterdorfensis*, a member of the *inconstans*-group.

It is worthy of note that the foreign allied species are reported from the Turonian and Emscherian, while the typical form of *I. yabei* ranges downward into the Gyliakian considered as equivalent to the Cenomanian of Europe.

Inoceramus sp. a, aff. *yabei* NAGAO et MATUMOTO

Pl. II, figs. 1, 2.

Shell small, subequivalve, rather thin-tested, inequilateral, oblique and nearly as high as long. Valve, especially the left valve, moderately inflated, with even vertical and antero-posterior curvature. Antero-dorsal marginal part steep, but passing rather gradually from the flank. Antero-dorsal margin almost straight, the anterior arched, passing gradually below into the ventral; ventral margin more or less narrowly rounded, posterior margin gently arcuated, forming an *obtuse angle* with the *very long hinge line*. Beak angle moderately large (130°-140°). Umbo inconspicuous, not incurved, a little more prominent in the left valve. Posterior wing flat and large, obtusely triangular in shape.

Surface sculptured with numerous crowded moderately elevated and round-topped *concentric rings*(?). Wing ornamented with fine parallel striae.

Remarks:

- 1) Examined specimens are frequently deformed, so that the variation of this form is not precisely determinable.

Measurements:

	H	L	h	l	th	length of hinge-line
sp. rg. no. 5653 (Hk) (right valve) (excluding the partly broken ventral portion) ..	35	35	33+	32-	9	10+
do. (left valve)	36	32	34	29?	13	
no. 4403 (Hk) (right valve) (deformed)	42	30	37	31	10+	23

- 2) The present form resembles the juvenile stage of *I. yabei*. *I. yabei* is in this stage, somewhat oblique backwards and ornamented with more or less closely arranged concentric elevations, while in the present form, the narrow and crowded concentric elevations which predominate throughout life, are usually represented by concentric rings, corresponding each to a concentric

element. But in some specimens (e.g. no. I-1191, Tk), the elevations in the ventral part of the valve may be called closely set concentric ridges, a few fine concentric rings(?) being observable in the interspaces. Thus the present form (sp. *a*) may be considered as representing an extreme variation of nearly contemporaneous *I. yabei*, but it will be adequate for the time being to distinguish this specifically from *I. yabei*, in having differences in the features of the wing and the surface sculpture.

- 3) *I. yabei* bears a relation to *I. sp. β* to be described later, in the outline of valve just as *I. angulicus* WOODS does to *I. cripsii* MANTELL. These just-mentioned forms are believed to bear some mutual connection.
- 4) Among foreign species, *I. angulicus* WOODS is one of the most nearly allied ones, but it seems to be more oblique and has a longer hinge line than the present form. No moderately large specimen of the Japanese form, which still has regular concentric rings as in *I. angulicus*, has been found. The present form is distinguished from *I. comancheanus* CRAGIN (REESIDE, 1922) from the Dakota formation of North America, in being lower and having a larger beak angle.
- 5) In short, the form under consideration seems to be related to the group typified by *I. anglicus* and *cripsii* on the one side, and to the group of *I. yabei* (*—inconstans*) on the other. However, the material at hand is insufficient for creation of a new name for this form.¹⁾

Occurrences:

- 1) Division B of the Cretaceous deposits exposed along the Hoegawa, South Saghalin.
- 2) *Trigonia* Sandstone in the Ikusyunbetu district, Hokkaidô.
- 3) Zone 0₁ of the Ônogawa-Cretaceous, prov. Bungo.

Inoceramus sp. *β*, aff. *I. cripsii* MANTELL

Pl. II, figs. 3, 6, 7.

1928. *Inoceramus* sp. aff. *I. cripsii* YABE and NAGAO: Cret. Fossils from Hokkaidô: Annelida, Gastropoda and Lamellibranchiata, p. 83, pl. XVII, figs. 11, 12.

1) MATSUMOTO, (1936, "Ônogawa Cretaceous") listed this form in his Table 2 under the name *I. subangulicus* (MS.).

Shell small or moderate in size, almost equivalve(?), inequilateral and oblique toward postero-ventral, nearly as high as long. Marginal outline roughly pentagonal; antero-dorsal margin short, almost straight, the anterior and the ventral rounded, and the posterior broadly arched. Hinge line of medium length, forming an obtuse angle with the posterior margin and a moderately obtuse one with the antero-dorsal. Umbo small, subterminal, only slightly curved anteriorly. Valves moderately and regularly inflated both vertically and antero-posteriorly; antero-dorsal marginal part steep, perpendicular to the plane of valve, and posterior part somewhat flattened forming a wing-like area.

Surface sculpture consisting of regular combination of concentric rings and an alternation of concentric ridges and grooves. Concentric ridges rather round-topped and on the anterior half of valve more prominent.

Measurements: (mm.)

	H	h	L	l	th	HL
I-785 (Tk)	57	53	52	50		23(?)
I-790 (Tk)	53	50	52	52		
5902 (Hk)	45	39	37	40	12	25

Remarks:

- 1) The present form bears some affinity with contemporaneous *I. yabei*, but is easily separable therefrom in having an oblique, less inflated shell, with a differently shaped wing. It is more closely similar to *I. sp. a* described above in the outline of the shell.
- 2) This form has, on the other hand, some relation to *I. hobetsensis* (s. lat.),¹⁾ but is characterised by its more inequilateral outline, relatively less height, a broadly rounded ventral margin, a usually short hinge-line, a larger beak angle, and an inwardly less curved umbo.
- 3) The form in consideration has some variation in obliquity of the valve, length of the hinge-line and curvature of the antero-dorsal margin. In these points, some specimens (e.g. sp. no. 5902, Hk) approach *I. balticus* em. Those from Zone O₃ of the

1) MATUMOTO: "Geology of the Ônogawa Basin, Kyûsyû." Listed in Table 2 as *I. hobetsensis* var. *crispoides* (MS.). This name is withdrawn.

Ônogawa Cretaceous, once named *I. eobalticus* (MS.) by Matumoto may be cited as an example of such a variation (cf. pl. II, fig. 7).¹⁾

4) *Comparison with foreign species:*

The Cenomanian species, *I. crispus* MANTELL in WOODS' paper and other recent works, including the representatives from the Gulf region and South America, seems to be closely akin to the present form, but differs in sculpture. Moreover, that foreign species has differences in obliquity of the valve, length of the hinge-line, flatness of the posterior part and curvature of the antero-dorsal margin. However, some of these points may be attributable to some extent to variations among individuals of one and the same species.

I. crispus MANTELL var. *reachensis* (ETHERIDGE) from the Turonian of England seems to be more closely allied to the present form than *I. crispus* (s. str.), but the Japanese form is more oblique and has a longer and more straight antero-dorsal margin. Furthermore, the surface ornamentation of *I. reachensis* is, according to HEINTZ, "Anwachskämmereifen" instead of "Anwachsringreifen." *I. labiatus* var. *latus* SOWERBY (non MANTELL)²⁾ may be another allied form.

- 5) Although various features of the Japanese form in consideration are rather distinct, it is not advisable to create a new specific name for it because of the insufficient material at hand for a precise comparison with foreign species and also for the study of individual variation within a species.

Occurrences:

- 1) *Trigonia* Sandstone, Yûbari, prov. Isikari, Hokkaidô.
- 2) *Trigonia* Sandstone exposed along the Ikusynbetu-gawa, prov. Isikari.

1) MATSUMOTO: Ibid., Table 5. This name is withdrawn.

2) As to the type of this species, various opinions have been proposed by foreign investigators. FIEGE considered *I. latus* MANTELL (1822) as the type, which is thought to be *I. lamarcki* var. *cuvieri* by WOODS. WOODS takes *I. latus* SOWERBY as the type of *I. labiatus* var. *latus*. On the other hand, HEINTZ is of the opinion that WOODS' variety is partly *I. plicatus* var. *hercynicus* and that *I. latus* MANTELL is new, and he named it *I. stillei*.

- 3) Uncertain horizon, the Obirasibe-gawa, prov. Tesio, Hokkaidô.
- 4) Zones O₁, O₁' , O₂' and O₅ of the Ônogawa Cretaceous, prov. Bungo.

***Inoceramus* sp. γ aff. *yabei* NAGAO et MATUMOTO**

Pl. II, figs. 4, 5.

This form resembles *I. yabei* in the outline of the valve, but differs in the following points:

Shell much more oblique and more inequilateral, the axis of growth running toward the antero-ventral angle. Posterior margin gradually continued to the ventral, no distinct angulation being observable between the two margins. Inflation of valve not conspicuous but gentle.

Concentric sculpture not much elevated.

Measurements: (mm.)

	h	l
Sp. no. I-772, Tk (immature specimen)	8	9
" " (mature specimen)	23	25

Remarks:

This form bears some similarity to *I. yabei*, especially to young specimens, marginal outline, umbo, hinge and sculptural elements being essentially common. On the other hand, it shows some affinity with the preceding one (*I. sp. β*), but it is easily distinguished therefrom in being oblique forward. These and some other points are suggestive in connection with variation among the group in consideration, but the material at hand is unfortunately insufficient for developing this problem.

Occurrences:

- 1) *Trigonia* Sandstone, Yûbari, prov. Isikari, Hokkaidô.
- 2) Lower Hutaba bed (?), prov. Iwaki.
- 3) Zones O₁, O₁' and O₂ of the Ônogawa Cretaceous, prov. Bungo.

The Group of *Inoceramus exoensis* and *Endocostea*

***Inoceramus incertus* JIMBO emend.**

Pl. III, figs. 1-5; Pl. X, fig. 2.

1894. *Inoceramus incertus* JIMBO: Beitr. Kennt. Fauna Kreidef. Hokkaido, p. 43, pl. VIII, fig. 7.

Shell usually of moderate-size, equivalve, inequilateral, obliquely ovate in outline. Anterior margin asymmetrically curved, gently arcuate, passing gradually into the ventral one; posteroventral margin more or less narrowly rounded. Hinge-line rather long, straight, forming a very obtuse angle with the broadly arched posterior margin. Angle between the hinge line and the postero-dorsal margin very obtuse (ca. 130°).

Valve regularly and uniformly convex; antero-dorsal marginal part steeply inclined forward; posterior part of valve compressed, passing very gradually into the flank. Beak rather inconspicuous, situated near the anterior end of the hinge-line.

Surface including the compressed postero-dorsal portion, ornamented with a combination of regularly spaced, broad and low concentric undulations and numerous narrow, sharp concentric rings.¹⁾

Types:

The original specimen of *I. incertus* JIMBO (no. I-151, Tk) is unfortunately imperfect, without the posterior part and the figure given by JIMBO was drawn with restoration. However, a number of specimens collected from the same locality manifest the precise features of this species. The following are selected for the pleisio-types:

Spp. rg. nos. 7242 (Hk), 7246 (Hk) 22740 (Sd), all from the lowest part of the Upper Ammonites beds along the Pombetu, Ikusyunbetu district, Hokkaidô.

Var. *yubariensis* NAGAO et MATUMOTO var. nov.

Pl. VI, fig. 1.

Shell similar in many points to the type species, but much higher, with the anterior and posterior margins long, the ventral one evenly rounded as indicated by lines of growth. Beak angle slightly obtuse and the angle between the hinge-line and the posterior margin smaller than the type form. Concentric rings apparently less sharp and more rounded.

Type: Sp. rg. no. 5960 (Hk) from the lowest part of the *Parapachydiscus* beds in the Hetonai district, Hokkaidô.

1) A typical example of "Anwachskämmereifen" of HEINTZ.

Measurements: *I. incertus* and var. *yubariensis*, in mm.

Specimens	H	L	h	l	th	HL
7246 (Hk) (deformed adult)	85	66	75	70		27
do. (undeformed immature specimen)	47	45	40	45		27
7242 (Hk) (middle aged specimen)			30	26		20(+)
22738 (Sd) (somewhat abnormal form)	52		41	45?		
5960 (Hk) (var. <i>yubariensis</i>)	95	72	92	70	20±	40

Remarks on *I. incertus* s. lat.

- 1) As is indicated in the above table, the present form is in general medium-sized, though sometimes fairly large (e.g. no. 7247, Hk).
- 2) This species shows a considerable variation in outline of the shell; obliquity and height of the valve, relative length along the axis of growth and other features are different among individuals. Some specimens are longer than high, but some others nearly as long as high or even a little higher than long. In some cases, the shell is very oblique postero-ventrally in youth and tends to become less oblique in the adult (eg. no. 7246, Hk), the axis of growth curving with its concavity toward the front. Var. *yubariensis* may be an extreme form; it is noteworthy that this variety is found at a stratigraphically somewhat higher horizon.

N. B. Relations between var. *yubariensis* and *I. amakusensis* will be discussed later.
- 3) Concentric undulations are generally low, broad and sometimes weak. Hence, this feature may be considered as a more primitive sculpture than those observable in other forms of the group.
- 4) A few specimens (e.g. no. 5978, Hk, a mould) bear more crowded, more elevated and rather sharp concentric ridges. But some intermediate specimens (e.g. no. 22740, Sd) link these with the typical one. However, the sharp concentric ridges may be to some extent due to deformation (for example, no. 5978, Hk).
- 5) In the outline of the shell and general construction of the surface sculpture this form resembles *I. balticus* (s. lat.) and its allies and is to be treated as a member of the group of *I. ezoensis*

which includes *I. balticus*. One of the important features of the present species is in the sharpness and narrowness of the concentric rings.

I. hercynicus PETRASCHECK from the Turonian of Europe and other countries (Colombia, Venezuela, etc.) is near to the form in consideration. It is closely similar to var. *yubariensis* in general outline of the shell, but stands nearer to the typical *incertus* (s. str.) in the ornamentation. The wing is in this foreign species distinctly delimited from the flank, at least in the young stage, and its sculpture consists of the direct prolongation of the concentric rings of the flank. A single somewhat abnormal specimen in the material (i.e. no. 7229, Hk, pl. III, fig. 6), transitional between *I. incertus* var. *yubariensis* and *I. amakusensis*, has a similar feature.

I. labiatus SCHLOTHEIM, a cosmopolitan Turonian species, bears some resemblance to *I. incertus* in the feature of the dorsal portion and the sculpture. But, as HEINTZ already pointed out, the former is ornamented usually with concentric lines and is more narrowly elongated to take mytiliform outline than the most elongated examples of the Japanese species. *I. vancouverensis* SHUMARD from the Pacific Coast of North America may be an ally,¹⁾ but it is more inflated, with a more elevated umbo and a somewhat different sculpture.

Occurrences:

I. incertus (s. str.). Division III₁ (lowest part of the Upper Ammonite beds) of the Ikusyunbetu district, prov. Isikari.
var. *yubariensis*. Upper Ammonite beds, near Yūbari, prov. Isikari.

***Inoceramus amakusensis* NAGAO et MATUMOTO sp. nov.**

Pl. III, fig. 6; Pl. IV, figs. 1, 3, 4; Pl. V, fig. 1.

Shell large, presumably equivalve, compressed, with somewhat convex umbonal region, steep but narrow antero-dorsal marginal area, and almost flat ventral and posterior portions.

1) The resemblance is in the general marginal outline, broad concentric "folds" and more or less prominent concentric "line." On examination of several specimens from Sucia Island, the present writers somewhat doubt Heintz' observation on this species.

Outline of shell inequilateral, subpentagonal or subquadrate, higher than long in the adult, and nearly as high as long in the young stage. Antero-dorsal margin slightly excavated beneath umbo, passing below into the broadly rounded antero-ventral angle; ventral margin asymmetrically curved, continuing gradually with the long, slightly convex and nearly vertical posterior margin. Hinge-line long, forming a nearly right angle with the posterior margin. Beak angle fairly obtuse. Umbo subterminal, prominent, not much incurved. Posterior wing broad, indistinctly limited, but often depressed, especially in its dorsal portion.

Surface sculptured with concentric undulations and rings; undulations usually low, broad, round-topped, somewhat irregular in size and distance, and asymmetrically curved; rings numerous low and round-topped, covering the elevations and interspaces. Undulations fading away toward the ventral portion where concentric lines are the sole ornamentation. Wing ornamented with direct prolongation of the sculpture of the flank.

Types: (Syntypes)

Spp. rg. nos. I-960, I-961 (Tk) from the Himenoura group of Hinoshima, Amakusa. Sp. (not registered) (Sd) from the same complex exposed at Higasiura, Amakusa-Kamisima.

Measurements: (mm.)

Specimens	H	h	L	l	th	HL
I-960 (Tk)		215+		175+		107
7226 (Hk) (juvenile specimen)	50	46	40	39	(small)	27
7229 (Hk) (<i>I. aff. amakusensis</i>)	66	58	40	49	12	30

Remarks:

- 1) Ontogenic development: In the early stage of growth, this species resembles *I. incertus* in the shape of the valve, the height not exceeding the length much and the outline more oblique than in the adult which is much higher than long. Thus the rate of growth is most rapid along the vertical axis which often curves toward the antero-ventral angle, with the concavity facing the front.
- 2) As is mentioned above, growth axis curves toward the antero-ventral angle; in some cases (e.g. no. 7198, Hk, and I-966, Tk) the shell is more or less produced in this direction.

- 3) In the type of ornamentation and the shape of the dorsal portion, the present form is similar to *I. incertus*, *I. ezoensis* and their allies. It is especially akin to *I. incertus* var. *yubariensis* in many points. But the former in general has a longer hinge-line, a longer and more straight posterior margin (hence a broader postero-dorsal compressed portion), a smaller postero-dorsal angle and a slightly larger beak angle than var. *yubariensis*. Surface sculpture is different in the two forms in breadth and sharpness of the concentric rings, although a single specimen (no. 7229, Hk, pl. III, fig. 6) belonging to this species is at hand and probably links it with *I. incertus* var. *yubariensis*.
- 4) On the other hand, in the adult stage this form is akin in outline of the valve to *I. cripsii* MANTELL (s. str.) and its allies. Among the latter, *I. belluensis* REESIDE from the middle Dakota Shale has a remarkable superficial (?) resemblance in various points, both being identical in outline and flatness of the valve with a rather irregular concentric sculpture. But the Japanese species is slightly higher and provided with a smaller postero-dorsal angle, besides a different sculptural element, for the American form is characterized by its narrow concentric ridges, concentric rings being absent.

The same statement may be applicable to the resemblance of this form to *I. moresbyensis* WHITEAVES from the Queen Charlotte Islands (Mesoz. Foss., pt. 3, p. 240, text-fig. 11).

I. elliotii GABB (GABB, 1869, Vol. II, pl. 193, pl. XXXI, fig. 90) is somewhat similar in shape to *I. amakusensis*, but differs therefrom in sculpture,¹⁾ the former not being ornamented with a combination of low and broad concentric undulations and rings of the latter.

N. B. *I. uwajimensis* var. *yeharai* is sometimes not unlike *I. amakusensis* in shape, but differs in the length of the hinge-line and posterior margin and in the sculpture; the sculpture of the former is the *uwajimensis*-type (or *kleini-glatziae*-type) and the latter of the *regularis*-type.

Occurrences:

- 1) The Amakusa Islands, middle division of the Himenoura group.

1) The precise nature of the sculpture in GABB's specimen is not accurately known.

- 2) Ikusyunbetu district, Hokkaidô, divisions IV and V.
- 3) Ôyûbari, Hokkaidô, top of the "Scaphites beds" and an uncertain horizon.

***Inoceramus ezoensis* YOKOYAMA**

Pl. VII, fig. 1?; Pl. X, fig. 3; Pl. XI, fig. 3?

1890. *Inoceramus* sp. YOKOYAMA: Verstein. japan. Kreide, p. 175, Pl. XVIII, figs. 6, 7.
1915. *Inoceramus ezoensis* YABE: Note Cret. Fossil Anaga, Awaji and Toyajo, Kii, p. 23, Pl. IV, fig. 1.

Shell moderate or comparatively large in size, equivalve, inequilateral, oblique, nearly as high as long. Antero-dorsal margin almost straight or gently arcuate, antero-ventral margin rounded, sometimes more or less produced, ventral margin asymmetrically curved, passing gradually into the posterior one which forms an obtuse angle with the hinge line. Hinge line moderately long, forming a nearly right or slightly obtuse angle with the antero-dorsal margin.

Valves relatively inflated near umbo, the remaining portion especially the posterior one, weak in inflation or nearly flat.

Surface sculptured with a combination of concentric ridges and rings. Concentric ridges rather low, relatively coarsely arranged and separated by broader interspaces, concentric rings also low and numerous.

Remarks:

YOKOYAMA (1890) described without a specific name a few specimens of this species, mentioning as follows:

"Diese Merkmale verleihen dem allgemeinen Habitus der beiden Formen ein verschiedenes Aussehen. Daher möchte ich nicht wagen, unsere Form mit der allbekannteren Senonart zu identificiren. Eher scheint mir eine Wahrscheinlichkeit vorhanden zu sein, dass wir es hier mit einer neuen Art zu thun haben, die allerdings mit *Inoc. Cripsii* sehr nahe verwandt ist. Leider ist die Zahl unserer Exemplare eine zu beschränkte, um constatiren zu können, ob die oben angeführten Unterschiede constant seien. Sollte sich später meine Vermuthung als richtig erweisen, so würde ich für die japanische Species den Namen *ezoensis* vorschlagen."

YABE (1915) considered YOKOYAMA's species as valid. Though the species is very near to *I. balticus* var. *toyajoanus* nov., the two forms are to be distinguished, as will be described later in detail.

I. balchii of SOKOLOV (1914) from North Saghalin very likely belongs to the present species, and not to the North American one.

Types: The following specimens are added to YOKOYAMA's original specimen:

Sp. rg. no. I-980 (Tk), *Parapachydiscus* beds of Oku-Noborikawa, prov. Isikari.

No. 4538 (Sd), Osousinai, a tributary of the Abesinai-gawa, prov. Tesio.

No. 50970 (Sd), the middle course of the Tinomi-gawa near Urakawa, prov. Hidaka.

Nos. 7349 and 310 (Hk), Abesinai district, prov. Tesio.

Measurements: (mm.)

	H	h	L	l	th	HL
I-977 (Tk)	56	50	47	48+	13	25
I-980 (Tk) (rather later stage)	20	110	115	120	20	60
do. (earlier stage)	54	45	45	47		
7249 (Hk) (middle age)....	40	31	33	37	7±	23

Occurrences:

- 1) Upper Togusi beds in the Towada district, South Saghalin.
- 2) Abesinai beds, Abesinai district, prov. Tesio.
- 3) *Parapachydiscus* beds, Ikusyunbetu district, prov. Isikari.
- 4) Hakobuti Sandstone, Yûbari district, prov. Isikari.
- 5) Upper part of *Parapachydiscus* beds and the basal part of lower Hetonai group, Hobetu-Hetonai-Noborikawa district, prov. Iburi and Isikari.
- 6) *Parapachydiscus* beds, Urakawa district, prov. Hidaka. (2-6 all in Hokkaidô).

Inoceramus exoensis var. *vanuxemiformis* NAGAO et
MATUMOTO var. nov.

Pl. X, fig. 4; Pl. XI, fig. 2.

A few specimens apparently allied to *I. vanuxemi* MEEK and HAYDEN are among the material. Among them, the following two represent a distinct form: rg. no. I-985 (Tk) from the upper course of the Bannosawa, province of Isikari, Hokkaidô, and rg. no. 7251 (Hk) from the Lower Hetonai group (Lower Hakobuti Sandstone) of Hetonai, province of Iburi, Hokkaidô.

Shell moderate in size, almost as high as long, only slightly oblique, nearly circular in outline, and flatly and evenly convex; margins uniformly convex. Hinge-line moderately long; umbo small, inconspicuous and slightly anterior to the median vertical.

Surface sculptured with numerous rather regular, comparatively crowded narrow, and round-topped concentric elevations. Insertion of concentric ridges not rare. Details of finer sculpture unknown.

Measurements: (mm.)

	H	L	h	l	th	HL
7251 (earlier part) (Hk)	47	45	40	5	(small)	27
do. (adult, partly restored) .	70	67	66	70		12

This species resembles *I. vanuxemi* MEEK and HAYDEN (MEEK, 1876, p. 57, pl. XIV, fig. 2), but the specific identity is not easily determined, owing to the imperfect state of the former. On the other hand, the present form bears some relation with *I. ezoensis*.¹⁾ It is distinguished from the typical representatives of the latter by the following points: somewhat bulged anterior portion, more circular outline, and more crowded concentric ridges. However, certain specimens²⁾ reveal the extent of variation of *I. ezoensis* which tends to be allied to the form in consideration. The material available at present is insufficient for a decision whether this form should be treated as a variety of *I. ezoensis* or as a separate species, but the name var. *vanuxemiformis* is proposed for the time being.

***Inoceramus balticus* J. BÖHM (s.l.)**

Pl. X, fig. 1; Pl. XIII, fig. 1.

Many specimens allied to *I. balticus* BOEHM (s. str.) are found in the Upper Cretaceous deposits of Southwest Japan. But their morphological characters are variable to some extent. Moreover, numerous specimens resembling the type one defined by BOEHM have been reported from various countries. "*I. regularis* D'ORB.", "*I. cripsiü*" of ZITTEL, and others with numerous varieties, and probably

1) In case the specimens are deformed, it is very difficult to distinguish these two forms.

