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Cretaceous Cephalopoda from the Hokkaidō.

PART II.[1]

Turrilites, Helicoceras, Heteroceras, Nipponites, Olcostephanus, Desmoceras, Hauericeras, and an undetermined Genus.

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With 6 plates

TURRILITES LAM.

D'ORBIGNY brought nearly all of the turreted forms of Ammonites under one of the three genera, *Turrilites*, *Helicoceras*, and *Heteroceras*, distinguishing at the same time two groups in the first genus, namely *Turrilites rotundati* and *T. angulati*.

1) Since the publication of the first part of this memoir, a number of valuable papers relating to foreign Cretaceous Cephalopod fauna have appeared both in Europe and America. First of all, mention must be made of the works of Dr. F. M. ANDERSON (Cretaceous Deposits of the Pacific Coast, 1902) and of Dr. J. F. WHITEAVES (On some Additional Fossils from the Vancouver Cretaceous, 1903), to both of whom we are indebted for much accurate and important knowledge concerning the Cretaceous deposits of the region along the Pacific coast of the United States and Canada. A comparison of the results of these papers with those reached by Professors YOKOYAMA and JIMBŌ and the present writer, will at once bring out some remarkable faunistic resemblances between the deposits of California and

Soon after D'ORBIGNY, QUENSTEDT[1] considered the separation of *Helicoceras* from *Turrilites* quite unnecessary, while SHARPE[2] and STOLICZKA[3] were of opinion that the so-called group of *T. rotundati* should be brought under the genus *Helicoceras*, retaining the name *Turrilites* only for the *T. angulati* of D'ORBIGNY. PICTET,[4] however, proposed to divide *Helicoceras* into two groups, the one having a short spire and widely separated volutions and the other showing a high spire and less widely separated volutions. The first of these groups he called *Helicoceras* proper, while the second as well as the group, *T. rotundati*, were considered by him to be distinct genera.

MEEK[5] like D'ORBIGNY took *Helicoceras* in the most restricted sense and divided it into *Helicoceras* proper, *Patoceras*, and

Canada on the one side, and those of the Hokkaidō on the other. A discussion of these, however, the writer intends to put forth in the last part of this work.

As to the new fossil localities in the Hokkaidō, no important addition to our knowledge has been made during recent years; but several new forms have been brought back by geologists who have lately visited the localities already known. Among these, the writer would mention a valuable collection made by Prof. YOKOYAMA at Urakawa, a locality that had not been visited by geologists for more than twenty years.

During the last four years, the writer has devoted much time to the study of the morphology of the Hokkaidō Ammonites, and has also taken the opportunity of making himself acquainted with the development of several of their predominating types, for it has now become clear that a mere morphological study of adult specimens is not sufficient for the establishment of their real affinities, and that by the study of their development only can such knowledge attained. Consequently, the result obtained from this side of the be study is also occasionally embodied in the following descriptions.

In this second part, the following genera are described:—

1) *Turrilites*, *Helicoceras*, *Heteroceras* and *Nipponites*.

2) *Olcostephanus*.

3) *Desmoceras* and *Hauericeras*.

There is also one species whose generic position is still undetermined.

The order in which the different groups are here treated is not due to the presence of any mutual relations existing among them but merely for the sake of convenience and of avoiding too long a delay in the publication of the paper.

1) QUENSTEDT: Petrefaktenkunde Deutschlands. I. Cephalopoden. P. 297.

2) SHARPE: Mollusca of the Chalk. P. 59.

3) STOLICZKA: l.c. p. 183.

4) PICTET: Paléont. Suiss. Foss. de Ste. Croix. P. 120.

5) MEEK: Invert. Cret. and Tert. Foss. of the Upper Missouri County, p. 485.

Spiroceras. STOLICZKA[1] said that "the position of the siphuncle and the symmetrical or unsymmetrical division of the sutures ought to be regarded as a much better distinguishing character than the kind of volutions," while MEEK[2] argued, "it seems not justified to unite typical *Helicoceras* characterized by very slender, widely separated volutions, forming so broad a curve as to give origin to a very wide umbilical cavity and *Turrilites rotundati*, generally provided with much rounded, contiguous whorls."

ZITTEL,[3] in his Handbuch, accepted four subgenera of *Turrilites*, namely *Turrilites* s. str., *Lindgia* (? *Helicancylus*), *Heteroceras*, and *Helicoceras*.

Remarkably different from the views above alluded to, are those held by NEUMAYR and HYATT. NEUMAYR[4] believed that *Helicoceras* together with *Toxoceras*, *Anisoceras*, *Ptychoceras* and others should be brought under the genus *Hamites* (in the wide sense), while he placed *Heteroceras* near to *Crioceras*, a genus which according to him is tolerably distinct from *Turrilites* and *Hamites*.

According to a later publication of HYATT,[5] these secondary forms have no affinity with *Lytoceras* and its allies, and consequently are brought by him under Acanthoceratida and Cosmoceratida. The genera which are treated as Acanthoceratids are *Helicoceras*, *Heteroceras*, and *Lindgia*, which form his family of Hamitidæ. Of those placed under Cosmoceratida, *Bostrycoceras* HYATT is treated under Nostoceratidæ, *Helicancylus* under Ancyloceratidæ, *Turrilites* and *Ostlingoceras* HYATT under Turrilitidæ, and *Hyphantoceras* HYATT under Anisoceratidæ.

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1) STOLICZKA: l.c. p. 183.
2) MEEK: l.c. p. 487.
3) ZITTEL: Handbuch der Palaeontologie, I, 2. p. 445.
4) NEUMAYR: Die Ammoniten der Kreide u. Systematik d. Ammonitiden, pp. 894, 938.
5) HYATT: Cephalopoda in ZITTEL's Text Book of Palaeontology, translated by EASTMAN.

In the study of the Cretaceous Cephalopoda, one of the most difficult tasks is to define the exact limits of the different genera established on the turreted forms of Ammonites. HYATT's classification by creation of many new genera may possibly be an improvement to the previously existing ones but it cannot be followed here, for the generic diagnoses and discussions on the taxonomy are not yet published. Therefore, the present writer is obliged to follow the old and well known classification of D'ORBIGNY as modified by SHARPE and STOLICZKA though it is apparently unnatural. Yet, it is quite necessary to create a new genus, as there is one specimen which entirely differs from the known types in the development of its shell.

The group *Turrilites*, in its most comprehensive sense, forms a rather inconspicuous element in our fauna. Notwithstanding their display of various modifications in the upper Ammonite-beds, specimens are rare in all the localities, so that the description of several species of them must be left imperfect. Besides those from the upper Ammonite-beds, two species of the Cenomanian types are also described below. These the writer considers as specially important, for the fauna of the lower horizons is very poor.

TURRILITES cfr. **BERGERI** BRONGNIART.

Pl. III., fig. 1.

1902. *Turrilites* cfr. *Mantelli* YABE: List Cret. Amm. Hokkaidō in the Outline of the Geology of Japan. 2nd Edition. 1902.

Compare :

1840. *T. Bergeri* D'ORBIGNY : Pal. Fr. Terr. Crét. Tome I., p. 590, pl. CXLIII., figs. 3–6.

1847. *T. Bergeri* PICTET et ROUX : Moll. des Grès Verts., p. 148, pl. XV., fig. 8.

1847. „ „ QUENSTEDT : Petref. Deutsch., I., p. 300, pl. XXI., fig. 26.

1856. „ „ SHARPE : Moll. of the Chalk, p. 65, pl. XXVI., figs. 9–11.

1861. „ „ PICTET et CAMPICHE : Sainte-Croix. T. II., p. 134, pl. LVIII., fig. 1–5.

1866. „ „ STOLICZKA : Cret. Ceph. South India. p. 185, pl. LXXXVI., figs. 3–6.

1897. „ „ KOSSMAT : Südindische Kreidef. p. 45.

1903. „ „ CHOFFAT : Le Crét. de Conducia, p. 15, pl. I., figs. 3–5.

Shell turreted, sinistral, with an apical angle of about 10°. Whorls contiguous, slowly increasing in size ; rounded externally, and slightly concave on the upper side. Umbilicus very narrow. External surface furnished with four rows of numerous short and laterally compressed spines, the upper two of which are a little closer together than the others. Also the number and size of spines in the two upper rows (about 32 on the last volution) are different from those in the lower ones, those of the latter being very slightly larger in size and fewer in number. The uppermost row of spines is concealed under the succeeding whorl. There are also feeble traces of ribs on the upper and lower surfaces of the whorl. The number of these equals that of the spines on it.

The septum has not been seen.

Only a single fragment of this shell having been found, it is hardly possible to get a general idea of its shape and sculpture. The writer has long been under the impression that it resembles more or less clearly *T. Mantelli* SHARPE, but the slender, elongate outline of the shell and the four rows of spines on the whorls being not much different in size and number, seem to show that it is more closely related to *T. Bergeri* BRONGNIART. Among the figures of the said species from foreign Cretaceous deposits, which are accessible to the writer, that of a fragment with two contignous whorls from the Chloritic Marl of Bonchurch, Isle of Wight (shown by SHARPE in his Pl. XXVII., fig. 10) exhibits the closest resemblances.

STOLICZKA describes the tubercles of *T. Bergeri* as often spinose and sharp, but none of his figures shows tubercles so sharp, and laterally so compressed as in our specimen which in this respect comes closer to an immature one figured by SHARPE in his monograph (Pl. XXVI., fig. 11).

In point of the existence of only a slight difference in the size and number of spines in the upper and the lower rows, this species resembles *T. Mantelli* more than *T. Bergeri*, while the close arrangement of the spines in each row makes it resemble *T. Bergeri* var. *miliaris* (PICTET et CAMPICHE: l. c. fig. 5).

Taking these several points into consideration, it appears to be quite evident that this form is specifically distinct, not only from *T. Bergeri* and *T. Mantelli*, but also from all others hitherto described, the nearest ally however being *T. Bergeri*.

Locality —The Popet, near the mouth of the Sanushibe.

Horizon :—Lower Ammonite-beds.

Foreign localities and horizons of *T. Bergeri* and *T. Mantelli*:

—*T. Bergeri* BRONGNIART occurs in the deposits of the Albian, Vraconian and Cenomanian ages of England (Chalk with green grains at Chardstock), France (Cenomanian of Bavet, Auxon; Albian of Aigulun and Savoy), Austria, Switzerland and Italy. This species has also been found in Algeria associated with *Turrilites costatus* and *Acanthoceras rotomagense*, and in Conducia together with *Belemnites minimus* LISTER, *Phylloceras* cfr. *semistriatum* D'ORB. and *Acanthoceras laticlavium* var. *moçambiquensis* CHOFFAT. STOLICZKA calls it a common fossil of the Utatur group of Odium and Moravatur, South India.

