757. CRETACEOUS NAUTILOIDS FROM HOKKAIDO — I*

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Abstract. I am going to monograph the Cretaceous nautiloids from Hokkaido on the available material in a series of papers, sometimes with coauthors. This paper contains, as Part 1, descriptions of three species from the Turonian and Coniacian of central Hokkaido. To describe two of them I establish a new genus (Kummeloceras) which is interpreted as a member of the root stock of the Nautilaceae derived directly from Cenoceras. In connexion with the establishment of the new genus, discussion is extended to the evaluation of the Eutrephoceratidae Miller, 1951 with necessary revision and the alteration of the concept of the Nautilidae, with Herco-glossidae Spath, 1927 as its synonymy.

The three species are new but allied to certain previously known species outside Japan. The first species is similar to “Nautilus” splendens Blanford and occurs in the Middle Turonian. The second is allied to “Nautilus” fleuriausianus d’Orbigny and occurs in the Coniacian. They are referred to the new genus. The third is allied to “Nautilus” indicus d’Orbigny and is assigned to Eutrephoceras. It occurs in the Lower Turonian.

Preface

Fossil cephalopods represented by various kinds of Ammonoidea occur abundantly in the Cretaceous deposits of Hokkaido and have been monographed to a considerable extent since the date of Yokoyama (1890). For some reasons, however, little work has been accomplished as to the Cretaceous nautiloids from Hokkaido. This is a great contrast to the situation in Europe, North America and certain other regions (e.g. India), where numerous species of Cretaceous and Jurassic nautiloids were described in the nineteenth century.

The scarcity of the work on the belemnoid cephalopods from the Upper Cretaceous of Hokkaido indeed owes to the absence or scarcity of the group in the North Pacific region for a palaeobiogeographic reason, but the same reason is not applicable for the nautiloids. The unfortunate situation was due to our collection failure and little scientific interests.

In fact some species of nautiloids have been already reported on the material from the Cretaceous of various areas in Japan by our predecessors, e.g. Yabe and Shimizu (1924), Shimizu (1931, 1935) and Yabe and Ozaki (1953), and by some palaeontologists of this generation, e.g. Matsumoto and Amano (1964), Matsumoto (1967), Obata et al. (1976), Obata and Ogawa (1976), Morozumi (1979), Matsumoto et al. (1980) and Furuiuchi (1982). These works are mostly concerned with the species from the areas other than Hokkaido, except for Shimizu (1935) and Matsumoto (1967). Shimizu (1935) covered most comprehensively the Japanese islands, but he only listed a few species, without giving palaeontologic descriptions.

While I have been doing field work for the Cretaceous biostratigraphy of Hokkaido, some nautiloids have been obtained along with ammonites, inoceramids and other fossils. Some friends of mine working in Hokkaido have also obtained nautiloids. Some of them have kindly

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provided their specimens to me and others joined with me as coauthors. The hitherto obtained material shows some changes from a stage to another and includes several new species. In this work palaeontological descriptions are given to show what species occur in which stage of whereabouts. I hope this would give stimulation for further advances. As the coauthors are different from stage to stage, the papers are to be issued in series under the same major title. The material dealt with by Shimizu (1935), which is kept in the Palaeontological Collection of Tohoku University, is not included in the present study. That should be studied on another occasion.

The repositories of the specimens to be described in the following serial papers are as follows with abbreviations (or symbols) at each head:

- GK.= Geological Collection, Kyushu University, Fukuoka 812
- MC.= The Muramotos' Collection, Mikasa 068-22
- MNH.= T. Miyachi's Natural History Collection of Northern Hokkaido, Wakkani 097
- TTC.= Takumi Takahasi's Collection, Mikasa 068-22
- UMMUT.= University Museum, University of Tokyo

The areas where the described specimens were obtained are as follows from north to south (Text-fig. 1):

- A. Cape Soya, northern Hokkaido
- B. Island of Rebun, off the west coast of northern Hokkaido
- C. Abeshinai-Saku area, Teshio province, northwestern Hokkaido
- D. Haboro area, Teshio province, northwestern Hokkaido
- E. Obira area, Rumoi district, northwestern Hokkaido
- F. Ikushumbets area (Mikasa), central Hokkaido
- G. Oyubari area, central Hokkaido
- H. Hobetsu area, central Hokkaido
- I. Urakawa area, southern Hokkaido

More specimens from these and other areas would be obtained in the future.

The stages to which the described specimens are assigned range from Barremian to Campanian. Some species from the Maastrichtian of Hokkaido would be expected, since there are few examples from Southwest Japan.

The following papers will be serially published under the present major title by the author(s) indicated in parentheses:

Text-fig. 1. Map of the main part of Hokkaido, showing Neocomian Cretaceous outcrops with dotted areas. The area where described nautiloids occurred are A = Soya, B = Rebun, C = Abeshinai-Saku, D = Haboro, E = Obira, F = Ikushumbets, G = Oyubari, H = Hobetsu, I = Urakawa.
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Part 1. Some nautiloids from the Turonian and Coniacian of central Hokkaido (T. Matsumoto)

Part 2. Three nautiloid species from the Santonian and Campanian of Hokkaido (T. Matsumoto & K. Muramoto)

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Part 6. A nautiloid species from the Neocomian of Rebun Island, northern Hokkaido (T. Matsumoto & Y. Ueda)

Part 7. A summary of results (T. Matsumoto)

Before going further, I express my sincere thanks to the above coauthors and other persons (whose names are to be indicated in respective parts) for their kind cooperation with me. I owe much to the authorities of the institutions listed as the repositories and also the Museum of Mikasa City for facilities given to this study. I appreciate very much Dr. Masayuki Noda's friendly help in taking photographs of the specimens and Miss Kazuko Haru's faithful assistance in preparing the typescript.

