

Jurassic Ammonites from Echizen and Nagato.

By

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With 4 plates.

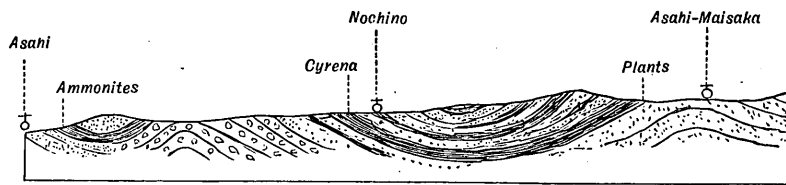
A. Ammonites from Echizen.

The occurrence of Ammonites in the Jurassic plant-bearing series of the province of Echizen was known as early as 1882, when Dr. KOCHIBE discovered them in a shale near the village of Shimoyama in the same province. No collection of them, however, was made, until Mr. M. MATSUSHIMA, after a careful search near Kaizara and its vicinity in 1885 succeeded in finding several specimens which were afterwards deposited in the museum of the Science College of the Tokyo University. The results of the study of these fossils are as follows.

According to Mr. MATSUSHIMA, the rock-layers exposed along the river Ishidoshiro, a branch of the Anamegawa in the district of Ono, consist of a basal conglomerate and a complex of shales and sandstones. This complex is divided by him into three parts, the *Lower* or *Ammonite-bed*, the *Middle* or *Plant-bed* and the *Upper* or *Cyrena-bed*. It is in this *Ammonite-bed* that the above fossils were found. The chief locality for them is Horadani near

the village of Kaizara, but there are also two other localities, viz., Nagano and Shimoyama which in a direct line are not quite 4 kilometers from the first named place.

The following is a profile along the river Ishidoshiro, as given by Mr. MATSUSHIMA in his geological paper on Echizen (MS).



As might be expected from the mostly freshwater nature of the Jurassic formation of Echizen, the Ammonite remains are of very rare occurrence. Moreover their preservation is such as to make their determination very difficult, the specimens being generally flattened by rock-pressure.

The following are the names of species which I have been able to distinguish in these Ammonites :

1. *Perisphinctes* (*Procerites*) *Matsushimai* nov. sp.
2. *Perisphinctes* (*Grossowria*) *Hikii* nov. sp.
3. *Perisphinctes* (*Biplices*) *kaizaranus* nov. sp.
4. *Perisphinctes* (*Biplices*?) *Kochibei* nov. sp.
5. *Perisphinctes* (*Ataxioceras*) sp.
6. *Oppelia echizenica* nov. sp.

Of the five species of *Perisphinctes*, four are new, and the remaining one is also probably so, although at present this is uncertain. They are, excepting *Perisphinctes Hikii* which shows some relation to a Kelloway species, *Perisphinctes Steinmanni* PAR. ET BON., all more or less allied to the foreign Oxford

forms; viz. *Perisphinctes Matsushimai* to *Perisphinctes promiscuus* BUKOW., *Perisphinctes kaizaranus* to *Perisphinctes triplex* QUENST, and *polygyratus* REIN., *Perisphinctes Kochibei* to *Perisphinctes subcolubrinus* WAAG., and *Perisphinctes sp.* to *Perisphinctes occultefurcatus* WAAG. The only other Ammonite beside *Perisphinctes* is a new form of *Oppelia* which exhibits a distant relationship to *Oppelia nobilis* NEUM. of the Tithonian. Therefore it is hardly to be doubted that we have here a bed which must be ascribed to the Malm. This assertion is also strengthened by the preponderance of *Perisphinctes* which has its greatest development in the same formation. To what part of the Malm this Ammonite-bed belongs is at present difficult to say, but probability points to its lower part or Oxford.

The determination of the Echizen Ammonites as those of the Malm leads to the important conclusion that the plant-bearing series developed in that part of Japan is not, as formerly believed, entirely Middle Jurassic, but that a part of it represents also the upper portion of the same formation.

DESCRIPTION OF THE SPECIES.

1. **PERISPINCTES (PROCERITES) MATSUSHIMAI** M.

Pl. I. Fig. 1.

The shell is compressed, discoidal, widely umbilicated, consisting of about 6 whorls which are nearly $\frac{1}{2}$ involute. The whorls are also laterally compressed, being only slightly convex. They are furnished with many rigid elevated ribs separated by smooth intervals of a much greater breadth. These ribs are

tolerably sharp in the inner whorls, but become gradually obtuse towards the mouth. They rise at the umbilical suture, are directed a little forward and divide into three smaller ones near the venter into which they seem to pass in a straight line. In the last and the next to the last whorls, there are two deep grooves which are more oblique than the ribs and separated from each other by about one-half the length of the whorl.