T. Mantelli has been met with in the Gray Chalk of Sussex and the Tourtia of Essen.

TURRILITES KOMOTAI M.

Pls. I. and II.

Dimensions :—

Height of the spire.	18.0 cm.
Diameter of the last volution.	18.0 „
Width of the umbilicus.	6.0 „
Height of the last whorl.	6.3 „
Breadth of the last whorl.	7.0 „

Shell sinistral, composed of numerous contiguous whorls,[1] rapidly increasing in size, with an apical angle of about 70°. Whorls rounded externally, slightly convex on the upper and concave on the lower surface. Section of the whorl nearly elliptical, somewhat broader than high; rather trapezoidal in the last volution. Suture of the spire deep. Umbilicus moderately

1) Only four volutions are present in the specimen, three or four others near the apex having been broken off.

wide, being about one third the diameter of the last volution. Surface with ribs and spines, the former arranged in two series and the latter in four rows. The ribs on the upper part of the whorl are numerous and flat, separated by wide intervals; they are oblique, bending strongly forward, distinct near the external side, but gradually becoming feeble toward the umbilicus. Each of these ribs bears three short spines, close to the external side; they are moderately sharp and compressed in the spiral direction. The external surface of the whorl shows a second series of ribs which are much broader than those of the first series and about a half their number. The ribs of this series are also slightly oblique and somewhat concave in front, with flat intervals of almost the same width as the ribs themselves. The middle portion of each of these ribs on the body whorl carries a long spine. The spines are more or less trigonal in a transverse section, rounded behind, and flattened in front. Their surface is ornamented with fine lines of growth, in addition to a delicate median line on the flat side. Most of the spines on the other whorls have been cast off, and the remaining basal portions which look like tubercles are usually covered with a thin calcareous layer. The umbilical side of the whorl is smooth while the basal surface shows the impression corresponding to the surface marking of the upper side of the foregoing volution.

The specimen is unfortunately not in a condition to show the position of the siphuncle, nor all the ramifications of the lobes and saddles which are only partly though distinctly seen on the whorl near the apex.

T. Komotai is related to *T. Cunliffianus* STOL.[1] from the Utatur Group of Odium, South India, although the distinction

1) STOLICZKA: Cret. S. India, p. 190, pl. LXXXIX.

is quite obvious. In the Indian species, the number of ribs on the upper side of the whorl is nearly equal to that of the ribs on the lateral side, or to that of the tubercles arranged in two rows between the upper and lower series of ribs, but more numerous than that of the tubercles in the lowest row.

Locality and horizon:—This majestic form of *Turrilites* is at present represented only by a single specimen which has been found by Mr. Komota in a marly nodule found below a cliff of the Ikushumbets directly above the coal mine.

The matrix of this specimen is a sandy marl, dark grey in color, and compact in texture, agreeing in every respect with that of the nodules in the sandstone of the cliff above cited. Therefore there is no doubt that the specimen came from that locality, as is also shown by the presence of an impression of *Margarita funiculata* YOKOYAMA on the matrix of this specimen, a Gasteropoda very common in the above sandstone. This sandstone cliff is the chief locality of the typical fossils of the lower *Acanthoceras*-zone.

The writer has much pleasure in associating with this species the name of its collector Mr. KOMOTA who was kind enough to present it to the museum of the Geological Department of the Tōkyō University.

HELICOCERAS SCALARE M.

Pl. III., figs. 2 and 3.

Shell helicoid, forming a widely open coil; either sinistral or dextral. Whorls circular or subcircular in section, gradually enlarging anteriorly. Surface with numerous transverse ribs,

separated from one another by a tolerably broad and flat interval. Ribs sharp, always simple and smooth, becoming somewhat feebler and more flexuous on the umbilical side.

The suture line has been only partly examined. It shows a single lateral saddle and lobe, both of which are twice deeply bifid and finely incised. The siphonal saddle is slightly higher than the lateral one.

One of the specimens (fig. 2.) is from the *Scaphites*-beds of the Opiraushibets. It is nearly a volution of a sinistral shell; less than 4 mm. in diameter at the smaller end, and about 8 mm. at the other end. One half of this whorl is furnished with 45 ribs of which 8 are broader and more elevated than the others, especially on the outer side. The smaller ribs which are found between these larger ones number 4 to 10. All the ribs are arranged transversely, except near the larger end of the whorl where they are a little oblique.

The second specimen is from the Yūbarigawa. It is a volution of a dextral shell, a little larger than the one mentioned above. As in *Heteroceras Otsukai*,[1] the siphon bends downward from the median line at a certain point of the external side of the whorl.

Another example drawn in fig. 3, pl. III., is a small fragment of a larger, dextral shell. These figures show in sufficient clearness the mode of arrangement of the ribs on the whorl.

Localities :—The middle course of the Opiraushibets, and the Yūbarigawa. Four specimens from the former locality and the two from the latter have been examined.

Horizon :—*Scaphites*-beds.

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1) Vide p. 15.

HELICOCERAS (?) VENUSTUM M.

Pl. III., fig. 4; pl. V., figs. 1 and 2.

1902. *Hamites venustus* YABE: the List of Ammonites from the Cretaceous of the Hokkaidō, in Outlines of the Geology of Japan: Descriptive Text to accompany the Geological Map of the Empire.

Shell sinistral, forming a helicoid spiral of a very wide coil. Whorls slender, very slowly increasing in diameter toward the anterior end; subcircular in cross-section when young, transversely oblong in the aged specimens. Surface with numerous transverse striæ and periodic ribs, the latter hardly distinguishable from the former on the umbilical side, but becoming gradually higher toward the external side, until they are most elevated on the upper side, each being here furnished with two tubercles. Intercalated striæ numerous, simple, smooth and uniform, becoming somewhat feebler on the umbilical surface; their intervals vary from 1.0 mm. to 0.5 mm. Both striæ and periodic ribs maintain a slightly oblique course.

The suture line is only partly visible. It is apparently very similar to that of the preceding species, being divided into three bifid saddles and a corresponding number of similarly bifid lobes on either side of the siphonal line. These saddles and lobes are nearly uniform in size and are moderately incised. The external lobe is somewhat shallower than the others. The siphon is on the median line of the external surface of the whorl.

There are two specimens of this pretty species in the writer's collection, one of which is from lower part of the *Pachydiscus*-beds, exposed along a right tributary of the Saushi-sanushibe.

It is a young volution with the umbilicus 5.5 cm. wide and the larger end 1.3 cm. broad. The other one which is from the *Scaphites*-beds of the Opiraushibets, is a fragment of the septate portion of a larger shell.

The present species is evidently related to *Heteroceras ceratopse* ANDERSON[1] from the Smith ranch, east of Phœnix, Oregon, for they have many points of resemblance in the general form and size of the shell and also in the character of the ribs. Indeed, the resemblance is so close that their separation into two distinct species may be doubted. But according to the description of ANDERSON, the American form possesses periodic ribs whose highest elevation is on the siphonal line and is not so elevated on the upper side as in the Japanese specimens. Although the difference seems to be trifling, yet the writer considers it prudent at present to regard them as two distinct species.

The discovery of more materials from both sides of the Pacific will doubtless throw light on this question.

Localities and horizons:—The lower horizon of the *Pachydiscus*-beds of the Saushi-sanushibe, Iburi Prov., and the *Scaphites*-beds of the Opiraushibets, Teshio Prov. One specimen from each locality.

HETEROCERAS (?) ŌSHIMAI M.

Pl. III., figs. 5 and 6.

Shell turreted, sinistral; volutions free, especially near the anterior end. Whorls growing slowly; obliquely elliptical in section; the surface carrying both ribs and tubercles. Ribs

1) ANDERSON: Cretaceous Deposits of the Pacific Coast. Proc. Calif. Acad. Sci. 3rd Series. Vol. II., no. 1, p. 91, pl. III., figs. 100–101.

numerous, the last volution having 45, separated by intervals wider than their breadth. Ribs uniform in size except on the upper border of the whorl, where the tuberculated ones become thicker, while the smooth ones become more faint; arranged obliquely, curving backward on the lower border and forward on the upper. Some of the ribs bear four tubercles or more correctly rounded spines which form four horizontal rows, two on the upper border, one in the middle of the external side and another on the lower border, and these tuberculated ribs alternate with 1–4 smooth ones. Tubercles subequal in size. Internal side of the whorl nearly smooth.

Of this species there is a non-septete fragment of moderately large size composed of two circuits, of which the posterior circuit and one half of the other are very close together although not quite in contact, while the remaining half is detached from the other part. The specimen is represented in pl. III., fig. 5.

The second example, which probably belongs to the same species, is a young shell, very loosely twisted and ornamented with distinct, narrow, oblique ribs alternately bearing two short spines on the upper border (fig. 6).

I have not yet seen the suture line of this species, but the other characters are enough to distinguish it from any known species of *Turrilites*. The nearest approach to the Japanese form is made by *T. Reussianus* D'ORBIGNY, from which it differs in having very oblique, flexuous and subequal ribs. Still their resemblance is so great that they must be considered as closely allied forms.

T. Reussianus is placed by SCHLÜTER[1] under the genus

1) C. SCHLÜTER: Cephalopoden d. oberen deutsch. Kreide. 1871. P. 109, pl. XXXII., figs. 13–21; pl. XXXIII., fig. 1.—A. FRITSCH u. U. SCHLOENBACH: Ceph. d. böhm. Kreidef.

Heteroceras, while FRITSCH and others bring it under *Helicoceras*. Recently, however, HYATT[1] raised it to the type of his genus *Hyphantoceras*.

T. Reussianus occurs in the *Reussianus*-zone of England and Northwestern Germany, in the zone of *Epiaster brevis* of France, in the Pläner Kalk of Saxony and the Priesen beds of Bohemia.

The species is named in honour of Dr. R. ŌSHIMA of the Hokkaidō Colliery Railway Company in recognition of his courtesy offered to the writer and his kind interest taken in this palaeontological study.

Localities:—The larger specimen was obtained in situ near the confluence of the Yoshiashizawa with the Ikushumbets, and the smaller one in the upper course of the Shi-kuruki, a tributary of the Yūbarigawa.

Horizon:—*Scaphites*-beds.

HETEROCERAS (?) ŌTSUKAI M.

Pl. IV., figs. 1–2., pl. VI., fig. 7.

1894. *Turrilites* sp. JIMBŌ: Beiträge z. Kennt. d. Fauna d. Kreidef. Hokkaidō, p. 41, pl. I. (XVII.), figs. 8, 8a.