Part 1. Some Nautiloids from the Turonian and Coniacian of Central Hokkaido

Introduction

To cooperate with the activity of the IGCP (International Geological Correlation Program) "Mid-Cretaceous Events" [MCE] project, research work in the stratigraphy and palaeontology of the sequences from Aptian to Coniacian has been very active in our country. Owing to the intensive field work, some interesting nautiloid specimens have been obtained. This paper is a result of my study of the nautiloids from the Turonian and Coniacian of central Hokkaido.

Through this work I have arrived at an idea which may be concerned with the fundamental problem in the taxonomy of post-Jurassic nautiloids. It will be discussed at length in connection with the proposal of a new genus.

Before going further, I appreciate very much the friendly cooperation of Dr. Masayuki Noda and Messers. Takemi Takahashi, Minoru Yamashita and Hiroharu Kokubu with me in providing the specimens which they obtained in the field work to the present study.

As stated above, this is a contribution to the MCE project, in which I owe much to the kind encouragement given by Professor R. A. Reyment, the project leader, and certain other members. Dr. Jost Wiedmann kindly sent me a copy of a reference which is inaccessible in Japan. Thanks are extended to Dr. Ikuwo Obata for fruitful discussions.

Palaeontological Description

Class Cephalopoda

Subclass Nautiloidea

Order Nautilida

Superfamily Nautilaceae

Family Eutrephoceratidae Miller, 1951

The family Eutrephoceratidae was proposed by Miller (1951, p. 31) but has been neglected by subsequent authors. I would evaluate Miller's idea, though with some revision. My reasoning will be presented in the discussion of a new genus proposed below.

Wiedmann (1960) treated the Nautilinae rather comprehensively, including in it the Nautilinae (with Eutrephoceratinae synony-mized), Hercoglossinae and Aturinae in the sense of Kummel (1956). One of the reasons for this is that the genera belonging to these subfamilies are intimately connected through certain species with transitional features. He also ranked the group at the level of subfamily. On the other hand, Kummel (1964) in the Treatise, to conform with others, ranked up his 1956 subfamilies
to families under the superfamily Nautilaceae.

In this paper I should follow generally Kummel's (1964) scheme in the authorized publication Treatise, although I propose to revise it. The presence of "transitional forms" would not necessary be an objection again the classification of continuously evolving organisms and the diversities in evolution should be expressed by genera, subfamilies, families, etc. according to their order of magnitude.

Genus Kummeloceras nov.

Type species:—Kummeloceras yamashitai sp. nov. (to be described below).

Generic diagnosis:—Shell nautilicone and involute, with very narrow umbilicus; subdiscoidal to subglobose in shape. Whorl typically ovoid in section, a little higher than broad, with a moderately arched venter, gently convex flanks, abruptly rounded umbilical shoulders and incurved walls. It may be more compressed with narrower venter in some species or somewhat broader than high with inflated flanks in some others.

Surface nearly smooth, with only growth lines or lirae, which show a ventral sinus. The reticulate ornament may remain in some species.

Septa considerably concave adorally. Septal suture characterized by a more or less pronounced large saddle on the ventral part without ventral lobe, a broad but distinct lobe of typically moderate depth on the main part of the flank and an incipient, small and low saddle at about the umbilical shoulder. Annular lobe may be present in some species.

Siphuncle subcentral to subdorsal in the typical species, but may vary considerably between species.

Etymology:—This genus is dedicated to the late Professor Bernhard Kummel, who made admirable contributions to the palaeontology of the cephalopods, including the Mesozoic nautiloids.

Remarks:—In addition to the type species I refer to this genus Nautilus splendens Blanford (1861, p. 21, pl. 9, fig. 5; pl. 10, fig. 1), from the Upper Cretaceous of India and Spain, which was left untouched by Kummel (1956, unlisted in p. 342 and p. 383) and assigned to Eutrepheoceras by Wiedmann (1960, p. 168), Nautilus angustus Blanford (1861, p. 27, pl. 14, figs. 1, 1a, b, 2), from the Cenomanian of southern India, which was referred to Cimomia by Kummel (1956, p. 450) and Wiedmann (1960, p. 176), Nautilus cookana Whitefield (1892, p. 285, pl. 48, fig. 1; pl. 49, figs. 4, 5) (Miller, 1947, p. 30, pl. 10, figs. 1, 2; pl. 11, figs. 1–3; pl. 12, fig. 1; pl. 13, figs. 1, 2), from the Eocene of New Jersey, which was assigned to Eutrepheoceras by Miller (1947) and Kummel (1956, p. 381), and preferably Nautilus bryani Gabb (1877) (see Whitfield, 1892, p. 244, pl. 38, figs. 5, 6; also Miller, 1947, p. 28, pl. 8, figs. 1–3), from the Eocene of New Jersey, which was assigned to Eutrepheoceras by Kummel (1956, p. 380) and to Angulithes by Wiedmann (1960, p. 180, pl. 18, fig. M). K. cookeanum and K. bryanni have an annular lobe. As will be discussed below, there are some other species which are better transferred to this genus.

Comparison and discussion:—In the classification of the Nautilaceae at generic level, the pattern of the septal suture is significant among other characters. The generic diagnosis may be manifested also in the conch shape, surface ornamentation and siphuncle position in some cases, but in certain plastic genera these characters are considerably variable. This general principle has been lead by the comprehensive and profound studies of our predecessors, especially the late Drs. L. F. Spath, A. K. Miller and Bernhard Kummel, although there may be minor differences in observation among the authors.