The diameter of the shell in our only specimen is 138 mm. with an umbilical width of about 77 mm., so that the ratio of the two is 10 to 5,7. But as the specimen is somewhat distorted, the real umbilical width may be a trifle less.

The number of ribs in one half of the last whorl is 28, so that the whole number may be about 55.

The suture line seems to be deeply incised, although it is not distinctly visible.

This species shows a great resemblance to *Perisphinctes promiscuus* BUKOWSKI (*Ueber die Jurabildungen von Czenstochau in Polen*, p. 308, pl. IV., fig. 1, pl. V., figs. 1, 2) of the Lower Oxford of Poland. The only difference which I could find in the surface markings of the two is in the number of ribs which in the Polish species is said to be 50. The shape of the whorls can not be well compared, as our specimen has been subjected to rock-pressure; but as far as I can judge from the general outline of the shell, the Japanese form appears to have a laterally more compressed whorl than the Polish one, in which it is said to be ovate in section.

Perisphinctes promiscuus occurs also in the Lower Oxford of France and Portugal.

Locality :—Nagano, in a hard dark-coloured shale.

2. **PERISPINCTES (GROSSOUVRIA) HIKII** M.

Pl. I. Figs. 2, 3.

There are two specimens belonging to this species which may be characterized as follows:

Shell flatly discoidal, with a wide umbilicus. Whorls numerous, very slightly involute, oval slightly higher than broad, transversely ribbed. Ribs numerous, elevated, with the upper edge obtuse, and showing the characters of the *Curvicosta* type, that is to say, rising at the umbilical suture, they are at first directed obliquely forward, but near the middle of the flanks bend backward and then bifurcate, the ribs arising from bifurcation going over straight to the venter. The division of ribs usually takes place near the external margin of the whorl, but sometimes a little lower. Now and then there are simple ribs between the divided ones. Number of ribs 43-45.

The larger of the two specimens shown in fig. 2 is pressed flat on the stone, especially near the mouth. It measures about 39 mm. in diameter, that of the umbilicus being 20 mm. The other specimen (fig. 3) which is better preserved shows the diameter of the shell 25 mm. and that of the umbilicus 11 mm. Therefore the umbilical width varies between 0.44 and 0.51.

The suture-line is unknown.

The hitherto described species to which the Japanese form can be compared is *Perispinctes Steinmanni* PARONA and BONARELLI (*Sur la faune du callovien inferieure de Savoie, pl. IX, fig. 2*) of the Italian Kelloway which, according to Siemiradzki, is identical with *Perispinctes Bucharicus* NIKITIN (*Notes sur les depôts jurassiques de l'Himalaya et de l'Asie Centrale, pl. I,*

figs. 1-4). But our species has a larger umbilicus and closer ribs.

Locality:—Kaizara, in a dark micaceous shale.

3. **PERISPINCTES (BIPLICES) KAIZARANUS** M.

Pl. I. Fig. 4.

The compressed, discoidal shell shows a wide umbilicus which is slightly deepened. The whorls are a little less than one-half involute, ovate in section, somewhat higher than broad and ornamented with numerous, elevated but obtuse, rigid, radial ribs separated by interspaces of a like breadth. These ribs which number about 50 on the last whorl generally split into two a little higher than the middle of their lengths, but occasionally there is a simple rib between. There are also two deep grooves in the last whorl, the one near the mouth and directed obliquely forward, and the other diametrically opposite the first one and directed radially. In the inner whorls too such grooves seem to have been present, as the third is seen diametrically opposite the second. The suture-line is unknown.

We have only a single specimen of this species which shows the following dimensions:

Diameter of shell	35 mm.
Umbilical width	0,54
Thickness of whorl	0,26
Height above umbilical suture	0,33

Our fossil shows many relations to *Perispinctes subcolubrinus* WAAGEN (*Jurassic Fauna of Kalch*, p. 180, pl. XLIX., fig. 3), an Oxford species found in India, Poland and Portugal. But

beside the size of the shell, the whorls are rounder and the ribs directed a little forward in the latter species.

Locality:—Kaizara, in a dark micaceous shale.

4. **PERISPINCTES (BIPLICES?) KOCHIBEI** M.

