

On Some Jurassic Fossils from Rikuzen.

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With 2 plates.

About the year 1885, Mr. I. BAN, then geologist to the Imperial Geological Survey, found a *Trigonia* belonging to the Group of *Undulatae* at Hosoura, Rikuzen, a place adjacent to Isadomaye, a well known locality of *Pseudomonotis ochotica* KEYS. of the Upper Triassic. This gave the first hint of the occurrence of Jurassic formation in that part of Japan.

Subsequently in the years 1887 and 1888, Professor JIMBO made a geological investigation, not only of the district above mentioned, but also of the adjoining region and fully established the occurrence of Jurassic deposits by the side of the Triassic.

The present paper is an attempt to determine the age of the respective strata of the Jurassic by data furnished by the study of their fossils, collected partly by Professor JIMBO and partly by Mr. IKI who, in 1895, made a special research in the district around Hosoura. The fossils, although few in number and mostly of ill preservation, are still characteristic enough to give a tolerably clear idea of the geological horizons of the various layers containing them.

Professor JIMBO in his "Report of the Geological Researches of Eastern Rikuzen" (M S) mentions six horizons or beds as constituting the Jurassic of that region, which counted from below are as follows :

I. *Cyrena bed of Magenosu and Nirano-hama*, a dark clayslate filled with *Cyrena*.

II. *Karakuwa Clayslate*, with Gastropods, Lamellibranchs and Crinoids.

III. *Irinosawa Clayslate* with *Estheria*-like shells.

IV. *Trigonia Bed*, consisting of a hard, light-grey, medium-grained sandstone filled with shells of *Trigonia V-costata* LYCETT.

V. *Sandy Clayslate*, with *Arietites* and *Belemnites*.

VI. *Clayslate*, with Ammonites.

Of these six beds, he considers the first three as the lower, and the other three as the upper part of the formation separated by a line of unconformability.

The subdivisions subsequently proposed by Iki are similar to the above, although not quite the same.

The fossils described below are those obtained in the beds I., IV., V., and VI. They are the following :

From Bed I.

1. *Cyrena lunulata* n. sp.
2. *Cyrena oblonga* n. sp.
3. *Trigonia hosourensis* n. sp.
4. *Perna rikuzenica* n. sp.
5. *Gervillia trigona* n. sp.
6. *Baiera* ? sp.

From Bed IV.

1. *Trigonia V-costata* LYCETT.

2. *Belemnopsis* sp.
3. *Belemnopsis* sp.
4. *Belemnites* sp.

From Bed V.

1. *Ammonites* sp.
2. *Ammonites* sp.
3. *Belemnites* sp.

From Bed VI.

1. *Harpoceras Ikianum* n. sp.
2. *Schlotheimia Jimboi* n. sp.
3. *Lytoceras* cf. *lineatum* SCHLOTH.

Judging from these fossils, there is not the least doubt about Bed VI being of a Liassic age. It is of course not possible at present to determine exactly to what part of the Lias it belongs. But as *Schlotheimia* is a genus hitherto confined to the Lower Lias and *Lytoceras lineatum* is a species only found in the Middle Lias, so it is most probable that the bed represents the lower half of the Lias, and it is also not altogether impossible that it is again divisible into two parts, the lower or *Schlotheimia*-bearing bed and the upper or *Lytoceras*-bearing bed.

Bed V is also probably Liassic, as the two *Ammonites* contained in it look very much like those of *Arietinæ*. By Professor JIMBO they have even been taken for *Arietites*. If such be really the case, then the bed must be assigned to the Upper Lias.

Bed IV is a very important one, as it contains *Trigonia V-costata* LYCETT, a species hitherto found only in the Inferior Oolite of England. And as a *Belemnopsis* which occurs together with it has never been found outside of the Dogger, so we may fairly assume that the bed represents the lower half of the Dogger, roughly corresponding to the Inferior Oolite of England.

The fossils found in Bed I are all new. But the resemblance of *Perna* to *Perna rugosa* of the Dogger and the occurrence of a *costated Trigonina* which has its greatest development in the same formation and of the genus *Cyrena* which is abundant in the Middle Jurassic plant-bearing series of other parts of Japan tend to show that the bed is still Middle Jurassic, possibly belonging to its upper part.

Beds II. and III., although their palaeontological characters are not yet known, must be considered as belonging also to the Dogger, as they lie between I. and IV.