The suture-line of Nautilus pompilius, the type species of Nautilus Linnaeus, 1758, was finely illustrated by Miller (1947, pl. 5, figs. 1, 2; text-fig. 3), showing a pronounced and broad saddle like curve on the ventral part without a ventral lobe, a large and distinct lateral lobe and a smaller but distinct saddle near the umbilical shoulder. A similar, if not quite identical, pattern of suture is shown in many species of Cimomia.
Conrad, 1866, represented by the type species: C. burtini (Galeotti) (reproduced by Miller, 1947, pl. 26, fig. 1 and Kummel, 1956, pl. 24, fig. 1), C. wylliei (Newton) (see Haas and Miller, 1952, p. 335, text-fig. 5; pl. 24, figs. 3, 4; pl. 25, figs. 1, 2), C. vaughani (Gardner) (1923, p. 115, pl. 33, figs. 1–3) (also Miller, 1947, p. 47, pl. 32, figs. 1, 2), etc. The only but probably minor difference is that there is a small annular lobe at the middle of the shallow and broad dorsal lobe in Nautilus pompilius but none in C. wylliei. As to the annular lobe Foord (1891, p. 180), Spath (1927, p.24) and Miller (1947, p. 27) have given remarks suggesting that it is of little taxonomic significance. There is a considerable variation in the intensity of the lateral lobe and saddle among various species of Cimomia. Similarly there is considerable extent of variation in shell-form from subglobular to subdiscoidal among various species of Cimomia. If we take the species with subdiscoidal shape, such as C. schlöderi (Wiedmann) (1960, p. 180, pl. 21, fig. K, pl. 27, figs. 6–8; text-figs. 11–13), no significant difference is recognized between Cimomia and Nautilus. The reason why the two genera were distinguished by previous authors is not clear. Nautilus is well known biologically through the study of the living species, whereas Cimomia has been studied on fossil material with emphasis on the transitional feature in sutural folding towards Hercoglossa Conrad, 1866. Another reason may be that there is a break of available records of nautiloids in the Pleistocene and also Pliocene. There is no record of Cimomia in the Miocene either.

Anyhow, the morphological difference between Nautilus and Cimomia does not seem to be great. All the living species of Nautilus are fairly high whorled, whereas many species of Cimomia, including the type species, Nautilus burtini Galeotti, have a subglobular shell with inflated broader whorls. Should this be taken as a generic distinction, then such species as C. schlöderi (Text-fig. 2B) and Nautilus sowerbianus d’Orbigny (which will be explained later) would be good examples of Nautilus in the Cretaceous. The genus Nautilus, thus, could have a long geological range from sometime in the Cretaceous to the Recent, with a few living species as its survivors.

Many species of Cimomia show the sutural pattern with lower ventral saddle and broader and shallower lateral lobe than Nautilus pompilius, but this difference is not clearly maintained in some species. For example, there is little difference of sutural pattern between C. wyllieri and N. pompilius (see Text-fig. 3A, B). Thus, the close similarity between Cimomia and Nautilus cannot be denied.

Because Cimomia is intimately connected with Hercoglossa, it has been included in the family Hercoglossidae Spath, 1927. Since Cimomia is closely similar to Nautilus, the family

Text-fig. 2. Nautilus and compressed "Cimomia" in comparison. A = Nautilus pompilius Linnaeus (adapted from Miller, 1947, pl. 5, figs. 1, 2). B = "Cimomia" schlöderi (Wiedmann) (adapted from Schlüter, 1876, pl. 45, fig. 3; suture after Wiedmann. 1960, fig. 12). Bar = 20mm
Hercoglossidae falls in the synonymy of the family Nautilidae de Blainville, 1825.

The genus *Angulithes* Montfort, 1808, with *A. triangularis* (Montfort, 1802) (see Kummel, 1956, p. 452, pl. 25, figs. 1, 2) as the type species, has the same type of suture-line (Text-fig. 3C) as *Cimomia* or *Nautilus* and is only distinguished by its trigonal to subtrigonal whorl section. Incidentally, Kummel (1956, p. 453) regarded *Deltoidonautilus* Spath, 1927 (with type species *Nautilus sowerbyi* Wetherell, 1836) as synonymous with *Angulithes*, but Teichert (in Kummel, 1964, p. K456) holds *Deltoidonautilus* as valid and treated *Angulithes* as nom. dub. As I have no basic material to discuss this nomenclatural problem, I follow Kummel (1956) in this paper.

Now, as to the suture-line of the present new genus *Kummeloceras*, which is to be shown clearly in the description of the type-species and also represented by that of *K. splendens* (see Wiedmann, 1960, text-fig. 9), the saddle on the ventral part is nearly as pronounced as that of *Nautilus* (or some "Cimomia"), the lateral lobe is broader and somewhat shallower than that of the recent species of *Nautilus*, but fairly similar to that of many species of *Cimomia*. In *Kummeloceras* the second saddle on the umbilical side of the lateral lobe is much lower and smaller and situated closer to the umbilical margin than that of *Nautilus* or typical *Cimomia*. We can see in *Kummeloceras* the fundamental sutural framework which can develop into the sutural pattern of *Nautilus* and that of some *Cimomia* as well as *Angulithes*. In other words, the saddle at or near the umbilical shoulder is incipient in *Kummeloceras*. If it is strengthened and shifted somewhat outwards, then the sutural pattern of *Nautilus* or certain "Cimomia" or *Angulithes* comes out.