2) Sp. rg. no. I-986 from the upper Togusi beds (pl. XI, fig. 3) is an example.

also *I. whitenyi* GABB¹⁾ may be cited. These forms are, according to PERVINQUIÈRE (PERVINQUIÈRE, 1912, p. 117) and other authors, to be included in a single "flexible" species, and *I. regularis* D'ORB. emend. is the valid specific name for them. As a matter of fact, the study on reasonable classification and variation of these "species" seem to be impossible at present (cf. footnote 1 on p. 20), and the type specimens and the allies are provisionally included under the name *I. balticus* s. l.²⁾ In the following lines it is intended to inform what sort of forms, so far as the examined specimens are concerned, are found in Japan.

The following forms are recognizable among the specimens, although they are not always distinctly separable from one another:

a) A form which is the most akin to the type of *I. balticus* BOEHM, being characterized by much elongated outline from the beak to the postero-ventral angle, remarkable convexity of valve in anterior and ventral portions, and surface ornamentation which consists of very distant concentric ridges and numerous concentric rings.

Sp. preserved in Kyoto Imperial University, from Toyazyo Series in Kii province (pl. XIII, fig. 1), and no. 22761(Sd) (pl. X, fig. 1) are the examples.

Measurements: (mm.)

	H	L	h	l	HL
no. 22761 (Sd) (earlier stage)	33	?	27	40	33

"Rippengabelung" pointed out by BÖHM, WOODS, etc. in *I. balticus* is recognizable in some specimens from Japan. The specimens show conspicuous inward-bending of the antero-ventral portion of the valve, which becomes perpendicular

1) STEWART (1930, p. 104) remarked the resemblance in outline between this form and *I. balticus* BOEHM in WOODS. Presence or absence of concentric rings is not exactly known in GABB's species. The latter is characterised by its large and prominent umbo, the feature being one of the most important differences to distinguish it from the Japanese allies.

2) This provisional naming seems to be more appropriate than *I. regularis*. (1) *I. balticus* BOEHM s. str. is definite, it being based upon good specimens and precisely described, while *I. regularis* D'ORB. s. str. seems to be more indefinite because of the ill-preserved state of the type specimen, and less accurately described. (2) Judging from the descriptions and figures by many authors, it is not improbable that *I. regularis* D'ORB. s. str. is a variety of *I. balticus* BOEHM em. (3) Most of the Japanese specimens referable to this type are more akin to *I. balticus* s. str. than to *I. regularis* s. str., except a few specimens which are treated as a variety.

to the earlier part. The sculpture tends in the later stage to decrease in strength, resembling the specimen described by BOEHM. On the other hand, no. 22761 (pl. X, fig. 1) does not bend much, being somewhat transitional to the next form in the convexity of the valve.

As compared with *I. balticus* s. str., the present form has a more produced antero-dorsal portion beneath the umbo. The specimen from the Gosau bed and denominated by ZITTEL (1866, pl. XIV, fig. 2) "*I. crispus* var. *typica*," seems to be closely similar to the form in consideration.

β) *I. balticus* BOEHM var. *toyajoanus* NAGAO and MATUMOTO var. nov. (Pl. IX, fig. 3).

1915. *Inoceramus* cfr. *regularis* YABE: Note Cret. foss. Anaga and Toyajo, p. 22, pl. III, fig. 3.

Typified by specimens nos. 4540 (Sd) illustrated by Yabe (1915) and I-990 (Tk), both from Toyazyô, province of Kii.

Measurements: (mm.)

	h	l	H	L	th	HL
I-990 (Tk)	58	70	75	60	17	45

Shell characterized by uniform and moderate inflation, being regularly curved from umbo to the ventral margin and also from anterior to posterior, with the posterior area flattened. Outline of valve very inequilateral and oblique, with a very long and straight hinge-line; antero-dorsal margin convex, the antero-ventral one broadly arched passing gradually into the evenly curved ventral. Beak subterminal.

Concentric ridges regular in size and distance, comparatively low, but often acute-topped near the ventral margin, and moderately separated from one another by slightly broader concave interspaces and sometimes provided with a weaker ridge on the posterior portion.

This form closely resembles the younger stage of the typical specimen of *I. balticus* s. str., but the conspicuous downward-bending seen in the latter does not occur, even in the adult. In this respect, the present form is rather akin to *I. regularis* D'ORB.¹⁾ with which

1) The regular inflation of this shell is, as BOEHM and WOODS considered, generally thought to be one of the most important distinctive features of this form from *I. balticus*. But according to RIEDEL (1931, p. 664), the type specimen of *I. regularis* also shows the ventral portion tending to become perpendicular to the upper portion. It is not impossible, as HEINTZ once remarked, that *I. regularis* D'ORB. is better treated as a variety of *I. balticus*, though this cannot be determined at present without an opportunity of examination of the foreign specimens.

YABE¹⁾ compared one of the specimens before the present writers. However, the foreign species has a different outline, i.e. less oblique and more circular. *I. crispus* var. *regularis* of ZITTEL (1866, pl. XIV, fig. 3) which is, according to WEGNER (1905, p. 162), synonymous with *I. regularis* D'ORB., has also somewhat different outline from the present form. Some specimens, e.g. no. 22761, Sd. (pl. X, fig. 1), are more or less intermediate between the form described in *a* and var. *toyajoanus* in convexity.

Relation to I. ezoensis: As YABE has already pointed out, *I. ezoensis* YOKOYAMA is to be distinguished from the present form. In well preserved specimens of *I. ezoensis*, the shell has considerable inflation near the beak with the angle between the hinge-line and the antero-dorsal margin smaller than in *I. balticus* var. *toyajoanus*. Furthermore, the former is characterized generally by a nearly straight antero-dorsal margin and a narrowly rounded antero-ventral angle. However, there is some possibility of the two forms' being geographical varieties, for one is known from Hokkaidô and Saghalin and the other is restricted in distribution to Southwest Japan.

In some specimens referable to this variety, the concentric ridges tend to be more crowded and more numerous (e.g. nos. I-922, Tk, 2276a, Sd. and 22708a, Sd). These specimens are related to the next form in this point.

γ) A form characterized by crowded ridges: (Pl. IV, Fig. 2; Pl. V, Fig. 3).

The density of concentric ridges is very great, hence the shell is ornamented with numerous concentric ribs which are shown to be narrow and sharp, suggested on internal moulds. These specimens are variable in outline of the shell.

γ_1) A form resembling in outline *I. balticus* var. *toyajoanus*. Spp. rg. nos. 22708b (Sd) and 22763 (Sd).

γ_2) A form extremely elongated, with a very long hinge-line and a long ventral margin; the anterior side is considerably produced forward. Sp. rg. no. 22741 (Sd) (pl. V, fig. 3) ($h = 27$, $l = 42$, $HL = 30$). This form is closely similar to the specimen described by ZEKELI under the name *I. crispus* var. *alaeformis*.

1) YABE compared the specimen with ZITTEL's "*I. crispus*" from Gosau, and not with D'ORBIGNY's specimen, following PETRASCHECK who compared the Gosau specimen above cited with D'ORBIGNY's species.

γ_3) A form somewhat abnormal in outline. Shell is less oblique and more circular, being nearly as high as long, and thus standing near *I. ezoensis* var. *vanuxemiformis*, described above, but rather akin to *I. balticus* var. *toyajoanus* in the nature of the dorsal portion.

Measurements: (mm.). Sp. rg. no. 7107 (Sd). H=41, l=38, HL=25. (pl. IV, fig. 2).

These forms described in the paragraphs (γ_1 , γ_2 and γ_3) with a constant stratigraphical horizon, may represent the multicostation-phase in the stock of *I. balticus* s.l., with some variation in outline. They should be better treated as varieties. However, some of them are very likely identical to certain foreign forms with distinct names. Under the circumstance that the foreign members of the stock of *I. balticus* are not appropriately classified, it will be unsafe to adopt certain foreign names for the Japanese forms in consideration.

Furthermore, there is a possibility that the form in consideration is a young individual of the next one, *I. balticus* var. *kunimiensis*, which itself includes specimens of various shape. However, notwithstanding this variation in shape, some forms (e.g. nos. 22708, Sd, and 7107, Sd) as large as the adult of *kunimiensis*, have a multicostate ornamentation throughout life, the distance of the ribs increasing regularly with age. To elucidate the relation of these forms, more material necessary.

δ) *I. balticus* var. *kunimiensis* NAGAO et MATUMOTO var. nov. (Pl. XI, fig. 4).

Valves moderately convex, as in *I. balticus* s. str., with a compressed posterior portion, but with rather convex anterior and ventral portions, the last one being almost perpendicular to the dorsal portion.

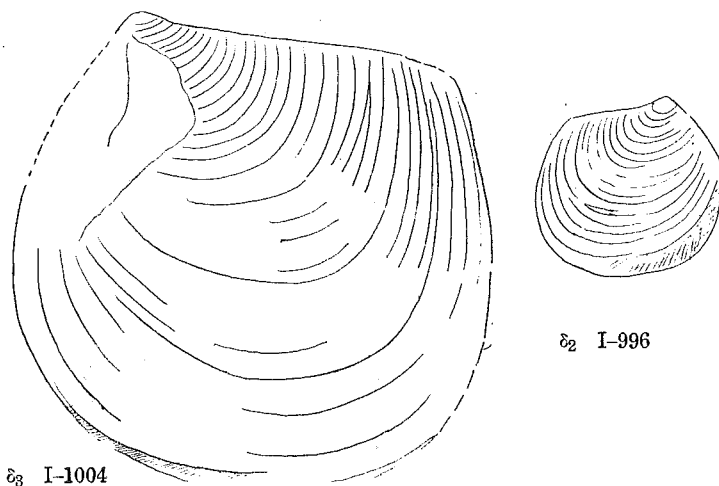
Concentric ribs on the dorsal half portion numerous, rather crowded, relatively elevated, and, as shown on internal moulds, more or less sharp anteriorly and rounded posteriorly. Ribs on the ventral half widely separated and conspicuously or moderately elevated. Concentric rings and internal radial riblets observable. Outline of valve somewhat variable, the following kinds being recognizable:

δ_1) Typical form represented by no. I-994, Tk. (Pl. XI, fig. 4). Same as *I. balticus* s. str., and hence var. *toyajoanus*, in marginal outline; very inequilateral, considerably oblique and much elongated from the beak to the postero-ventral angle.

δ_2) A form represented by nos. I-996, Tk (text-fig. 1) and I-997, Tk. Not much different from the preceding one, but less elongated with a less arched antero-dorsal margin, and a slightly shorter hinge-line. Internal radial riblets hardly discernible.

δ_3) A form represented by no. I-1004, Tk. (text-fig. 1). Nearly as high as long, with rather circular marginal outline, the character resembling that described in γ_3 . Concentric ribs rather sharp-topped, more numerous and more crowded than in the preceding form.

Compared with *I. balticus* s. str. and its allies, this variety is characterised by more crowded concentric ribs in the dorsal half and more widely spaced ones in the ventral.



Text-fig. 1. *I. balticus* var. *kunimiensis*. $\times \frac{2}{3}$

Occurrences: *I. balticus* s. l. in Japan.

a) ¹⁾ Toyazyo series, Toyazyô, prov. Kii.

β) Toyazyo series (middle part of the Izumi Sandstone series), near Matuyama, prov. Iyo; Himenoura group in Amakusa; Uwazima (horizon uncertain).

γ) Miyakura beds, Miyakura, prov. Awa in Sikoku; Izumi Sandstone series, prov. Awaji and prov. Sanuki.

δ) Kunimi, prov. Tosa, calcareous siltstone (the stratigraphy of the Mesozoic strata of this district is not yet accurately known).

1) The form described above in paragraph a).

***Inoceramus japonicus* (SASA MS.) NAGAO et MATUMOTO sp. nov.**

Pl. V, fig. 2; Pl. VI, figs. 2,3; Pl. VII, figs. 2,3; Pl. VIII, figs.
1(?), 2-4; Pl. IX, figs. 1,2.

Shell equivalve, moderate or considerably large in size. Similar in marginal outline, umbo, hing-line and "wing" to *I. incertus* s. l. and *I. ezoensis*, with variations described later.

Convexity of valve gentle and uniform, posterior and postero-ventral portions more or less flattened. Surface ornamentation consisting of concentric and divergent sculptures; the former more prominent on the dorsal portion, being similar to that of *I. balticus-ezoensis* stock in the combination of numerous, fine and low concentric rings and concentric undulations, regularity in size, strength and distance. Divergent sculpture composed of broad and round-topped ribs, separated by concave and as wide interspaces; ribs appearing in a more or less later stage of growth, those on the posterior half of valve often less numerous and stronger than those on the anterior portion. Nodulous elevations shown at the intersection of the two kinds of sculpture.

Variations and Types:

Outline of shell considerably variable, the following three forms being recognisable:

forma a (Pl. V, fig. 2; Pl. VI, figs. 2, 3; Pl. IX, fig. 2).

Shell much elongated from the beak to the ventral margin, antero-dorsal margin nearly straight, the anterior broadly rounded and the posterior long and also broadly arcuated. Compared with the other two forms described below, this is less oblique, with the ventral margin comparatively narrowly rounded in the earlier stage of growth as well as in the later stage. Hinge-line moderately long, forming a slightly obtuse angle with the posterior margin. Thus this form is akin to *I. incertus* var. *yubariensis* in the outline of valve.

Types: (Syntypes)

- 1) Sp. rg. no. 7232 (Hk) from the Upper Ammonite beds of the Abesinai district, prov. Tesio.
- 2) no. 7233 (Hk) and no. 7134 (Hk) from the middle division of the Himenoura group of the Amakusa Islands.

Measurements: (mm.)

Specimens	H	L	h	l	th	HL
7134 (Hk) (earlier stage) ..	43	35	38	40		25
do. (later stage)	82	60+	78	60+	14±	
7233 (Hk) (deformed)	79	58	67	68	?	35?

forma β (Pl. VII, fig. 2; Pl. VIII, figs. 2-4)

Fan-shaped in outline, nearly as high as long; antero-dorsal margin broadly arcuate, the antero-ventral one convex, with a rounded angle, the ventral one relatively broad in curvature, passing gradually into the posterior which is not very long and forms a very obtuse angle with the hinge-line. In general aspect, this form resembles *I. ezoensis*.

Types: (Syntypes)

- 1) Sp. rg. no. 241 (Hk) from the *Parapachydiscus* bed of the Hetonai district, prov. Iburi.
- 2) no. 5445 (Hk) from the same bed of the Sanusibe, Hobetu, prov. Iburi.

Measurements: (mm.)

Specimens	H	L	h	l	th	HL
4464 (Hk) (rough estimation)	240	160				
7241 (Hk) (in dorsal half) ..	60	47	53	50		29+
22705 (Sd) (middle age)	92	78	86	84		45+

forma γ (Pl. IX, fig. 1)

Inequilateral, very oblique, much elongated from the beak to the postero-ventral angle. Anterior side moderately convex and produced beneath the umbo, passing gradually down into the very asymmetrically curved ventral margin; postero-ventral margin rather broadly rounded in the earlier stage of growth, very narrowly rounded in the later stage, the posterior one broadly arched and, in the later stage of growth, very long. Hinge-line long, forming very obtuse angles with both antero-dorsal and posterior margins. This form is similar to *I. balticus* var. *toyajoanus* in outline.

Type: Sp. rg. no. I-1013 (Tk) from the Kunitan beds of the Kuzi district, prov. Rikutyû.

Measurements: (mm.)

	H	L	h	l	th
I-1013 (Tk)	170	115	140	120	small

Among the specimens at hand, besides those safely included into the above three forms respectively, there are some other specimens with intermediate features (e.g. no 4464, Hk, pl. VII, fig. 3). The extent of the produced anterior side is somewhat variable in *forma* β . Moreover, marginal outline is generally similar among the three forms in the earlier stage of growth.

2) *Variation of Sculpture*: The divergent ribs appear at different distances from the beak. In some specimens, they are developed earlier, while in others they are discernible only near the ventral margin. On the other hand, they are not always strong. For instance, one specimen, no. 7257 (Hk) (pl. VI, fig. 3) referable to *forma* α , is provided with very weak ribs, notwithstanding its large size.

It is generally the case that the anterior series of ribs appears earlier than the posterior one, the feature being best manifested in *forma* α .

The ribs are often less numerous and much stronger on the posterior half of the valve, e.g. posterior ribs numbering 5 to 6 and the anterior ones 8 to 10. This feature seems to be characteristic to *forma* β and *forma* γ , especially well recognizable in larger individuals, but not yet observed in *forma* α .

3) In the later stage of growth where the divergent ribs are prominent, the concentric ridges tend to decrease in breadth, elevation and distance, as well shown in no. 4464 (Hk). (pl. VII, fig. 2). These closely set ridges apparently resemble rather distantly arranged concentric rings seen on the ventral portion of a large specimen belonging to *I. schmidtii*. However, in the present species very crowded and fine concentric lines or striae cover the ridges and interspaces, and the essential construction of the concentric sculpture is constant throughout life. In some specimens in which the divergent ribs are not conspicuous, the concentric ridges or undulations are regular and moderately distant throughout life.

4) There are at hand two abnormal specimens, nos. I-1010, Tk (pl. VIII, fig. 1) and 22746, Sd, which are provisionally called *I. aff. japonicus forma* β . In these, the concentric lines, not concentric rings, are predominant, but they are identical in the other characters with *forma* β .

Remarks:

- 1) SASA listed a new name, *I. japonicus*, without description nor illustration, in his "Geology of the Kuzi District." His specimens are to be included in the present species, hence the manuscript name given by him is here used.
- 2) From the characters above described, the present species evidently belongs to the stock represented by *I. incertus*, *ezoensis* and *balticus* s. l. There seems to be no essential difference between *I. incertus* var. *yubariensis* and *I. japonicus* forma *a*. On the other hand, this species is akin to *I. schmidti* MICHAEL em., but this is no doubt only superficial.¹⁾
- 3) *I. undulato-plicatus* ROEMER, a well known species, is somewhat indefinite,²⁾ its systematic position seemingly uncertain.³⁾ Yet, this foreign species fairly well agrees with the present one in many features; it is possible that *I. undulato-plicatus* s.l., including *I. digitatus* SCHLÜTER (teste WOODS), is identical to, or included within the variation of, *I. japonicus* s.l.

I. undulato-plicatus WHITEAVES (1879) from Vancouver Island seems to belong to some other stock.

- 4) *I. diversus* STOLICZKA from the Trichinopoly Group of India is somewhat akin to *I. japonicus*, as far as its outline and ornamentation (similar to forma *γ*) are concerned. However, in the Indian species the presence or absence of concentric rings is not known and the shell is stated to be inequivalve, with an incurved beak.⁴⁾ Consequently, its relation to *japonicus* is not accurately determinable.

1) Owing to a bad state of preservation, some specimens belonging to this species have often been mis-identified with *I. schmidti*.

2) According to the description and figure given by ROEMER (1852, p. 59, pl. VII, fig. 1), the concentric ridges are not recognizable in the original specimen of *I. undulato-plicatus*, while concentric furrows are stated to be present and concentric lines illustrated. The European representative of this species seems to have concentric ribs, as described by WOODS.

3) According to WOODS (Monograph of Cretaceous Lamellibranchiata of England), it seems probable that *I. undulato-plicatus* has descended from a flat variety of "*I. inconstans*."

4) These features are very likely attributable to the state of preservation.

*Occurrences:**forma a:*

- 1) Togusi Shale, Nisinotoro peninsula; Kawakami; South Saghalin.
- 2) Lower Abesinai Group, Abesinai district, prov. Tesio.
- 3) Upper Ammonite Beds; Obirasibe district, prov. Tesio.
- 4) Div. V (*Parapachydiscus* beds), Ikusyunbetu district, prov. Isikari.
- 5) *Parapachydiscus* Beds, Yûbari and Ôyûbari districts, prov. Isikari.
- 6) *Parapachydiscus* Beds, Hobetu district, prov. Iburi.
- 7) Middle part of the Himenoura Group, Amakusa Islands.

forma β et γ:

- 1) Div. V (*Parapachydiscus* Beds), Ikusyunbetu district, prov. Isikari.
- 2) *Parapachydiscus* Beds, Ôyûbari district, prov. Isikari.
- 3) *Parapachydiscus* Beds, Hobetu and Hetonai districts, prov. Iburi.
- 4) Kunitan formation, Kuzi district, prov. Rikutyû.

***Inoceramus shikotanensis* (INAI MS.) NAGAO et
MATUMOTO sp. nov.**

Pl. XI, fig. 1; Pl. XII, figs. 1, 3, 4, ? 2.

Shell modertae in size, equivalve, thin-tested. Valves considerably inflated, abruptly curved inward in the middle stage of growth.¹⁾ Dorsal half convex, especially in the anterior portion, antero-dorsal marginal area broad and steep, but not sharply separated from the flank. Ventral portion of valve compressed, partially almost flat. Very inequilateral, strongly oblique, much elongated from the beak to the postero-ventral angle; antero-dorsal border nearly straight and slightly concave near the umbo, antero-ventral extremity rather produced, ventral margin broadly arched, sometimes with a sinuosity, passing gradually into the narrowly rounded postero-ventral angle. Posterior border relatively long and straight. Hinge-line moderately long, forming an obtuse angle with the antero-dorsal margin. Wing or postero-dorsal flattened area comparatively narrow, long and somewhat depressed, with a very obtuse postero-dorsal angle.

1) This feature is distinctly manifested on the anterior portion where a step-like bending of valve occurs.

Surface ornamented in the earlier stage of growth with concentric ridges and rings or lines; the ridges numerous, rather crowded, narrow and regular, with a subangular summit, the rings very narrow and weak, numbering a few in the interspaces between the major concentric elevations, concentric lines observable near the summit of the ridges. In the later stage, that is, downward from the level of the abrupt bending of the valve, the surface is decorated with a few broad and low concentric undulations, which are almost obsolete near the ventral margin where the shell is nearly smooth. Undulations themselves covered with slightly elevated concentric lines.¹⁾ Wing ornamented with parallel striae continued from the flank.

Types: (Syntypes)

- 1) Sp. rg. no. 7265 (Hk) from the lower part of the Upper Hetonai (Hakobuti) group, Hetonai, prov. Ihuri.
- 2) no. I-664 (Tk) from the Kita-ama Sandstone of the Izumi Sandstone in the province of Awazi.
- 3) no. 7257a (Hk) from Sikotan Island, Tisima (Kurile Islands).

Measurements: (mm.)

Specimens	H	h	L	l	th	HL
I-664 (Tk)	100+	85	72	85+	20+	40-(?)
do. (earlier stage)	63	50	52	62		30-
I-664 (Tk) (earlier stage) .	48	40	45	54		25+
7264 (Hk)	70	60	55	66	20±	?

Remarks:

- 1) The present species is easily recognizable from its characteristic outline and other features, except for the case described below.

N. B. The shell of this species which has thin-tested and much inflated valves, is very liable to secondary deformation after burial in sediments, often being so compressed as to become almost flat. (e.g. no. 7257, Sd). Furthermore, in deformed specimens the concentric ridges in the dorsal portion are hardly distinguished from the concentric rings, and consequently the sculpture is composed of very crowded concentric rings of unequal size. There is a specimen (no. 5976, Hk) at

1) In the anterior portion, weak concentric rings are observable.

hand which is most probably a young individual of this species. (Pl. XII, fig. 2). But it is not also impossible that this form is referable to *I. kusiroensis* nov. to be described later.

- 2) This species is fairly similar in shape to *I. balticus* and its allies. Among the latter, var. *kunimäensis* NAGAO et MATUMOTO nov. tends to bear crowded concentric ridges in the earlier stage and distant ones in the later. Its valve shows, moreover, a conspicuous bending near the ventral margin. Thus it is similar in these points to the present species, but distinguished therefrom in many other features; marginal outline, concentric sculpture, and the absence of a distinct wing.
- 3) *I. pembertoni* WARING (1917) from the Upper Chico group of Southern California seems to be an ally. An exact comparison is difficult owing to the fact that the California species has been founded on a few ill-preserved specimens and also to the very brief description.

Occurrences:

- 1) Greenish grey mud-stone, Sikotan Island, South Tisima.
- 2) Lower sandy shale and Hukausi Sandstone(?) of the Upper Hetonai (Hakobuti) group, developed in the Hetonai district, prov. Iburi, Hokkaidô.
- 3) Two places in Hidaka, geological horizon unknown.
- 4) Kita-ama Sandstone of the Izumi Sandstone in Awazi province.

The present species is the youngest form in the Japanese *Inoceramus*, found in the uppermost part (Uu) of the Cretaceous deposits of Japan.

Inoceramus ("Endocostea") sp. indet.

Pl. XIII, fig. 2.

Two specimens referable to the genus *Endocostea* WHITFIELD have been obtained from the Toyazyo series of Kii province; (1) an internal mould of both valves intact, from a place near Nakaihara and (2) a mould of a right valve, from Simo-ogawa (Inoue coll.).

Outline of valve closely similar to that of *I. balticus* var. *toya-joanus* nov., having a broadly and evenly arched antero-ventral margin which passes gradually into the ventral; considerably inflated, but uniform in convexity. Concentric ridges comparatively distant,

regular in size and distance, stronger in the anterior portion of the valve. Impression of concentric lines discernible. Internal rib distinct, thickest in its middle length, seemingly becoming obsolete at the ventral margin.

Compared with *E. typica* WHITFIELD, the genotype, this form has much coarser ribs. *E. typica* var. *adversa* RIEDEL, in which the concentric ribs are more distant in the earlier stage of growth than in the typical form, is not identical with the Japanese species.