Pl. I. Fig. 5.

The single specimen, probably from Shimoyama, shows a compressed, discoidal shell about 50 mm. in diameter, with umbilical width of about 22 mm. The whorls are laterally compressed and only very little convex, the umbilical wall being almost perpendicular. The transverse ribs are numerous, radial, generally rigid, elevated but obtuse, about 38 in the last whorl, separated by intervals usually about twice as broad as the ribs themselves, but sometimes less. These ribs bifurcate either at half their lengths or a little higher up, and between the riblets thus formed there is commonly a simple free rib, so that the main ribs appear as if split into three. In a rare case the simple rib reaches down to the edge of the umbilicus and assumes the appearance of a main rib with the intervals with the neighboring ones much narrower than in other cases. The shape of the venter can not clearly be made out, but it seems to have been more or less rounded.

Suture-line unknown.

Our species shows a close relationship to *Perispinctes triplex* QUENSTEDT and *Perispinctes polygyratus* REINECKE of the Oxford formation. The main difference, if we set aside the shape of the whorl which is at present uncertain, appears to be the irregularity of ribs in the Japanese form.

5. **PERISPHINCTES (ATAXIOCERAS) SP.**

Pl. I. Fig. 6.

A single specimen from Kaizara, not quite perfect, shows a flat discoidal shell with a wide umbilicus and numerous volutions which are about $\frac{1}{2}$ involute. The whorls are oval in transverse section, slightly higher than broad, with convex lateral sides and steep umbilical wall. The transverse ribs which rise at the umbilical suture number about 34 in the last whorl, and are nearly radial in the same whorl, while in the inner ones they are directed obliquely forward. These ribs are more or less rigid and sharp, and split into two at half their length or a little more.

The diameter of the shell measures 40 mm. and that of the umbilicus 19 mm.

Our species much resembles *Perisphinctes occultefurcatus* WAAGEN from Katch (*Jurassic Fauna of Katch*, p. 195, pl. XL., fig. 4). But as the venter in our specimen is not well preserved it is not possible to determine whether there is a shallow dorsal groove as in the Indian species. Moreover the ribs are somewhat less in ours.

6. **OPPELIA ECHIZENICA M.**

Pl. I. Fig. 7.

A single specimen of a strongly compressed, discoidal, keeled shell, about 31 mm. in diameter with an umbilical width of about 12 mm. The whorls are laterally compressed and only slightly convex, apparently without any ribs, the only ornamentation being a row of distant nodes which bounds the keel on both sides and

which disappear in the last one fourth of the last whorl. The umbilical wall is nearly perpendicular with the edge more or less angulated. Body-whorl about $\frac{3}{8}$.

The several irregular transverse grooves seem to be accidental characters caused by rock-pressure.

The suture-line is only partly visible. It consists of deeply toothed lobes and saddles.

As an *Oppelia* this species shows a comparatively wide umbilicus, recalling in this respect *Oppelia nobilis* NEUM. of the Tithonian of Transylvania and Switzerland.

Locality:—Kaizara, in a micaceous shale.

B. Ammonites from Nagato.

The first discovery of Ammonites in the province of Nagato is attributed to a certain school-master, KIMURA by name, who, in 1887, is said to have noticed them in a new road-cutting near Nishi-Nakayama in the district of Toyora. But they were not known to the scientific world, until they were collected by Mr. K. INOUE in 1895.

At present, the fossils are known from two places very near to each other, namely, Nishi-Nakayama and Ishimachi, the discovery in the latter place being due to Mr. OKADA who visited the district in 1899. In both places they occur in a clayslate, which at Nishi-Nakayama has been weathered into a soft yellowish shale. The preservation must be called imperfect, as the fossils have been almost without exception pressed flat on the stone, making their determination extremely difficult.

The Ammonite-bearing slate belongs to the so-called *Inkstone Series* which overlies the Rhætic plant-bed of the neighboring district. The series consists of thick layers of clayslates, sandstones and conglomerates which, in the upper part, contain strata of schalstein and which, therefore, have been distinguished by Mr. INOUE into the *Upper or Schalstein-bearing Part* and the *Lower or Non-Schalstein Part*. It is in this lower part that the above Ammonites occur.