Shell turreted, volutions free, sometimes sinistral and sometimes dextral; the anterior ones making occasionally a narrower

P. 47, pl. XIII., fig. 16?; pl. XIV., figs. 14-19 (?14-18); pl. XVI., fig. 9?—A. FRITSCH: Studien im Gebiete der böhm. Kreidef. IV. Die Iserschichten, p. 92, fig. 44. V. Priesener Schichten, p. 79, fig. 62.—H. WOOD: The Mollusca of the Chalk Rock. Pt. 1. Quart. Jour. Geol. Soc. London. Vol. LII. 1896. P. 74, pl. II., figs. 3–5.

1) HYATT: Cephalopoda in ZITTEL's Text Book of Palaeontology, translated by EASTMAN. 1899. P. 578.

coil than the posterior, at times a wider one. Umbilicus as wide as the breadth of the whorl. Whorls slowly increasing in diameter with growth, nearly round or somewhat transversely oblong in section and ornamented with numerous ribs (about 50 on a volution). Ribs uniform, smooth, usually simple, rarely bifid; arranged slightly obliquely; moderately sharp but broad at the base on the external side, thence becoming gradually narrower toward the upper border and suddenly toward the lower border, while they are fine, though still distinct, on the umbilical side. Interspaces between the ribs flat or slightly concave, being twice as broad as the ribs.

Suture line partly known. External lobe shallow, with a high broad siphonal saddle; first lateral lobe very broad, regularly bifurcating twice; external saddle symmetrically bipartite, inclining inward; first lateral saddle broad and also bifid. All the lobes and saddles are finely serrated.

Of the three examples of this species hitherto found, one (pl. IV., fig. 2.) is a partly septate fragment composed of 1½ volutions, measuring 2.5 cm. in diameter at the smaller end. Where the shell is not preserved the ribs appear broad and round, separated by very shallow furrows. The suture line and the siphuncle are also seen in the part above alluded to. The siphuncle is abnormal, being pushed down anteriorly from the normal median position on the external side of the whorl. A quite similar case has already been noticed by F. B. MEEK on a shell of *Heteroceras tortum* MEEK and HAYDEN.[1)]

The second specimen (pl. IV., fig. 1.) is a somewhat smaller one, composed also of 1½ volutions.

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1) MEEK: Invert. Cret. and Tert. Foss. Upp. Missouri County. Rep. U. S. Geol. Surv. of the Territories. Vol. IX., 1876. P. 481, pl. XXII., figs. 4a, b, c.

Turrilites sp. of JIMBŌ is a small specimen, of ill preservation, but its form and surface markings are so like the two individuals above described that it may safely be regarded as belonging to the same species.

Compare *Heteroceras elongatum* WHITEAVES[1] from the Nanaimo group of Vancouver. Though decidedly distinct, the two show certain similarities in their characters.

The writer takes this opportunity of associating with this species the name of Mr. ŌTSUKA of the Imperial Geological Survey, who once undertook a geological trip in the Mesozoic district along the upper course of the Yūbarigawa.

Localities and horizon:—The first specimen was picked up in the river bed of the Yūbarigawa above the confluence of its right branch, the Wenhorokabets, with it, while the second is from the *Pachydiscus*-beds of the Kikumezawa, a tributary of the Ikushumbets. JIMBŌ's specimen is labelled "Ponnaibuts, a place close to the town of Urakawa, Hidaka Prov."

VAR. **MULTICOSTATA** M.

Pl. III., fig. 9; pl. IV., fig. 3; pl. VI., fig. 8.

Under this head, the writer brings four fragments of turreted shells which in their general habit agree fairly well with the typical species, but differ in having more open coils, slender whorls, and narrower and more numerous ribs. Consequently, the ribs of these shells are set more closely and also more obliquely than in the typical species.

1) WHITEAVES: Mesozoic Fossils. Pt. 2, p. 100, pl. XII. Pt. 5, p. 331, pl. XLIV., fig. 2.

All these distinguishing characters, however, vary much among the specimens. One of these specimens approaching the typical species in the surface marking possesses, at the same time, whorls not so widely open as in the others, thus undoubtedly forming a connective link between the typical species and the above mentioned type of the variety. A specimen representing the opposite extremity of variation shows a suture line which does not essentially differ from that of the typical species (fig. 8). There is another specimen from the Shisanushibe which the writer with some hesitation refers to the same variety.

Localities:—The four specimens above mentioned are from (1) the Opiraushibets where it was found as a pebble close to the confluence of the Panke-kenebets (fig. 3), (2) the Opiraushibets in its middle course, (3) the Shisanushibe, a tributary of the Popet, and (4) the Yūbarigawa (fig. 9). The specimen from the last locality was found in the collection of JIMBŌ.

Horizon:—All the specimens being obtained from among the river gravels, the exact geological horizon in which they occur is of course unknown. But the one from the middle course of the Opiraushibets was found associated with *Scaphites puerculus* JIMBŌ in a marly nodule; hence, there is a great probability, that it was derived from the extensive *Scaphites*-beds in the neighborhood of the above river.

HETEROCERAS (?) JAPONICUM M.

Pl. III., fig. 8.

1902. *Turrilites* cfr. *indicus* YABE: List of Ammonites from the Cretaceous of the Hokkaidō, in Outlines of the

Geology of Japan: Descriptive Text accompanying the Geological Map of the Empire.

The writer proposes the following diagnosis by examining a specimen with two volutions of the anterior portion of the shell preserved.

Shell dextral, narrowly elongated; volutions widely apart longitudinally; umbilicus moderate in width. Whorls somewhat obliquely elongated in cross-section. Surface ornamented with numerous ribs and also some periodic ones. Ribs strong, simple, smooth and uniform, transverse and nearly straight on the external surface of the whorls, curving gently on the inner upper margin and thinning gradually inside; intervals wide (about 2 mm. on the average), smooth and flat. Periodic ribs very remote from one another, one on two volutions, somewhat broader and much higher than the other ribs. Septation unknown.

It is by no means certain that the present species is specifically distinct from *T. indicus* STOLICZKA[1]. The Indian species is provided with volutions, contiguous when young and detached in the advanced stage of growth with the ribs also nearly similar in characters, the only difference being in that the deeper periodic furrows are bounded behind by a strong rib. According to KOSSMAT,[2] *Heteroceras indicum* is a species resembling *H. polyplocum* RŒMER but distinguished by its constantly smaller size and total absence of tubercles which often appear on the surface of the whorl of *H. polyplocum.*

F. M. ANDERSON[3] referred a small form from Oregon, coiled in a flat spiral, to *H. indicum* with query. The whorl of the

1) STOLICZKA: Cret. S. Ind., p. 184, pl. LXXXVI., figs. 1–2. KOSSMAT: Untsuch. ü. d. südind. Kreidef., p. 143, pl. XX., figs. 5 and 6.

2) KOSSMAT: l. c. p. 143.

3) ANDERSON: Cretaceous Deposits of the Pacific Coast. 1902. P. 91, pl. III., figs. 96–97.

American specimen is described as showing three or four constrictions, besides the numerous ribs of the ordinary kind.

Besides the specimen on which the above description is based, there is another from the Opiraushibets which is much more fragmentary, and which therefore the writer refers with much hesitation to the same species.

Localities :—The Yubarigawa, Ishikari Prov. (figured), and the Opiraushibets, Teshio Prov.

Horizon :—Upper Ammonite-beds.

Localities and horizons of the allied species :—

H. indicum STOL. The uppermost bed of the Trichinopoly group of South India.

H. indicum STOL. (?). The lower Chico group of Smith ranch near Phœnix, Oregon.

HETEROCERAS (?) ORIENTALE M.

Pl. III., fig. 7.

There are two internal casts of a shell which the writer takes for a new species. The larger and better of these two specimens, has only one and a half volutions preserved. The diagnosis runs as follows :—

Shell sinistral, very much elongated longitudinally. Volutions slender, increasing in size gradually toward the anterior portion, making very oblique and open coils. Whorls oblong in cross-section with the longer axis oblique to the axis of volution. Surface marked with very flexuous, transverse ribs except on the smooth inner side. Ribs slightly irregular in size, usually simple

and strong but not seldom bifurcating and then weaker; they make a backward curve on the lower margin and another forward one near the upper, where sooner or later they disappear. Intervals also not quite uniform, the breadth varying from 2 mm. to 3 mm. Tubercles rather prominent, arranged in four rows of which three are on the external side and one on the lower margin. All the rows are equidistant from one another and parallel to the suture except on the last portion of the shell in which they are more or less oblique to the latter. Ribs, except weak and short ones, bear a set of tubercles.

Although this species agrees with *T.* cfr. *Bergeri*[1] in having four rows of tubercles and transverse ribs, yet there seems to be no further resemblance between the two. *Helicoceras hystriculum* WHITE[2] from the Cretaceous of Sergipe, South America, represents a species probably belonging to the same type as ours. Excepting this *H. hystriculum*, the writer is at present unaquainted with any form which makes even a distant approach to the Japanese shell.

Localities:—The Ikushumbets, Ishikari Prov., the exact position of the bed from which the specimens were derived is unknown. But the other Molluscan remains found together in the same marly nodule belong to the species common in the *Pachydiscus*-beds.

NIPPONITES MIRABILIS GEN. ET SP. NOV.

Pl. IV., figs. 4–7; pl. VI., fig. 6.

We have only a single specimen belonging to this entirely new and extraordinary type of Ammonites.

1) Vide supra.

2) WHITE: Contributions to the Palæontology of Brazil. 1888. P. 229, pl. XXII., figs. 3, 4.

At first the shell forms a more or less flat spiral coil wound sinistrally as in *Helicoceras*, its diameter being about 2.7 cm. and the cross-section of the whorl at the end of the second volution about 0.9 cm. The further growth is no longer spiral, but it consists in turning to the right and then to the left several times and thus forming many U-shaped curves which cover the first part of the shell from six directions, so that the plane of the curves roughly corresponds to the six sides of a cube. The limbs of each single curve and of those adjacent come nearly in contact.

In cross-section, the whorls of the younger, spiral portion are nearly round, while those of the older are somewhat oblong, the dorso-ventral diameter being a little narrower than the lateral one. The body chamber is probably long, as about two anterior curves seem not to be septated.

As our shell consists of several U-shaped curves, when it is compared with the ordinary *Turrilites*, one limb of a curve corresponds to a whorl of a sinistrally wound *Turrilites*, and the other to that of a dextrally wound one.