N. B. Although the material available is very scanty, the internal rib of *Endocostea* probably has no generic importance, no more valuable than, for instance, divergent ribs are, in systematic significance. "*Endocostea*" possibly includes many forms related to or derived from various species belonging to the group of *I. balticus* (s.l.)—*ezoensis*, and is treated here as a subgenus of *Inoceramus*.

The group of *Inoceramus naumanni*

Numerous specimens referable to the stock provisionally called the group of *Inoceramus naumanni*, are found in the Upper Cretaceous Urakawa Series, and are especially common in Hokkaidô and Saghalin. Through a close examination of a rich material at hand, the writers now believe that the members of this group are closely related to one another, forming a large and solid stock. And it is more natural, the writers believe, to classify these individuals into the species and varieties as enumerated below, than to establish numerous new species or to include them under a few species. Most of the hitherto established specific names are available, with more or less modification of definition in some cases.

In the following pages, first come the description, range, relation and occurrence of each species or variety, then follows the comparison with foreign allies.

Inoceramus naumanni YOKOYAMA emend.

Pl. XIII, fig. 4; Pl. XIV, figs. 1-10; Pl. XV, fig. 1, 2;
Pl. XVII, fig. 6; Text-figs. 2-4.

1890. *Inoceramus naumanni* YOKOYAMA: Verstein. Japan. Kreide, p. 174,
pl. XVIII, figs. 3-5.

Shell equivalve, small, sometimes medium-sized, thin-tested. Marginal outline (cf. text-fig. 2) inequilateral, very oblique, much

elongated from the beak to the postero-ventral extremity; antero-dorsal margin nearly straight or slightly convex, the anterior broadly arched, passing gradually below into the relatively narrowly rounded ventral, and the posterior margin long and almost straight. Hinge-line short, being shorter than a half of the length of the shell. Beak angle nearly 90° or slightly obtuse; hinge-plate thick.

Posterior wing long, very narrow, smooth, flat, sharply defined, bounded by a distinct, straight groove and provided with a very obtuse postero-dorsal angle. Anterior area or wing *lunule-like*, depressed, not well discernible. Beak small, pointed, not much incurved, nor prominent.

Valves rather thin, gently convex along the axis of growth; umbonal region moderately convex, antero-dorsal marginal part steep, sometimes laterally compressed, posterior portion of the valve almost flat, with or without a very shallow, straight posterior radial depression.

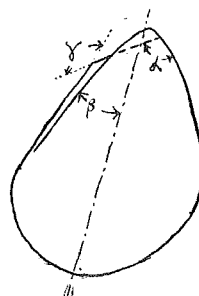
Surface sculptured with numerous concentric rings¹⁾ which show variation as will be described below. And these rings form a characteristic double rings, at least in a certain stage of growth (concentric ring of *naumanni*-type).

Remarks:

- 1) Size: Most individuals belonging to this species are small, the length along the axis of growth (H) being usually 4 or 5 cm., but larger specimens, H = 7 cm., are not uncommon.²⁾

1) Concentric rings converge on the anterior marginal part. On the other hand, these rings are rather abruptly turned upwards along the posterior margin of the flank.

2) Very small specimens are sometimes found abundantly. Whether they are juvenile individuals of *I. naumanni* or some other species of this group, is not easily determined. However, to say that all the specimens referable to *I. naumanni* are the young of *I. schmidti* or other species may be incorrect.



Text-fig. 2.
Marginal outline of
I. naumanni.
 $\alpha = \text{ca. } 100^\circ$ $\beta = \text{ca. } 25^\circ$
 $\gamma = \text{ca. } 160^\circ$

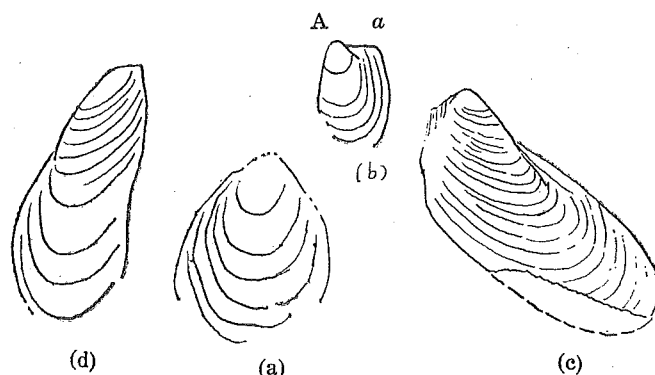
Measurements: (mm).

Specimens	H	L	th
I-1044 (Tk)	55	37	14
I-1027 (Tk) (middle age)	28	20	6-7
22719 (Sd)	42	24	8-9
363 (Hk)	45	26	8-9

2) Shape: Shape is fairly constant, but shows some variation in convexity, sometimes being rather flat and sometimes moderately convex resembling *I. yokoyamai*.¹⁾

3) Surface sculpture: The concentric rings are usually small with round top and form very often double-rings, a characteristic feature of this form (concentric rings of *naumanni*-type). Various kinds of sculpture are recognizable,²⁾ the typical ones being as follows: (Cf. text-fig. 4 and pl. XIV).

a: Concentric undulations are of the second order,³⁾ elevations relatively broad, almost as wide as the interspaces. When



Text-fig. 3.

1) Modification of shape by secondary deformation is frequently great (text-figs. 3).

a. Very flat form, sp. no. I-201, Tk, no. 22798, Sd, no. 22755, Sd.

b. Those obliquely compressed and the originally steeply inclined antero-dorsal marginal part is brought to the same plane as the flank.

c. Those whose originally flat posterior part is bent or even reflected.

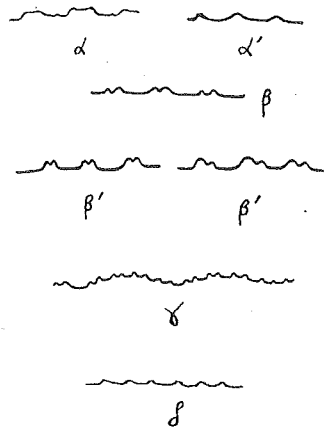
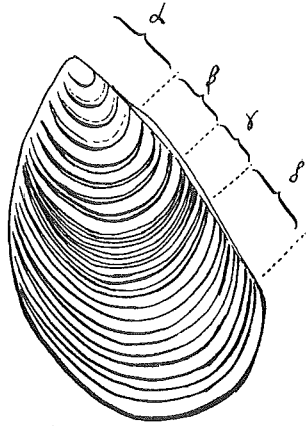
d. Those which became narrow and convex from anterior to posterior owing to lateral compression.

2) These are not sharply separable from one another. Typical forms or examples are selected.

3) In most of *Inoceramus*, the concentric ridges are of the first order in magnitude and the concentric rings of the third order. The intermediate magnitude is here designated as the second order.

the test is preserved, a very shallow depression is often observable on the elevation and a very fine line (i.e. narrow ring) on the interspace. (Pl. XIV, fig. 1).

α' : Concentric elevations are of the second order as in α , narrow, rather sharp-topped, and alternated with much broader interspaces. A very fine line (ring) is sometimes discernible on the interspace. (Pl. XIV, fig. 8).



Text-fig. 4.
Types of concentric sculpture
in *I. naumanni*.
(schematically drawn)

β : Typical double rings ("Doppel-rippen" of YOKOYAMA), namely two adjacent rings are closely set, forming a pair, and united with each other near the anterior and posterior margins of the flank. In this case, the two minor composing a double ring are nearly of equal size, or different size, one of the two being broader and more elevated. Double rings are sometimes distantly arranged and sometimes relatively crowded. (Cf. pl. XIII, fig. 4; pl. XIV, fig. 4).

β' : Concentric double rings are like β , but very elevated, being of the second order. (Pl. XIV, fig. 5; pl. XV, fig. 2).

γ : Concentric rings fine, low, and very closely set. Except for the size, this type is essentially identical with the specimens of β with close-set ornamentation, for two adjacent rings unite with each other, as illustrated in text fig. 4. It is noteworthy that very low major concentric undulations are usually developed at the time when γ is predominant. (Pl. XIV, fig. 3a, b).

δ : Regular concentric rings of equal size and distance, the interspaces being a little broader than the rings, especially well shown on internal moulds. In this case also some, if not all, pairs of the adjacent rings tend to unite at the margin of the valve. Moreover, there is some variation in height of the rings and breadth of the interspaces, β and δ not being thus essentially different from each other in these points. (Pl. XIV, fig. 2; pl. XVII, fig. 6).

The sculptural type α or α' is usually developed in the earlier stage of growth, followed β (or β'), γ and δ successively. However, these types are not always uniformly distributed, one or more types are more predominant than the other. The omission of certain types not uncommon, and in some cases, the sequence of appearance is irregular. Under these circumstances various kinds of sculptural combination are present among the individuals. The typical examples are enumerated below.¹⁾

- a) Spp. nos. 22719 (Sd), 57889 (Sd), in which types α , β (or β'), γ and δ are rather equally developed.
- b) Spp. nos. I-1031 (Tk),*²⁾ I-1034 (Tk), I-1032 (Tk), 22737 (Sd),* in which type- δ is very conspicuous.
- c) Spp. nos. 322 (Hk),* I-1042 (Tk), in which type- γ is predominant.
- d) Sp. no. I-1051 (Tk),* in which the rather coarsely distributed type- β is conspicuous. Sp. no. 7121 (Hk)* is characterized by the comparatively close-set type- β . Sp. no. I-1038 (Tk) has the predominant type- β with distance intermediate between the last two cases. Spp. nos. 359a (Hk), 55305a (Sd)* and I-1066 (Tk)* whose surface is covered mainly with type- β rings.
- e) Spp. nos. 22750 (Sd),* 50966 (Sd.), 7116 (Hk), I-604 (Tk) and I-1041 (Tk) in which α or α' is comparatively well developed.

1) a. Among the large material at hand, very few fossil individuals preserve both valves. However, so far as the examined specimens are concerned, the type of sculpture is similar or quite identical on both valves.

b. These various types are found from one and the same bed.

2) *, Figured specimens.

- f) Spp. nos. I-1044 (Tk)* and 7126 (Hk), in which the sequence of sculpture is somewhat irregular: the former has the sequence of $a-\beta?$ $-\gamma-\delta$ (long duration) $-a?$ (short duration) $-\beta-\delta$, and the later $a-\beta-\gamma-\delta$ (long duration) $-\beta$ or $\delta-a-\delta$.
- g) Sp. no. 359b (Hk)* which has rather coarse ornamentation, for the surface is occupied mainly by a' and β' type. Thus the specimen is somewhat akin (superficially?) to certain specimens of *I. orientalis* var. *ambiguus* (p. 37).

Types: The writers had no opportunity to examine YOKOYAMA's original specimens preserved in Munich, but relying on his description and figures and on the specimens collected from the same locality, this species is distinctly defined. The specific name given by him is here adopted, though the concept of the species is somewhat emended. The above enumerated specimens at hand are pleisiotypes.

Occurrences:

- 1) Near Alexandrofsk, North Saghalin, middle part of the Cape de la Jonquière group.
- 2) Aton district, northern part of South Saghalin, division D- a , and γ .
- 3) Naibuti district, South Saghalin, Miho beds and Ryugase beds, abundant in the former; probably also from the equivalent beds in other districts in South Saghalin.
- 4) Abesinai district, prov. Tesido, lower Abesinai beds.
- 5) Ikusyunbetu district, prov. Isikari, Division IV.
- 6) Hobetu and adjacent district, prov. Iburi, *Parapachydiscus* beds.
- 7) Urakawa district, prov. Hidaka, *Parapachydiscus* beds.
- 8) Izumi Mountain Range, Asenotani shale of Izumi Sandstone series.
- 9) Uwazima district, prov. Iyo, horizon uncertain.
- 10) Ônogawa district, prov. Bungo, abundant in zone O₆, and comparable specimens from O₅, O₇ and O₈.
- 11) (?) Amakusa Islands, Himenoura group.

This form has a wide geographical distribution and a comparatively long geological range, abundantly known in the epochs U1 and Um.

***Inoceramus orientalis* SOKOLOW emend.**

Pl. XVI, figs. 4, 5; Pl. XVII, figs. 3, 7; Pl. XVIII, figs. 1-4.

1894. *Inoceramus digitatus* JIMBO: Beitr. Kennt. Kreideform. Hokkaido, p. 43, pl. VIII, fig. 8 only.
1914. *Inoceramus orientalis* SOKOLOW: Russisch. Sachalin, Kreideinoceramen, p. 73, pl. III, fig. 5; pl. IV, figs. 2 and probably 3.

A species of *Inoceramus* belonging to the group of *I. naumanni*, usually of medium size, and with concentric ridges and oblique ribs. Divergent ribs present or absent.

Types: Besides SOKOLOW's original specimens, the following are to be added:

a. Sp. rg.

- No. 7137a (Hk), along the Abesinai, prov. Tesio. (Nanpo coll.).
- No. 22721 (Sd), Higasi-siritori-gawa, South Saghalin.
- No. 53303 (Sd), Kawakami?, South Saghalin.
- No. 57820 (Sd), Lower Abesinai group along the Wakkawen, Abesinai district, prov. Tesio. (Morita coll.).

β. Sp. rg.

- No. I-153 (Tk), Ikandai near Urakawa, prov. Hidaka (Jimbo coll.).
- No. I-1087 (Tk), Urakawa, prov. Hidaka.
- No. 7140a (Tk), conglomerate at about 100 m. east of Urakawa, prov. Hidaka.

(*a*, without divergent ribs; *β*, with divergent ribs.)

Var. *ambiguus* NAGAO et MATUMOTO var. nov.

Pl. XV, figs. 3, 4; Pl. XVII, figs. 1, 2.

Belonging to the group of *I. naumanni* with concentric ridges, and without divergent and oblique ribs.

Types: (Syntypes)

- Sp. rg. no. I-1073 (Tk), *Parapachydiscus* beds of the Sausiusibetu, a tributary of the Mukawa, prov. Iburī.
- no. 3808 (Hk), *Parapachydiscus* beds of Osatinai, prov. Hikada (ÔTATUME coll.).
- no. 50905a (Sd), greenish fine sandstone of Kawakami, South Saghalin.
- no. 50926b (Sd), sandstone at about 100m. east of Urakawa, prov. Hidaka (IGARASI coll.).
- no. I-156 (Tk) (= *I. lobatus* MÜUSTER in K. JIMBO, 1894), Urokobetu near Urakawa.

Measurements: (mm.)

Specimens	H	h	L	l	th	HL
I-1087 (<i>I. orientalis</i> β)	150	125	82	105	30	40
I-645 (<i>I. aff. orientalis</i> β) . . .	100		65			18
I-1073 (var. <i>ambiguus</i> , anterior margin broken)	60		40 \pm		12-13	
3808a (Hk) (var. <i>ambiguus</i>) .	46	37	33	40	10	15
7137 (Hk) (middle age) (a) . .	62	45	39	53		17
5977 (Hk) (somewhat deformed) (a)	70	59	53	60		

Remarks:

- 1) Marginal outline, convexity of the valve, and features of the wing and the hinge-plate are similar to, or identical with, those of *I. naumanni*. In the present species, however, the antero-dorsal part is moderately high, the posterior one more or less compressed, usually with a shallow radial depression along the posterior margin, which is sometimes very indistinct or hardly discernible.
- 2) The presence of concentric ridges and oblique ribs are the characteristic features of this species. These two kinds of sculpture are developed in many individuals together with each other, but there is some variation in the stage of appearance of the oblique ribs.¹⁾ Furthermore, a considerable number of probably adult specimens have the concentric ridges only, without conspicuous development of the oblique ribs; these individuals are considered at present as a variety, var. *ambiguus*.²⁾
- 3) The mode of development of the concentric ridges is somewhat variable, the following kinds being recognizable:
 - a) Distinct concentric ridges appear in a rather later stage of growth and are covered each with a concentric ring similar to that seen in *I. naumanni*. (e.g. nos. 3808, Hk; 7119, Hk). This "*naumanni*-stage" sometimes continues fairly long

1) The oblique ribs appear in a relatively early stage of growth, but sometimes in old age, the ornamentation being observable only in the antero-ventral portion of the valve.

2) The specimens of *I. orientalis* or var. *ambiguus* sometimes occur independently, without intermingling in one bed, but sometimes the two forms are found together. In the juvenile stage, var. *ambiguus* is often almost indistinguishable from the type species.

(e.g. no. 58305b, Sd). The major concentric ridges on the later portion of the valve are covered with concentric rings of the *naumanni*-type.

- b) The sculpture identical with β' of *I. naumanni* apparently introduces the development of major concentric ridges; prominent concentric double rings are present in the earlier stage of growth, and major concentric ridges take the place of them in the later stage. (e.g. no. 7118, Hk).¹⁾
 - c) Major concentric ridges are developed²⁾ in the early stage of growth, rather regular in size and distance and alternated with slightly broader interspaces. Concentric rings cover the major sculpture (not being always impressed on internal moulds) and are small and rather regular, sometimes very distinct, but sometimes weak, round-topped, occasionally forming double rings. The rings frequently run somewhat obliquely across the ridges, especially near the posterior flattened area.
- 4) Oblique ribs are generally better developed on the anterior portion of the valve. They run obliquely from the median part of the flank downward and forward and are arranged sub-parallel or *en echelon* with one another, displacing or interrupting the concentric ridges on crossing.³⁾
- 5) Divergent ribs are present or absent. If present, some variation in development is shown; a gradual transition is recognizable between the specimens without divergent ribs and those with them. Provisionally these two forms are designated as *forma a* and *forma β* respectively.⁴⁾ In *forma β* the concentric sculpture

1) The sculptural types a) and b) connect *I. naumanni* and *I. orientalis* var. *ambiguus*. Type b) does not differ much from that of type g) in the remarks of *I. naumanni*. This and many other features indicate a close relation of these two forms. The interpretation that all the specimens referred to *I. naumanni* are young individuals of *orientalis* s.l. seems incorrect. But *I. naumanni* is hardly distinguished from *I. orientalis* var. *ambiguus*, as far as young specimens are concerned.

2) In some specimens the concentric ridges are rather inconspicuous (cf. pl. XVII, fig. 1), a feature not determined precisely whether owing to deformation or to specific variation.

3) SOKOLOW'S „doppelten konzentrischen Berippung von verschiedener Krümmung.“

4) Excluding *I. pseudosulcatus* var. *elegans* to be described later, no specimen with distinct concentric ridges and divergent ribs, but without trace of oblique ribs, has been obtained. There are sometimes found specimens with divergent ribs and intermediate in the feature of the concentric sculpture between the *naumanni*-type and the *ambiguus*-type; they are to be included in *I. schmidti*.

becomes less elevated in the ventral portion of the valve where the divergent ribs are very conspicuous. (Pl. XVI, fig. 4, no. I-1087, Tk).

- 6) SOKOLOW's concept of *I. orientalis* appears to be accurate and correct in essential points, with some emendation concerning the variety *ambiguus*.

I. lobatus GOLDFUSS in SOKOLOW belongs very likely to *I. orientalis* var. *ambiguus* nov., though the original specimens of SOKOLOW did not come under examination. *I. aff. lobatus* JIMBO, 1894 (i.e. no. I-156, Tk), is certainly one of the typical forms of *I. orientalis* var. *ambiguus*, though the ventral portion is missing.

Occurrences:

I. orientalis s. str.

- 1) Near Alexandrofsk, North Saghalin, probably the middle division of the Cape de la Jonquièrre group.
- 2) Upper course of the Nisisakutan in the northern part of South Saghalin, uppermost part of D- γ beds.
- 3) Higasi-siritori-gawa, South Saghalin, horizon uncertain.
- 4) Naibuti-Kawakami district, South Saghalin, Ryugase beds and the equivalent beds in the adjacent areas.
- 5) Abesinai district, prov. Tesio, Abesinai group.
- 6) Hobetu-Hetonai district, prov. Iburi, uppermost part of the *Parapachydiscus* beds and the lowest part of the Hetonai group.
- 7) Urakawa district, prov. Hidaka, *Parapachydiscus* beds, especially abundant in the lenticular sandstone.
- 8) Nemuro peninsula, prov. Nemuro, horizon uncertain.
- 9) Awazi, Minato shale of the Izumi Sandstone series.

I. orientalis var. *ambiguus*.

- 1) Nannai, North Saghalin, horizon uncertain.
- 2) Keton-Aton-Hoe district, South Saghalin, D- γ beds.
- 3) Siritori-Motodomari district, South Saghalin, horizon uncertain.
- 4) Naibuti-Kawakami district, South Saghalin, Ryugase sandstone.
- 5) Abesinai district, prov. Tesio, a certain horizon in the lower Abesinai group.
- 6) Ikusyunbetu district, prov. Isikari, Division V.
- 7) Ôyûbari district, prov. Isikari, *Parapachydiscus* beds.

- 8) Hobetu district, prov. Iburi, ditto.
 9) Urakawa district, prov. Hidaka, ditto.

In short, *I. orientalis* s.l. occurs in Um, especially in its upper portion.

***Inoceramus schmidti* MICHAEL emend.**

Pl. VIII, fig. 5; Pl. XVII, figs. 4, 5; Pl. XIX, figs. 1-4 Pl. XX, fig. 1?

1873. *Inoceramus digitatus* SCHMIDT: Über Petref. Kreideform. Insel Sachalin, pl. V, fig. 10?; pl. VI, figs. 1, 2, 4, 6; pl. VII, figs. 1, 3, 5-10; pl. VIII, fig. 14?
 " *I. digitatus* var. *decussata* SCHMIDT: Ibid., p. 31, pl. VII, fig. 4.
 " *I. digitatus* var. *irregulari-costata* SCHMIDT: Ibid., p. 31, pl. VIII, fig. 15.
 1894. *I. digitatus* JIMBO: Beitr. Kennt. Kreideform. Hokkaidô, p. 43, pl. VIII, fig. 10 only.
 1899. *I. schmidti* MICHAEL: Über Kreidefoss. Insel Sachalin, p. 160, pl. V, fig. 1; pl. VI, figs. 1, 3, 4, 5.
 1914. *I. schmidti* SOKOLOV: Kreideinoceramen russ. Sachalin, p. 67, pl. I, fig. 1; pl. II, figs. 1, 2; pl. III, figs. 1, 2.
 1915. *I. schmidti* YABE: Foss. Anaga and Toyajô, p. 23, pl. I, figs. 10, 11.

Shell sometimes attaining a very large size. In outline and convexity of the valve and feature of the wing and umbo, essentially identical with *I. naumanni* YOKOYAMA emend. Surface sculptured with combination of concentric rings of the *naumanni*-type and divergent ribs. Nodulous elevations found at the intersection of these two kinds of ornamentation. Divergent ribs, appearing earlier or later in life, rather uniform in size and distance, broad and round-topped; those on the anterior side appear generally earlier than the posterior ones. A very shallow radial furrow sometimes present near the posterior margin.

Remarks:

- 1) Size: Specimens of this species range in height from 2 or 3 cm. to more than 10 cm., and sometimes attain as large as 30 cm. Many small specimens may be young of larger ones, but some moderate-sized specimens are certainly in adult stage and not young individuals of large forms. The large form is of a large scale morphologically; this form is frequently sculptured in a larger scale even in the young stage than those specimens which

match in size with the young stage of the large form and are presumably already adult.

This feature is most probably attributable to intraspecific variation, hence there seems no need of establishing a distinct name for such huge examples which are often found abundantly in a restricted bed.

Measurements: (mm.)

Specimens	H	L	h	l	th
I-1140 (Tk)	40	30			8
I-1161 (Tk)	45	31	37	37	10
I-1128 (Tk)	250+	140+			
I-1125 (Tk) (excluding the ventral border)	150+	100+			
362a (Hk)	36	25			
7128 (Hk) (middle age).....	74	49			
I-1184 (Tk) (var. <i>mirabilis</i>)	145	90			15±

2) Shape: There is observable some variation in convexity of the valve, proportion of height and length, and size of the anterodorsal area. Some extreme specimens show a resemblance, though apparently, with *forma* β of *I. sachalinensis*, to be described later.

3) Surface sculpture:

- a) Various types of concentric sculpture are recognizable in this species, paralleling with those of *I. naumanni* (a-g). In some specimens predominantly with very fine concentric double rings and low major elevations; nodulous ornamentation is developed at the intersection of concentric elements with divergent ribs, for example, nos 362a Hk (pl. XIX, fig. 4) and 5459, Sd: This kind of ornamentation is also not uncommon in small individuals. On the other hand, in many large specimens concentric rings are fairly widely separated and broad, especially in the ventral portion of the valve.
- b) In a few specimens concentric ridges tend to develop, besides rings; they possess concentric sculpture transitional between the *naumanni*-type and the *ambiguus*-type. These specimens are included, it seems more naturally, in this same species.

- c) Divergent ribs appear earlier or later; sometimes the ribs appear near the beak, whereas in other cases they are restricted to the ventral portion of the valve. In many individuals intermediate in this point, reticulated sculpture is developed.
- d) The number of divergent ribs is also variable; generally 6 to 9 sometimes 11 of them are counted in each of the anterior and posterior half of the flank.
- e) Major concentric ridges are usually absent, except for the b) above described. However, some specimens always have "subconcentric" ribs, that is ribs which a little obliquely cross the concentric sculpture, on the posterior portion of the valve. As the feature is fairly distinct and constant, these specimens are better separated from the typical ones, under the name

I. schmidti var. *mirabilis* NAGAO et MATUMOTO var. nov.
(pl. XV, fig. 6).

Typical specimens: Sp. no. I-1184 (Tk) from green sandstone exposed at Motunai on the Aniwa Bay, South Saghalin; nos. 7135 (Hk) and 7136 (Hk) from Kawakami, South Saghalin.