The species of Ammonites hitherto found at Nishi-Nakayama and Ishimachi are as follows :

1. *Hildoceras chrysanthemum* nov. sp.
2. *Hildoceras densicostatum* nov. sp.
3. *Hildoceras Inouyei* nov. sp.
4. *Grammoceras* (?) *Okadaei* nov. sp.
5. *Harpoceras* sp.
6. *Harpoceras* sp.
7. *Cœloceras subfibulatum* nov. sp.
8. *Dactylioceras helianthoides* nov. sp.

Besides, there is an impression of a large *Aegoceras*-like Ammonite, together with flat *Mytilus*-like bivalves.

Of the eight species of Ammonites above mentioned, *Hildoceras chrysanthemum* bears a close relationship to *Hildoceras boreale* SEEBACH of the Upper Lias, while the two other *Hildoceras* are more or less allied to the first. Of the two *Harpoceras* not specifically determined, the one shows a great resemblance to *Harpoceras Lythense* YOUNG also of the Upper Lias. *Cœloceras subfibulatum* and *Dactylioceras helianthoides* resemble respectively *Cœloceras fibulatum* and *Dactylioceras annulatum*, both described by WRIGHT from the Upper Lias of England. From these facts it is clearly to be seen that we have here a

formation which undoubtedly belongs to the Lias, and indeed to its upper part.

There seem to be several horizons in the Ammonite-bearing layers. Mr. INOUE speaks of three such as existing at Nishi-Nakayama, while Mr. OKADA mentions only two from Ishimachi. It is to be hoped that future investigations will throw more light on this subject.

DESCRIPTION OF THE SPECIES.

1. *HILDOCERAS CHRYSANTHEMUM* M.

Pl. II. Figs. 1-4.

The shell is discoidal, very much compressed, carinated and widely umbilicated, with the umbilical wall very steep or nearly perpendicular. The whorls are narrow and only very slightly involute, with lateral sides flat and furnished with numerous, broad, obtuse, sigmoidal ribs separated by valleys of a like breadth. These ribs become flatter and less prominent toward the mouth, and where they bend backward, which takes place at about $\frac{1}{3}$ their length from the umbilical edge, the surface of the whorl is marked by a shallow depression which is most distinct in the last half of the last whorl. Body-chamber about $\frac{2}{3}$. The external saddle is broader than the external lobe, and divided into two unequal parts by a shallow incision; the external lobe is quite simply incised, the incisions being pointed.

The specimen shown in fig. 1 is the best preserved, and one of the largest. Its diameter measures 84 mm., with an umbilical width of 40 mm. The ribs number 43 in the last whorl,

and are accompanied by fine sigmoidal lines which are especially numerous in the valleys near the mouth. In young specimens (figs. 2, 3) the general characters of the ribs are the same, but their number is less, being at most 40; the sigmoidal striæ are often more distinct.

The keel is sharp and bounded by a furrow on each side, but as our specimens have all been subjected to rock-pressure, its exact shape can not be made out.

In one of the fragments of a large shell, there was found an impression of aptychus (fig. 4) marked by oblique ribs between which there are several oblique striations, so that it looks not unlike the one figured by WRIGHT (*Lias Ammonites*, pl. LXI., fig. 4).

Our species is closely allied to a shell figured by WRIGHT as *Ammonites Levisoni* (*Lias Ammonites*, p. 438, pl. LXI., figs. 5, 6) which, according to HAUG, is not a true *Ammonites Levisoni*, but *Ammonites borealis* SEEBACH (*Der Hannoversche Jura*, p. 150, pl. VII., fig. 5), both of which occur in the Upper Lias of Europe. The Japanese form, however, differs from *Ammonites borealis* as figured by SEEBACH in having a steep umbilical wall and more deeply incised suture-line, in which latter respect it resembles *Ammonites Levisoni* as figured by WRIGHT in his fig. 3, pl. LXI. Anyhow it must be looked upon as a species strongly akin to these European forms.

Locality:—Nishi-Nakayama and Ishimachi; tolerably frequent.

2. **HILDOCERAS DENSICOSTATUM** M.

Pl. III. Figs. 1, 2.

Shell discoidal, compressed, keeled, widely umbilicated; whorls compressed, flat, scarcely involute, with umbilical edge rounded

and umbilical wall perpendicular, ornamented with thickly set, obtuse, sigmoidal ribs separated by valleys mostly narrower, and in adult specimens running out in numerous, unequal, sigmoidal striæ near the mouth; the place where ribs bend backward is marked with a slight depression; keel sharp, bounded on each side by a furrow.