The ribs are simple, smooth and uniform (except at the anterior end), sharp and high on the external surface, becoming somewhat weaker inside; they are closely and obliquely set, separated by flat intervals of a moderate width. Only near the anterior end of the shell, the ribs become dissimilar, some of them being higher and broader than others, which proves the growth at these points had been frequently checked. With the exception of the anterior portion, the surface sculpture of this species is so much like that of *H. Ōtsukai* as to suggest the existence of a relationship between the two species. In the spirally coiled, posterior portion of this shell, the siphuncle is

sutural by which fact it is distinguished from *Helicoceras*. On the portion of the irregular growth, however, the siphuncle is always (?) situated in the median line of the external side.

The suture line was partly examined on the whorl which succeeds the regular spiral growth. It shows two saddles and corresponding lobes on one side of the siphonal line, and does not essentially differ from that of *H. Ōtsukai*. The two saddles are comparatively slender and nearly equal in height; both are bipartite with bifid subdivisions. The lateral lobe is very broad and bipartite, slightly exceeding the ventral one in depth. The siphonal saddle is relatively broad and high, with a few serrations along the margin.

The complicated mode of coiling the whorls in this species is better seen in the accompanying figures. In Plate IV., figs. 4 and 5 show its external aspect seen from two different directions, each U-shaped curve is marked with the Roman numerals II.—VI. and I'. II'. in the order of their succession. The first curve (I.), immediately succeeding the spiral portion, is not to be seen in these figures; the second curve which is only partly visible is marked II. and the third III. and so on. The seventh curve, being nearly upon the first one, is marked I'. and the eighth, for the same reason, II'.

Fig. 6 shows a longitudinal section of the specimen, the cross-sections of the whorls being hatched. The two volutions of the spiral portion appear as four round sections marked with Arabian numerals 1–4. The position of the siphuncle is also indicated on the sections by S.

Fig. 7 was drawn after a wire model showing the mode of coiling the whorls from the beginning to the end. Roman numerals are here also used in the same sense as before.

We do not know any morphological equivalents of this peculiar shell among similar tube-forming animals of the past or the present. The following cases of abnormal growth of the shell of *Turrilites* and its allied genera may be taken into consideration.

(1.) The Ammonites with a conically spiral shell usually follow a certain law in their growth, having volutions which are either mutually in contact or separate; but cases often occur in which they show a portion near the mouth more or less perceptibly deflected in position from the preceding volutions. This change may be produced by the animal either pathologically or as the result of old age. We also learn from various sources, the occurrence of many examples in discoidal species, showing a slight tendency to become conically spiral in the anterior portion. QUENSTEDT and some others early called attention to this fact and seem to have believed the probable derivation of secondary forms from ancestral individuals of pathologic growth.

(2.) In some of the secondary forms, it is known that at the very beginning of development they show a normal growth, that is to say, a discoidal shell with volutions more or less involute. A remarkable case has recently been described by WHITEFIELD[1] in *Heteroceras simplicostatum* from the Fort Benton group of the Black Hills. According to this author, the species has its younger portion composed of two straight limbs, close together, like *Hamites*. This seems to indicate the derivation of a more abnormal type from a less abnormal one.

(3.) Besides, there are a few cases in which the shell is coiled in a conical spiral, first to the right and then to the left,

1) WHITEFIELD: Observations on and emended Descriptions of *Heteroceras simplicostatum* WHITEFIELD. (By review.)

the latter portion surrounding the earlier one. Such double coils of a tubular shell around the same axis of volution, but in opposite directions, may be either accidental, or due to the animal itself having an inherent power of producing such coils.

(4.) Again, there are some species of the later Cretaceous which are remarkable in exhibiting a great range of individual variations on the mode of coiling the shell. The variations, however, are due to a loss of power in the animal, which as it grows no longer maintains its normal mode of coiling.

In the present species, in spite of its being represented by a single specimen, the mode of coiling the whorls can neither be accidental nor due to a loss of power to produce the regularly wounded shell, as it is too regular to admit any such supposition. That it is a *Turrilites* or some allied genus which has modified its mode of growth on account of its advanced age is also inconceivable. Therefore, this formation of several U-shaped curves must be ascribed to the inherent power of the animal. It is for these reasons that the writer proposes to give a new generic name to this single specimen.

As above mentioned, this species has both suture and sculpture which indicate its derivation from some species of *Heteroceras* (?), e.g., *Heteroceras* (?) *Ōtsukai* in turreted groups of Ammonites. From the form of the shell, we can readily see that the animal led neither a free swimming life nor a sessile one, but was a creeper on the sea-bottom as is the generally accepted view of *Turrilites*.

QUENSTEDT after describing *Turrilites reflexus*—an extraordinary form of a doubly coiled shell, says:[1]

"Es mag wahrscheinlich Formen gehen, wo sich dieses hin-

1) QUENSTEDT: l.c. p. 306.

und herdrehen noch zum öftern wiederholt, sie sind den Weberspulen zu verglichen, über welche die Faden sich hin und her über einander windet. Was setzt das nicht für eine Beweglichkeit der Organe voraus!"

Of course, QUENSTEDT did not know, then, that such a peculiar form as the present species would occur in Japan.

INCERTÆ SEDIS.

There are few forms of Ammonites in our fauna, more interesting than the single specimen described below under the name of *Ammonites Kotoi*. Its characters agree in several respects with *Olcostephanus superstes* KOSSMAT[1] which that author, together with *Ammonites rudra* STOLICZKA,[2] temporally brought under the genus *Olcostephanus*. He, of course, acknowledged the phyletical relation of these two Ammonites to *Vascoceras* on one side and to *Acanthoceras* on the other, although they much resemble, not only in the general aspect of their external form, but also in their suture line, the lower Cretaceous and the Jurassic species of the genera *Olcostephanus* and *Stephonoceras*—a good example of heterochronous homœomorphy, a phenomena now known as often occurring in the Cephalopoda.

Vascoceras[3] is a genus lately proposed by P. CHOFFAT to include Ammonites intermediate between *Olcostephanus* and *Acanthoceras* (*Mammites*). According to this author, *Amm. superstes* differs from *Vascoceras* in respect of the higher saddles

1) KOSSMAT: l.c. p. 133, pl. XVII., figs. 1 a, b, c.

2) KOSSMAT: l.c. p. 20.—STOLICZKA: l.c. p. 122, pl. LX. Further see NEUMAYR: l.c. p. 933.

3) CHOFFAT: Faune Crétacique du Portugal, II Série. P. 51.

of the suture line, while GROSSOUVRE[1] considered it to be a species rather referable to the genus *Acanthoceras*. Thus, the question in regard to the particular generic name that should be retained for the group under consideration seems at present an open one.

Ammonites rudra occurs in the middle, and *Amm. superstes* in the upper division of the Utatur group of South India. According to PERON[2] and CHOFFAT, Ammonites closely resembling the latter occur also in the deposits of the Turonian age of Algeria and Portugal. *Ammonites* (*Buchiceras*) *Hartii* HYATT from the upper Cretaceous of Sergipe in Brazil which has been referred by KOSSMAT to the same group, together with the above two species, shows also a close relation to *Vascoceras*, but the specimen in this case seems too imperfect for the decision of its proper generic position.

AMMONITES KOTOI M.

Pl. VI., figs. 3 and 4.

The only specimen here figured is an imperfect cast of the interior in which only a portion of the outer volution is well preserved. The suture line, however, is tolerably well preserved.

Shell globose, inflated, consisting of many volutions. Umbilicus deep, moderate in breadth. Whorls lunular in cross-section, broader than high; uniformly rounded on the ventral and lateral sides. Surface with numerous transverse ribs, and a

1) GROSSOUVRE: Sur *l'Ammonites peramplus*, p. 334.

2) PERON: Les Ammonites du Cretacé supérieur de l'Algèrie, p. 14.—KOSSMAT: l.c. p. 135.

row of tubercles bordering the umbilicus. Ribs round, simple and uniform, separated by intervals of like breadth, gently curving forward on the ventral surface of the whorl and generally bearing a moderately sized tubercle on the umbilical margin. Umbilical wall perpendicular and smooth.

The volution next to the outer one differs from it mainly in having a relatively wider umbilicus.

The siphonal saddle is broad and high, flat on the top, and with a few denticles on both sides. The external and the first lateral saddles are exceedingly high and simple, with a few short branches, and are tripartite on the top. Each branch terminates in a round lobule. The first lateral lobe is bifid and somewhat shorter than the external one.

As already mentioned, the present species is an ally of *Amm. superstes* and *Amm. rudra*; of these two, it exhibits a greater resemblance to the first than to the second. However, it differs from the first by its higher whorl bearing more numerous ribs and tubercles.

Locality:—The specimen was found in a nodule of marl, obtained as a pebble in the Yūbarigawa. This being the sole example now at the writer's disposal, its stratigraphical position cannot be given with any certainty.

OLCOSTEPHANUS NEUMAYR.

NEUMAYR[1] correctly remarked that an Ammonites from Urakawa brought under the genus *Stephanoceras* by BRAUNS[2]

1) NEUMAYR: Neues Jahrb. für Mineralog. Geolog. u. Palæontolog. 1881 Bd. II., p. 80.
2) BRAUNS: Vorläufige Notiz über Vorkomnisse der Juraformation in Japan.

might belong to *Olcostephanus*, while NAUMANN[1] believed it to be in reality a specimen, foreign to Japan. In the JIMBŌ collection, however, there is a specimen of Ammonites referable, as the present writer believes, to *Olcostephanus*, with a label written "Loc. Takambe, a branch of the Ikushumbets river." Thus, at present there is no doubt about the occurrence of the Ammonites of the above named genus in our fauna.

A specimen described by JIMBŌ[2] as a species of *Olcostephanus*, long ago, is now believed by the present writer to be merely an imperfect specimen of a new species of *Scaphites* which will be described in some detail in the succeeding part of this memoir.

OLCOSTEPHANUS UNICUS M.

Pl. VI., figs. 5, a, b.

Dimensions:—

Diameter.	4.2 mm.
Height of the last whorl.	1.9 „
Breadth of the last whorl.	2.3 „
Width of umbilicus.	1.2 „

Shell composed of many volutions, inflated. Umbilicus moderate in size, deep; the umbilical wall is perpendicular and its margin rounded. Aperture subcrescentic, broader than high, uniformly rounded on the lateral as well as on the ventral side. Involution rather deep. Surface with numerous transverse ribs; straight, uniform, narrow but prominent, separated by flat intervals wider than their breadth. The ribs are closely set and nearly

1) NAUMANN: Ueber das Vorkommen der Kreideformation auf der Insel Jezo.
2) JIMBŌ: l.c. p. 33 (179), pl. IX., figs. 3, a, b.

parallel to one another, while near the umbilical margin, three or more of them unite to form a bundle. Besides, there are five constrictions on the last volution which are broader and deeper than other intervals and are bordered behind by a rib somewhat more prominent than the usual ribs to which they are arranged quite parallel.