If the sutural pattern is evaluated, *Nautilus fleurtausianus* d'Orbigny (1840, p. 82, pl. 15,

Text-fig. 3. A — C. Suture-lines of *Nautilus, Cimomia* and *Angulithes*. D — E. External suture-lines of *Cenoceras, Kummeloceras* and *Eutrepheoceras.*

A = *N. pompillus* Linnaeus (adapted from Miller, 1947, pl. 5, figs. 1, 2; text-fig. 3), B = *Cimomia wyllieri* (Newton) (adapted from Haas and Miller, 1952, pl. 25, figs. 1, 2; text-fig. 5), C = "*Deltoidonautilus* elliottii" Stenzel (adapted from Miller, 1947, text-fig. 14B), D = *Cenoceras orbignyi* (Prinz) (adapted from Kummel, 1956, pl. 1, figs. 1, 2), E = *Kummeloceras yamashitai* sp. nov., F = *Eutrepheoceras sublaevigatum* (d'Orbigny) (adapted from d'Orbigny, 1840, pl. 17).

**Explanation of Plate 4**

Fig. 1. *Kummeloceras yamashitai* sp. nov. .................................................. Page 18
   Holotype, GK, H5923 [= M. Yamashita Coll. 3301]; back (a) and left lateral views, x1.
   Photos in pls. 4—9 all by courtesy of Dr. M. Noda
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figs. 1–3; Wiedmann, 1960, p. 183, pl. 26, figs. 4, 5; text-figs. 14, 15), from the Upper Cretaceous of Europe, may be better regarded as a species of Kummelloceras, which shows a tendency towards Angulithes in the subtrigonal whorl section. The form called N. fleuriusianus var. by Stoliczka (1886, p. 206, pl. 94, fig. 1, 1a) and Spengler (1910, p. 143, pl. 13, fig. 1a, b), from the Cretaceous of southern India, shows a further step towards the Angulithes like shell-form but its suture is of Kummelloceras type. Anyhow, these forms strongly suggest that Angulithes was derived from Kummelloceras.

On the other hand, Angulithes sowerbianus (d’Orbigny) (1840, p. 83, pl. 16, fig. 1, 2) (Kummel, 1956, p. 456), from the Cretaceous (Cenomanian?) of France, which resembles K. fleuriusianus in shell-form but has a moderately arched venter and the “Angulithes-like suture”, could be referred to Nautilus in view of its essential similarity in the sutural pattern and shell-form to Nautilus. The minor point that its lateral lobe is broader and shallower than that of N. pompilius might be a specific difference. Thus, in my view, N. sowerbianus could be a good example of Cretaceous Nautilus, as “Cimomia” schlöderi mentioned above. This fact suggests strongly that Nautilus and also some (if not all) Cimomia may have evolved from Kummelloceras, which is a member of the regular stock of the Nautilacea.

I agree with Kummel (1956, p. 362) in regarding the genus Cenoceras Hyatt, 1883 as the fundamental stock of the Nautilacea in the Jurassic, with its ultimate origin in Late Triassic C. trechmannii (Kummel) (1953, p. 2, pl. 1, figs. 1, 12 under Bisiphytes; revised to Cenoceras in 1956, pl. 2, figs. 1–3). According to Kummel (1956, p. 366), Cenoceras is very plastic showing a great variation in shell-form and other characters. Its sutural-line, however, as seen in the type species, Nautilus intermedius d’Orbigny (non Sowerby) [= N. orbignyi Prinz (1906, p. 213)] (see Kummel, 1956, pl. 1, figs. 1, 2) and other species, is fairly constant, showing a large, broadly projected saddle like curve on the ventral part, a broad asymmetric lobe on the main part of the flank and a small incipient saddle at about the umbilical shoulder. This is fundamentally similar to the suture of Kummelloceras, but in Cenoceras there is a very shallow ventral lobe and the lateral lobe is sometimes shallower (see Text-fig. 3D, E). The presence or absence of the small annular lobe may not be significant enough for the generic distinction.

Nautilus turcicus Krumbeck (1905, p. 137, pl. 14, fig. 6a, b), from the Upper Jurassic of Libya, was described to have a short saddle at the umbilical edge. Probably on this ground it was assigned to Cimomia by Kummel (1956, p. 452), but I presume that it may be a Late Jurassic example of Kummelloceras. Its lateral lobe is shallower and its shell-form is more globular than in K. yamashitai and K. splendis. It may represent a transitional form from Cenoceras to Kummelloceras.

Another distinctive character of Cenoceras is the reticulate ornamentation on the surface of the shell which persists up to the adult stage, as clearly illustrated by Kummel (1956, pl. 1, figs. 1, 2; pl. 2, figs. 1, 2; pl. 3, figs. 1, 2). This is probably another original character of the Nautilacea. The same kind of reticulate ornament or lattice structure is clearly recognized in the early immature shell of Nautilus pompilius (see Miller, 1947, pl. 2, figs. 1–4), Eutrephoceras montanense (Meek) (1876, p. 496, pl. 27, figs. 1, 1a-e; pl. 27, figs. 2, 2a-f) (non Kummel, 1954), from the Upper Cretaceous of the Western Interior, and also in the young and the middle-aged shells of Nautilus justus Blanford (1861, p. 22, pl. 10, figs. 2, 3; also Stoliczka, 1886, p. 206, pl. 93, fig. 2), from the Upper Cretaceous of India. The last species is possibly referable to Kummelloceras.

Under some weakly weathered condition, as seen in a specimen of N. pompilius in the Geological Collection of Kyushu University and in some examples of Eutrephoceras, such as E. thorii Reeside (1927, p. 7, pl. 44, figs. 1, 2), faint longitudinal striae are discernible on the ventral part, which may reflect the fundamental structure of the shell.

On these and other lines of evidence, I con-
sider that the smooth looking shell of *Eutrephoceras* and *Nautilus* does not imply the primitive, fundamental character but a reduction in the evolution of the Nautilaceae, whereas the original reticulate shell is best manifested in *Cenoceras*, that is the oldest and the fundamental stock of the Nautilaceae.