Occurrences:

- 1) Near Alexandrofsk, middle part (*I. schmidti* zone) of the Cape de la Jonquière group.
- 2) Aton-Hoe district, South Saghalin, D- β beds, rather rare.
- 3) Nisisakutan, South Saghalin, Oyau sandstone.
- 4) Kitasiretoko peninsula, South Saghalin, Tirié formation (middle division).
- 5) Naibuti district, South Saghalin, abundant in the Ryugase beds.
- 6) Other localities in South Saghalin.
- 7) Tiputausibetu, prov. Tesio, horizon uncertain.
- 8) Abesinai district, prov. Tesio, a certain horizon in the upper part of the Abestinai group.
- 9) Ikusyunbetu district, prov. Isikari, horizon uncertain, comparatively rare.
- 10) Urakawa district, prov. Hidaka, *Parapachydiscus* beds.
- 11) Nemuro peninsula, prov. Nemuro, horizon uncertain.
- 12) Toyazyo, prov. Kii, Toyazyô series.

This species is characteristic to the epoch Um and has a wide distribution in Japan.¹⁾

***Inoceramus yokoyamai* NAGAO et MATUMOTO sp. nov.**

Pl. XVI, fig. 2; Pl. XX, fig. 2; Pl. XXI, fig. 2.

Shell equivalve, rather small, inflated with uniform and moderate curvature along the axis of growth, very convex from anterior to posterior; antero-dorsal marginal part steep and broad, posterior area not compressed. Marginal outline of valve similar to that of *I. naumanni*, but a little less oblique. Wing comparatively narrow and long, separated by a distinct groove from the flank. Hinge-line short, hinge-plate thick. Umbo small, but prominent, curved more or less considerably inward and forward, projecting beyond the level of the hinge-line.

Surface ornamented with numerous regular concentric rings which are rather narrow, relatively acute-topped and alternated with somewhat broader interspaces. A few broad concentric elevations and depressions developed in the ventral portion of full grown valve.

Types: (Syntypes)

Sp. rg. no. 7124 (Sd) from Kawakami, South Saghalin.
no. 376a (Hk) from the Abesinai district, prov. Tesio, Hokkaidô.

Measurements: (mm.)

Specimens	H	L	h	l	th	HL
I-1088 (Tk)	35±	22±			12-13	
I-1090 (Tk)	30	19			11	
376a (Hk) (middle age).....	44	26	32	35	13	14
7124 (Hk)	33	21			12±	

Remarks:

- 1) This form is closely akin to *I. naumanni*. However, the shell is more inflated, more oval and less oblique, with a more prominent and convex umbo and a somewhat broader wing. The presence of a few broad concentric undulations in the ventral portion is characteristic to this form.²⁾

1) Almost all the specimens formerly listed under the name *I. schmidtii* from Amakusa, belong to *I. japonicus*.

2) It is difficult to distinguish this form from *I. naumanni*, when the specimens are deformed.

- 2) The feature of the concentric rings is usually similar to the δ -type of *I. naumanni*, but in some specimens (e.g. nos. I-1088 to 1090, Tk; nos. 50905 and 57837, Sd.), the concentric rings are relatively broad, rather acute-topped and asymmetric in cross-section (i.e. "unsymmetrische Anwachskämme" by HEINTZ), and alternated with very narrow interspaces.

The present species is, though superficially, in outline of the shell and the umbo similar to some specimens of the left valve of *I. concentricus* var. *costatus* (e.g. no. I-690, Part I, pl. II, fig. 1).

- 3) Surface sculpture: A few specimens have a very shallow radial depression along the posterior margin, as in *I. naumanni*. Moreover, ventral concentric undulations are sometimes slightly oblique to concentric rings.

Occurrences:

- 1) Kawakami-Naibuti district, South Saghalin, Miho beds, exact horizon uncertain (together with *I. naumanni*).
- 2) Abesinai district, prov. Tesio, lower Abesinai group.
- 3) Provinces of Iburi and Hidaka, *Parapachydiscus* beds.

***Inoceramus sachalinensis* SOKOLOW emend.**

Pl. XV, fig. 5; Pl. XVI, fig. 1; pl. XX, figs. 3, 4; Pl. XXI, figs. 1, 4; Pl. XXII, fig. 1?

1873. *Inoceramus digitatus* (pars.) SCHMIDT: Über Petrefakt. Kreideform. Insel Sachalin, p. 25, pl. VI, fig. 7.

1894. *I. digitatus* (pars.) JIMBO: Beitr. Kennt. Kreideform. Hokkaidô, p. 43, pl. VIII, fig. 9.

1914. *I. sachalinensis* SOKOLOW: Kreideinoceramen russ. Sachalin, p. 71, pl. I, fig. 2; pl. II, figs. 3, 4?; pl. III, figs. 3, 4; pl. IV, fig. 1.

Shell of medium to large size, presumably equivalve. Valve much inflated and step-like along the axis of growth owing to the presence of one or a few more or less strong concentric furrows. Antero-dorsal marginal part steep and very broad. Marginal outline somewhat similar in the young stage to that of *I. yokoyamai*, but different in tending to become fan-shaped and in having a considerably large beak angle. Wing comparatively narrow, but much broader than that of *I. naumanni*, and distinctly bounded; anterior area *lunule-like*. Hinge-line moderately long, beyond which the prosogyrous umbo projects a little.

Surface ornamented with prominent divergent ribs and less conspicuous concentric rings; divergent ribs appear near the umbo, more prominent on the anterior half of the flank, sometimes nodulous; concentric rings of the *naumanni*-type, sometimes wavy between two adjacent divergent ribs, especially in the concentric furrows. Moreover, major concentric undulations frequently developed.

Types: Besides SOKOLOW's original specimens, the following are selected here as additional typical specimens:

Sp. rg. no. I-154 (Tk) (*I. digitatus* JIMBO, 1894, pl. VIII, fig. 9) from the Abesinai group, Rubesibe, a tributary of the Abesinai-gawa, prov. Tesio (JIMBO coll.).

no. 5444 (Sd) from the Lower Abesinai group, the Osôsinai-zawa, a tributary of the Abesinai-gawa.

nos. 150 (Hk) and 50908 (Sd) from green sandstone developed near Kawakami, South Saghalin.

Measurements: (mm.)

Specimens	H	h	L	l	th	HL
I-154 (Tk)	ca. 60	55	43±	45±	23-25	22+
150 (Hk) (large example)	ca. 210	ca. 185	115		ca. 70	
358 (Hk)	47	38	33	37	12-13	22
7137 (Hk) (early stage) ..	50		36		15	
do. (deformed adult)	106		84		25	

Variation: Besides the typical form, four other forms are recognized in this species (s. l.).

A) Var. *ventriformis* NAGAO et MATUMOTO var. nov. (pl. XVI, fig. 3)

Types: Spp. rg. nos. I-1103 and I-1104 (Tk), Ryûgase beds of the Naibuti district, South Saghalin.

This variety is characterized by less inequilateral, much inflated and fan-shaped valves, as long as high or slightly longer than high, and by a very large beak angle. Concentric furrows sometimes developed near the ventral margin. In other features, identical with the typical form.

Measurements: (mm.)

	H	h	L	l	th	HL
I-1103 (Tk)	37	36	40+	40	15	17
I-1104 (Tk)	48		55		20	

B) *forma a.* Represented by spp. nos. I-1105 and I-1097 (Tk), etc.

Very akin in size and shape to *I. yokoyamai*, with a sculpture similar to that of the typical form of *I. sachalinensis*.

Measurements: (mm.)

	H	L	th
I-1087 (Tk)	42	30	13
I-1096 (Tk)	35	26	12

C) *forma β.* (pl. XV, fig. 5) Spp. nos. I-1109(Tk) from the middle part of the Cape de la Jonquière group of Alexandrofsk, North Saghalin, and I-1111(Tk) from the Ryûgase beds of the Naibuti district, South Saghalin. Shell small, inequilateral, very inflated, considerably oblique and sometimes subquadrangular in outline. Hinge-line moderate in length, wing broad, with an obtuse postero-dorsal angle. Concentric furrow absent (?). Sculpture akin to that of *I. sachalinensis* s. str.

Measurements: (mm.)

Specimens	H	h	L	l	th	HL
I-1111(Tk)	65	48	52	55-	25-	33
I-1110(Tk) (much elongated form from beak to ventral margin)	50	45	32	32	17	21

D) An abnormal form represented by a single well preserved specimen from the Abesinai district, province of Tesio (no. 7258, Sd, pl. XXII, fig. 1). Shell large with a large beak angle, ventricose in the umbonal region, very inflated, with concentric depressions; divergent ribs appearing near the umbo. In these features it is identical with the typical form, except for the wing details of which are unfortunately unknown. However, it is less inflated, with both anterior and posterior margins less divergent than in the type, resembling in many points *I. schmidti*.

Remarks:

1) The present species is distinguishable from its allies by the features above described. One of the most important features is in the concentric depressions, though sometimes absent (?) in the varietal forms enumerated above. In small specimens, they are developed near the ventral part of the valve, and in larger individuals

at the middle height. Three depressions are observed in some specimens on the middle portion of the valve. (Sp. rg. no. 150, Hk, pl. XX, fig. 4)

The predominance of divergent ribs is also another feature which characterizes this species, and the anterior divergent ribs tend to intersect with the posterior ones at the median vertical line. In some very large specimens, the ribs frequently become obsolete near the ventral margin.

2) *forma* β is, though distinct, somewhat akin to the more inflated individuals of *I. schmidtii*. The relation of *I. schmidtii* to *I. sachalinensis* may be entirely parallel.

3) A close relationship of *I. yokoyamai* and *I. sachalinensis* is suggested by several points: Inflation of the valve, breadth of the wing and development of concentric depressions. The presence of *forma* β of *I. sachalinensis* favors this supposition.

Occurrences:

- 1) Near Alexandrofsk, Cape de la Jonquière group (middle division).
- 2) Naibuti district, South Saghalin, Ryûgase beds or "zone of *I. schmidtii*", probably also from equivalent beds in the adjacent areas.
- 3) Abesinai district, prov. Tesio, a certain horizon in the lower Abesinai beds.

This species is common in the epoch Um, especially abundant in Hokkaidô and Saghalin. The variety and formae are nearly contemporaneous with the typical form.

Inoceramus pseudosulcatus (ÔTATUME MS.) NAGAO et
MATUMOTO sp. nov.

Pl. XXI, fig. 3?; Pl. XXII, fig. 2.

Shell equivalve¹⁾, small, inequilateral, elongated from the beak to the postero-ventral extremity; much higher than long. Umbonal region considerably convex, the rest of the flank rather gently convex, except for an abrupt bending at some distance from the

1) Probably equivalve, but no individual with both valves preserved has been examined.

beak. Convexity from anterior to posterior very conspicuous. Umbo much curved inward and forward. Antero-dorsal marginal part steeply inclined. Anterior margin itself almost straight, passing rather gradually into the broadly arched antero-ventral, the ventral narrowly rounded and the posterior long, nearly straight.

Wing relatively large and long, distinctly separated from the flank. Hinge-line rather short forming an obtuse angle with the posterior margin.

Surface ornamented with radial ribs and concentric element; radial ribs rather few in number, very strong, appearing near the umbo and running almost straight toward the ventral margin. A few short ribs present on the anterior half of valve branching off from the median one. Concentric sculpture similar to that of *I. naumanni* and *I. orientalis* var. *ambiguus* and it gives an nodulous appearance to the radial ribs on crossing.

Types: (Syntypes)

Spp. rg. nos. 5988a, b (Hk) from the basal part of the Lower Hetonai (Hakobuti) group, Hetonai district, prov. Iburī, Hokkaidō; nos. I-1115 and 1116 (Tk) from the Hakobuti group, the Sanusibe-zawa, Hobetu district, prov. Iburī.

Measurements: (mm.)

Specimen	H	L	h	l	th	HL
no. 5988a (Hk)	50	29	47	32	7	17

Var. *elegans* SOKOLOW emend. (comb. nov.)

Pl. XXII, fig. 3.

1917 *Inoceramus elegans* SOKOLOW: Kreideinoceramen russ. Sachalin, p. 74, pl. I, figs. 3, 4.

This form identical with *I. pseudosulcatus* s. str. in size and shape of the valve as well as in the feature of the wing. Sculpture in the ventral portion very different from that of the flattened umbonal region; umbonal region ornamented with concentric *naumanni*-type sculpture only, while the ventral portion of the valve has very prominent radial ribs and less conspicuous concentric rings.

Types: Besides SOKOLOW's original specimens, the following specimens are selected as paratypes: Spp. nos. 50926 (Sd) and 36484 (Sd).

Remarks:

- 1) The type species is distinguished from *I. sachalinensis* and *I. schmidti*, to which it is somewhat akin, by a number of features; small, inflated and abruptly bent valve ornamented with a few prominent radial ribs, with a small beak angle and a relatively large wing.
- 2) In most specimens, the radial ribs are persistent throughout life, appearing in the umbonal region, hence the "*Actinoceramus*"-like sculpture. In other specimens, however, the radial ribs appear at a considerable distance from the umbo, the concentric sculpture being predominant on the dorsal half and often tending to become divaricate from the median vertical line. Those specimens with the sculpture just described seem to belong to *I. elegans* SOKOLOV which is considered at present as a variety of *I. pseudosulcatus* nov. There is at hand an intermediate specimen linking these two forms (v. no. I-1114, Tk).
- 3) The present species is considered as a member of the group of *I. naumanni* from general outline of the valve, feature of the concentric sculpture and a close similarity with *I. sachalinensis*. The concentric sculpture is the α - β - γ -type of *I. naumanni*; the main portion of the flank where the radial ribs predominate, is ornamented with very fine concentric rings (α) or double rings (β) and low major undulation (γ). A close affinity is suggested between var. *elegans* and *I. sachalinensis* in convexity of the valve, large size of the wing and the strong development of non-concentric ribs.

*Occurrences:**I. pseudosulcatus* s. str.:

- 1) Ôyûbari district, prov. Isikari, *Parapachydiscus* beds or the lower part of Hakobuti Sandstone.
- 2) Noborikawa, prov. Isikari and the Mukawa district, prov. Iburi, Lower Hetonai beds or *Parapachydiscus* beds.
- 3) Urakawa district, prov. Hidaka, the lenticular sandstone in the *Parapachydiscus* beds.
- 4) Aton district, South Saghalin, D- γ beds.

I. pseudosulcatus var. *elegans*

- 1) Near Alexandrofsk, North Saghalin, the Amba (according to SOKOLOV).

- 2) Kawakami district, South Saghalin, green sandstone.
- 3) Abesinai district, prov. Tesio, a certain horizon in the lower Abesinai group.
- 4) Ikusyunbetu district, prov. Isikari, *Parapachydiscus* beds along the Kikumezawa.
- 5) Urakawa district, prov. Hidaka, the lenticular sandstone in the *Parapachydiscus* beds.

Comparatively rare. It is remarkable that this peculiar form is the last representative of the *I. naumanni* group.

Comparisons of the group of *Inoceramus naumanni* with some allied foreign species

1) Among the hitherto described species of foreign countries, none is identical with any species of the group of *I. naumanni*. MICHAEL identified with *I. schmidti* the specimen from the Emscherian of Germany described by SCHLÜTER (1867, p. 159, pl. XXXVIII, fig. 1) under the name *I. undulato-plicatus*. But this identification does not seem warrantable.

2) There is no North American species conspecific with the Japanese forms belonging to this group, although some specimens from North America allied to *I. naumanni* and *I. orientalis* var. *ambiguus* are found in the collections of some institutes in Japan.

Three allied forms may be cited among the Cretaceous *Inoceramus* of South America, *I. papuanus* BRÜGGEN, *I. plicatus* D'ORB. and *I. striato-concentricus* GÜMBEL. The first of these latter described from Peru¹⁾ has the concentric sculpture similar to type- β of *I. naumanni*, but as HEINTZ once pointed out, it is longer and more circular in outline and has its antero-dorsal portion more produced anteriorly.

I. plicatus D'ORB. from Colombia, as judged from D'ORBIGNY'S description and HEINTZ' good illustration, seems to bear double rings²⁾ similar to those of *I. naumanni*. Moreover, it is akin to the

1) As to the geological age of the fossiliferous rock of Urakawa, Hokkaidô, HEINTZ (1928, "Oberkreide Inoceramen Süd-Americas"), unfortunately ignored recent investigations by Japanese geologists.

2) HEINTZ considered the sculpture as "Anwachskämmreifen."

Japanese form in being oval and oblong in shape. A straight posterior margin and long and narrow wing characteristic to the Japanese species are stated to be wanting in that South American form.¹⁾

I. striato-concentricus GÜMBEL which is reported, besides South America, from Germany and the Carpathians, may be related to *I. naumanni* but is easily distinguished therefrom in having a quite different character in the posterior wing (or the postero-dorsal part of the valve.)

I. pacificus WOODS from New Zealand has a similar concentric sculpture to some specimens of form b) of *I. naumanni*. But in other features it differs, for it is stated to have affinity with *I. cycloides* WEGNER which is very different from the Japanese form in outline of the valve.

3) It is interesting and noteworthy that a parallelism, possibly apparent, is observable between the stock of *I. naumanni* and some European representatives, the stock represented by *I. lingua* GOLDFUSS, *I. lobatus* GOLDFUSS, *I. patootensis* DE LERIOI, *I. pachtii* ARKHANGUELSKY, *I. cardisoides* GOLDFUSS and *I. steenstrupi* DE LORIOI (i.e. *I. tuberculatus* WOODS). The analogy between the two stocks is as follows:

(1) They have similar general outline, (2) and usually similar inflation of the valve. (3) Posterior radial depression is developed or tends to develop. (4) Numerous concentric rings characterize *I. naumanni* and *I. lingua*, the presumably respective simpler representatives of the two stocks. (5) Major concentric ridges or concentric rings (usually called "ribs") particularly elevated among others, are developed in some forms, *I. orientalis* var. *ambiguus* on the one side, and *I. patootensis* on the other. (6) Radial or divergent ribs are present in the morphologically more advanced forms, *I. schmidtii*, etc., and *I. cardisoides*. (7) Moreover, an approximate correspondance in the geological occurrence may be cited.

These two stocks with their own members are distinguished from each other in various points. Besides difference in details of sculpture, a long and distinctly defined wing characterizes the stock

1) HEINTZ laid special attention upon the anterior ear. The presence of an anterior lunule-like area preserved in a few specimens of the group of *I. naumanni*, has been cited before in the present paper.

of *I. naumanni*, while the presence of a ridge-like elevation behind the posterior depression is one of the distinctive features of the European stock.

The sculpture of the *lobatus*-type is different from that of the *ambiguus*-type; in the former the concentric rings are periodically strengthened and elevated, and in the latter the major concentric ridges occur and concentric rings occur on the ridges and the inter-spaces.

I. schmidti, *I. orientalis forma-β* and *I. sachalinensis* are ornamented with strong divergent ribs, whereas *I. steenstrupi* and *I. cardisoides* are covered with comparatively narrow, straight radial ribs or riblets.

4) *I. schmidti*, *I. sachalinensis* and some other members of this stock have been often mis-identified with *I. digitatus* SOWERBY,¹⁾ probably of a different stock. *I. digitatus* s. str. is characterized by the presence of strong, broad and elevated radial ribs, coming near *I. pinniformis* WILLET, *I. subcardisoids* SCHLÜTER and *I. corrugatus* WOODS.

WOODS is probably incorrect in putting *I. schmidti* MICHAEL in synonym with *I. undulato-plicatus* RÖMER, as already pointed out by SOKOLOV. Although the systematic position of *I. undulato-plicatus* is uncertain, its resemblance to *I. schmidti* may be attributable to convergence, as that is the case between the latter and *I. japonicus*.

I. fasciculatus HEINE, 1929, an Emscherian species, is similar to *I. orientalis* in sculpture. HEINE's figure shows a sculpture which is designated in this paper as "oblique ribs." As there is no such statement in the text and the specimen of this species has not come under examination, the present writers can not more precisely compare the Japanese species with *I. fasciculatus*.

5) *I. pseudosulcatus* apparently resembles *I. (Actinoceramus) sulcatus* PARKINSON from the Gault of Europe, especially in the prominent radial ribs. This European species is inequilateral and doubtless belongs to a stock different from the group of *I. naumanni*. The resemblance is believed to be superficial and owing to convergence.

1) *I. digitatus* seems to be an indefinite species.

*Incertae sedis**Inoceramus (Sergipia?) akamatsui* YEHARA

Pl. XIII, figs. 3, 5; Pl. XXII, fig. 6.

1924. *Inoceramus akamatsui* YEHARA: Japan. Jour. Geol. and Geogr., vol. III, p. 37, pl. II, figs. 2-4.

Shell small equivalve, thin-tested, much compressed and nearly flat; very slightly inequilateral, subquadrate in outline and longer than high. Antero-dorsal margin short and nearly straight, the anterior and posterior margins evenly rounded, and the ventral broadly convex.

Hinge line of medium length, straight, forming very obtuse angles with both antero-dorsal and postero-dorsal margins. Wing lying along the postero-dorsal margin, narrow, flat, and distinctly separated from the flank of the valve. Beak subcentral, small, inconspicuous and pointed.

Surface sculpture consisting of numerous broad concentric bands, very fine growth lines and very fine occasional radial grooves.

Measurements: (mm.)

h	l	th
16	23	3 ?
13	18	?

Rarely attaining 25mm. in height

Remarks:

- 1) Variations: Outline of valves is fairly constant, whereas the sculpture shows some variation. The concentric bands are usually broad, low, regularly spaced and alternated with much narrower interspaces. The summit of each band is flat and often decorated with a median longitudinal depression, tending to become an ill-defined double ring. In a more or less adult stage, the shell is covered with numerous closely set rings with double summits.¹⁾

In certain specimens, very narrow concentric rings are predominant even in a juvenile stage, otherwise identical with the

1) In some specimens which have suffered secondary compression, the concentric bands show sharp edges, resulting in "asymmetrische Anwackskämme."

typical specimens. These are, as SUGAI described in his manuscript, better treated as a variety, var. *delicatocostatus* (SUGAI MS.) NAGAO et MATUMOTO nov.

- 2) Affinities: The present form is very peculiar in character, reminding us of some forms of *Posidonomya*. It probably belongs to the section *Sergipia* of MAURY,¹⁾ though the precise nature of the hinge plate is not observable.²⁾ *I. akamatsui* is closely similar to *I. (Sergipia) posidomyaformis* MAURY (1925) from the Maestrichtian equivalent of Brazil in which however, the wing is ill-defined, the radial grooves and the very fine concentric striae observed in the Japanese form are not known.

On the other hand, the species under consideration is somewhat akin to *I. pilvoensis* SOKOLOW, especially in its young stage, but the latter is larger and sculptured with concentric ridges and lines. BÖSE (1923) has reported a species without a new name, from the Turonian or Lower Emscherian of Mexico, which seems to be intimately related, if not identical, with the present species. *I. planus* MÜLLER in GOLDFUSS is an allied form, differing therefrom in being lower and in having a radial sculpture.

Occurrences:

- 1) The *Scaphites* beds (III) in the Ikusyunbetu district (in the *I. uwajimensis* beds and also underlying strata), prov. Isikari.
- 2) Yûbari district, prov. Isikari, in an uncertain horizon.
- 3) Zone O₅ of the Ônogawa Cretaceous, found together with *I. uwajimensis*, prov. Bungo.
- 4) Furusiroyama shale and its equivalent rocks?, found with *I. uwajimensis* YEHARA, Uwajima district, prov. Iyo.

***Inoceramus pilvoensis* SOKOLOW**

Pl. XXII, fig. 5.

1914. *Inoceramus pilvoensis* SOKOLOW: Kreideinoceramen des russischen Sachalin, p. 39 and p. 77, pl. V, figs. 3-5.

Of this species, which SOKOLOW established on a few imperfect specimens, a single imperfect specimen is available at present (sp.

1) Monograph do Servico Geologico e Mineralogico do Brazil, vols. 4 and 11.

2) A series of very small ligamental pits is shown in one of the specimens at hand.

rg. no. I-1185, Tk, the postero-ventral portion is missing). SOKOLOW's diagnosis is as follow:

"Gleichklappigkeit und schwache Wölbung der ganzen Schale, regelmässige und gleichmässig-rundliche Form jeder Klappe von einer Länge, die ungefähr der Höhe (Breite) gleichkommt, und einem Wirbelwinkel der 130° erreicht; ausserordentlich schwache Wölbung jeder Klappe, wobei die gerade Linie der grössten Wölbung beinahe mit der Mittellinie der Klappe zusammenfällt; gerader, nicht langer Schlossrand; kleiner, wenig bemerkbarer, flacher und gerader Wirbel; kleines Ohr und Flügel vor und hinter dem Wirbel; vollständiges Fehlen einer radialen Skulpture und Auftreten regelmässiger, dichter, feiner und symmetrisch konzentrischer Rippen, die sich in mittleren Teil der Klappe spalten und mit dünnen gleichmässigen Zuwachsstreifen der Schale bedeckt sind."