The suture line which is only partly seen, shows three saddles. The first lateral saddle is narrow, but high and bipartite; the lobes are also bipartite.

Of Ammonites described from the Cretaceous deposits of the Pacific border, *Olcostephanus Logannianus* WHITEAVES[1] from the Chorizon of the Queen Charlotte Islands in some respects appears nearest to this species. The periodic ribs seen on the Japanese specimen are not present in the American species, and moreover the whorls of the former increase as the shell grows more rapidly than the latter.

Locality:—The specimen here figured is from the Kami-takambe, a right branch of the Ikushumbets, between the Poronai and the Ikushumbets coal mines.

Horizon:—Unknown.

HAUERICERAS GROSSOUVRE.

The genus *Hauericeras* was established by A. DE GROSSOUVRE,[2] in 1893, to include Ammonites which have smooth, strongly compressed, discoidal shells, with a sharp, ventral keel and having the suture line composed of two broad saddles followed by 3–7

1) WHITEAVES: Mes. Foss. Vol. I., pt. 1, p. 27, text fig. 3; pl. VIII., fig. 2. Pt. 3, p. 211, pl. XXIII., figs. 1 and 1a. Pt 4. p. 276.

2) GROSSOUVRE: Recherches sur la Craie supérieure. 1893. P. 219.

smaller ones. The external and lateral saddles are unequally bipartite and especially so in the former, so that it may more properly be called tripartite; the lateral lobe is also broad and tripartite, and about as long as the external one. The siphonal saddle is relatively high and broad, being inflated at the top. The auxiliary saddles and lobes rapidly diminish in size and hang obliquely toward the umbilical suture.

KARL V. ZITTEL[1] treats *Hauericeras*, *Desmoceras*, *Puzosia* and *Pachydiscus* under the family of Desmoceratidæ, while GROSSOUVRE[2] brings them together with *Schlüteria* under the family of Phylloceratidæ. AL. HYATT[3] includes them, with the exception of *Pachydiscus*, in the family of Haploceratidæ. However, the general character of *Hauericeras* in its developmental stages differs slightly from Phylloceratidæ, being on the contrary closely allied to the typical *Desmoceras*, and therefore the writer is at a loss to see why GROSSOUVRE included it among the Phylloceratidæ.

As is generally accepted by palæontologists, *Hauericeras* has a close affinity to the group of *Desmoceras Sugata* FORBES and also to the genus *Puzosia* BAYLE, the resemblance to the former being in its ventral keel, and to the latter in the suture line. The writer himself also at first adopted the same view, but a further examination of the specimens from the Hokkaidō led him to think that the latter belonged rather to the family of Phylloceratidæ than to Desmoceratidæ. He, of course, thinks it scarcely safe to determine their taxonomic position on such an external resemblance, and this question, consequently, may be treated, in some detail, in the later part of this memoir.

1) ZITTEL: Grundzüge d. Palæontologie 1895.

2) GROSSOUVRE: l. c. p. 163.

3) HYATT: Cephalopoda in ZITTEL's Text Book of Palæontology translated by EASTMAN. 1899. P. 569.

No matter to what family our genus belongs, it is, undoubtedly one of the most important groups of Ammonites for stratigraphical purposes, as though much restricted in the number of species its geographical distribution is very wide.

The type of the genus is *H. Gardeni* BAILY sp.,[1] recognized in the Cretaceous (horizon f. of GRIESBACH) of Natal in South Africa, the Ariyalur and Trichinopoly groups of South India, the Nanaimo group (Horizon B of RICHARDSON) of Vancouver, and the Cretaceous of the Hokkaidō. To the same species, an Ammonites from the Cretaceous of Tunis has lately been referred by PERVINQUIERE[2] although with some doubt, and *Ammonites sulcatus* KNER[3] from Galicia is by some palæontologists taken as a synonym of *H. Gardeni*. If the above determinations are correct, then it is a cosmopoliton species of the upper Cretaceous Ammonites.

According to GROSSOUVRE and KOSSMAT, this genus also includes *Ammonites rembda* FORBES, *Amm. pseudogardeni* SCHLÜTER, *H. Fayoli* GROSS. and *H. Welschi* GROSS. *H. rembda*[4] occurs in the Valudayur bed of South India, the Cretaceous of Natal (horizon d) and Madagascar[5] while *Amm. pseudogardeni*[6] is found in the zone of *Scaphites binodosus* of the German Cretaceous. *Amm. pseudogardeni* var. *nodotum* SCHLÜTER[7] from Braunschweig

1) Vide p. 32.

2) L. PERVINQUIÈRE: Un facies particulier du Sénoinen de Tunise. 1895. (By review).

3) FAVRE: Descrip. des Mollusques foss. la craie des environs de Lemberg 1869. P. 12, pl. IV., fig. 7.

4) STOLICZKA: Foss. Ceph. Cret. Rock South India. P. 63, pl. XXXIII., fig. 5; pl. LXXI., fig. 9. GRIESBACH: Geol. of Natal. P. 63, pl. III., figs. 2, 3. KOSSMAT: Unters. ü. d. Südind. Kreidefom. P. 124, pl. XVIII., fig. 9.

5) GROSSOUVRE: Sur quelques Fossiles Crétacés de Madagascar. p. 378, 1899.

6) SCHLÜBER: Cephal. d. oberen deutsch. Kreide, p. 54, pl. XVI., figs. 3–6.

7) SCHLÜTER: Podocrates im Senon von Braunschweig. Zeitsch. d. deut. geol. Gesell. Bd. LI., p. 411.

has not yet been fully illustrated and the specific identification seems to be uncertain. Of the two species described by GROSSOUVRE from the Cretaceous of France, viz. *H. Fayoli*[1] and *H. Welschi*,[2] the former is in the Campanien and the latter in the zone of *Mortoniceras texanum*.

The present writer proposes to bring two other species under this genus. The one is *Amm. lagarus* REDTENBACHER[3] from Gossau which shows such agreement in every particular with the above mentioned typical species that the writer has no hesitation in stating their generic identity. The other is a new form found in the Cretaceous of the Hokkaidō, and is described below under the name of *H. angustum*.

HAUERICERAS GARDENI BAILY.

1855. *Ammonites Gardeni* BAILY: Cret. Foss. South Africa, p. 456, pl. XI., fig. 3.

1865. *Amm. Gardeni* STOLICZKA: Foss. Ceph. Cret. Rock S. India, p. 61, pl. XXXIII., fig. 4.

1879. *Amm. Gardeni* WHITEAVES: Mes. Foss. vol. I., pt. 2, p. 102.

1880. *Haploceras Gardeni* NAUMANN: Kreidef. auf der Insel Jezso, p. 10.

1890. *Desmoceras Gardeni* YOKOYAMA: Verst. Jap. Kreide, p. 184, pl. XX., fig. 10 a–c.

1895. *Desmoceras Gardeni* WHITEAVES: On some Foss. from the Nanaimi Group of the Vancouver Cret. p. 131.

1) GROSOUVRE: l.c. p. 221, pl. XXVII., fig. 3.
2) GROSSOUVRE: l.c. p. 222, pl. XXXV., fig. 9.
3) REDTENBACHER: Cephalopoden Fauna d. Gosauschichten, p. 112, pl. XXV., figs. 3 a, b.

1895. *Desmoceras Gardeni* WHITEAVES: On some Foss. from the Nanaimo Group of the Vancouver Cret. P. 131.

1895. *Hauericeras Gardeni* GROSSOUVRE: Les Ammonites de la Craie supérieure. P. 220.

1897. *Hauericeras Gardeni* KOSSMAT: Unters. ü. d. S. Ind. Kreidef. P. 123 pl. XVIII. figs. 7 a, b, 8, 10.

1903. *Hauericeras Gardeni* WHITEAVES: Mes. Foss. vol. I., pt. 5, p. 352.

The remarks of YOKOYAMA on the Japanese specimens given in the above quoted work need no special additions, and everyone who sees his figure is at once convinced that the Japanese form must be identified with that of South Africa.

Localities:—Urakawa and Chashikots in Ikandai near Urakawa, Hidaka Prov.; the Sanushibe and the Shirikuru-pokomanai, in the Sōshibets, both branches of the Mukawa, Iburi Prov.; the Shi-kuruki, a tributary of the Yūbarigawa and the Kikumezawa, a tributary of the Ikushumbets, Ishikari Prov.; the Opiraushibets and the Abeshinai, a tributary of the Teshiogawa, both in Teshio Prov.; north of Chietomanai near Cape Sōya, Kitami Prov. Although this species is found everywhere in the *Pachydiscus*-beds, the number of its individuals is always limited.

HAUERICERAS ANGUSTUM M.

Pl. V., figs. 5, 6.

In the JIMBŌ collection, there are two other specimens of *Hauericeras* showing an aspect distinct from the preceding species. Both are small but beautifully preserved, one of them showing

the suture lines in detail up to the end of the outer volution. In the writer's collection, there are also two specimens, referable to the same species; one of them is somewhat larger and flattend on the sides by pressure, but agrees in point of essential characters with the above examples.

The dimensions of these three examples measured are as follows:—

	(1)	Ratio.	(2)	Ratio.	(3)	Ratio.
Diameter.	3.65 cm.	100	3.45 cm.	100	2.60 cm.	100
Height of the last whorl.	1.50 „	41	1.35 „	39	1.10 „	42
Breadth of the last whorl.	—	—	0.75 „	22	0.55 „	21
Width of umbilicus.	1.15 „	31	1.10 „	31	0.85 „	32
Involution.				%		

1). A specimen from the Kikumezawa.

2). „ „ „ „ Urakawa; (pl. V., fig. 5.)

3). „ „ „ „ Urakawa.

As is seen from the above table, the variation is very slight in the three specimens except in size.

This species is readily distinguished from *H. Gardeni* BAILY,[1] *H. rembda* FORBES[2] and *H. Fayoli* GROSSOUVRE[3] by its narrower umbilicus and higher whorl. It is, no doubt, much like *H. Welschi* GROSSOUVRE,[4] with which at first glance it seems to agree in nearly all its characters. But a closer examination reveals a marked difference in the form of the whorl. In the Japanese species the lateral sides converge gradually upward to the ventral keel, while in the GROSSOUVRE's figure of *H. Welschi*, the sides converge very slowly to the ventral margin whence they suddenly bend to the base of the keel.