In the type species of *Kummeloceras* and also in Blanford’s specimen of *K. splendens*, the same kind of reticulate ornamentation is not shown on the mature shell but could be expected in early immature shells, which ought to be examined on some material of favourable preservation. It is, however, interesting to note that *Nautilus clementinus* d’Orbigny (1840, p. 77, pl. 13 bis, figs. 1–6), from the Cretaceous (Albian) of Europe, resembles *K. splendens* in many respects, as Wiedmann (1960, p. 169) pointed out. It has a finely reticulate ornament even on the adult shell. The specimen of *K. splendens* from Spain (Wiedmann, 1960, p. 169) seems to show the spiral striae weakly. Therefore, it is better to refer *N. clementinus* to *Kummeloceras* rather than to *Eutrephoceras* (Kummel, 1956, p. 381; Wiedmann, 1960, p. 168). The reticular ornament as seen in *Cenoceras*, thus, survived in some species of *Kummeloceras*.

It should be noted that *Nautilus cantabrigenensis* Foord (1891, p. 237, text-fig. 63), another Albian species from England, closely resembles *K. clementinus* but has more sinuous *Cimomia* like suture. This is another example to suggest the derivation of *Cimomia* or *Nautilus* from *Kummeloceras*.

The genus *Eutrephoceras* Hyatt, 1894, has been regarded as representing the fundamental stock of the Nautilidae which showed a great plasticity giving rise to various offshoots (e.g. Kummel, 1956, p. 380). I have, however, some doubt about this statement. The type species of *Eutrephoceras*, *N. dekayi* Morton (1834) (see Miller and Garner in Richards et. al.[ed.], 1962, p. 102, pl. 65, figs. 5, 6; pl. 66, figs. 1, 2) has “more or less straight and directly transverse external sutures”. The suture may be slightly sinuous in some species (e.g. *E. sublavenigatum* (d’Orbigny) (Text-fig. 3F), *E. balchistanense* (Spengler), *E. ahltense* (Schütter), etc.), but the ventral and lateral lobes are very shallow and the external suture runs roughly transversely. I interpret that the seemingly simple suture of *Eutrephoceras* does not imply the primitive, fundamental character but is a product of a reduced evolution from a little more sinuous suture of *Cenoceras*, just as the seemingly smooth shell is so as mentioned above. The difference in sutural pattern between the two genera is by no means sharp and gradational features may be seen in some species.

From the above observation, I am indeed sympathetic with Miller (1951; in Miller and Garner, 1962, p. 101) in stating that “the genus *Eutrephoceras* is not particularly close to *Nautilus*.” Miller (1951, p. 31) proposed the monogenetic family Eutrephoceratidae, but I should refer *Cenoceras*, *Pseudocenoceras* and *Kummeloceras* to the family Eutrephoceratidae in addition to *Eutrephoceras*. This is the group composed essentially of the genera which represent the fundamental root stock of the Nautilaceae and a few genera which were close to the root but deviated to a certain extent. *Eutrephoceras* and *Pseudocenoceras* belong to the latter subgroup. Although the *Cenoceratidae* might be preferable for the family name, we should use the Eutrephoceratidae in a revised sense following the rule of priority in the nomenclature.

There are several species of “*Eutrephoceras*” which show fairly sinuous sutures, such as “*E.* splendens”, “*E.* clementinus”, “*E.* bryani” and “*E.* cookanum”. They are better transferred to *Kummeloceras*, as mentioned above. Wiedmann

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**Explanation of Plate 5**

**Fig. 1.** *Kummeloceras yamashitai* sp. nov. ................................................ Page 18
Holotype, GK. H5923 [= M. Yamashita Coll. 3301]; frontal (a) and right lateral views, x1.
(1960, p. 151) listed many species under Eutrepheoceras with "cimomider Sutur", in which the species with slightly sinuous sutures were included. There are a few species, e.g. E. darupense (Schlüter) (1876, p. 176, pl. 49, figs. 4, 5), which show a seemingly intermediate degree of sutural sinuosity between the typical patterns of Eutrepheoceras and Cenoceras or Kummeloceras. This does not necessarily mean the genetically transitional forms. It would be desirable to express quantitatively the degree of sinuosity and other features in the sutural pattern, although I do not propose a formula or an index at the moment. Anyhow, the true genetical relationship should be led through consideration of all the characters as well as stratigraphic occurrences.

The genus Pseudocenoceras Spath, 1927, which is represented by the type species Nautilus largilliertianus d'Orbigny (1840, p. 86, pl. 18, figs. 1–4) and several other Cretaceous species, is interpreted here to have been derived either directly from Cenoceras or by way of early Kummeloceras, acquiring the subtrapezoidal to subrectangular whorl section, with subangular umbilical shoulders, flattened flanks and a sub-rounded to flattened venter, smooth shell and subdorsal to dorsal position of the siphuncle. It should be noted that the sutural patterns in several species of Pseudocenoceras varies from the one which is similar to that of Cenoceras to the more sinuous Kummeloceras like and even Angulithes like ones, as is shown in P. archiacianus (d'Orbigny) (1840, p. 91, pl. 21, figs. 1–4), P. applanatum (Wanner) (1902, p. 143, pl. 30, figs. 20, 20a) and P. fittonii (Sharpe) (1853, p. 17, pl. 6, fig. 4). In the latter cases, therefore, Pseudocenoceras is distinguished from Kummeloceras or Angulithes only by its shell-form.