This species is closely related to the preceding one from which it is distinguished by a greater number of ribs. In a specimen (fig. 2) which measures 63 mm. in diameter, their number is about 53, while in one with the diameter of 48 mm. there are about 55 of them in the last whorl. Fig. 1 shows the largest specimen, 90 mm. in diameter and with ribs near the mouth splitting into many finer ones. The proportion of the shell-diameter to the umbilical width is about 10 to 4.

Locality:—Nishi-Nakayama and Ishimachi; quite frequent.

3. **HILDOCERAS INOUYEI** M.

Pl. II. Figs. 5, 6.

The shell is discoidal, much compressed, keeled, with a narrow umbilicus, its breadth being about $\frac{1}{3}$ or a little less of the shell-diameter. Involution about $\frac{1}{3}$. The whorls are flat with obtuse sigmoidal ribs whose number varies between 40 and 60 according to age. The umbilical wall is perpendicular, with its edge rounded. Keel high and sharp, and bounded by a channel on each side.

This species resembles the two preceding in the shape and surface markings of the shell, but is decidedly more narrowly umbilicated.

Most of the specimens are small, the largest complete one (fig. 6) being 40 mm. in diameter with an umbilical width of 11 mm., and bearing about 58 ribs. There are however fragments of larger shells which seem to have attained over 50 mm. in diameter. A small specimen (fig. 5) 25 mm. in diameter has an umbilical width of about 8 mm. and some 40 ribs.

Locality :—Frequent at Nishi-Nakayama; less so at Ishimachi.

4. **GRAMMOCERAS (?) OKADAI** M.

Pl. IV. Fig. 3.

We have a single specimen of a compressed, discoidal, keeled shell, about 35 mm. in diameter and with an umbilical width of about 10 mm. The whorls are laterally very flat, with a steep umbilical wall and obtuse umbilical edge, and ornamented with about 60 fine S-shaped obtuse ribs, separated by intervals of a like breadth. The keel is sharp and bounded by shallow channels.

This form resembles in its outer sculpture *Grammoceras acutum* TATE (WRIGHT, *Lias Ammonites*, pl. LXXXII., fig. 7) of the English Upper Lias, which seems to have more convex lateral sides.

Locality :—Nishi-Nakayama.

5. **HARPOCERAS** SP.

Pl. IV. Fig. 1.

A flat, compressed, keeled shell, nearly 90 mm. in diameter, with the umbilicus 24 mm. wide. The whorls are laterally flattened and furnished with about 43 flat sigmoidal ribs, separated

by intervals of nearly a like breadth. The edge of the umbilicus is nearly right-angled, and its wall perpendicular, so that if the inner whorls were preserved in our specimen, they would appear descending stair-like into their centre.

The general form, the mode of costation and the small umbilicus with perpendicular walls make our species resemble *Harpoceras Lythense* YOUNG and BIRD (WRIGHT, *Lias Ammonites*, p. 444, pl. LXII., figs. 4-6) of the English Upper Lias; but how far the resemblance extends, it is at present not possible to make out from the imperfect state of preservation of our fossil.

Locality :—Nishi-Nakayama.

6. **HARPOCERAS** SP.

Pl. IV. Fig. 2.

This is another flat, keeled, narrowly umbilicated shell, about 85 mm. in diameter, and with an umbilical width of 20 mm. The ribs are sigmoidal as in the preceding species, but decidedly denser and more numerous, the number reaching up to 70, and near the mouth running out into many sigmoidal striations. The umbilical wall is perpendicular.

The form and outer sculpture show a great resemblance to *Harpoceras exaratum* WRIGHT (*Lias Ammonites*, p. 441, pl. LXII., figs. 1-3) of the Upper Lias.

Locality :—Nishi-Nakayama.

7. **CÆLOCERAS SUBFIBULATUM** M.

Pl. III. Figs. 3-6.

There are several specimens of a *Cæloceras* which may be characterized as follows :

The shell is discoidal, compressed, and very widely umbilicated. The whorls are scarcely involute, laterally a little convex, externally rounded, with a steep umbilical wall and obtuse umbilical edge. They are transversely ribbed, the ribs being numerous (about 50 in number in a shell 50 mm. in diameter), radial, straight or slightly concave toward front, sharp, elevated, either simple, or united in twos by a knob near the venter forming the so-called "loop and button style," whence they again separate into two on the venter. The intervals between the ribs are wider than the ribs themselves. The proportion of the shell-diameter to the umbilical width is about 5 to 3.