From what has been said above, it is quite clear that the strata are inverted, Bed VI. which Professor JIMBO considered as uppermost being the lowest, and Bed I which was taken by him as the lowest being uppermost. According to my opinion, the so-called line of unconformability between III. and IV. may possibly be a line of fault.

DESCRIPTIONS OF THE SPECIES.

A. Fossils from Bed VI.

1. *SCHLOTHEIMIA JIMBOI* N. SP.

Pl. I, Fig. 6.

The form which I designate under the above name is a discoidal shell somewhat distorted by pressure. Its diameter measures about 34 mm, while that of the umbilicus is about 6 mm, so that the shell may be said to be tolerably widely umbilicated. The lateral sides of the whorls are only slightly convex and ornamented with somewhat flexuous ribs which number 38-40

on the last whorl. Most of these ribs rise at the edge of the steep, almost perpendicular umbilicus, but there are some which commence either at a short distance from the edge or, as is sometimes the case, near the middle of the lateral side. The longest of these ribs are at first directed slightly forward, and then curve somewhat backward, and then again forward on the external side, where they are interrupted by a deep narrow groove, an unmistakable sign of the genus *Schlotheimia*.

Our only specimen being not in a good state of preservation does not permit its strict comparison with European species. But that it is not *Schlotheimia angulata* to which it presents some resemblance is clearly shown by the different course of the ribs.

The genus *Schlotheimia* is confined in Europe to the lower Lias.

Locality :—Sandy Clayslate of Hosoura.

2. HARPOCERAS IKIANUM N. SP.

Pl. I., Fig. 5.

The shell flattened and furnished with a distinct keel. The whorls are tolerably convex and about $\frac{2}{3}$ involute. The umbilicus is small being only 6 mm. in a shell whose diameter measures 20 mm. The umbilical wall is steep. The lateral sides of the whorls bear distinct ribs which are about 40 in number on the last volution. Of these 40 ribs, only about one half rise at the umbilical edge, the others being formed by their bifurcation at about $\frac{1}{3}$ the distance from the umbilicus. But now and then between the bifurcating ribs there is intercalated a simple rib which does not reach the umbilicus. The course of the ribs may

be called weakly falcate, as they curve a little backward after bifurcation and then bend strongly forward near the external keel.

This form closely resembles the Middle Liassic species *Harpoceras lythense* YOUNG, but it is at once distinguished from it by its bifurcating ribs, in which respect it is not unlike some of the many varieties of *Harpoceras aalense* ZIETEN.

A single cast of an external surface of the shell was obtained in a sandy clayslate of Hosoura, our figure having been drawn from a plaster cast of it.

3. **LYTOCERAS** CF. **LINEATUM** SCHLOTH.

Pl. II. Fig. 5.

An external impression of a *Lytoceras* found in a clayslate of Aratohama, though water-worn and imperfect, shows characters so peculiar to the group of *Lytoceras fimbriatum* Sow. of the Lias, that I do not hesitate to bring it under that group, and indeed very near to *Lytoceras lineatum* SCHLOTH. The last volution of the shell measuring about 70 mm. in diameter is provided with many fine ribs which at certain intervals are coarser and decidedly fimbriate. The fimbriation of the ribs becomes more frequent as we approach the shell-mouth near which almost every rib is fimbriate. The non-fimbriate ribs are very fine, thread-like, more or less straight, and in some cases showing a tendency to fimbriation.

Besides those above mentioned, there is a single wall-like elevated rib near the middle of the last half of the last whorl.

Although our specimen lacks the outer portion of the whorl near the mouth, yet the characters given above agree so well with those of *Lytoceras lineatum* that it must be at least closely allied to, if not quite identical with, this European species.

Lytoceras lineatum SCHLOTH. occurs in the Middle Lias of England and Germany.

Our figure was drawn from a plaster-cast.

B. Fossils from Bed V.

1. AMMONITES SP.

Pl. II. Fig. 11.

This is an external impression of a flat discoidal shell, about 45 mm. in diameter with a wide umbilicus of about 20 mm, and furnished with coarse, forwardly bent ribs about 33 in number in the last whorl. It closely resembles some of the forms of *Arietinae*.

Locality :—Hosoura. The figure was drawn from a plaster-cast.

2. AMMONITES SP.

Pl. II. Fig. 10.