1) See p. 32.
2) l.c.
3) l.c.
4) l.c.

This species agrees tolerably well with *H. Gardeni* in its suture line, there being in both four auxiliary saddles. That *H. pseudogardeni* differs from the present species notwithstanding their great resemblance in external shape is easily seen in that it has more numerous auxiliaries.

Localities :—The Kikumezawa, a tributary of the Ikushumbets, Ishikari Prov.; the Popets, a branch of the Mukawa, Iburi Prov.; Urakawa, Hidaka Prov.

Horizon :—The only case in which the mode of occurrence of this species has been determined, is in the Kikumezawa, where it was found in the *Pachydiscus*-beds together with *H. Gardeni*.

DESMOCERAS Zittel.

DESMOCERAS DAWSONI Whiteaves var. **JAPONICA.**

Pl. V., figs. 3, 4.

1884. *Haploceras Beudanti* Whiteaves: Mes. Foss., vol. I., pt. 3, p. 205, pl. XXVI., figs. 1 and 1a.

1900. *Desmoceras* (*Puzosia*) *Dawsoni* Whiteaves. Mes. Foss., vol. I., pt. 4, p. 286, pl. XXXVII., fig. 3.

The specimens of this species in the writer's collection, excepting one which has been figured, are more or less distorted by pressure. The suture line is also quite obscure on account of the bad state of preservation.

Dimensions:

	(1)	Ratio.	(2)	Ratio.	(3)	Ratio.
Diameter.	11.3 cm.	100.	11.1 cm.	100.	13.2 cm.	100.
Height of the last whorl.	5.7 „	50.	5.5 „	49.	6.8 „	51.
Breadth of the last whorl.	4.5 „	38.	3.3 „	29.	—	—
Width of umbilicus.	2.1 „	16.	—	—	2.35 „	18.

1). The figured specimen from the Ikushumbets.

2). *Desmoceras Dawsoni* WHITEAVES from Cumshewa Inlet; measured from the figure on Pl. XXVI. in Mes. Foss. vol. I., pt. 3.

3) *Desmoceras Dawsoni* WHITEAVES from Cumshewa Inlet; measured from the figure on Pl. XXXVII. in Mes. Foss. vol., I., pt. 4.

Shell discoidal, compressed on the sides and rounded on the ventral surface. Umbilicus narrow, with a steep wall and more or less rectangular margin. Involution very deep, about $\frac{5}{6}$ of each volution being covered. Section of the whorl elliptical, higher than broad. Surface with eight distant, very flexuous constrictions, parallel to the lines of growth. Constrictions narrow, bordered behind by an elevated rim which becomes more prominent and bends strongly forward on the ventral surface. On aged specimens, these constrictions become strongly sigmoidal as is shown in the anterior portion of the figured example, and the lines of growth, otherwise appearing as delicate striæ, also become coarser.

The suture line is only partly visible. The first lateral lobe is about as long as the external lobe and tripartite, but not so deep and wide as in the case of *Puzosia*. The external saddle as well as the two lateral ones are bipartite.

The general outline, surface marking and suture line of the Japanese species much resemble those of *Desmoceras Dawsoni*

WHITEAVES from the Queen Charlotte Islands. But the shell is somewhat broader and periodic constrictions are less numerous in the Japanese species, so that the writer feels warranted in proposing a new specific name for it.

According to WHITEAVES, *Desmoceras Dawsoni* is quite abundant in the Cretaceous rocks on the northern shore of Cumshewa Inlet, while in Bear Skin Bay a few specimens are said to occur which are however distinguished from the typical form by their rectangular umbilical margin. The latter is considered by that author as a variety to which the Japanese form seems to approach more closely.[1]

At first, WHITEAVES[2] identified his specimens with a European form—*Ammonites Beudanti* BRONGNIART—which is also recorded by STOLICZKA as occurring in the South Indian Cretaceous fauna.[3] Afterwards, however, KOSSMAT[4] proved the distinction between *Amm. Beudanti* and the allied form from South India. The latter, as described by him, shows the suture line of the type of *Puzosia*, and hence it is a species quite different from *Ammonites Beudanti* which no doubt belongs to *Desmoceras*. He stated also that *Ammonites Beudanti* of WHITEAVES from the Queen Charlotte Islands is a true *Desmoceras*. This view was afterward adopted by WHITEAVES[5] himself who in his later publication made a new specific name for what he had formerly taken for *Ammonites*

1) J. C. MERRIAMI later reported this species from Spanisch Gulch of the John Day Basin.

2) D'ORBIGNY: Ter. Crétacés. Ceph. P. 278, pl. XXXIII., XXXIV. 1840.—PICTET: Moll. des Grès Verts. P. 33, pl. II., fig. 3. 1848.—QUENSTEDT: Ceph. P. 222, pl. XVII., fig. 10. 1849.—PICTET et CAMPICHE: S. Croix. P. 277, pl. XL., figs. 1–4. 1860.—PARONA e BONARELLI: Fossili albiani d'Escragnolles. P. 86 (34), pl. XI. (II.), fig. 6. 1896.

3) STOLICZKA: Foss. Ceph. Cret. Rock South India. P. 142, pl. LXXI., figs. 2–4; pl. LXXII. 1865.

4) KOSSMAT: Süd. Ind. Kreidef. P. 120 (185). 1897.

5) WHITEAVES: Mes. Foss. Vol. I. pt. 4., P. 286. 1900.

Beudanti, giving the Characters which distinguish it from *P. Stoliczkai* KOSSMAT of Southern India. However, he differs from KOSSMAT in one point; viz. in referring his species not to *Desmoseras*, but to *Puzosia*, in which respect the present writer is more inclined to adopt the opinion of KOSSMAT.

The reason why the present writer hesitates to bring this species under *Democeras* is because its suture line is only imperfectly known. KOSSMAT who examined the Canadian specimen, thinks that it has a typical *Desmoceras* suture as he says "mit ganz typischer zur Naht gehender Lobenlinie." A part of the suture line seen on a Japanese specimen gives no clue to distinguish it from *Desmoceras*. On the other hand, the suture line on pl. XXVI in the WHITEAVES' monograph which does not appear to be very satisfactorily drawn, shows in some respects a resemblance to that of *Cleoniceras*,[1] a genus proposed by PARONA and BONARELLI to include *Amm. Cleon.* d'ORB., formerly assigned to *Sonneratia*, *Amm. Beudanti* and a few other allied forms. Such being the case, it is quite impossible at present to determine whether this species is *Desmoceras* or *Cleoniceras*.

Desmoceras Dawsoni shows also a distant relation to *Desmoceras voyi* Anderson[2] from the Horsetown beds of California. The latter possesses, however, a broader and somewhat inflated shell with lateral sides gently converging to the ventral surface, and although the periodic ribs are of the same nature as those of *Desmoceras Dawsoni*, yet they are fewer in number. The suture line is described as agreeing with that of *Desmoceras latidorsatum* MICHELIN.[3]

1) PARONA e BONARELLI: Fossili albiani d'Escragnolles, p. 85 (33). 1896.

2) ANDERSON: Cret. Dep. Pacific coast, p. 100, pl. III., figs. 89, 90. 1902.

3) D'ORBIGNY: l.c. p. 270, pl. LXXX.—PICTET: Foss. d. Gres. Verts. p. 44, pl. III., figs. 4, 5.—STOLICZKA: l.c. p. 148, pl. LXXIV., figs. 1-4.—KOSSMAT: l.c. p. 107 (172), pl. XIX (XXV), figs. 2-5.

The occurrence of *Desmoceras Dawsoni* in the Cretaceous of the Hokkaidō is of special importance, as among the few Japanese forms which show some relation to those of the North American Pacific species, none is more closely related than the present one, and it is also a remarkable fact that a bivalve, very much like *Thetis affinis* WHITEAVES[1] from the C horizon of the Queen Charlotte Islands is found abundantly together with this Ammonites in the same layers.

Locality and horizon :—Several specimens of this Ammonites, one of which is here figured, were obtained along the Ikushumbets 10 miles east of the Ikushumbets coal mines, Ishikari Prov. Up to this time it has been met with only at the above locality where it is quite numerous in a sandstone of the *Thetis*-zone, associated with *Thetis* aff. *affinis* WHITEAVES.

DESMOCERAS PORONAICUM M.

Pl. VI., figs. 1, 2.

Dimensions :—

		Ratio.
Diameter.	2.5 cm.	100.
Height of the last whorl.	1.2 „	48.
Breadth of the last whorl.	1.1 „	44.
Width of umbilicus	0.4 „	16.

Shell small, discoidal, composed of a few compressed whorls, which are nearly parallel sided and slope gradually to the rounded ventral surface. Involution very deep; umbilicus narrow with the perpendicular wall, exposing only a very small portion

1) WHITEAVES: Mes. Foss. vol. I., pt. 3, p. 226, pl. XXX., figs. 4, 4 a, b; pt. 4. p. 290.

of the inner whorls. Aperture somewhat elongated, higher than broad. Surface of the shell apparently quite smooth, with a faint groove on a portion of the anterior whorl where the shell has been taken off. The groove curves strongly forward in crossing the ventral surface where it is more distinct than on the lateral sides. Suture line with four saddles and four lobes on each lateral side, and the two on the umbilical wall. These saddles and lobes diminish very gradually in size and are all similar in shape, the former being bipartite and the latter tripartite excepting the three or four innermost ones which are always simple.

There is scarcely any doubt as to the existence of a close relationship between this species on the one hand and *Desmoceras inane* STOLICZKA[1] from the Utatur Group and *D. diphylloides* FORBES[2] from the Ariyalur and the Voludayur group of S. India on the other. *D. diphylloides* agrees fairly well with this species in its general outline if we except the slightly narrower umbilicus and more numerous saddles and lobes. *D. inane* is thicker than the Japanese species although it much resembles it in the suture line. *Ammonites Selwynianus* WHITEAVES[3] from the Horizon A of Vancouver Island and *D. pyrenaicum* GROSSOUVRE[4] from the Santonien of France are also our distant allies.

From *D. Dawsoni* WHITEAVES var., the present species is distinguished by the higher whorls and narrower umbilicus. But as the specimens of these two species examined by the writer are quite different in size, the above distinctions must be taken

1) STOLICZKA: l.c. p. 121, pl. LIX., fig. 13 (non fig. 14).—KOSSMAT: l.c. p. 107, pl. XIX., figs. 6-7.

2) STOLICZKA: l.c. p. 119, pl. LIX., figs. 8-9.—KOSSMAT: l.c., p. 108, pl. XIX., figs. 8-9.