The transverse section of a whorl can not be clearly made out, owing to the rock-pressure to which the shell has been subjected; but as far as can be judged from several specimens, it seems to have been oblong.

The general shape of the shell and the manner in which the ribs are joined bring our species close to *Cœloceras fibulatum* WRIGHT (*p.* 476, *pl.* LXXXV., *figs.* 5-11) of the Upper Lias, from which however it seems to differ in having ribs sometimes concave toward the front and the body-whorl a little lower, in which latter respect it more closely resembles *Cœloceras subarmatum* YOUNG.

Locality :—Ishimachi and Nishi-Nakayama; not rare.

8. **DACTYLIOCERAS HELIANTHOIDES** M.

Pl. IV. Figs. 4-6.

Several specimens of this neat Ammonite have been obtained, both from Nishi-Nakayama and Ishimachi, though in a more or less crushed condition.

The shell is flatly discoidal, and widely umbilicated, the umbilicus occupying about $\frac{1}{2}$ of the shell-diameter. The whorls are only slightly convex on the lateral sides, while rounded on the external side or venter, with the umbilical edge obliquely sloping to the umbilical suture. Involution about $\frac{1}{3}$ or a little less. The transverse ribs which rise at the umbilical suture are numerous, fine, elevated, radial, somewhat flexuous, regularly bifurcating in the inner whorls at about $\frac{2}{3}$ their lengths, often remaining simple in the body-whorl. In this latter case, a short loose rib may be intercalated between two long simple ones, beginning free near the place where bifurcation usually takes place and going over to the venter. The number of ribs varies according to age, and also according to the individuals. In a shell 60 mm. in diameter (fig. 4), there are 80-90 ribs, while in one 45 mm. in diameter (fig. 5) we count about 60. The interspaces are flat and two to three times broader than the ribs themselves. In a specimen shown in fig. 6 which represents one-half of a shell nearly 70 mm. in diameter, the ribs are not so close together as in those above mentioned. Still I believe it belongs to the same species.

This form is closely related to *Dactyloceras annulatum* WRIGHT (*Lias Ammonites*, p. 475, pl. LXXXIV., figs. 7-9) of the English Upper Lias. But the latter has more numerous (up to 130), and flatter straight ribs.



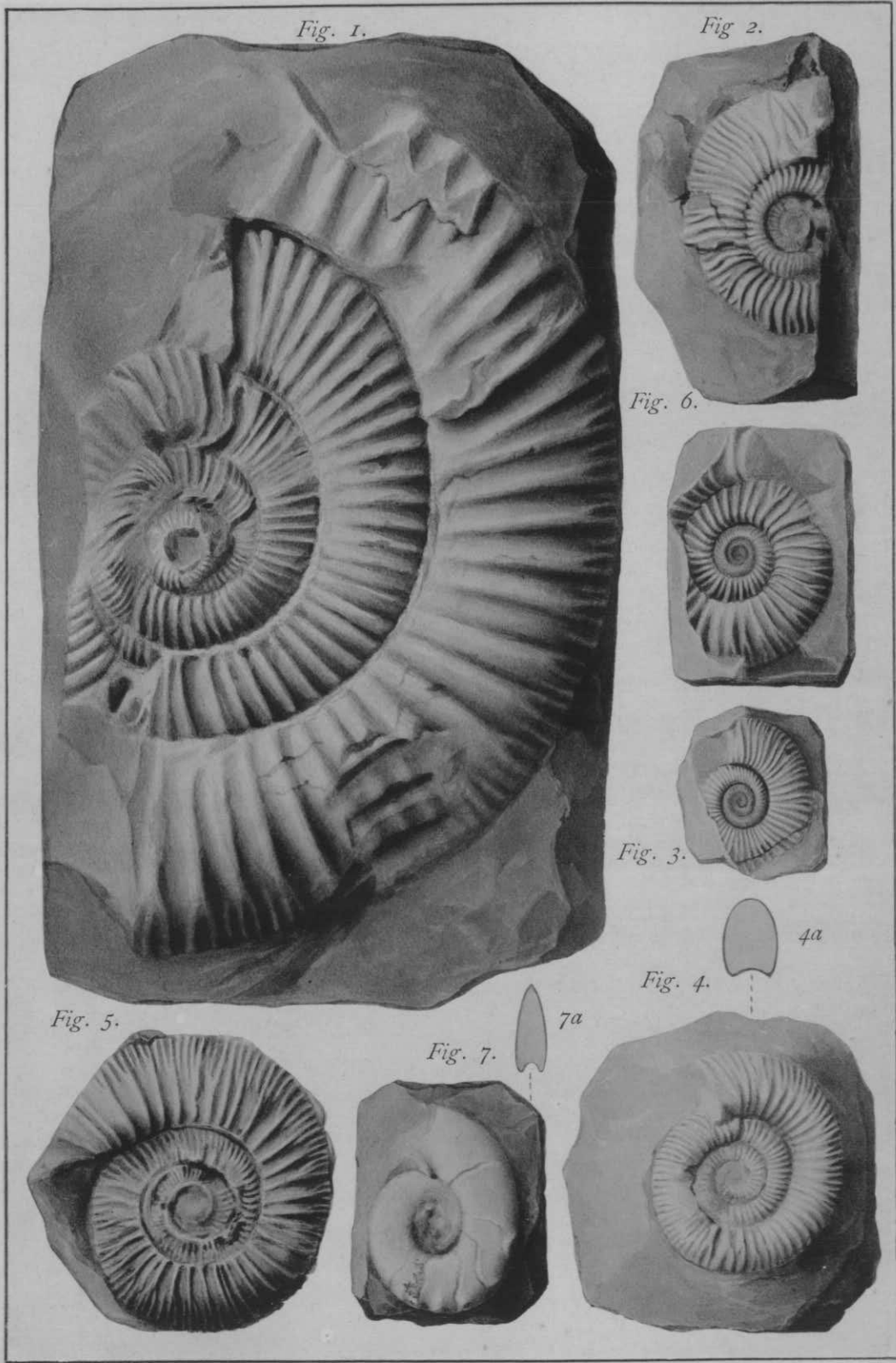
M. YOKOYAMA.