Another impression of a discoidal, widely umbilicated shell, about 35 mm. in diameter, which may be more or less closely allied to the preceding form, but its ribs (36 in number) are finer, more rigid and sharper.

The figure was drawn from a plaster-cast.

Locality :—Hosoura.

3. **BELEMNITES** SP.

Pl. II, Fig. 12.

A single specimen. It is provided with a part of the phragmocone and is lanceolate in shape, measuring about 37 mm. in length, and about 7 mm. in breadth near the upper end, reminding one of *Belemnites acutus* MILLER of the Lias. However the preservation is such that a strict specific determination is at present impossible.

Locality :—Hosoura, in a sandy clayslate.

C. Fossils from Bed IV.

1. **TRIGONIA V-COSTATA** LYCETT.

Pl. II, Figs. 2, 3, 4.

LYCETT. *A Monograph of the British Fossil Trigonæ*,
p. 66, pl. XIII, fig. 5, pl. XVI, fig. 1-4.

A *Trigonia* belonging to the group of *Undulatæ* and present in numerous specimens coincides so well in its characters with the species above named from England that I have not the slightest doubt about the identity of the two forms. The most important character of the species lies in the formation of a V-shaped angle by the meeting of the subtuberculated antea and postea ribs near the carina. This angle which is particularly distinct near the ventral margin of the shell gradually passes into a curve towards the beak.

Most of our specimens are small, being about the size of those figured as smaller ones by LYCETT. Fig. 4 shows the inner

side of a right valve on which is seen a rounded ridge on the posterior margin just below the upper edge and parallel to it.

The species occurs in England in the Inferior Oolite.

Locality:—Hosoura and Niranohama, in a greyish sandstone.

2. **BELEMNOPSIS** SP.

Pl. II. Fig. 1.

There are several specimens of a lanceolate Belemnite, one of which is about 35 mm. long and 8 mm. broad near its upper end. They all show a deep ventral groove running down to the apex. Therefore, although much water-worn, it is quite certain that they belong to the subgenus *Belemnopsis*.

Locality:—Hosoura.

3. **BELEMNOPSIS** SP.

Pl. II. Fig. 6.

A specimen of another form of Belemnopsis, the lower end of which is not preserved, is much larger than that of the preceding one. It seems to be broadest a little below the alveole where it measures about 12 mm. in diameter, thence slightly tapering upward.

Locality:—Hosoura.

4. **BELEMNITES** SP.

Pl. I. Fig. 7.

This fragment of a large Belemnite more than 20 mm. in

diameter has the lower end of the phragmocone intact. The transverse section of the rostrum is slightly oblong.

Locality :—Hosoura.

D. Fossils from Bed I.

1. **BAIERA ?** SP.

Pl. I. Fig. 2.

This is a fan-shaped leaf wanting the upper end, but looking very much like the basal portion of either a *Baiera* or a *Phœnicopsis*. Fine, longitudinal, simple veins constitute all that can be observed in the leaf.

Locality :—Hosoura.

2. **CYRENA LUNULATA** N. SP.

Pl. II. Fig. 9.

Shell moderately thick, ovately triangular, slightly inequilateral, subrostrated both in front and behind, with curved ventral margin. Beaks prominent, touching, and directed forward. Surface with fine but unequal concentric striæ. In front of the beak is an ovate lunula about twice as long as broad and bounded by a fine deep groove running from the beak to the anterior margin. Behind the beak there is a sharp keel running to the posterior margin and enclosing a lanceolate valley-like area. Proportions of length to height and thickness are as 10 to 8 to 4.

The figured specimen measures about 25 mm. long, 20 mm. high and 11 mm. thick, and may be taken as representing the average size of the shell.

Locality :—Hosoura. Very numerous.

3. **CYRENA ELLIPTICA** N. SP.

Pl. I. Fig. 4.

Shell elliptical, broader than high, somewhat inequilateral, with anterior and posterior margin rounded and ventral margin curved. Beaks submedian, prominent, touching. Surface only with fine concentric striations. Proportions of length, height and thickness, 10 : 8 : 4.

This form is a little larger than the preceding one, and seems to have been comparatively thin shelled. There are specimens larger than the one figured.

Locality:—Hosoura. Rarer than the foregoing species.

4. **TRIGONIA HOSOURENSIS** N. SP.

Pl. I. Fig. 3.