3) WHITEAVES: l.c. pt. 2, p. 104, pl. XIII., fig. 1; pt. 5, p. 351.

4) GROSSOUVRÉ: Amm. de la Craie supérieure, p. 168, pl. XXXVII., figs. 9 a, b, c.

with some reserve. Also it may not be impossible, as it sometimes happens, that they are really individuals of one and the same species at different stages of growth. However, for the present, it seems preferable to treat them as two distinct species.

Locality and horizon:—This species is known only from two small, probably immature specimens, obtained near the source of the Poronai, Ishikari Prov. At this place, they were found in a pebble of a marly module, the exact horizon in which they occur being unknown, but it is almost certain that the nodule was derived either from the lower part of the upper Ammonite-beds or from a layer below it.

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Contents.

PLATE I.

Turrilites.

Plate I.

Turrilites Komotai m. Pp. 7–9.

Fig. 1. Side view of the type, preserved in the Sci. Coll. Mus. From lower *Acanthoceras*-zone of the Ikushumbets, Ishikari Prov. Nat. size.

Fig. 1.

PLATE II.

Turrilites.

Plate II.

Turrilites Komotai m. Pp. 7–9.

Fig. 1. Upper view of the specimen drawn in Pl. I.

Fig. 1.

PLATE III.

Turrilites, Helicoceras and Heteroceras.

Plate III.

(All the specimens here figured are in Sci. Coll. Mus.)

Turrilites aff. *Bergeri* Brgt. Pp. 4–7.

Fig. 1. Side view of the type. From lower Ammonite-beds of the Popets, Iburi Prov. Nat. size.

Helicoceras scalare m. Pp. 9–10.

Fig. 2. Upper view of the type. From *Scaphites*-beds of the Opiraushibets, Teshio Prov. Nat. size.

Figs. 3 a, b, c. Upper and lower views and cross-section of another specimen. From *Scaphites*-beds of the Opiraushibets. Nat. size.

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Fig. 4. Side view (slightly oblique) of a large specimen. From *Scaphites*-beds of the Opiraushibets. Nat. size.

Heteroceras Ōshimai m. Pp. 12–14.

Fig. 5. Side view of the type. From upper Ammonite-beds of the Ikushumbets, Ishikari Prov. Nat. size.

Fig. 6. Side view of a smaller specimen. From upper Ammonite-beds of the Shikuruki, Ishikari Prov. Nat. size.

Heteroceras orientale m. Pp. 19–20.

Fig. 7. Side view of the type. From the upper Ammonite-beds of Urakawa, Hidaka Prov. Nat. size. In this drawing, the larger end of the shell is shown below and the smaller end above.

Heteroceras japonicum m. Pp. 17–18.

Fig. 8. Side view of the type. From upper Ammonite-beds of the Yūbarigawa, Ishikari Prov. Nat. size.

Heteroceras Ōtsukai var. *multicostata* m. Pp. 16–17.

Fig. 9. Side view of the type. From *Scaphites*-beds of the Opiraushibets. Nat. size. On this figure, the larger end of the shell is shown below and the smaller end above.

Fig. 8.

Fig. 7.

Fig. 9.

Fig. 2.

Fig. 5.

a.

Fig. 3.

b.

c.

Fig. 6.

Fig. 1.

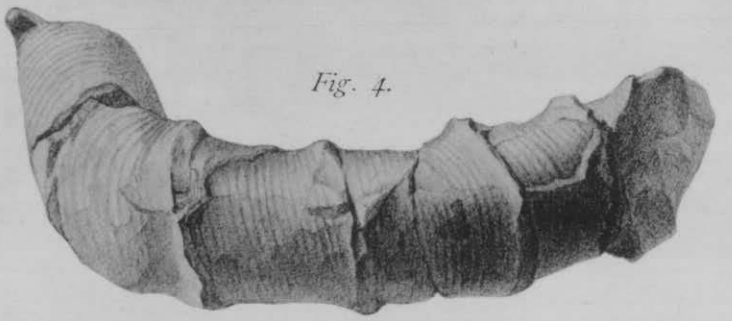

Fig. 4.

PLATE IV.

Heteroceras and Nipponites.

Plate IV.

(All the specimens, here figured, are in Sci. Coll. Mus.)

Heteroceras Ōtsukai m. Pp. 14–16.

Fig. 1. Side view of the type. From *Pachydiscus*-beds of the Kikumezawa, Ishikari Prov. Nat. size. Slightly restored. In this figure, the larger end of the shell is shown below and the smaller end above.

Fig. 2. Side view of a portion of whorls of another specimen. From upper Ammonite-beds of the Yūbarigawa. The siphon comes nearer the lower margin toward the anterior end. Nat. size.

Heteroceras Ōtsukai m. var. *multicostata* m. Pp. 16–17.

Fig. 3. Side view of a specimen with numerous ribs. From upper Ammonite-beds of the Yūbarigawa. Nat. size.

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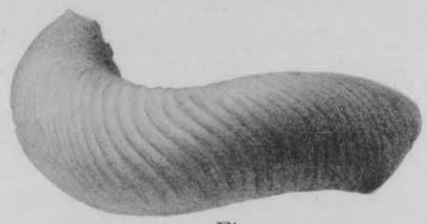


Fig. 3.

Fig. 2.

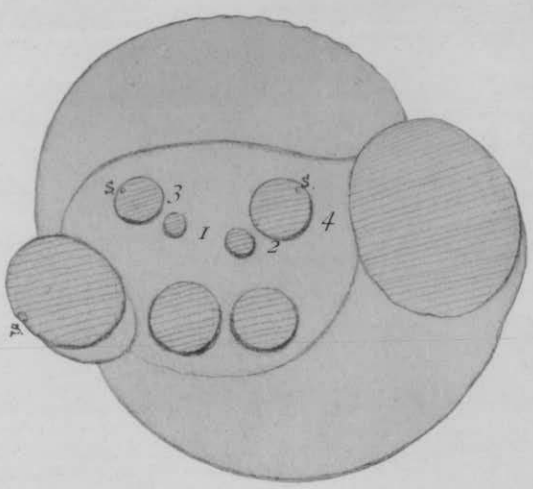


Fig. 6.

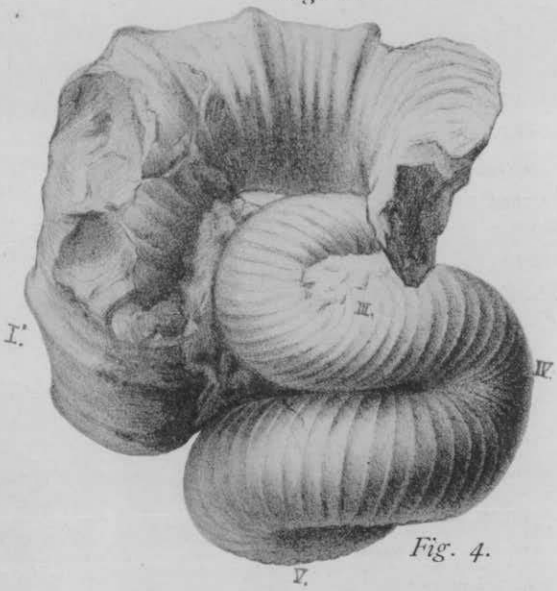


Fig. 4.

Fig. 5.

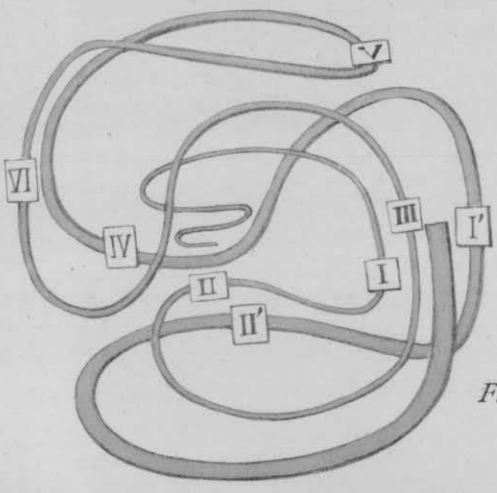


Fig. 7.

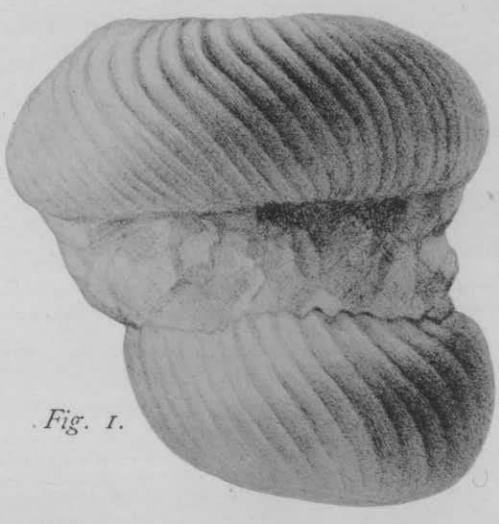


Fig. 1.

PLATE V.

Helicoceras, Desmoceras and Hauericeras.

Plate V.

(All the specimens, here figured, are in Sci. Coll. Mus.)

Helicoceras venustum m. Pp. 11–12.

Fig. 1. Upper view of the type. From *Pachydiscus*-beds of the Sanushibe, Iburi Prov. Nat. size.

Fig. 2. Diagram of a suture line, drawn from the same specimen. s. siphonal line. × 4.

Desmoceras Dawsoni WHITEAVES var. *japonica*. Pp. 35–39.

Figs. 3 a, b. Side and front views of the type from the *Thetis*-zone of the Ikushumbets. Nat. size.

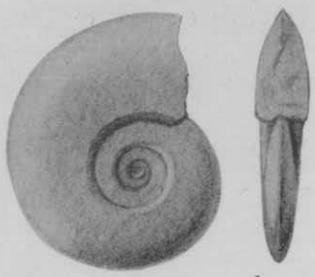
Fig. 4. Diagram of a suture line, drawn from another specimen. Nat. size.

Hauericeras angustum m. Pp. 33-35.

Figs. 5 a, b. Side and front views of the type. From the Upper Ammonite-beds of Ikandai, near Urakawa. Nat. size.

Fig. 6. Diagram of a suture line, drawn from the same specimen. s. siphonal line; u. m. umbilical margin. × 4.

Fig. 1.



a. b.

Fig. 5.