SOKOLOW stated that the shell is as high as long, but the specimen at hand is longer than high. SOKOLOW's figures seem to indicate this nature, at least in the earlier stage of growth.

As the notations of the sculpture here used are different from those used by SOKOLOW, it will be adequate to give the description of the ornamentation, based on the present specimen.

The shell is sculptured with major concentric undulations and concentric rings. Very fine growth striae covering the whole surface are partly preserved. The concentric undulations are low and broad, as in *I. incertus* JIMBÔ, and somewhat band-like in the young stage. Concentric rings are developed even in the umbonal portion, narrow and sharp, sometimes forming characteristic double rings. The radial sculpture is absent except for a faint radial depression on the inner side of the shell. The wing is ornamented with parallel striae.

I. hercynicus PETRASCHKE seems to be closely similar to the present form, but has a different outline of the shell. *I. naumanni* YOKOYAMA and its allies (such as *I. orientalis* var. *ambiguns* nov.) resemble the species in consideration in the form of the wing and the nature of the double rings, but have quite different outline of the shell. Moreover, *I. incertus* JIMBO has a similar concentric ornamentation, though its wing is not so distinctly separated from the flank as in *pilvoensis*.

Inoceramus kusiroensis NAGAO et MATUMOTO sp. nov.

Pl. XXII, fig. 4.

Shell moderate in size, equivalve, inequilateral, longer than high, somewhat oblique backwards and downwards, moderately in-

flated. Hinge line straight, shorter than a half of the length of the shell. Both wings flat and very distinct, the posterior one narrow and long with a very obtuse postero-dorsal angle and a straight posterior margin, anterior wing small, triangular with an obtuse antero-dorsal angle. Ventral margin very broadly arcuate with asymmetric curvature, postero-ventral margin rather narrowly rounded. Beak small, situated at one third of the length from anterior.

Sculpture consisting of concentric rings and narrow and sharp radial ribs. Concentric sculpture variable from the umbonal region to the lower margin, the following succession being recognizable:

- 1) In the youngest stage, the rings are rather distantly spaced.
- 2) In the next stage, the rings become more crowded, and two, three or several adjacent ones are united near the anterior and posterior margins of the shell, tending to form very low concentric undulations.¹⁾
- 3) In the mature stage, the rings are regular in size and distance, being separated from one another by broader interspaces.²⁾
- 4) In the last gerontic stage, the rings are crowded again.

The radial ribs are developed rather late in the growth stage and a little earlier on the anterior part of the shell than on the posterior. They are very narrow and sharp, separated from one another by broader interspaces with long or short interstitial ribs. The ribs are straight but show gentle curvature on the anterior portion of the flank.

Besides, a very shallow posterior radial depression is sometimes present, and, moreover, four or five broad radial plications³⁾ are discernible near the ventral margin.

Types: A few specimens from one stratum have been examined. The shell may have been very thin-tested, and consequently often deformed, but the figured specimen, the holotype, is relatively well preserved. (Sp. rg. no. 7271, Hk).

Measurement: h = 49 mm., l = 56 mm.

Remarks: The present form is peculiar in form and sculpture, though it is akin to the group of *I. naumanni* in the nature of the

-
- 1) Ill-defined double rings sometimes appear.
 - 2) In this stage, double rings are often observable.
 - 3) This feature is possibly due to a secondary deformation.

posterior wing and the essential character of the concentric sculpture. *I. kusiroensis* is closely allied to *I. pilvoensis* SOKOLOW in outline of the shell, but different in the sculpture. *I. n. sp.* of BÖSE (1923, pl. XVII, fig. 20) from Mexico is one of the related forms, though easily distinguishable.

Occurrence: Ôtamura, Akkesi district, prov. Kusiro, Hokkaidô; the exact horizon is unknown, but presumably equivalent to the Hakobuti Sandstone in the Isikari coal-field.

A specimen (no. 5976, Hk) from the Hukausi Sandstone of the Hetonai group in the province of Iburi (pl. XII; fig. 2) is referred to *I. shikotanensis* nov. described before, but it aslo is not improbably a deformed individual of this species.

PLATES I—XXII

The figures are of natural size, unless otherwise stated.

Plate I

- Fig. 1. a, b. *Inoceramus yabei* sp. nov. Yûbari, Tk. no. I-759, internal mould of a left valve.
 Fig. 2. *I. yabei* sp. nov. Ônogawa Basin, Tk. no. I-737, artificial external cast showing surface sculpture
 Fig. 3. *I. yabei* sp. nov. Ônogawa Basin, Tk. no. 740, artificial external cast of a compressed specimen.
 Fig. 4. *I. yabei* sp. nov. Ônogawa Basin, Tk. no. I-732.
 Fig. 5. *I. yabei* sp. nov. Ônogawa Basin, Tk. no. 738a, rather elongated form.
 Fig. 6. *I. yabei* sp. nov. Ônogawa Basin, Tk. no. I-734, rather elongated form.

Plate II

- Fig. 1. a, b. *Inoceramus* sp. α , aff. *I. yabei* nov. (or *I. angulicus* WOODS.), Ikusyunbetu, Hk. no. 5653. a, right valve, b, left valve.
 Fig. 2. a, b. *I.* sp. α , aff. *I. yabei* nov. Ikusyunbetu, Hk. no. 4403, right valve.
 Fig. 3. *I.* sp. β , aff. *I. crispisii* MANTELL. Kamihobetu, Hk. no. 5902, internal mould of a right valve.
 Fig. 4. *I.* sp. γ , aff. *I. yabei* nov. Yubari, Hk. no. 7160, right valve.
 Fig. 5. *I.* sp. γ , aff. *I. yabei* nov. Ônogawa Basin, Tk. no. I-789, right valve.
 Fig. 6. a, b. *I.* sp. β , aff. *I. crispisii* MANTELL. Kamihobetu, Hk. no. 5966, lateral and dorsal views of a right valve.
 Fig. 7. *I.* sp. β , aff. *I. crispisii* MANTELL. Ônogawa Basin, Tk. no. I-790, slightly reduced. (Cf. description on p. 9).
 Fig. 8. a, b. *I.* sp. aff. *I. yabei* nov. Naibuti district, Sd. no. 57824. $\times \frac{1}{2}$.

Plate III

- Fig. 1. *Inoceramus incertus* JIMBO emend. Ponbetu, Hk. no. 7246, deformed specimen.
- Fig. 2. a, b. *I. incertus* JIMBO em. Ponbetu, Hk. no. 7242, typical form.
- Fig. 3. a, b. *I. incertus* JIMBO em. Ponbetu, Sd. no. 22740, specimen with comparatively sharp concentric ridges.
- Fig. 4. a, b. *I. incertus* JIMBO em. Ponbetu, Sd. no. 22738, abnormal form due to secondary deformation (?).
- Fig. 5. *I. cfr. incertus* JIMBO em. Ponbetu, Hk. no. 7162, internal mould with sharp concentric ridges.
- Fig. 6. a, b. aff. *I. amakusensis* sp. nov. Kikumezawa, Hk. no. 7229, specimen resembling *I. incertus* JIMBO var. *yubariensis* var. nov.

Plate IV

- Fig. 1. *Inoceramus amakusensis* sp. nov. Sd., Higasiura in Amakusa.
- Fig. 2. *I. balticus* BÖHM (s.l.) *forma* γ (nom. indet.). Awazi, Sd. no. 7107, high specimen characterized by multicostation.
- Fig. 3. *I. amakusensis* sp. nov. Ikusyunbetu, Hk. no. 7226.
- Fig. 4. *I. amakusensis* sp. nov. Hinosisima in Amakusa, Tk. no. I-961.

Plate V

- Fig. 1. *Inoceramus amakusensis* sp. nov. Hinosisima in Amakusa, Tk. no. I-960, left valve. $\times \frac{3}{4}$.
- Fig. 2. *I. japonicus* (SASA MS.) sp. nov. *forma* *a*. Nakahobetu, Hk. no. 5931, specimen with weak divergent ribs.
- Fig. 3. *I. balticus* BÖHM (s.l.) *forma* γ . Miyakura, specimen characterized by much elongated outline and multicostation.
(Cfr. "*I. crispiss* var. *aleaformis*" in ZITTEL)

Plate VI

- Fig. 1. a, b, c. *Inoceramus incertus* JIMBO var. *yubariensis* var. nov. Kamiho-betu, Hk. no. 5960, a, lateral, b, dorsal, and c, anterior view.
- Fig. 2. a, b. *I. japonicus* (SASA MS.) sp. nov. *forma* *a*. Kawakami, Hk. no. 7134, internal mould of a right valve.
- Fig. 3. *I. japonicus* (SASA MS.) sp. nov. *forma* *a*. Nakahobetu, Hk. no. 7257, specimen of comparatively large size and with weak divergent ribs. $\times \frac{1}{2}$.

Plate VII

- Fig. 1. *Inoceramus cfr. ezoensis* YOKOYAMA. Abesinai, Hk. no. 7249, internal mould of an immature shell.

- Fig. 2. *I. japonicus* (SASA MS.) sp. nov. *forma* β . Hetonai, Hk. no. 4464. $\times \frac{1}{2}$.
 Fig. 3. *I. japonicus* (SASA MS.) sp. nov. Hetonai, Sd. no. 22705. $\times \frac{1}{2}$.

Plate VIII

- Fig. 1. *Inoceramus* aff. *japonicus* (SASA MS.) sp. nov. *forma* β . Bannosawa, Tk. no. I-1010. (Cf. description on p. 26).
 Fig. 2. *I. japonicus* (SASA MS.) sp. nov. *forma* β . Hetonai, Hk. no. 241. $\times \frac{1}{2}$.
 Fig. 3. *I. japonicus* (SASA MS.) sp. nov. *forma* β . Kikumezawa, Hk. no. 7240.
 Fig. 4. *I. japonicus* (SASA MS.) sp. nov. *forma* β . Sanusibe, Hk. no. 5445.
 Fig. 5. *I. schmidti* MICHAEL. Kawakami, Saghalin, Hk. no. 7138, weathered specimen.
 N.B. Superficially resembling *I. japonicus*.

Plate IX

- Fig. 1. *Inoceramus japonicus* (SASA MS.) sp. nov. *forma* γ . Kunitan, Kuzi district, Tk. no. I-1013.
 Fig. 2. *I. japonicus* (SASA MS.) sp. nov. *forma* α . Wakkawen, Tesio, Hk. no. 7232.
 Fig. 3. *I. balticus* J. BÖHM var. *toyajoanus* var. nov. Toyazyo, Sd. no. 4539, internal mould of a left valve.

Plate X

- Fig. 1. a, b. *Inoceramus balticus* J. BÖHM (s.l.), *forma* α . (Specimen allied to *I. balticus* s. str., but somewhat related to *I. balticus* var. *toyajoanus*.) Toyazyo, Sd. no. 22761, a, lateral, b, dorsal view.
 Fig. 2. *I. incertus* JIMBO em. Ponbetu, Sd. no. 57821, left valve.
 Fig. 3. *I. ezoensis* YOKOYAMA. Abesinai, Hk. no. 310, right valve.
 Fig. 4. a, b. *I. ezoensis* YOKOYAMA var. *vanuxemiformis* var. nov. Hetonai, Hk. no. 7251, a, lateral, b, anterior view.

Plate XI

- Fig. 1. *Inoceramus shikotanensis* (INAI MS.) sp. nov. Awazi, Tk. no. I-664, internal mould.
 Fig. 2. *I. ezoensis* YOKOYAMA var. *vanuxemiformis* var. nov. Bannosawa, Tk. no. I-985, internal mould.
 Fig. 3. *I. aff. ezoensis* YOKOYAMA. Togusi, Tk. no. I-986. (Specimen apparently transitional between *I. ezoensis* and var. *vanuxemiformis*.)
 Fig. 4. *I. balticus* J. BÖHM var. *kunimiensis* var. nov. Kunimi, Tk. no. I-996, a, lateral, b, anterior view.

Plate XII

- Fig. 1. *Inoceramus shikotanensis* (INAI MS.) sp. nov. Hetonai, Hk. no. 7265.
 Fig. 2. a, b. *I. aff. shikotanensis* (INAI MS.) sp. nov. Nakahobetu, Hk. no. 5976, internal mould; a, right valve, b, left valve.
 Fig. 3. a, b, c. *I. shikotanensis* (INAI MS.) sp. nov. Osatinai, Hidaka, Hk. no. 7264, a, lateral, b, anterior, c, dorsal view.
 Fig. 4. *I. shikotanensis* (INAI MS.) sp. nov. Hetonai, Hk. no. 38.

Plate XIII

- Fig. 1. a, b. *Inoceramus balticus* J. BÖHM (s.l.), *forma a.* (Specimen most allied to *I. balticus* s. str.). Toyazyo, Ky. without rg. no., a, antero-lateral, b, dorsal view.
 Fig. 2. *I.* ("Endocostea") sp. Toyazyô, Ky, without rg. no.
 Fig. 3. *I.* (*Sergipia?*) *akamatsui* YEHARA. Ikusyunbetu, Hk. no. 7254, left valve.
 Fig. 4. *I. naumanni* YOKOYAMA emend. Ônogawa Basin, Tk. no. I-1051. Specimen characterized by β -type concentric sculpture.
 Fig. 5. *I.* (*Sergipia?*) *akamatsui* YEHARA. Ikusyunbetu, Hk. Example showing variation of sculpture.

Plate XIV

Inoceramus naumanni YOKOYAMA emend.

- Fig. 1. Example (a), with a typical succession of the concentric sculpture. Abesinai, Sd. no. 22719.
 Fig. 2. Example (b), with predominant δ -type sculpture. Wakkawen, Sd. no. 22737.
 Fig. 3. a, b. Example (c), with predominant γ -type sculpture in the middle part. Abesinai district, Hk. no. 322.
 Fig. 4. Example (d), with predominant close-set β -type sculpture. Kawakami, Hk. no. 7121.
 Fig. 5. Example (d), characterized by β' -type sculpture. Kawakami, Sd. no. 53305.
 Fig. 6. Example (d), with predominant β' -type sculpture; probably a juvenile specimen of *I. orientalis* var. *ambiguus*. Sd. no. 22803.
 Fig. 7. Example (e), with predominant α - and α' -type sculptures. Kawakami, Hk. no. 7116.
 Fig. 8. Example (e), with α' -type sculpture. Kawakami, Sd. no. 22750.
 Fig. 9. Example (f), with a rather irregular succession of sculpture. Kawakami, Hk. no. 7126.
 Fig. 10. Example (g), characterized by coarse β' -type sculpture and somewhat skin to *I. orientalis* var. *ambiguus*. Abesinai district, Hk. no. 359b.

Plate XV

- Fig. 1. *Inoceramus naumanni* YOKOYAMA emend. Example (f), Abesinai, Tk. no. I-1044.
- Fig. 2. *I. naumanni* YOKOYAMA em. Example (d) or (g), Tk. no. I-1066.
- Fig. 3. *I. orientalis* SOKOLOW var. *ambiguus* var. nov. Loc. uncertain. Tk. no. I-1073.
- Fig. 4. *I. orientalis* SOKOLOW var. *ambiguus* var. nov. Tk. no. I-156 (= *I. lobatus* MÜNSTER in JIMBO, 1894).
- Fig. 5. *I. sachalinensis* SOKOLOW forma β . Naibuti district, Tk. no. I-111, lateral view of a left valve.
- Fig. 6. *I. schmidti* MICHAEL var. *mirabilis* var. nov. Alexandrofsk, Tk. no. I-1184.

Plate XVI

- Fig. 1. a, b, c. *Inoceramus sachalinensis* SOKOLOW emend. Abesinai district, Tk. no. I-154. (= *I. digitatus* Jimbo, 1894, Pl. 8, fig. 9.). a, lateral, b, dorsal, c, anterior view.
- Fig. 2. a, b. *I. yokoyamai* sp. nov. Naibuti district, Tk. no. I-1088.
- Fig. 3. a, b. *I. sachalinensis* SOKOLOW var. *ventriformis* var. nov. Naibuti district, Tk. no. I-1103. a, lateral, b, posterior view.
- Fig. 4. *I. orientalis* SOKOLOW em. forma β . Urakawa district, Tk. no. I-1087. $\times 3$.
- Fig. 5. *I. orientalis* SOKOLOW em. Awazi, Tk.

Plate XVII

- Fig. 1. a, b. *Inoceramus orientalis* SOKOLOW var. *ambiguus* var. nov. Osatinai, Hidaka, Hk. no. 3808a.
- Fig. 2. *I. orientalis* SOKOLOW var. *ambiguus* var. nov. Abesinai, Sd. no. 22702.
- Fig. 3. *I. orientalis* SOKOLOW em. Abesinai, Hk. no. 7124.
- Fig. 4. *I. schmidti* MICHAEL emend. Wenbetu, Tk. no. I-1183.
- Fig. 5. *I. schmidti* MICHAEL em. Toyazyo, Sd. no. 4542.
- Fig. 6. *I. naumanni* YOKOYAMA em. Example (b), possibly a young specimen of large *I. schmidti*. Naibuti district, Tk. no. I-1031.
- Fig. 7. a, b, c. *I. orientalis* SOKOLOW em. Osatinai, Hidaka, Hk. no. 3808b.

Plate XVIII

Inoceramus orientalis SOKOLOW emend.

- Fig. 1. Hk. no. 5977, Osatinai.
- Fig. 2. a, b. Hk. no. 7137b, Abesinai.
- Fig. 3. Hk. no. 7137 a, Abesinai.
- Fig. 4. a, b. Sd. no. 22721, Higasi-siritoru.

Plate XIX

Inoceramus schmidti MICHAEL emend.

- Fig. 1. a, b, c. Hk. no. 7128, Kawakami; a, lateral view (showing a shallow posterior radial depression), b, dorsal, c, anterior view to show an anterior ear-shaped area.
- Fig. 2. Hk. no. 355a, Abesinai.
- Fig. 3. Hk. no. 7231, Obirasibe.
- Fig. 4. Hk. no. 362a, Abesinai. (Specimen characterized by γ -type concentric sculpture.)

Plate XX

- Fig. 1. *Inoceramus* aff. *schmidti* MICHAEL emend. Abesinai, Hk. no. 362a. (N.B. The wing is well shown).
- Fig. 2. a, b, c. *I. yokoyamai* sp. nov. Abesinai, Hk. no. 376a. a, lateral, b, dorsal (showing the wing), c, anterior view (showing a concentric depression).
- Fig. 3. *I. sachalinensis* SOKOLOW em. Abesinai, Hk. no. 358.
- Fig. 4. a, b. *I. sachalinensis* SOKOLOW em. Kawakami, Hk. no. 150, a, lateral, b, anterior view of a large specimen. $\times \frac{1}{2}$.

Plate XXI

- Fig. 1. a, b. *I. sachalinensis* SOKOLOW emend. Abesinai, Sd. no. 5444. a, lateral view, showing the wing, b, anterior view.
- Fig. 2. *I. yokoyamai* sp. nov. Kawakami, Hk. no. 7127.
- Fig. 3. *I. cfr. pseudosulcatus* (ÔTATUME MS.) sp. nov. Noborikawa, Hk. no. 5962. Somewhat worn specimen.
- Fig. 4. *I. sachalinensis* SOKOLOW em. Kawakami, Hk. no. 150 (the same specimen as fig. 4. on Pl. XX).

Plate XXII

- Fig. 1. *Inoceramus* aff. *sachalinensis* SOKOLOW emend. (Similar to *I. sachalinensis* s.s. in the young stage and to *I. schmidti* in the later stage.) Sd. no. 7258. Abesinai. $\times \frac{1}{2}$.
s.s. in the young stage and to *I. schmidti* in the later stage.) Sd. no. 7258. Abesinai. $\times \frac{1}{2}$.
- Fig. 2. a, b, c. *I. pseudosulcatus* (ÔTATUME MS.) sp. nov. Horokakuriki in Yûbari, Hk. no. 5988. a, lateral, b, anterior, c, dorsal view.
- Fig. 3. *I. pseudosulcatus* NAGAO et MATSUMOTO var. *elegans* SOKOLOW. Urakawa, Sd. no. 50926d.
- Fig. 4. *I. kusiroensis* sp. nov. Ôtamura, prov. Kusiro, Hk. no. 7271a.
- Fig. 5. *I. pilvoensis* SOKOLOW. Tk. no. I-1185.
- Fig. 6. *I. akamatsui* YEHARA. Ikusyunbetu, Hk. (N.B. Faint radial striae are shown.) $\times 2$.

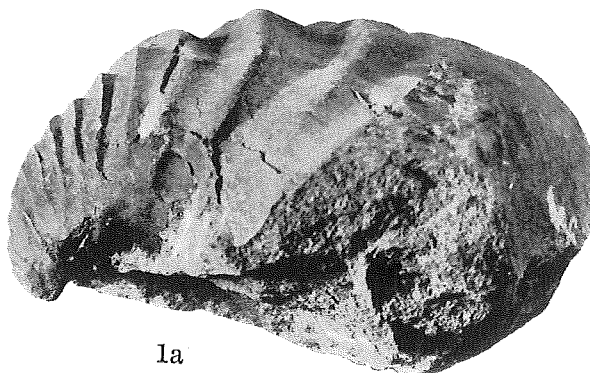
T. NAGAO and T. MATUMOTO:
A Monograph of the Cretaceous *Inoceramus* of Japan,
Part I (Vol. IV, Nos. 3-4, 1939)

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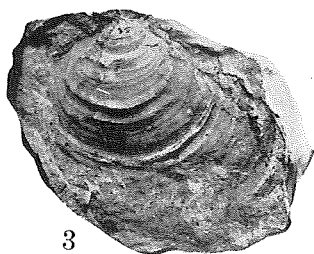
Page	<i>line from above (a)</i> or from below (b)	<i>for</i>	<i>read</i>
241	14 (a)	Inoceramus	<i>Inoceramus</i>
243	10 (a)	may	many
"	18 (a)	T. MATSUMOTO	T. MATUMOTO
"	13 (b)	Ikusyubetu	Ikusyunbetu
"	7 (b)	Nemuro	Hidaka
246	13 (a)	(in the upper part)	(\otimes in the upper part)
247	3 (a)	K _s , K _y , K _x , K _r	K _s , K _y , K _x , K _w
249	7 (a)	(UWATOKO, K.	UWATOKO, K.
253	20 (a)	species	specimens
254	15 (a)	group <i>Inoceramus</i>	group of <i>Inoceramus</i>
256	1 (a)	break angle	α beak angle
"	5 (a)	apical angle	β apical angle
"	8 (a)	postero-dorsal angle	γ postero-dorsal angle
257	16 (a)	<i>Concentric depressions</i>	(C) <i>Concentric depressions</i>
259	6 (a)	divide	divided
260	14 (b)	UI	U
264	24 (a)	Nizol	Mizol
267	11 (b)	Ugoizawa	Uguizawa
271	8 (a)	rg. no. 22725 (Sd) from an unknown locality	rg. no. 22725 (Sd) from the Simo-kenebetu, prov. Tesio, horizon uncertain.
"	6 (b)	SPEGLER	SPENGLER
275	2 (a)	no. 711 (Tk)	no. 721 (Tk)
275	5 (a)	no. 22642 (Sd)	no. 22643 (Sd)
275	12 (a)	40 40 13-14	40 29 13-14
276	5 (a)	Pl. XXIV (II)	Pl. XXV (III)
277	9 (a)	comparing, with	comparing with
278	3 (a)	wing-line	wing-like
281	17 (a)	Pl. XXIX (VI)	Pl. XXVIII (VI)
"	"	Pl. XXX (VII)	Pl. XXIX (VII)
"	"	Pl. XXXI (VIII)	Pl. XXX (VIII)
"	" Pl. XXX (VII), figs. 1-6	Pl. XXX (VII), figs. 1, 3-6
282	14 (a)		Add: Pl. XXIX (VII), fig. 2
283	9 (a)	in	is
287	19 (a)	Pl. XXXIV (XI)	Pl. XXXIII (XI)
"	"	Pl. XXXV (XII)	Pl. XXXIV (XII)
289	5 (a)	Pl. XXXIV (XI)	Pl. XXXIII (XI)
290	11 (a)	type	typical
291	10 (a)	Pl. XXXII (IX)	Pl. XXXI (IX)
"	"	Pl. XXXIII (X)	Pl. XXXII (X)
293	4 (b)	Pl. XXXI (VIII)	Pl. XXXII (X)
295	5 (a)	Pl. XXXI (VIII)	Pl. XXX (VIII)
298	22 (a)	<i>I. hobetsensis</i> sp. nov.	<i>I. hobetsensis</i> var. <i>nonsulcatus</i> var. nov.