A few specimens of a *Trigonia* belonging to the Group of *Costatae* were obtained from the *Cyrena* slate of Hosoura which, though imperfect, show sufficient characters to be created into a new species.

The shell is ovately triangular, flattened and strongly inequilateral. The anterior side is very short with its border rounded. The posterior side is long and produced. Beaks prominent, and recurvate. The surface is ornamented with about 17 smooth concentric ribs which near the marginal carina descend with a very steep slope so that the curvature is stronger than in any of the known species of this group. Escutcheon narrow and lanceolate. Area depressed, and smooth.

The group of *Trigonia costata* has occurred hitherto only in the Oolite.

5. **GERVILLIA TRIGONA** N. SP.

Pl. II, Fig. 7, 8.

The shell is triangular, inflated and smooth. The beaks are prominent, close to the anterior extremity of the straight hinge-line, in which there are four ligamental pits, three of which are just below the beak, while the remaining one is situated a little behind it. They are separated from one another by nearly equal distances, although differing in shape the two middle ones being longitudinally elongated, the posterior transversely elongated, and the anterior obliquely elongated, the upper end being away from the others. The hinge line is anteriorly eared and posteriorly produced forming a large wing pointed at the end. The posterior border is nearly vertical and slightly concave below the hinge-border, while the anterior border which is also somewhat excavated in the middle recedes obliquely to a short rounded ventral border, so that the shape of the shell is decidedly triangular.

The proportions of the various dimensions of the shell are best seen in a cast drawn in fig. 7, in which the length of the hinge border measures 28 mm., the height of the shell 25 mm. and the thickness of the left valve 10 mm. The specimen shown in fig. 8 is more than double the size of the above, but it looks broader than it actually is, as it has been distorted by pressure.

The posterior wing of this species reminds one of the genus *Pteroperna* occurring in the Lower Oolite of France and England.

Locality :—Hosoura. Tolerably frequent.

6. **PERNA RIKUZENICA** N. SP.

Pl. I. Fig. 1.

Several specimens of a large quadrate *Perna* were obtained, which are however more or less broken. The figured specimen has both valves preserved and measures 8 cm. long, 6 cm. broad and 3 cm. thick. The shape of the shell, which is decidedly four-sided and has the anterior border concave resembles that of *Perna rugosa* GOLDF. figured by MORRIS and LYCETT in their *Monograph of the Mollusca of the Great Oolite* (pl. XII., fig. 1; pl. XIV., fig. 16). But on a closer examination our shell differs in several points from the European. In the first place our shell is a little more inflated; in the second place the greatest inflation lies very close the anterior border, so that the surface descends abruptly to it, while towards the posterior border the slope is very gradual; and in the third place the surface is not rugose, being marked only by fine concentric lines of growth.

Locality:—Hosoura.



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ON SOME JURASSIC FOSSILS FROM RIKUZEN.

PLATE I.

Plate I.

- Fig. 1. *Perna rikuzenica* n. sp. *a* lateral view of a right valve; *b* front view of both valves.
- Fig. 2. *Baiera* ? sp.
- Fig. 3. *Trigonia hosourensis* n. sp. *a* Left valve; *b* right valve, *c* showing area and escutcheon.
- Fig. 4. *Cyrena elliptica* n. sp. *a* right valve; *b* front view of the same.
- Fig. 5. *Harpoceras Ikianum* n. sp. *a* lateral view; *b* view of the external side.
- Fig. 6. *Schlotheimia Jimboi* n. sp. *a* lateral view; *b* showing the groove of the external side which is narrowed by pressure.
- Fig. 7. *Belemnites* sp. *a* and *b* seen from opposite sides, *b* showing a part of the phragmocone.