Two other genera of the Eutrepheoceratidae, Carinonautus Spengler, 1910, based on the type species C. ariyalurensis Spengler (1910, p. 149, pl. 14, figs. 1a–c), from the Upper Cretaceous of southern India, and Obinautus Kobayashi, 1954, based on the type species O. pulchra Kobayashi (1954, p. 183, pl. 22, figs. 1–4),

Text-fig. 4. Kummeloceras yamashitai sp. nov.
Diagrammatic sketch (frontal and left lateral views) of holotype. Broken line = reconstructed; LS = last septum, S = siphuncle. Scale bar = 10 mm.
from the Lower Tertiary of southern Kyushu (Japan), are, in my preliminary view, the derivatives of *Pseudocenoceras* rather than *Eutrephoceras*, although their sutural patterns and young shells should be examined on suitable material.

*Kummeloceras yamashitai* sp. nov.

Pl. 4, Fig. 1; Pl. 5, Fig. 1;
Pl. 6, Fig. 1; Pl. 7, Fig. 1;
Text-figs. 4–6

**Material:**—Three specimens are before me, of which the holotype is GK. H5923, a part of the outer whorl and the next inner whorl, represented by the internal mould for the most part, with a portion of the shell, collected by Mr. Minoru Yamashita (MY. 3301 on 1973. 5. 5), from loc. Y5203 on the Hakkin-zawa, Oyubari area and transferred to me for this study. Paratype 1, GK. H5920, collected by Mr. Takemi Takahashi (TTC. 1968. 10. 20) from the Kaneo-betsu, Oyubari area and GK. H5921, collected by Mr. Hirohiko Kokubu from the Pombets Colliery; both internal moulds with a partly preserved test; both transferred to me for this study.

**Description:**—The shell is fairly large, as is shown by the incompletely preserved holotype, whose diameter would be over 220 mm (nearly 250 mm) in a roughly restored outline on the assumption that the body-chamber occupied about 150°. The whorl increases with a moderate rate, about 1.57 in the proportion of radius per half whorl in the paratype 1. The umbilicus is narrow, about 10 percent of the shell diameter in the holotype and slightly less than that amount in the paratypes.

The whorl is ovoid in section, slightly higher than broad, with B/H = 0.96 in the holotype and 0.97 in the paratypes, and broadest somewhat below the mid-height. The umbilical wall is incurved and the umbilical shoulder is abruptly rounded. The flanks are gently inflated and convergent, passing to the moderately arched venter.

The surface of the internal mould is smooth. (Occasionally there are irregular depressions as seen in GK. H5920. They can be interpreted as impressions of the shell injury.) The surface of the partly preserved shell is nearly smooth, but

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**Text-fig. 6. Kummeloceras yamashitai** sp. nov.


**Text-fig. 5. Kummeloceras yamashitai** sp. nov.
Left lateral and frontal views and external suture of paratype 1 (GK. H5920). Bar = 10 mm.

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**Explanation of Plate 6**

Fig. 1. *Kummeloceras yamashitai* sp. nov. ............................................ Page 18
Paratype 1, GK. H5920 [= T. Takahashi Coll. 68-10-20], two lateral (a, b), frontal (c) and ventral (d) views, x1.
Table 1. Measurements (in mm), *Kummeloceras yamashitai* sp. nov.

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Diameter</th>
<th>Umbilicus</th>
<th>Height</th>
<th>Breadth</th>
<th>B/H</th>
</tr>
</thead>
<tbody>
<tr>
<td>GK. H5923</td>
<td>[175 (1)]</td>
<td>[21 (.12)]</td>
<td>102 (.58)</td>
<td>98 (.56)</td>
<td>0.96</td>
</tr>
<tr>
<td>&quot; (inner)</td>
<td>79.0 (1)</td>
<td>10.4 (.13)</td>
<td>46.0 (.58)</td>
<td>44.0 (.56)</td>
<td>0.96</td>
</tr>
<tr>
<td>GK. H5920</td>
<td>83.0 (1)</td>
<td>7.5 (.09)</td>
<td>48.0 (.58)</td>
<td>46.5 (.56)</td>
<td>0.97</td>
</tr>
<tr>
<td>&quot; (--180°)</td>
<td>54.0 (1)</td>
<td>—</td>
<td>31.0 (.57)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>GK. H5921</td>
<td>67.0 (1)</td>
<td>5.9 (.09)</td>
<td>38.5 (.57)</td>
<td>37.5 (.56)</td>
<td>0.97</td>
</tr>
</tbody>
</table>

[ ] measured on restored outline.

for very fine lirae or striae which show a moderately backward curvature on the venter.

The septa are considerably concave adorally and of moderate density, numbering 7 or 8 per half whorl. The suture-line is considerably sinuous. No ventral lobe is perceptible and the suture-line descends strongly from the venter to the flank forming a large and pronounced saddle like curve on the ventral part, an asymmetric lateral lobe of moderate depth on the main part of the flank and then an indistinct, small and low saddle near the umbilical margin.

The siphuncle is dorsocentral, a little below the midst of the dorso-ventral median line of the septum. Annular lobe is discernible in GK. H5921.

**Comparison:**—This species resembles *Kummeloceras splendens* (Blanford) (1861, p. 21, pl. 9, fig. 5; pl. 10, fig. 1), from the Upper Cretaceous of India and Spain (Wiedmann, 1960, p. 168, pl. 18, fig. N; pl. 27, figs. 4, 5; text-fig. 9) in the frequency and pattern of sutures, dorso-central positon of siphuncle and proportion of B/H, but is distinguished in that the latter has subparallel, instead of convergent, flanks, closed umbilicus and more dorsad position (inner third of the median line) of the siphuncle.