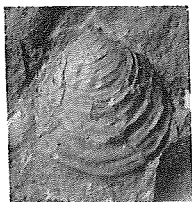
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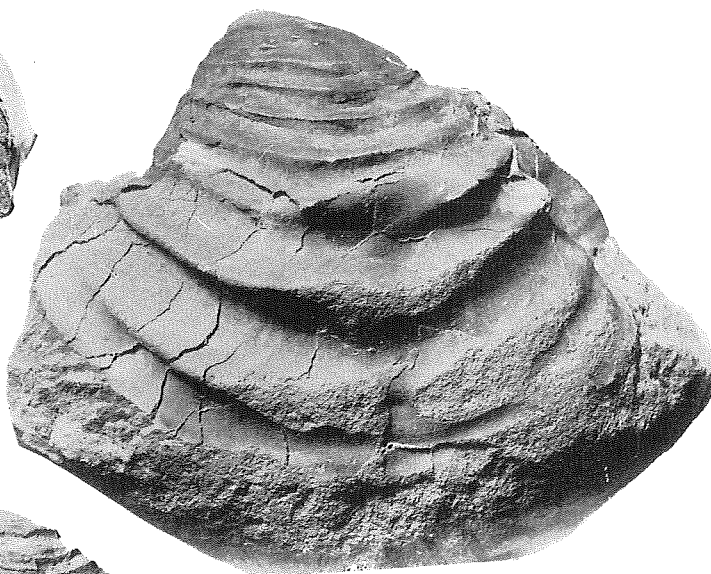
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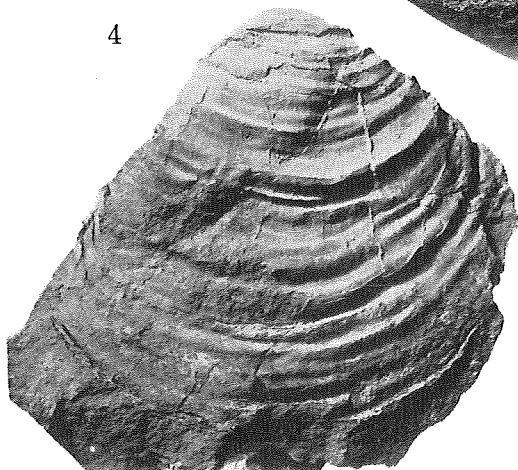
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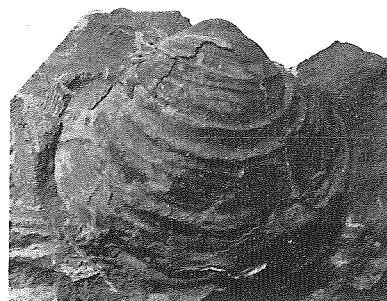
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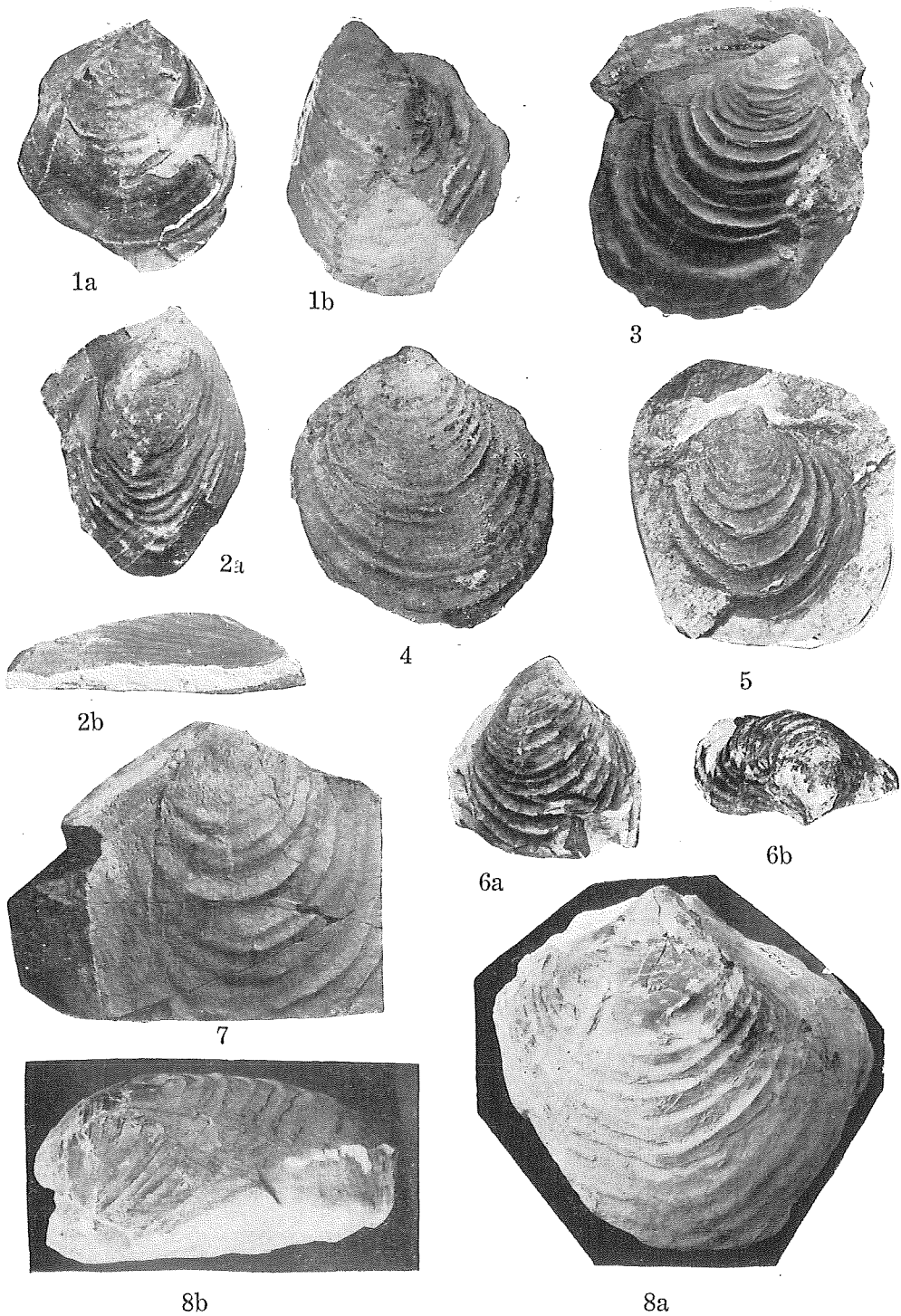
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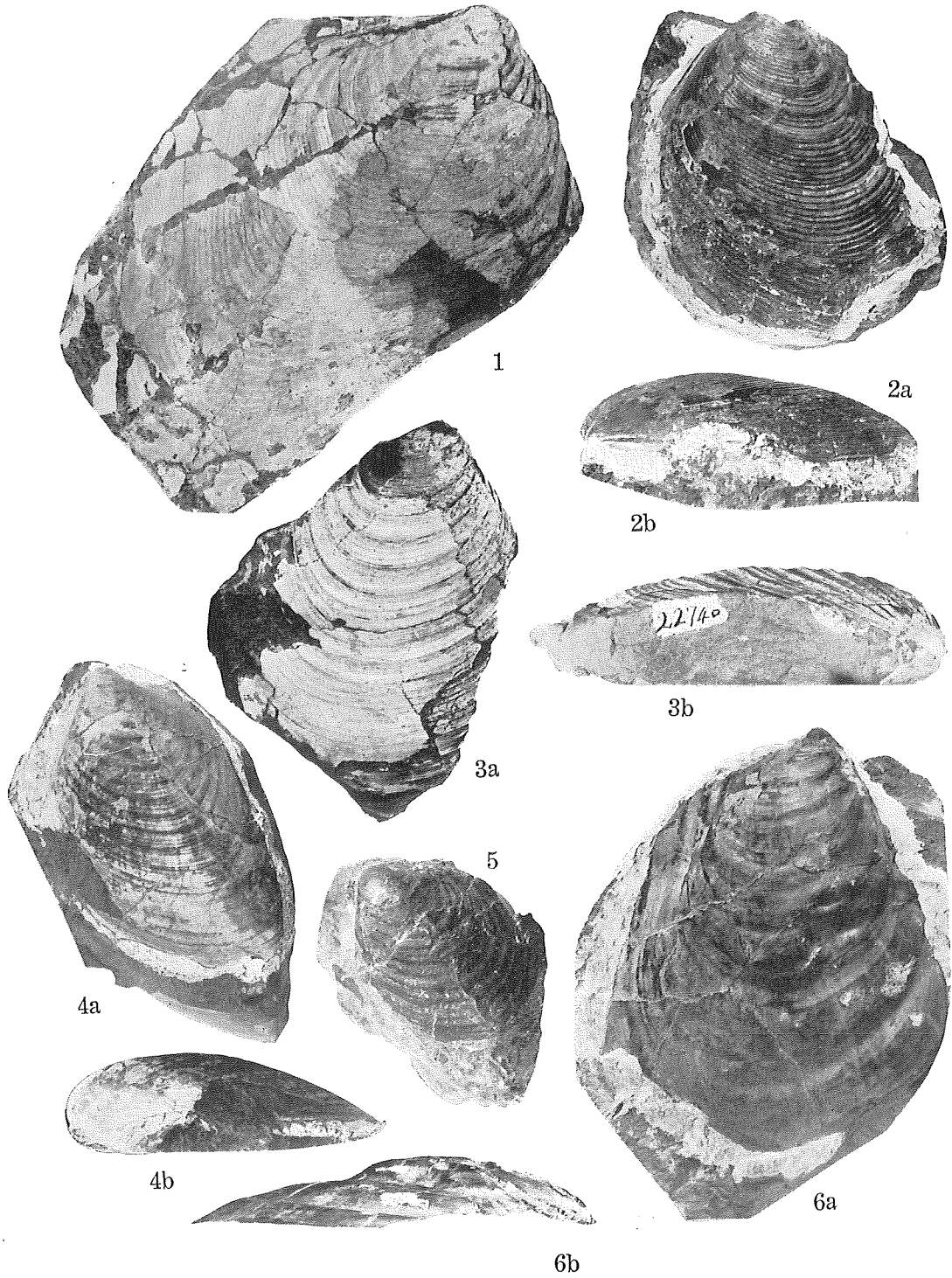
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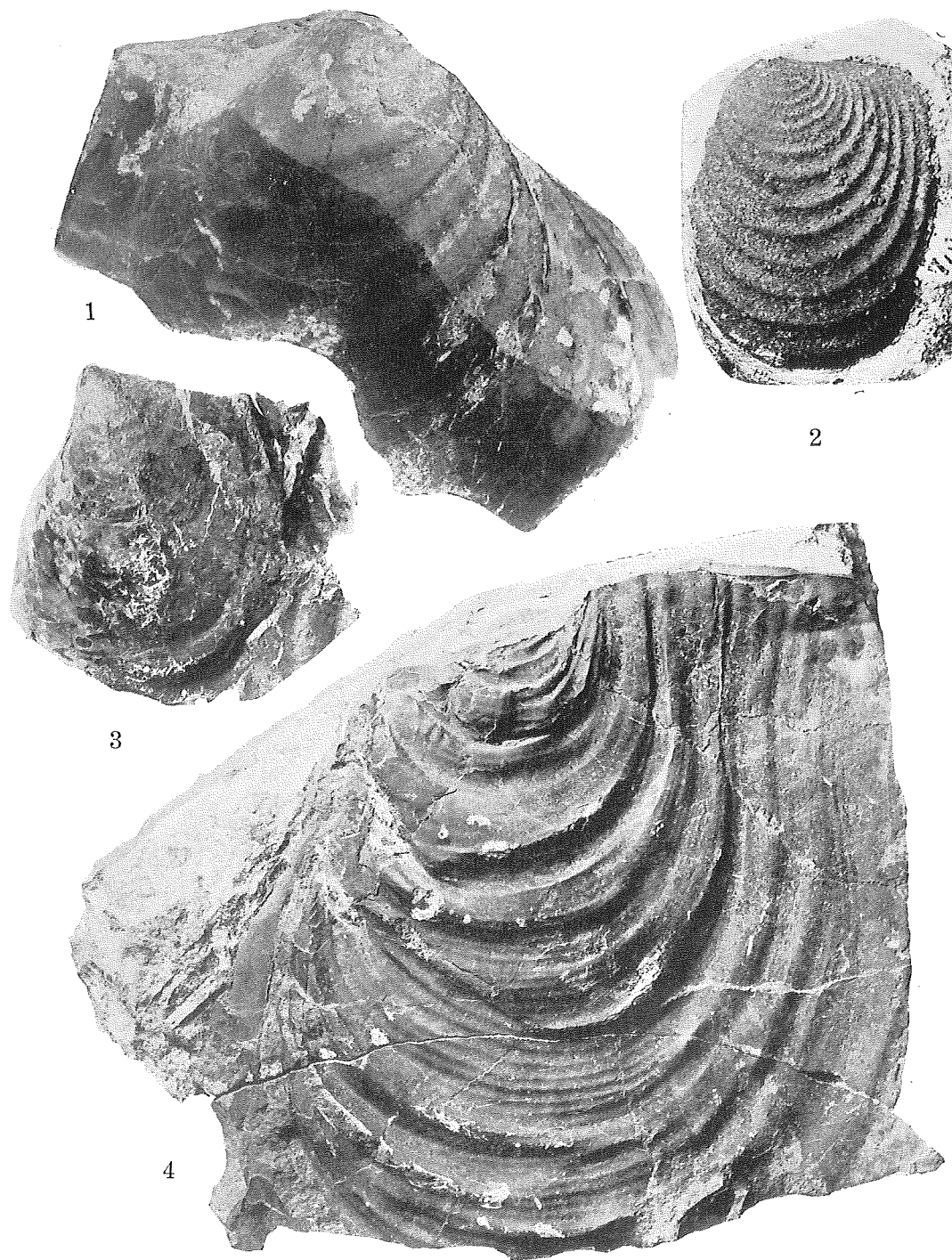
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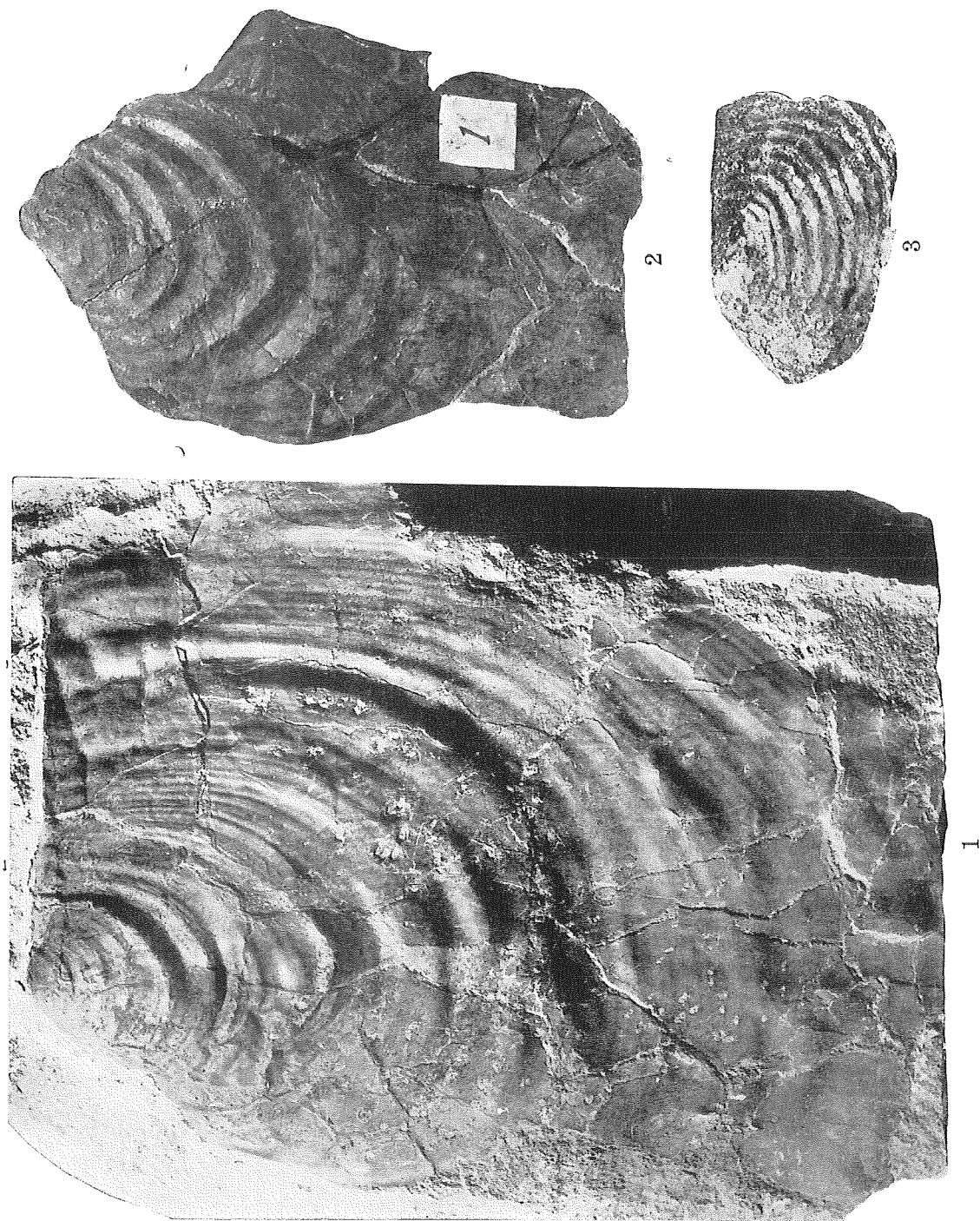
T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



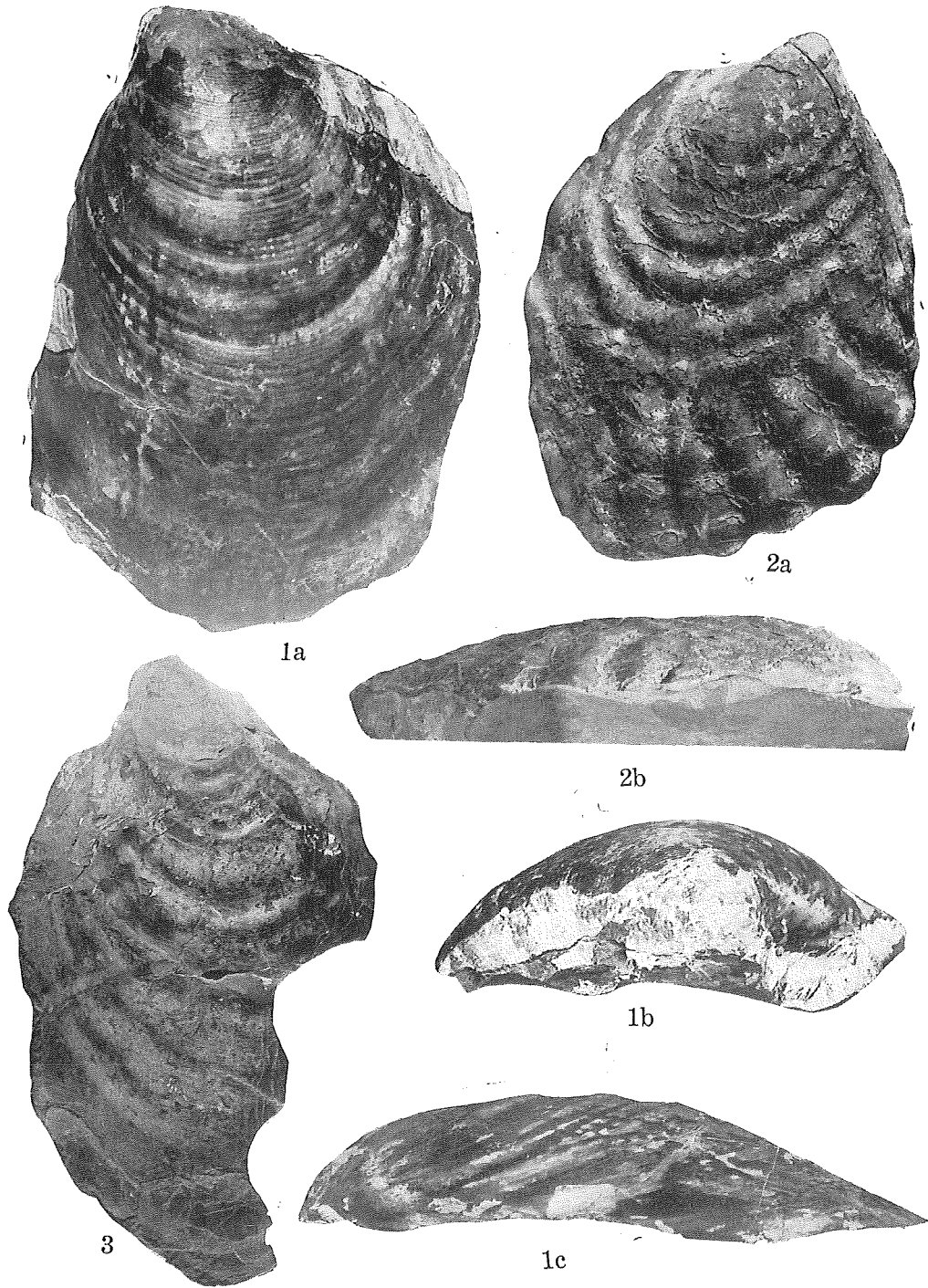
T. Nagao and T. Matumoto : Cretaceous Inoceramus. Pt. II.



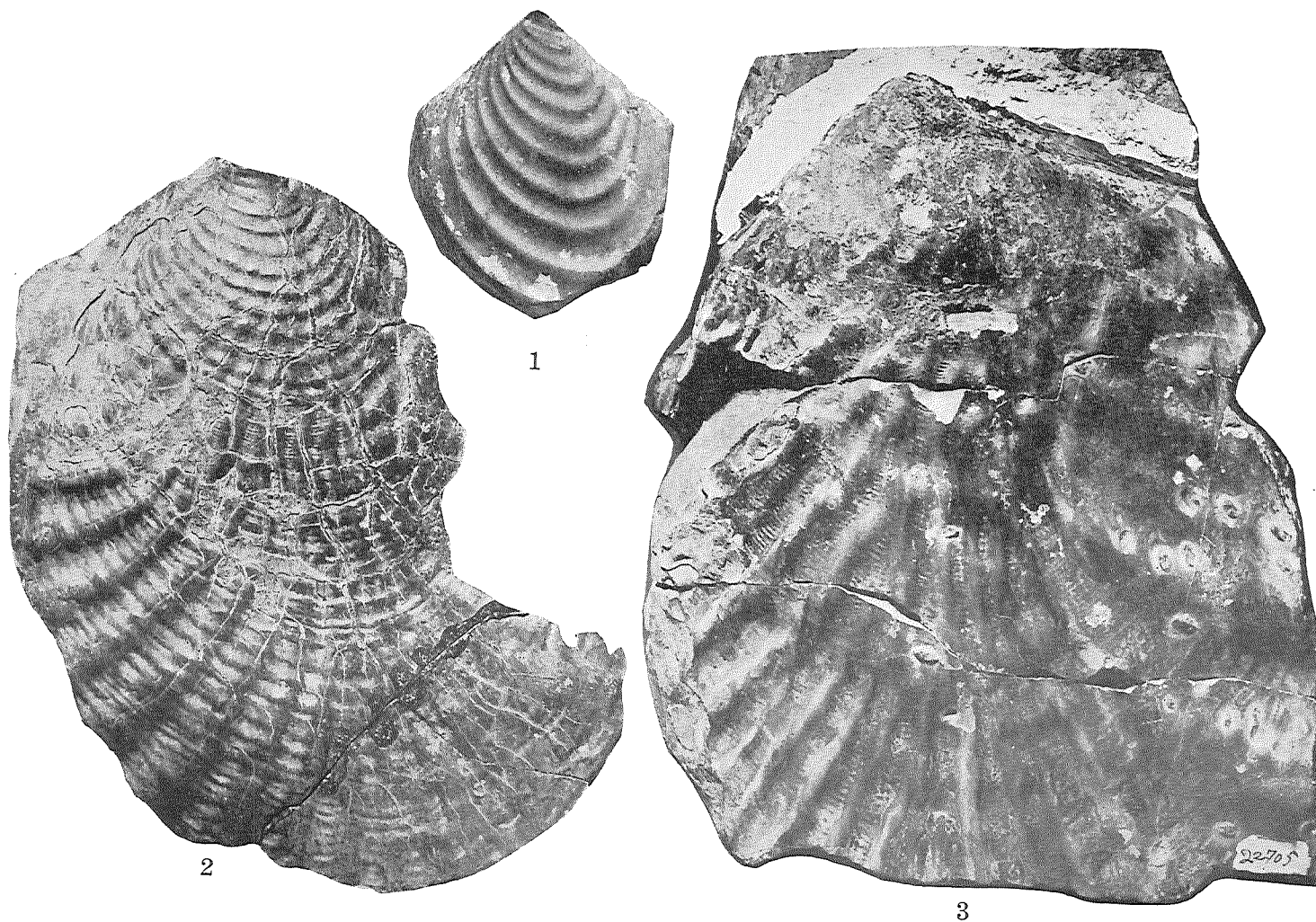
T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