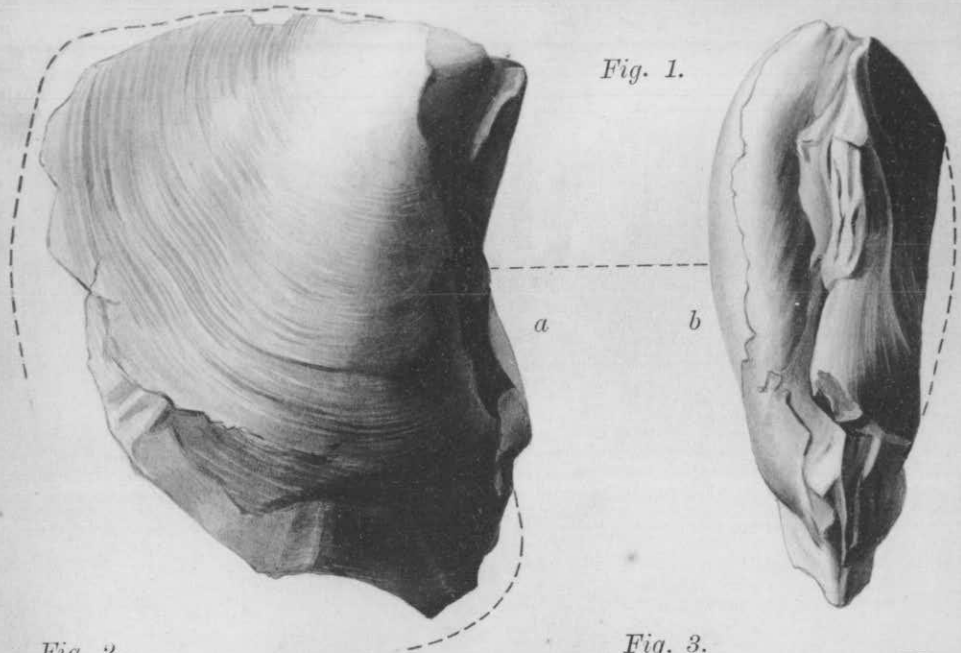


Fig. 1.

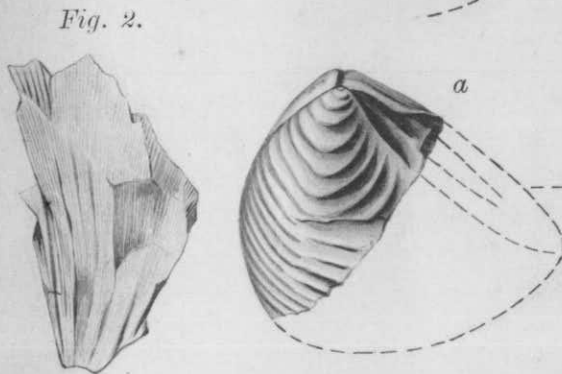


Fig. 2.

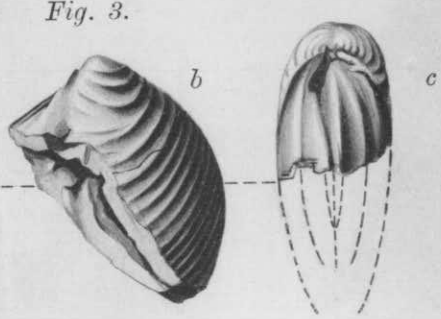


Fig. 3.

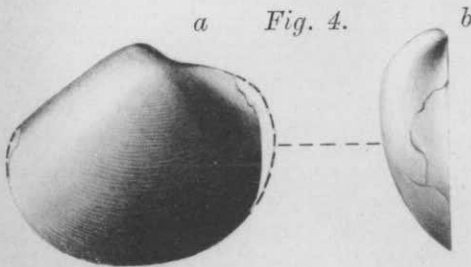


Fig. 4.

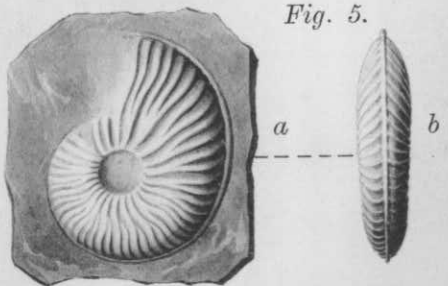


Fig. 5.

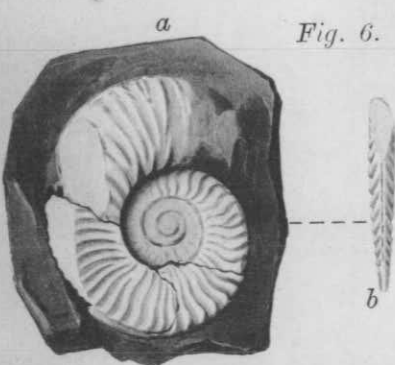


Fig. 6.