It should be noted that this species is fairly similar to such species as "*Nautilus" sowerbianus d'Orbigny and "*Angulithes* (Cimonia)" schlöderi Wiedmann in having the ovoid whorl section, narrow umbilicus, pronounced saddle like curve of suture on the venter and reclining broad but distinct lateral lobe. The difference is the presence of distinct (instead of incipient) saddle near (outside of) the umbilical shoulder in the latter two species. If the less globular but subdiscoidal shells like these two are excluded from *Cimonia* and transferred to *Nautilus*, the above facts can be taken as indicating the possible derivation of Cretaceous species of *Nautilus* directly from *Kummeloceras* by developing the second lateral saddle.

**Occurrence:**—The holotype was obtained by M. Yamashita from the mudstone exposed at loc. Y5203 on the left side of the Hakkin-zawa of the Oyubari area (see text-figs. 1, 2 in Hirano et al., 1977 for the location), which is referred to the middle part of the Turonian. Paratype 1 was obtained by T. Takahashi from the floated nodule in the Kaneobelsu of the Oyubari area. It is probably from the Zone of *Inoceramus hobetsensis*, middle part of the Turonian. Paratype 2 was obtained by H. Kokubu from the sandy siltstone exposed on the subground 700 m level in the eastern gallery of the Pombets Colliery (now abandoned). The rock is probably referable to either upper or middle part of the Turonian (unpublished information of the coal mining company).

*Kummeloceras yezoense* sp. nov.

Pl. 7, Fig. 2; Pl. 8, Fig. 1; Text-figs. 7—9

**Material:**—Holotype, GK. H5922, collected by myself at loc. Ik6605 (Samata-zawa) of the Ikushumbets area, Coniacian, wholly septate internal mould with a portion of squashed outer whorl. Paratypes GK. H5929, collected by H. Kokubu (47. 6. 26) from the Obira area; a specimen (Kw3) of Y. Kawashita (56. 5. 5) from
the Oyubari area; a specimen of M. Koshisaka (46. 8. 10) from his loc. 27 of the Oyubari area, now on display in the Museum of Mikasa City (550704-20).

Description:—The shell is fairly large, as seen in the last two specimens, in which the diameter is about 170 mm at the end of the phragmocone. It is involute, with a very narrow umbilicus, about 10 percent of the diameter in the internal mould. The umbilicus seems to be covered by callus when the shelly material is preserved.

The whorl grows with a fairly high ratio in height. It is slightly broader than high in a young stage but fairly higher than broad in later stages, with B/H = 0.8 or less (0.79 to 0.76 in actual measurements) at the end of the phragmocone. It is ovoid in section, being broader in its lower part, with gently convex and convergent flanks and a rounded (earlier) and then more narrowly arched (later) venter.

The surface of the internal mould is smooth. That of the shell, as seen in a part of Kokubu's specimen, is nearly smooth, with weak growth lines or lirae which are very gently flexuous on the flank and show a backward sinus on the venter.

The septa are fairly concave adorally. They are of moderate density, about 8 or 9 per half whorl. The septal suture shows a moderately pronounced saddle like curve on the ventral part, an asymmetrically reclining broad but distinct lobe on the main part of the flank and an indistinct small or low saddle near the umbilical margin.

The siphuncle is subdorsal, being situated at the point at about lower one third of the dorso-ventral median line of the septum.

Comparison:—This species is closely allied to

Text-fig. 7. *Kummeloceras yezoense* sp. nov.
Sketch (right lateral view) of holotype, whose outer whorl is squashed. S = siphuncle. Bar = 10 mm.

Text-fig. 8. *Kummeloceras yezoense* sp. nov.
Diagrammatic whorl section of M. Koshisaka's specimen on display at Mikasa Museum (550704-20). Bar = 10 mm.

Explanation of Plate 7

Fig. 1. *Kummeloceras yamashitai* sp. nov. .................. Page 18
Paratype 2, GK. H5921 [= H. Kokubu's Coll. from Pombets Colliery], ventral (a) and left lateral (b) views, x1.

Fig. 2. *Kummeloceras yezoense* sp. nov. .................. Page 19
Paratype 1, GK. H5929 [= H. Kokubu's Coll. 47-6-26], left lateral (a) and frontal (b) views, x2/3.
Table 2. Measurements (in mm), Kummeloceras yezoense sp. nov.

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Diameter</th>
<th>Umbilicus</th>
<th>Height</th>
<th>Breadth</th>
<th>B/H</th>
</tr>
</thead>
<tbody>
<tr>
<td>GK. H5922 [restored]</td>
<td>45.0 (1)</td>
<td>4.2 (.09)</td>
<td>25.6 (.57)</td>
<td>—</td>
<td>0.77</td>
</tr>
<tr>
<td>&quot;     — 360°</td>
<td>37.0 (1)</td>
<td>3.5 (.09)</td>
<td>20.9 (.57)</td>
<td>23.0 (.62)</td>
<td>1.10</td>
</tr>
<tr>
<td>GK. H5929</td>
<td>155 [restored]</td>
<td>—</td>
<td>~96 (.61)</td>
<td>~75 (.48)</td>
<td>0.78</td>
</tr>
<tr>
<td>&quot;     — 90°</td>
<td>131.5</td>
<td>~15.0 (.11)</td>
<td>80.0 (.61)</td>
<td>~70 (.53)</td>
<td>0.85</td>
</tr>
<tr>
<td>Kw. 3</td>
<td>176.0</td>
<td>14.0 (.08)</td>
<td>108.6 (.61)</td>
<td>86.2 (.48)</td>
<td>0.79</td>
</tr>
<tr>
<td>550704-20</td>
<td>~170.0</td>
<td>—</td>
<td>~97. (.54)</td>
<td>~74 (.44)</td>
<td>0.76</td>
</tr>
<tr>
<td>&quot;     —</td>
<td>108.0</td>
<td>12.0 (.11)</td>
<td>67.0 (.62)</td>
<td>~52 (.48)</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Kummeloceras fleurianum (d'Orbigny), which has been mentioned in the discussion of the genus, in many respects including the sutural pattern, but distinguished by the rounded, somewhat broader venter and somewhat broader umbilicus. Its inner whorl is more inflated and more rounded than that of K. fleurianum. The subtrigonal whorl section of that species, which shows a tendency to the characteristic shell-form of Angulithes, is not manifested clearly in the present species. The seemingly sharpened venter of the outer whorl of GK. H5922 and GK. H5929 are probably the product of the secondary distortion. The original outline of the outer whorl in section is oval in the present species, whereas that of K. fleurianum is subtrigonal with narrowly arched to nearly sharpened venter.