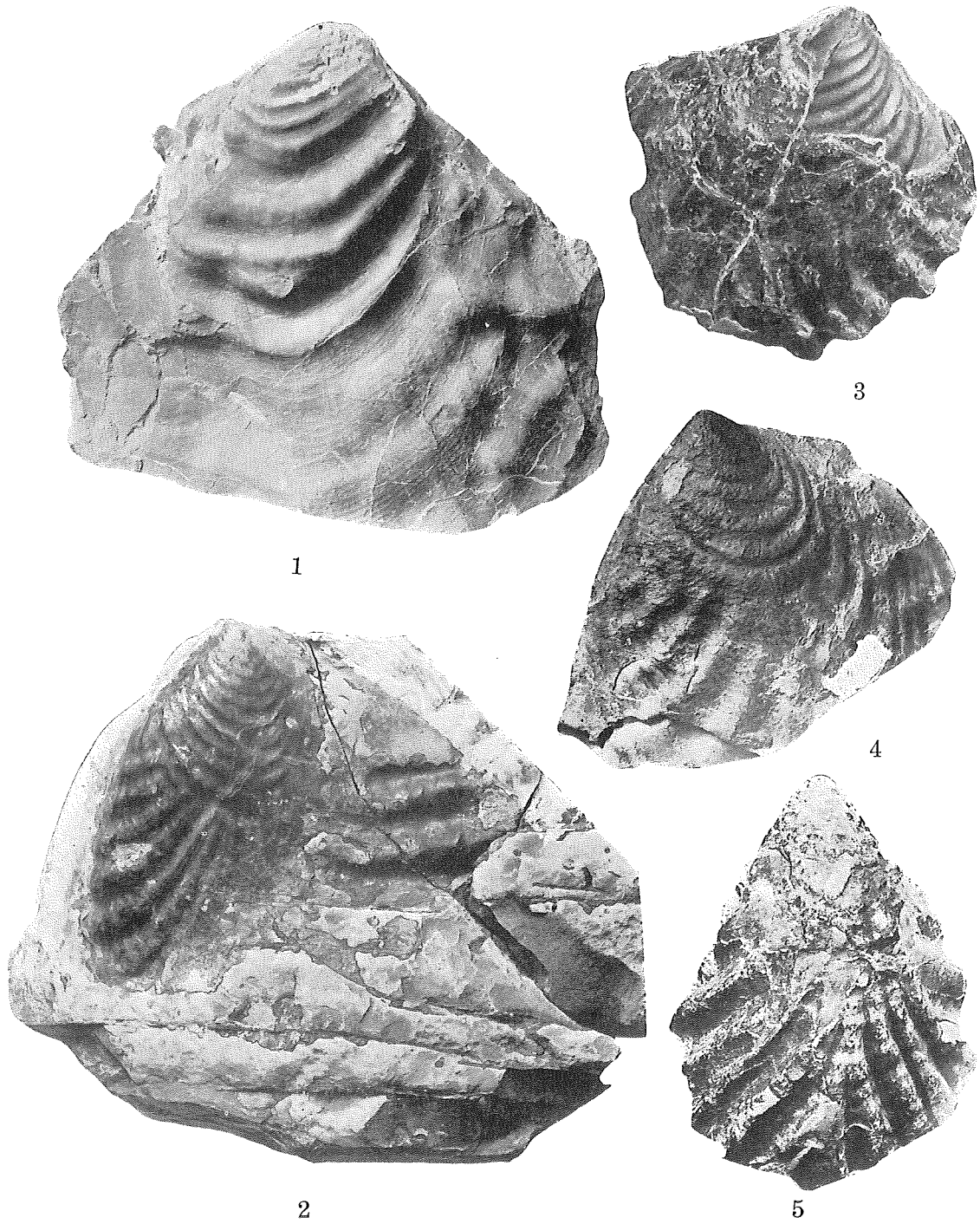
T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



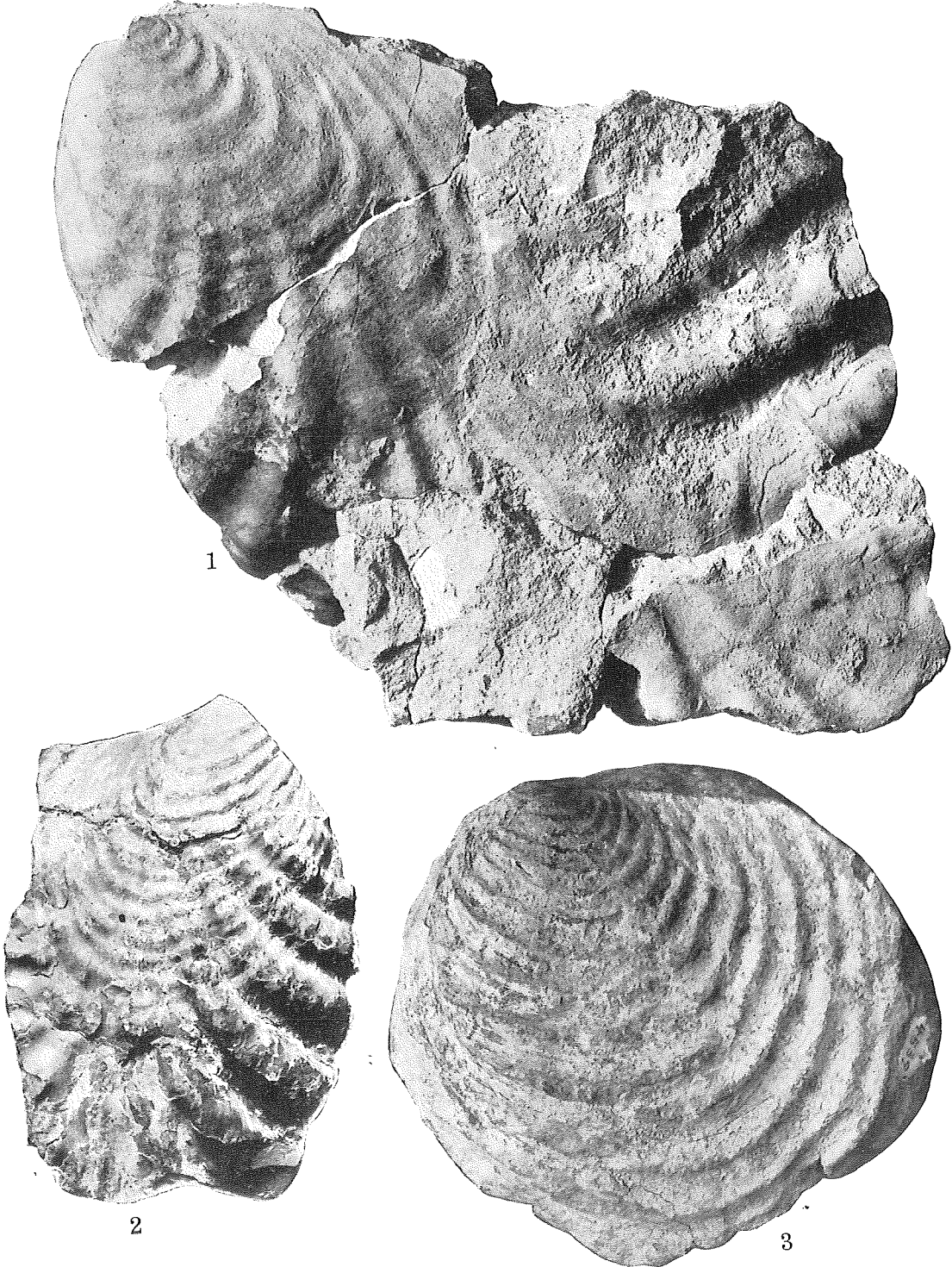
T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



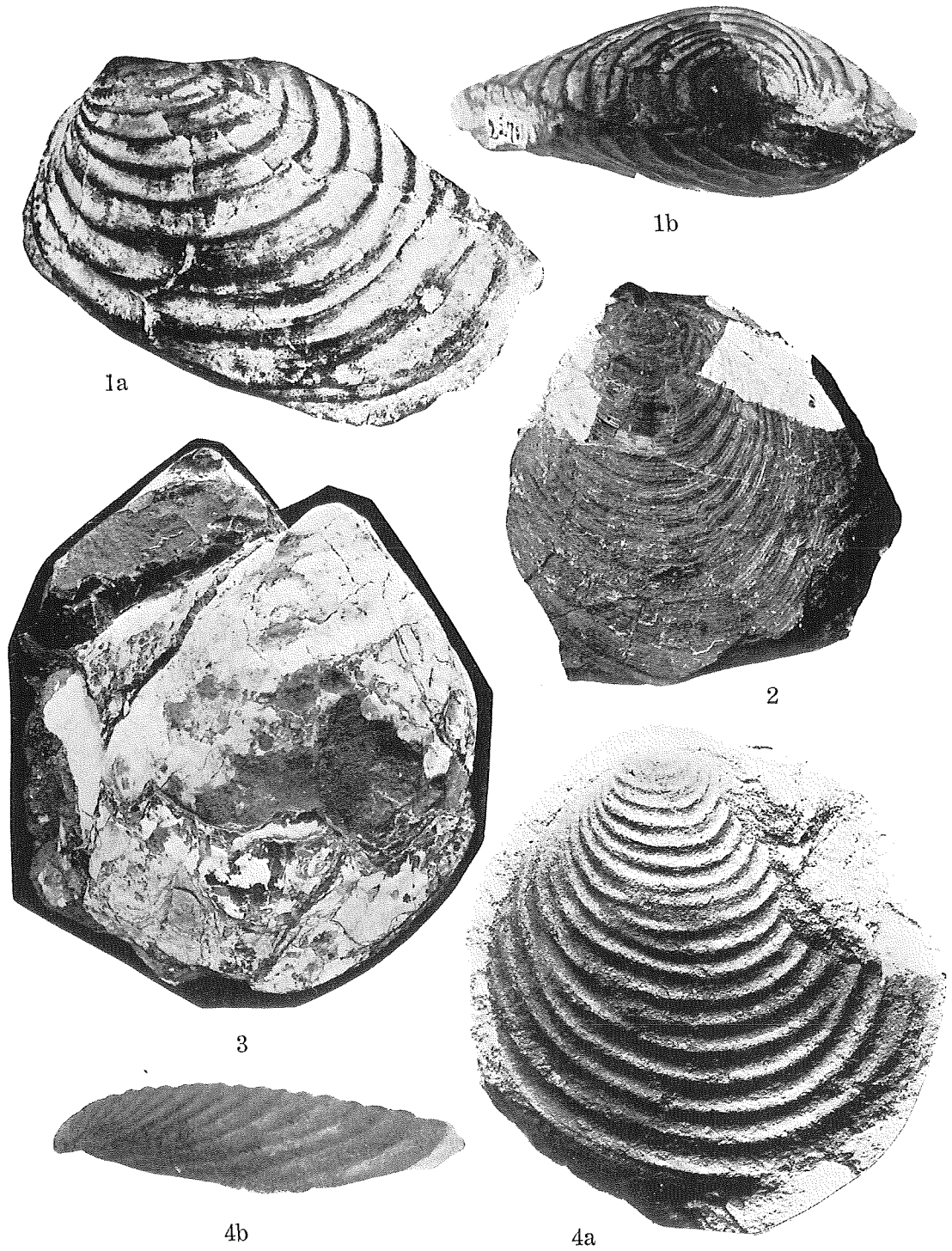
T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



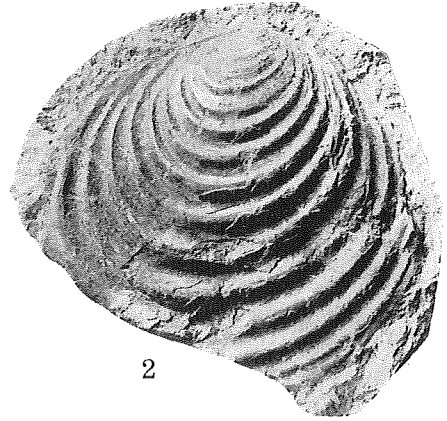
T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



T. Nagao and T. Matumoto : Cretaceous Inoceramus. Pt. II.



1



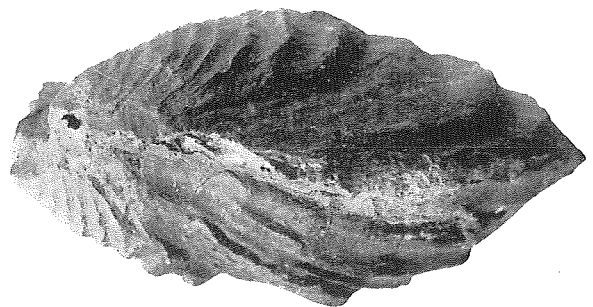
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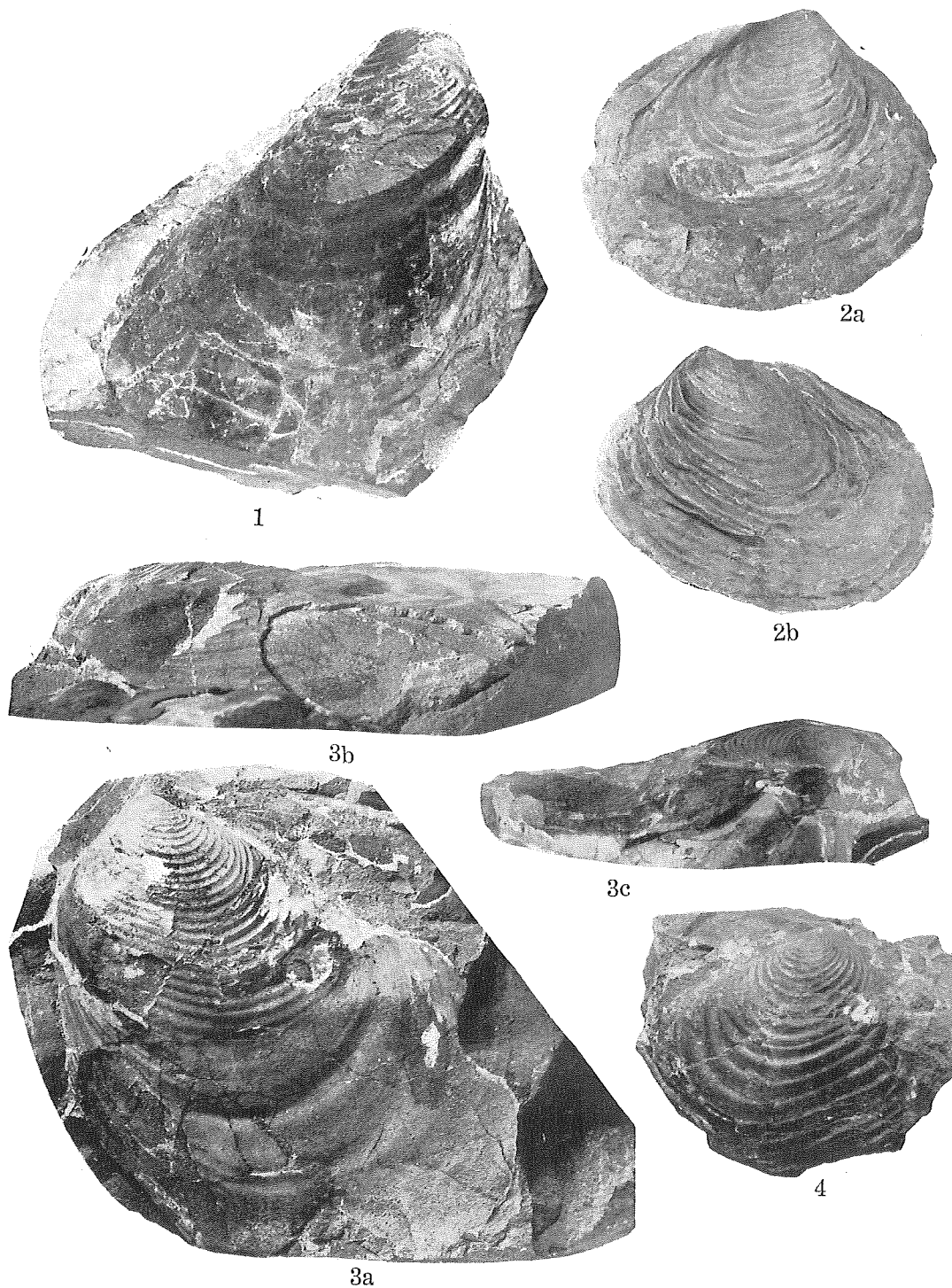
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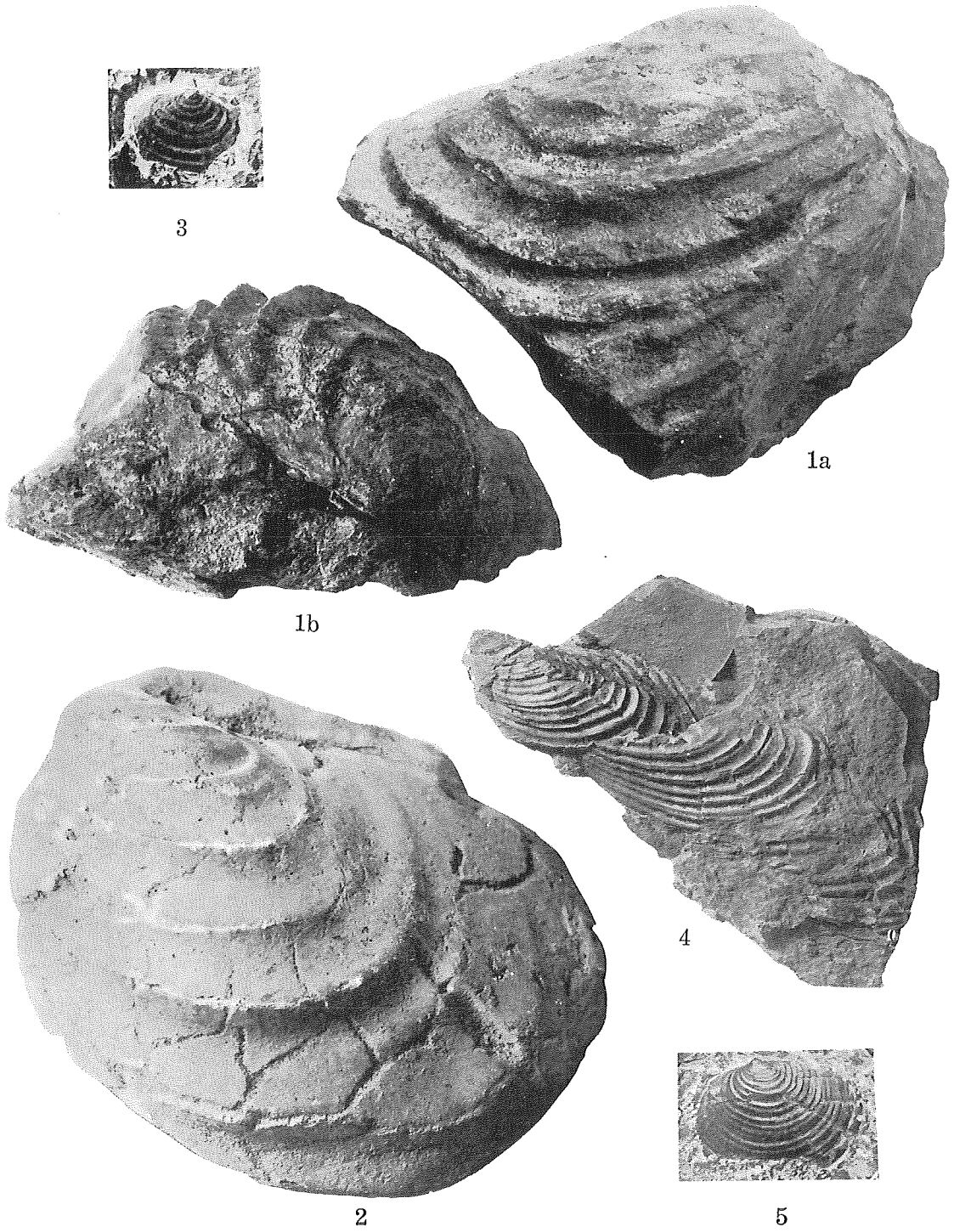
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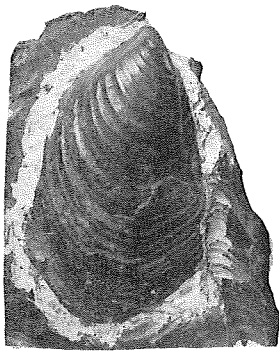
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T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



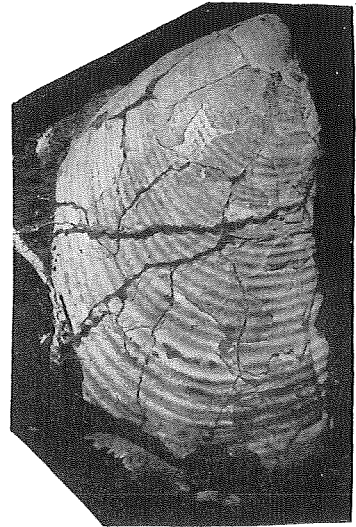
T. Nagao and T. Matumoto : Cretaceous Inoceramus. Pt. II.