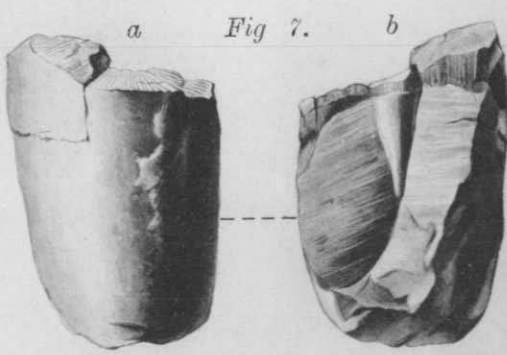


Fig. 7.

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ON SOME JURASSIC FOSSILS FROM RIKUZEN.

PLATE II.

Plate II.

- Fig. 1. *Belemnopsis* sp. A water-worn specimen; *a* showing the ventral groove and alveole; *b* the same seen from the opposite side.
- Fig. 2, 3, 4. *Trigonia V-costata* LYCETT. 2 left valve. 3 right valve. 4 inner side of a right valve.
- Fig. 5. *Lytoceras* cf. *lineatum* SCHLOTH.
- Fig. 6. *Belemnopsis* sp. *a* showing the ventral groove and alveole; *b* the same seen from the opposite side.
- Fig. 7, 8. *Gervilla trigona* n. sp. Fig. 7, internal cast.
- Fig. 9. *Cyrea lunulata* n. sp. *a* lateral view; *b* seen from front; *c* showing lunula and area.
- Fig. 10. *Ammonites* sp.
- Fig. 11. *Ammonites* sp.
- Fig. 12. *Belemnites* sp.

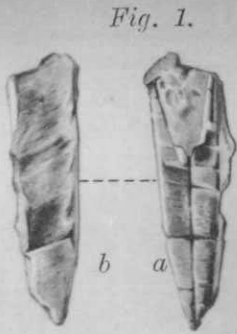


Fig. 12.

Fig. 5.

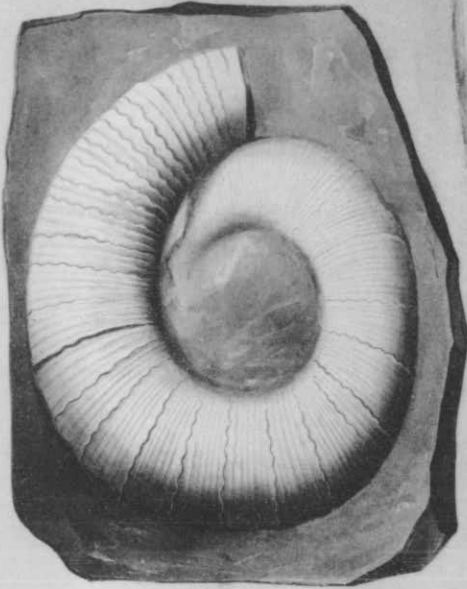


Fig. 6.

Fig. 7.

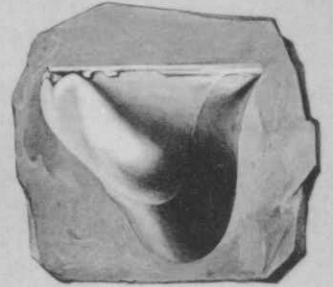
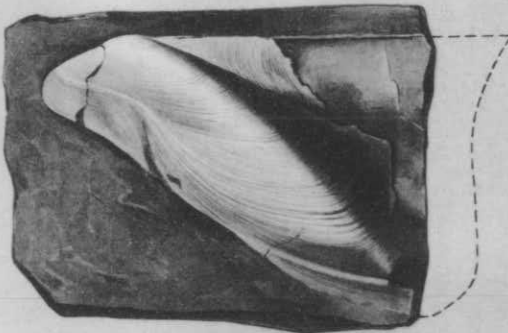


Fig. 11.



Fig. 8.

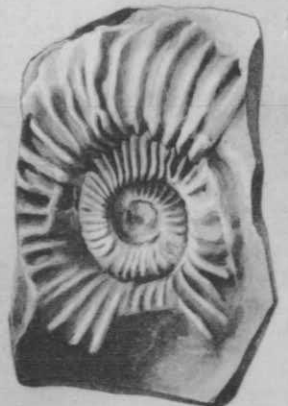


b



Fig. 9.

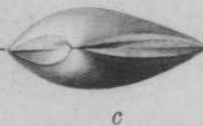
Fig. 10.



a



b



c