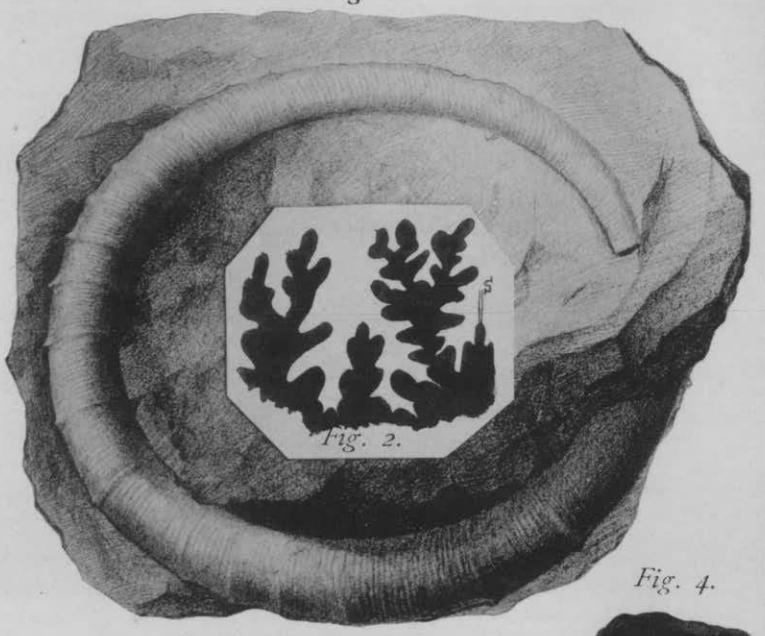


Fig. 2.

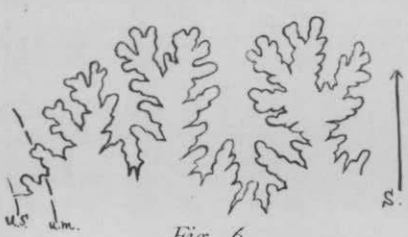
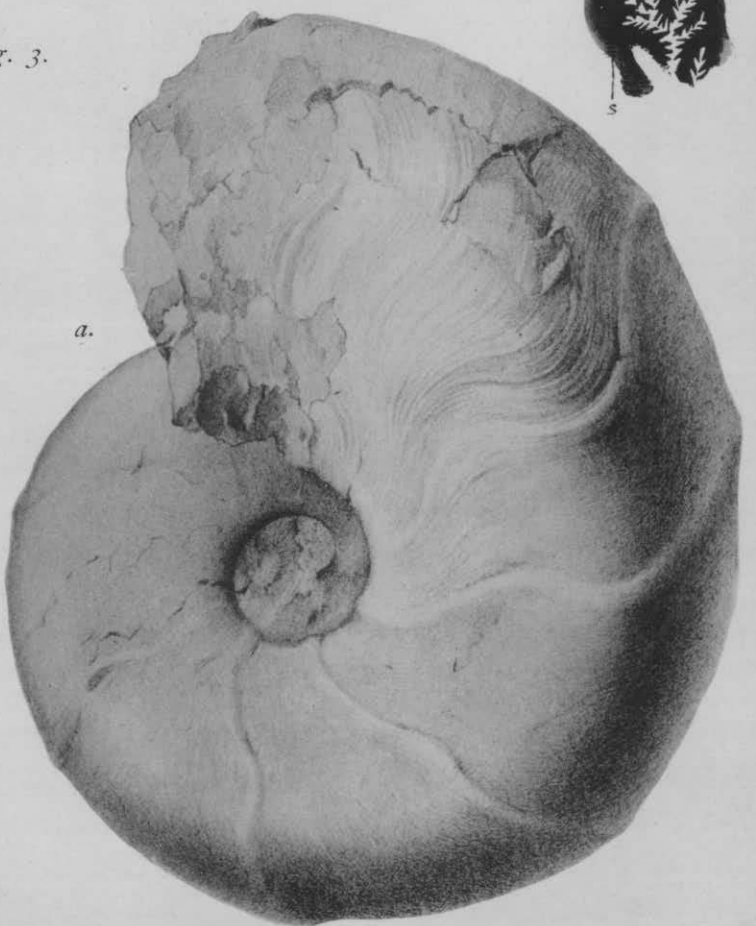


Fig. 6.

Fig. 4.

Fig. 3.

b.



a.

H. Yabe: Cret. Cepl., Hokkaidō. Pt. II.

PHOTO. BY K. OGAWA.

PLATE VI.

Desmoceras, Olcostephanus, Nipponites, Heteroceras
and an undetermined Genus.

Plate VI.

(All the specimens, here figured, are in Sci. Coll. Mus.)

Desmoceras poronaicum m. Pp. 39–41.

Figs. 1 a, b. Side and front views of the type from the Upper Ammonite-beds of the Poronai, Ishikari Prov. Nat. size.

Fig. 2. Diagram of a suture line, drawn from the same specimen. S. siphonal line; u.m. umbilical margin. × 3.

Ammonites Kotoi m. Pp. 26–27

Fig. 3. Side view of the type. From the Yūbarigawa. Slightly restored. Nat. size.

Fig. 3 a. Cross-section of the whorl. Nat. size.

Fig. 4. Diagram of the suture line, drawn from the same specimen. S. siphonal line; u.m. umbilical margin. × 2.

Olcostephanus unicus m. Pp. 28–29.

Figs. 5 a, b. Side and front views of the type. From the Takambets, Ishikari, Prov. Nat. size.

Nipponites mirabilis m. Pp. 20–25.

Fig. 6. Diagram of a suture line, drawn from the specimen figured in Pl. IV. S. siphonal line. Nat. size.

Heteroceras Ōtsukai m. Pp. 14–16.

Fig. 7. Diagram of a suture line, drawn from the specimens figured in Pl. IV., fig. 2. S. siphonal line. Nat. size.

Heteroceras Ōtsukai var. *multicostata.* Pp. 16–17.

Fig. 8. Diagram of a suture line, drawn from the specimen figured in Pl. IV., fig. 3. S. siphonal line; a.s. antisiphonal line. × 2.

Fig. 5a.

Fig. 5b.

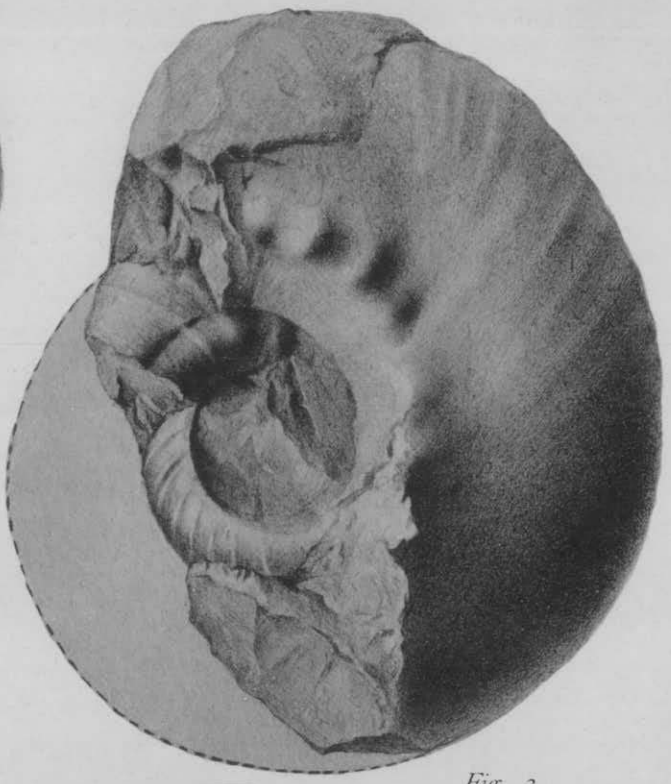


Fig. 3.

Fig. 1a.

Fig. 1. 6.

Fig. 6.

Fig. 2.

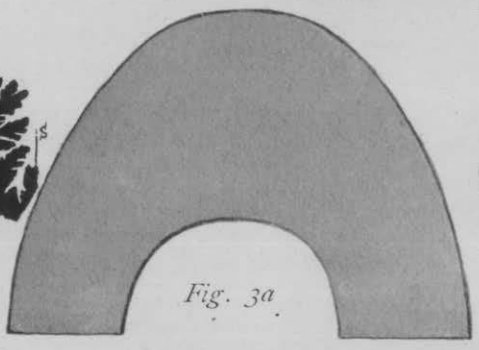


Fig. 3a.

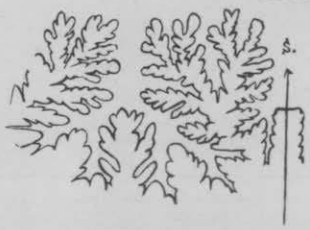
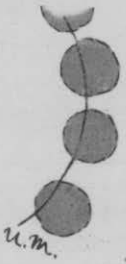


Fig. 7.



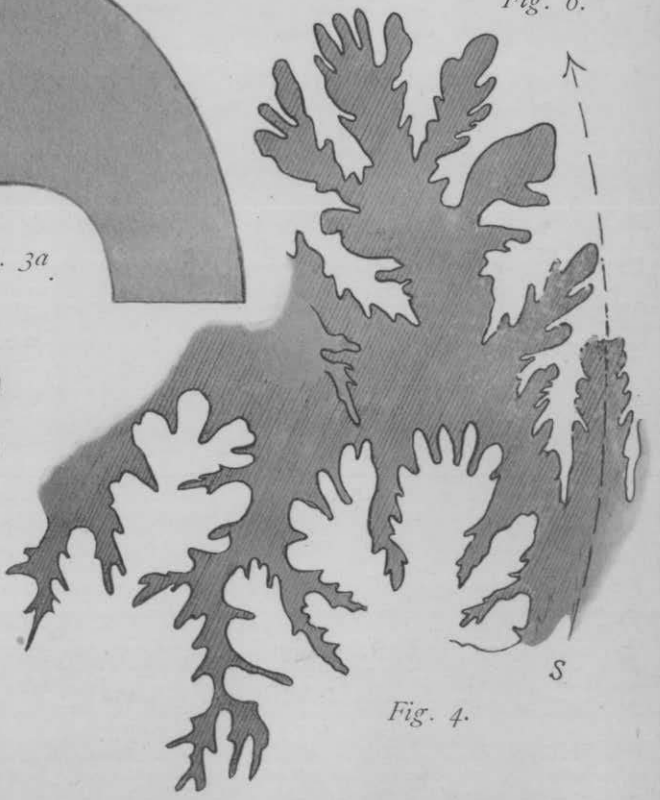


Fig. 4.

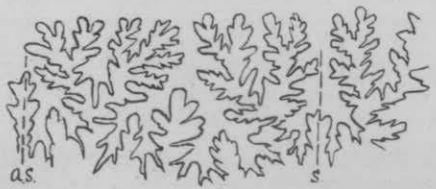


Fig. 8.