JURASSIC AMMONITES FROM ECHIZEN AND NAGATO.

PLATE I.

Plate I.

- Fig. 1. *Perisphinctes (Procerites) Matsushimai* n. sp.
Figs. 2, 3. *Perisphinctes (Grossouvria) Hikii* n. sp.
Fig. 4. *Perisphinctes (Biplices) kaizaranus* n. sp. 4a transverse section of a whorl.
Fig. 5. *Perisphinctes (Biplices ?) Kochabei* n. sp.
Fig. 6. *Perisphinctes (Ataxioceras)* sp.
Fig. 7. *Oppelia echizenica* n. sp. 7a transverse section of a whorl.



M. YOKOYAMA.

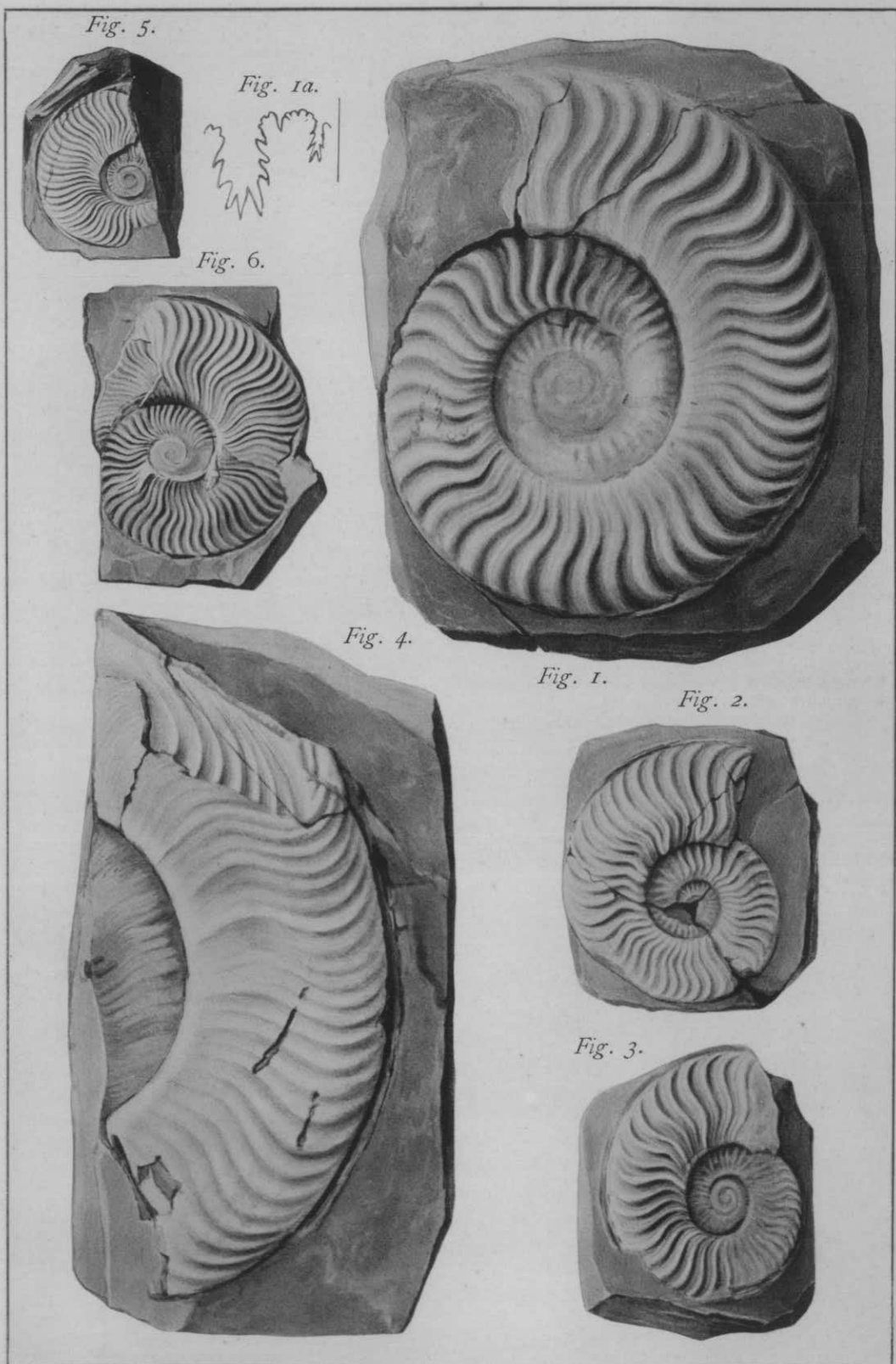
JURASSIC AMMONITES FROM ECHIZEN AND NAGATO.

PLATE II.

Plate II.

Figs. 1-4. *Hildoceras chrysanthemum* n. sp. 1a part of the suture-line.
4 showing an impression of one-half of the aptychus.

Figs. 5, 6. *Hildoceras Inouyei* n. sp.