1



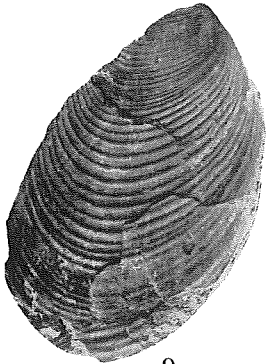
3a



2



3b



9



5



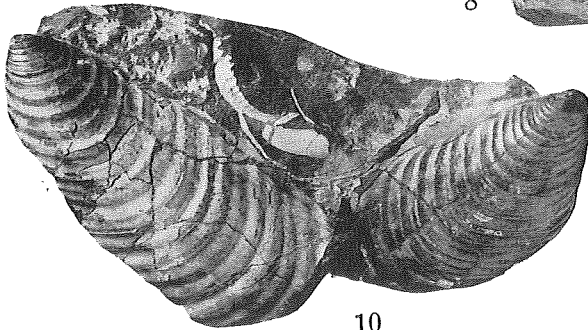
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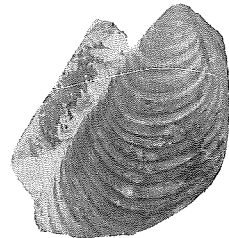
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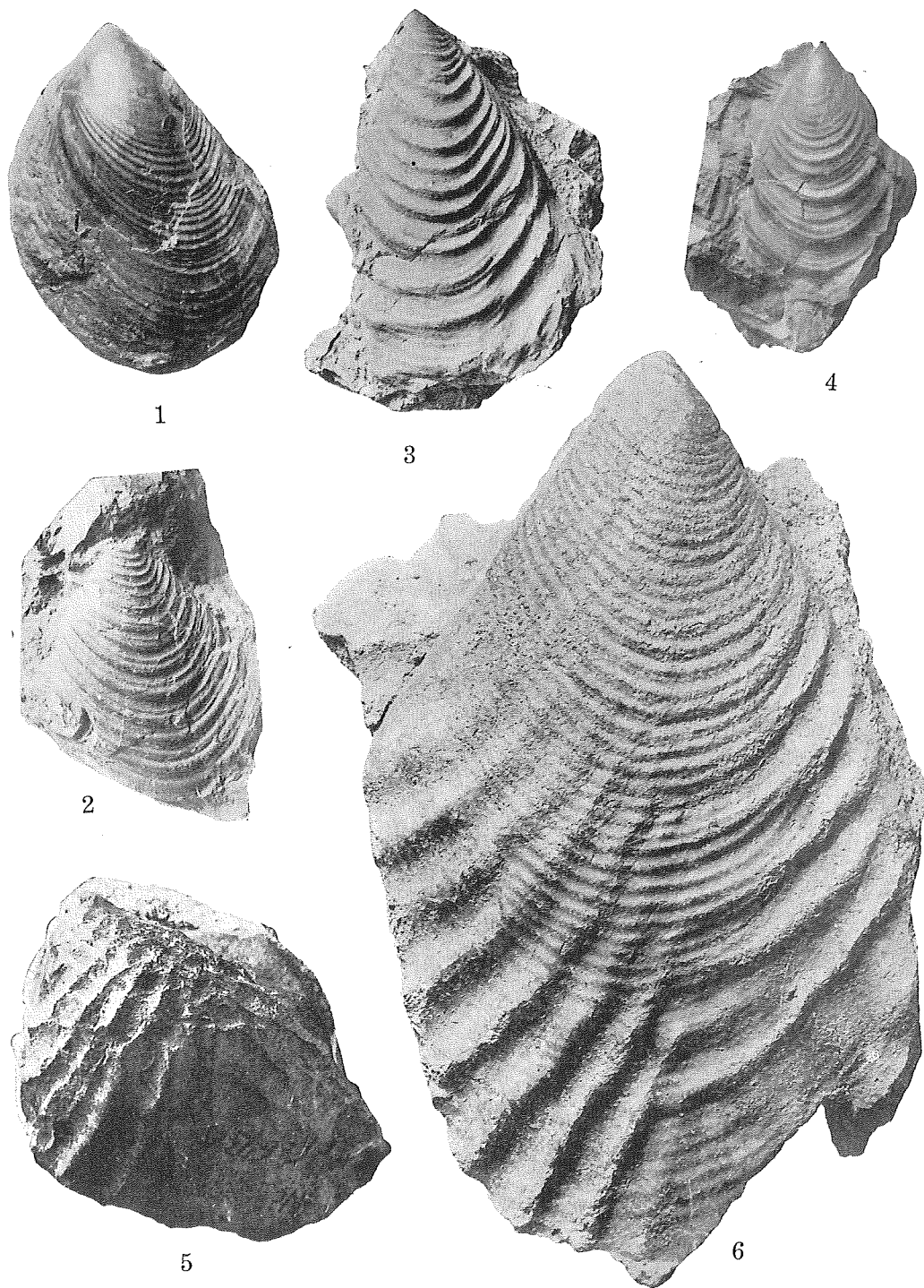
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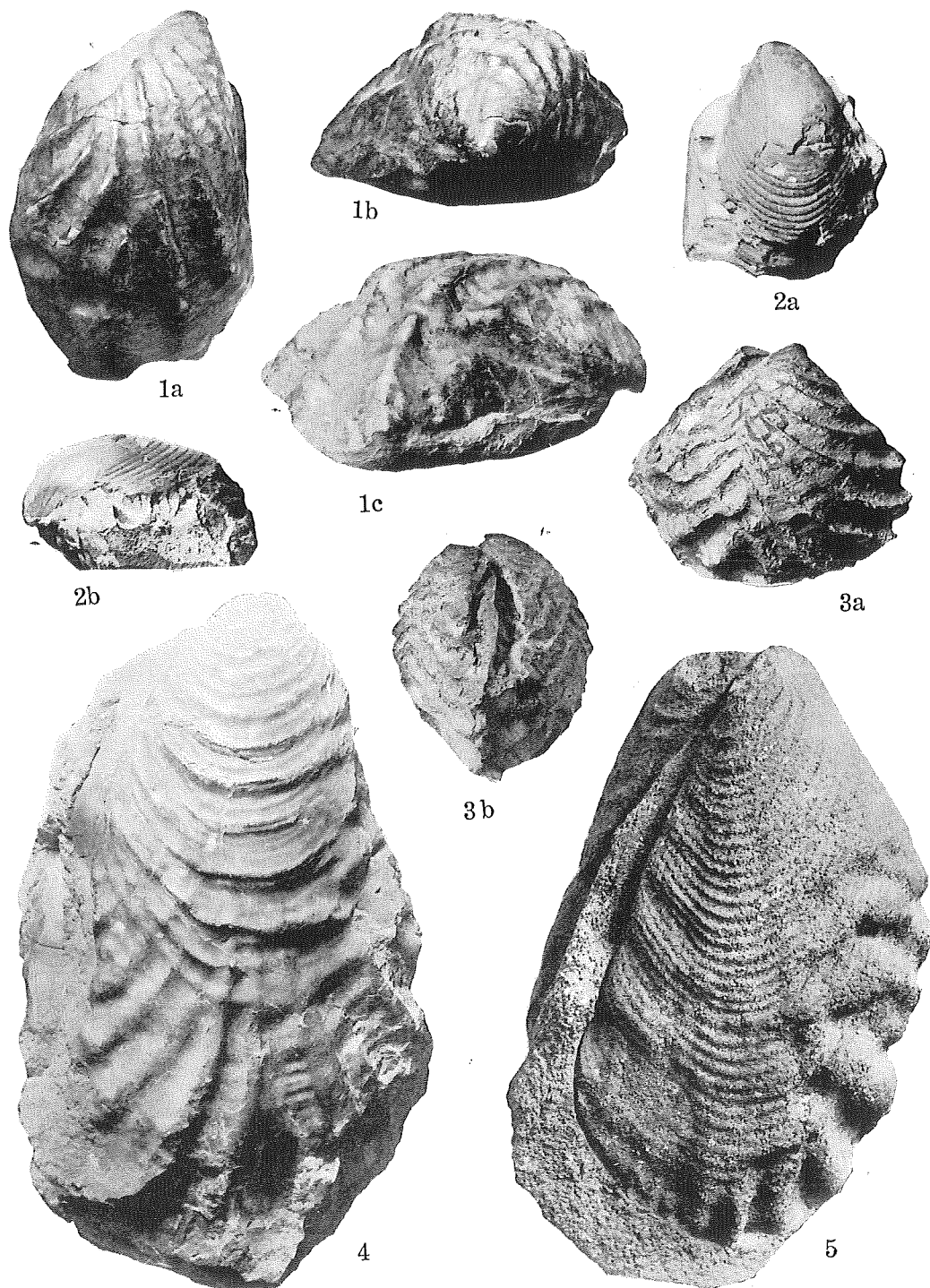
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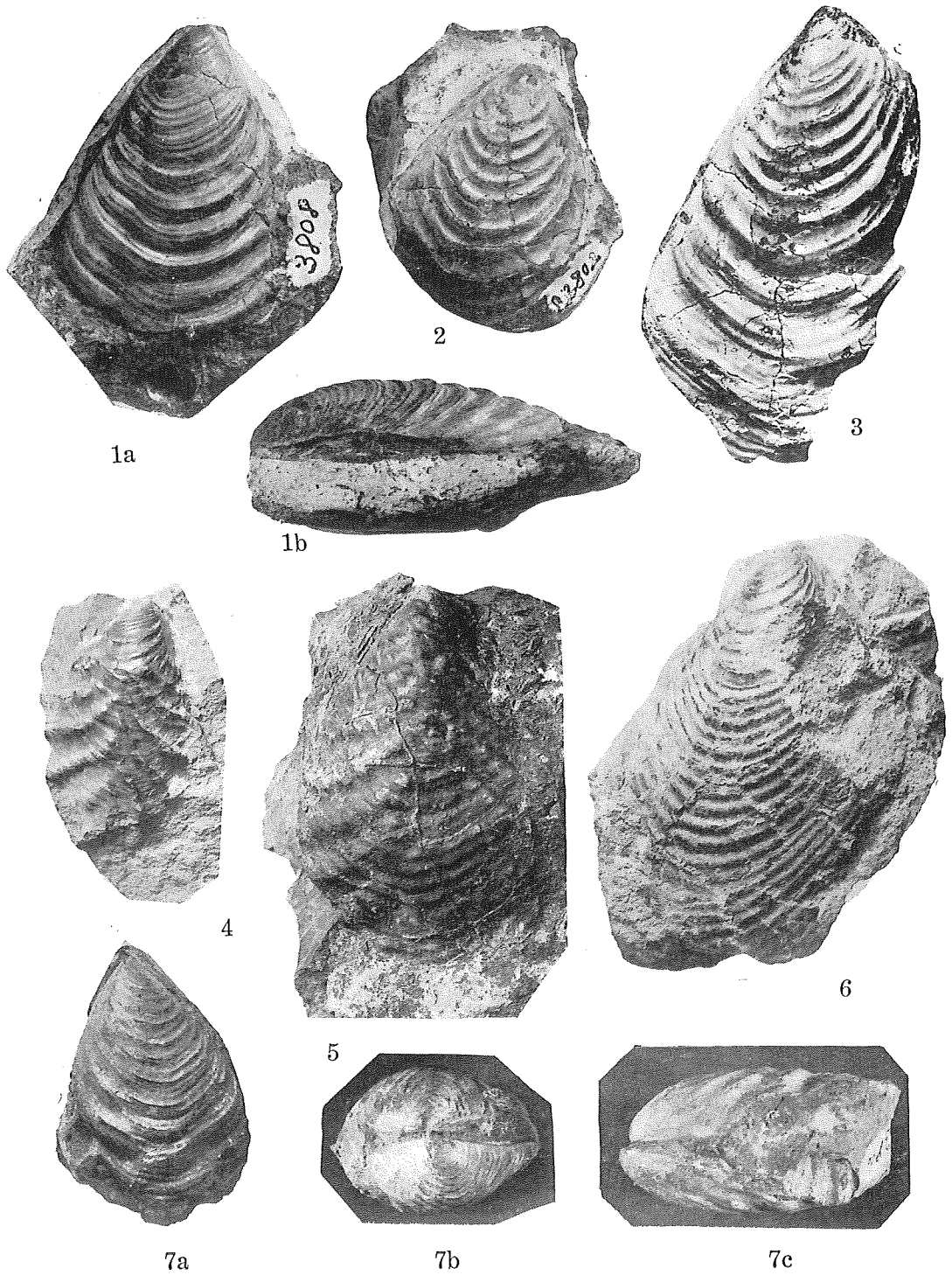
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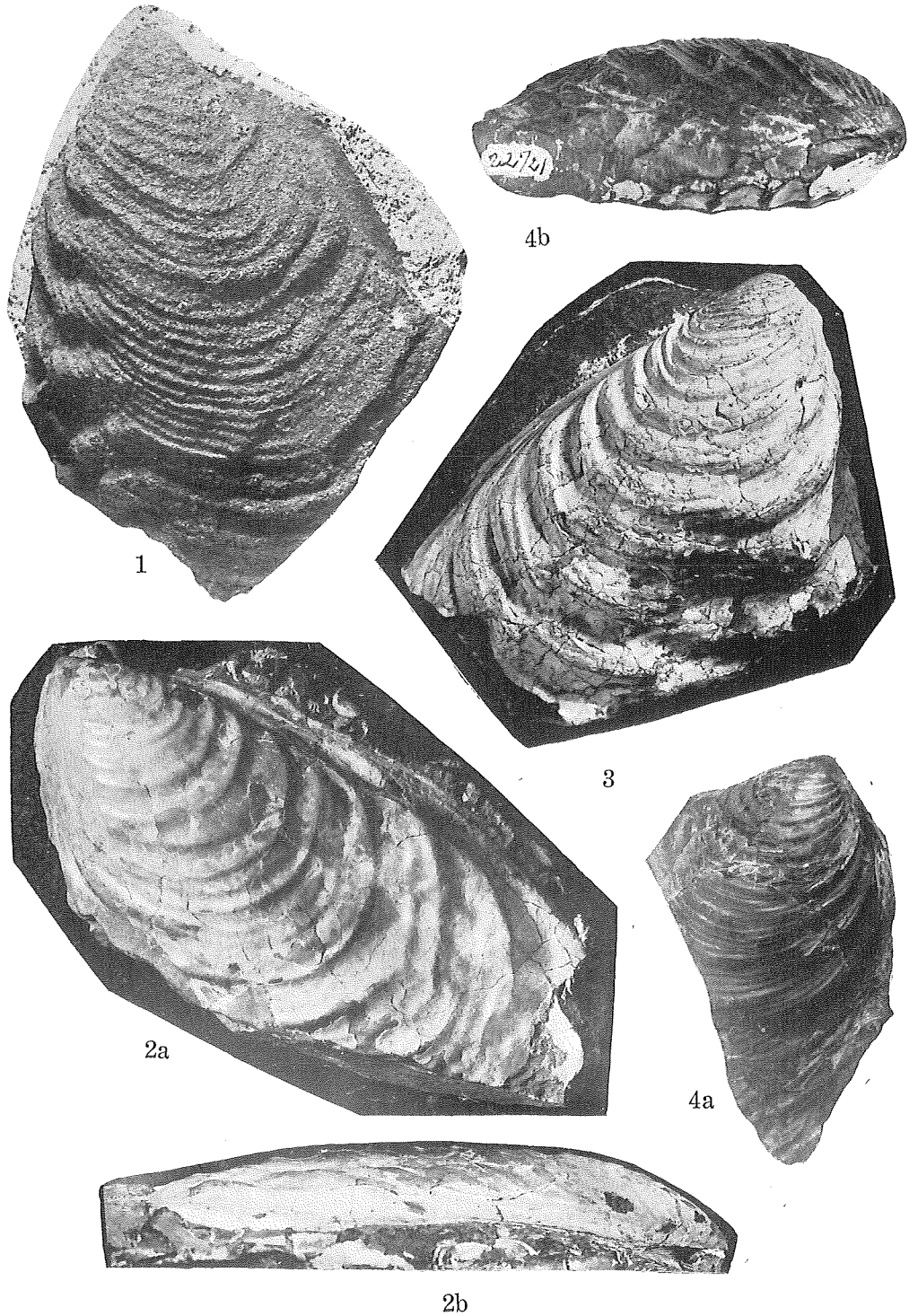
T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



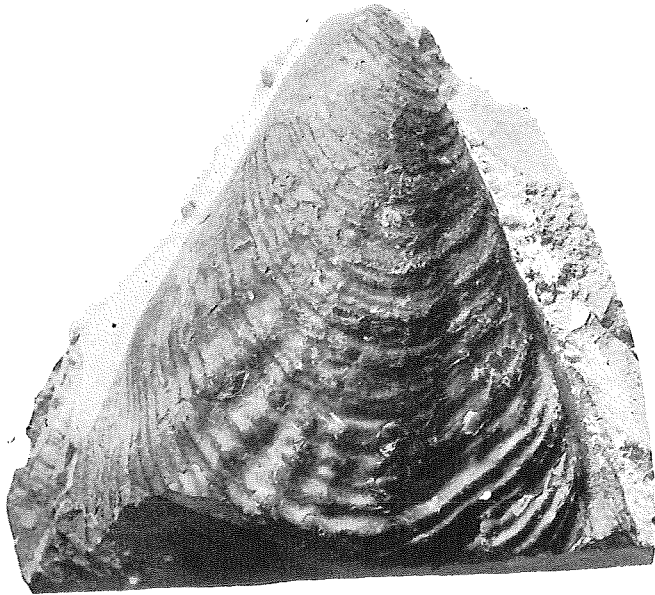
T. Nagay and T. Matumoto: Cretaceous Inoceramus. Pt. II.



T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



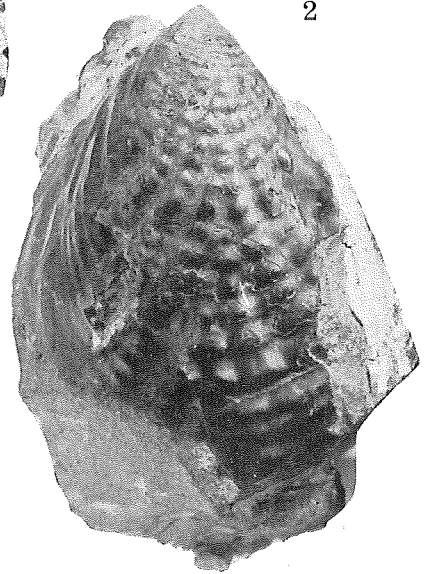
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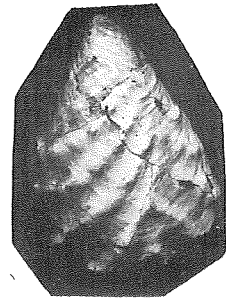
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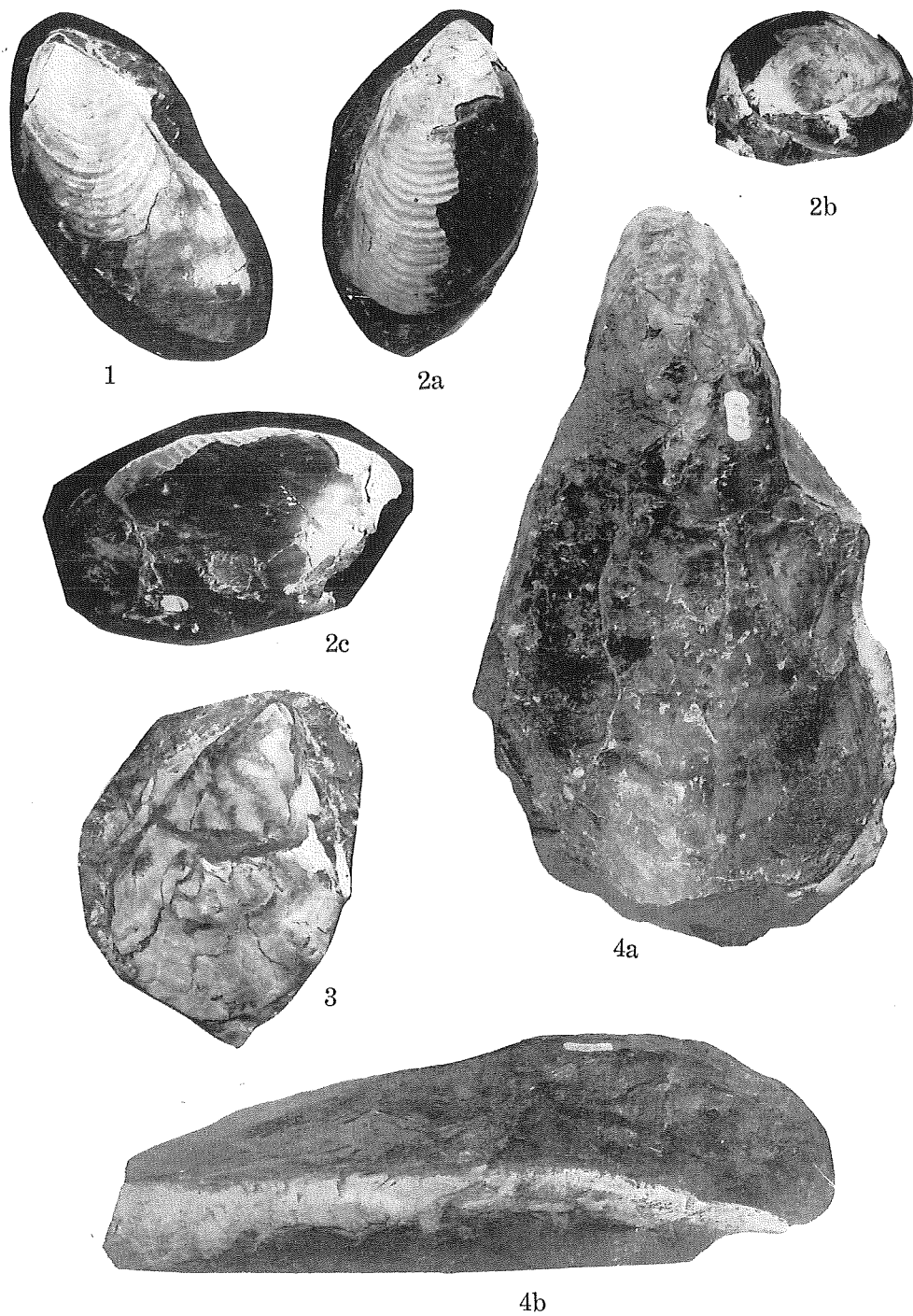
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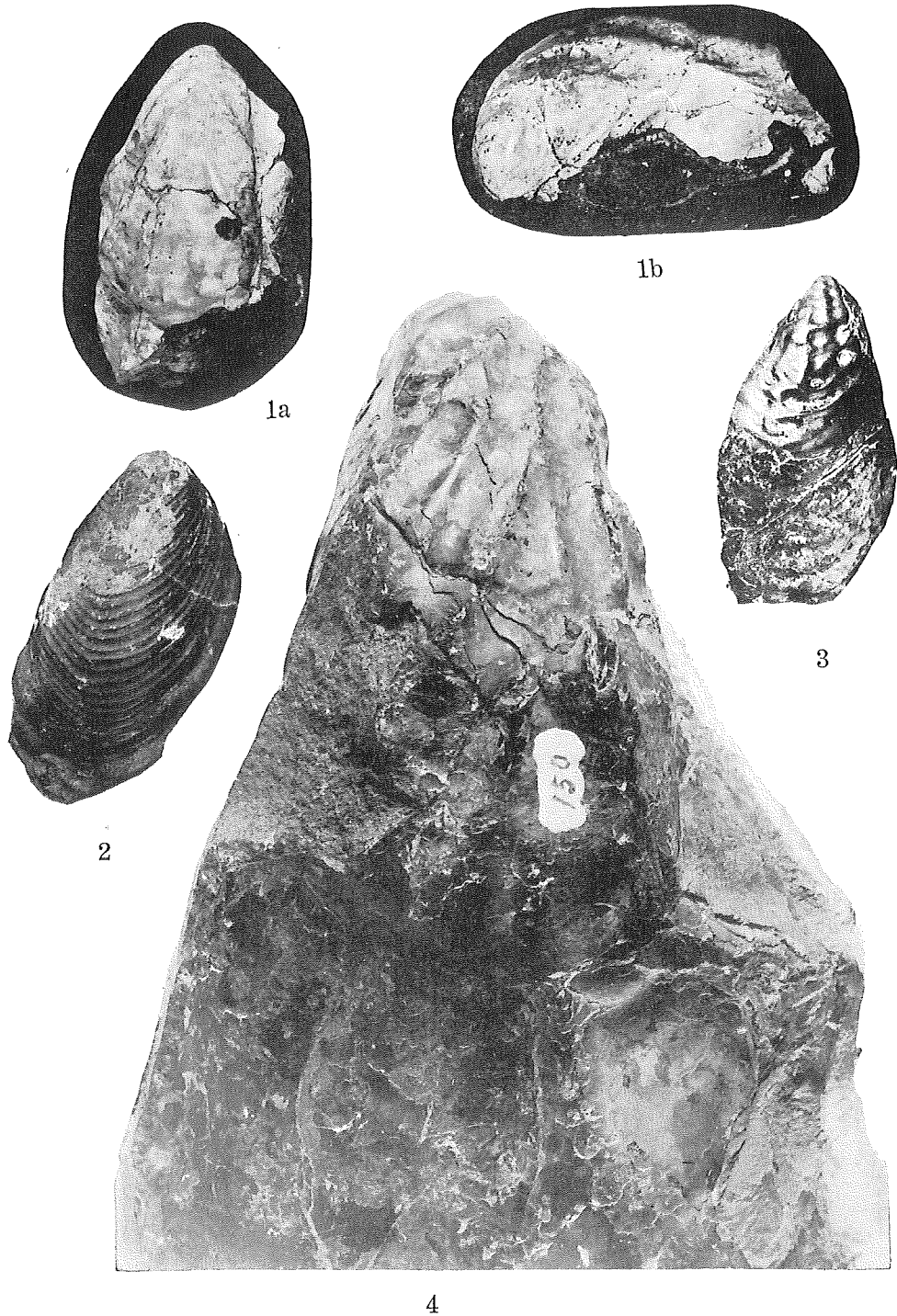


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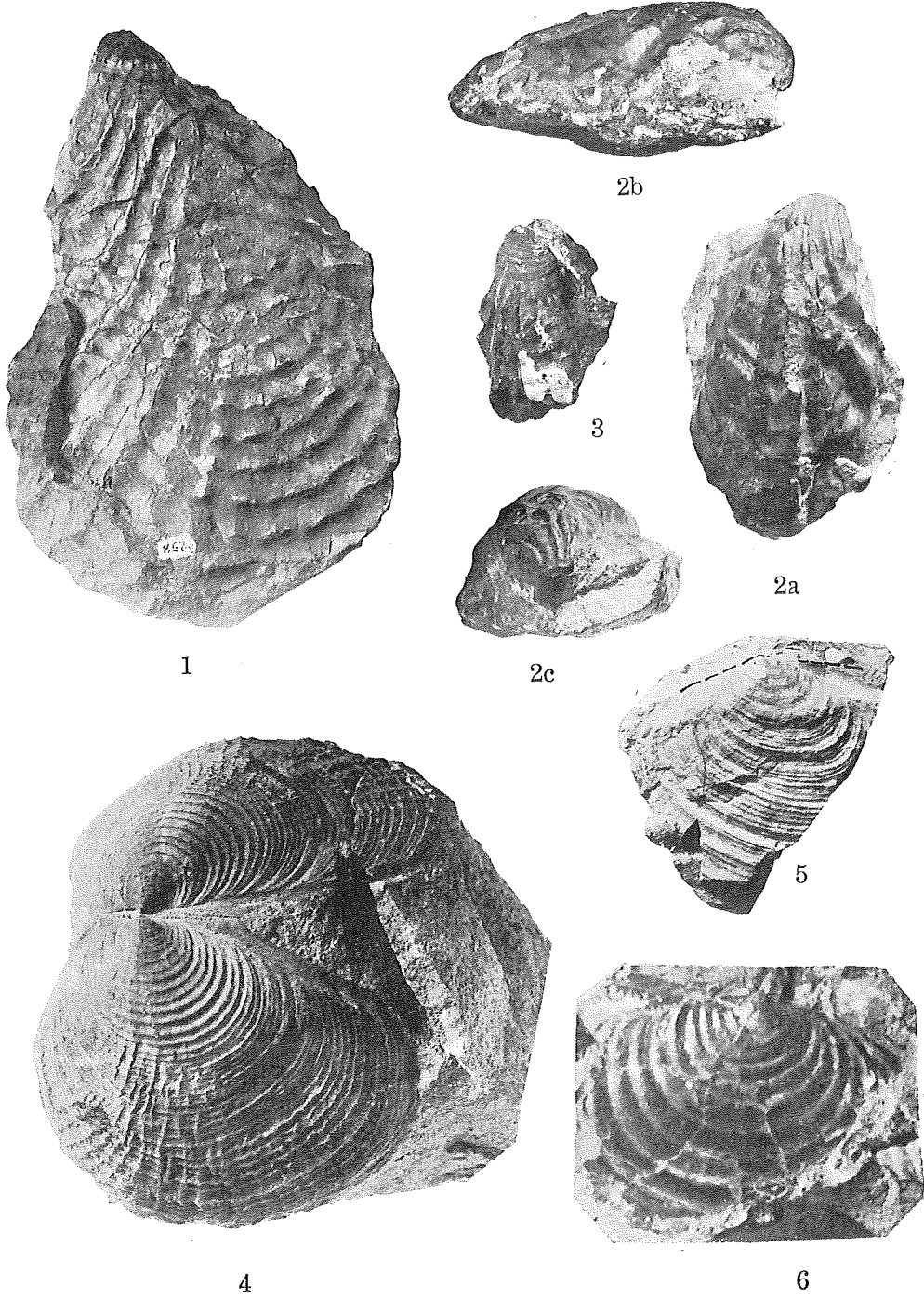


4





T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.



T. Nagao and T. Matumoto: Cretaceous Inoceramus. Pt. II.