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JURASSIC AMMONITES FROM ECHIZEN AND NAGATO.

PLATE III.

Plate III.

Figs. 1, 2. *Hildoceras densicostatum* n. sp.

Figs. 3-6. *Cæloceras subfibulatum* n. sp.

Fig. 1.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.



Fig. 2.



Plate IV.

- Fig. 1. *Harpoceras* sp.
Fig. 2. *Harpoceras* sp.
Fig. 3. *Grammoceras* (?) *Okadai* n. sp.
Figs. 4-6. *Dactylioceras helianthoides* n. sp.

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JURASSIC AMMONITES FROM ECHIZEN AND NAGATO.

PLATE IV.



Fig. 1.



Fig. 2.

Fig. 3.



Fig. 6.

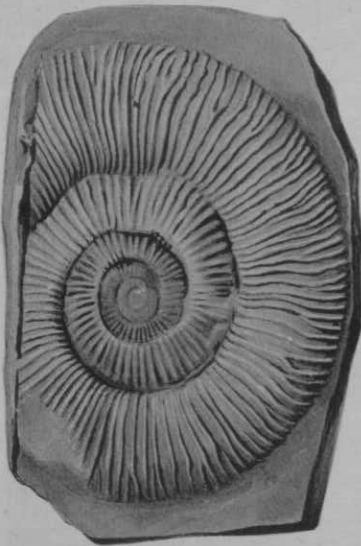
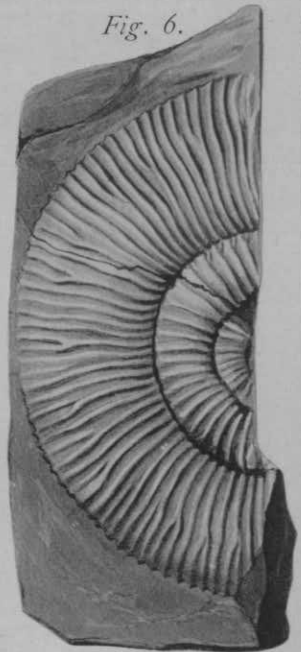


Fig. 4.



Fig. 5.