K. yezoense is somewhat similar to K. yamashitai but distinguished by its more rapid increase of whorl-height and more dorsal positon of siphuncle.

Occurrence:—The holotype came from the mudstone exposed at loc. Ik5605 of the Samatazawa, a tributary in the upper reaches of the River Ikushumbets, central Hokkaido. At loc. Ik5606, close to Ik5605, Inoceramus uwaimensis occurs commonly and, accordingly, these two localities are assigned to Coniacian. H. Kokubu's specimen was obtained on the stream Kamikinembets, at loc. 300 m upstream from its confluence with the River Obirashibe, Obira area, northwestern Hokkaido. This part is again Coniacian. Y. Kawashita's specimen was collected on the stream of Masago-zawa, a branch of the River Shiyoubari in the Oyubari area, central Hokkaido. Coniacian strata are exposed along the Masago-zawa, M. Koshisaka's specimen was from a locality on the River Shiyoubari.

Etymology:—Yezo is the old name for Hokkaido.

Text-fig. 9. Kummeloceras yezoense sp. nov. Sketch of Y. Kawashita's specimen in lateral and frontal views. LS = last suture. Bar = 10 mm.
Genus *Eutrephoceras* Hyatt, 1894

*Type species:* — *Nautilus dekayi* Morton, 1834.

*Remarks:* — In the preceding description I have excluded certain species from *Eutrephoceras* and referred them to the new genus *Kummeloceras*. In my opinion, *Eutrephoceras* does not represent a root stock from which *Nautilus* and certain other genera were derived but is a somewhat modified derivative of the root stock represented by *Cenoceras* and *Kummeloceras*. Reasoning for this idea has been discussed in the description of *Kummeloceras*.

*Eutrephoceras nodai* sp. nov.

Pl. 9, Fig. 1; Text-fig. 10

*Material:* — A single specimen, GK. H5924, from loc. Y6014a obtained by Dr. Masayuki Noda during the 1975 field work with me in the Oyubari area; holotype.

*Description:* — The shell is fairly large, nearly 200 mm in diameter in the probably adult stage. The whorl increases with a moderate rate (about 1.37 in a half whorl) in both height and breadth. It is higher than broad, with B/H = 0.8, and ovoid in cross-section, with the maximum breadth somewhat below the mid-height. The venter is moderately arched in early stage and more narrowly arched later. The flanks are gently convex and the umbilical shoulders are rounded. The umbilicus is very narrow (7.6 per cent of diameter) in the internal mould and covered by callus when shelly material is preserved.

The surface of the internal mould is smooth and that of the shell nearly smooth, with only weak growth lines or lirae which show a backward curve on the ventral part.

Septa is of moderate density, numbering 9 per half whorl. The last septum is at whorl-height =

88 mm. The septal suture is only slightly sinuous, with a very shallow and broad lateral lobe and a very slight saddle like elevation at about the umbilical shoulder. It runs nearly radially and crosses the venter nearly straightly or with slight backward sinus.

The siphuncle is subventral but not close to the ventral margin.

*Comparison:* — *E. nodai* is closely allied to *E. indicum* (d’Orbigny) (1850, p. 211) [= *Nautilus suowerbianus* d’Orbigny, 1846, pl. 4, figs. 1, 2] (see Wiedmann, 1960, p. 159, pl. 21, fig. G; pl. 24, figs. 1–4; textfigs. 3–5), from the Senonian of Quiriquina (Chile) and southern India and the Turonian of Spain, in the general shell form, nearly smooth surface, only slightly sinuous or nearly linear suture and ventral position of siphuncle, but is distinguished by its

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**Explanation of Plate 8**

Fig. 1. *Kummeloceras yezoense* sp. nov. .................................................. Page 19

Holotype, GK. H5922 [= T. Matsumoto Coll. from loc. IK5605], left (a) and right (b, c) lateral, back (d) and frontal (e) views. b, d, e: x1; a, c: x0.9 (umbilicus developed in c).
ovoid, higher than broad whorl-section. *E. indicum* has a subtrigonal whorl-section, with the maximum breadth near the umbilical shoulder and is nearly as high as broad. Its siphuncle is closer to the ventral margin.

**Occurrence:** In the middle part (a) of the exposure at loc. Y6014 [= Y5111], on the right side of the Takino-sawa, Oyubari area, central Hokkaido (for the location see text-figs. 1, 4 in Hirano et al., 1977), obtained by Dr. M. Noda who donated the specimen to the Geological Collection of Kyushu University through me. The siltstone with intercalated sandstone of this locally is referred to Lower Turonian, because *Mammmites* sp. was found at loc. Y5112 [= Y6015] below Y6014 and *Mytiloides mytiloides* (Mantell) occurs abundantly at loc. Y6013, stratigraphically slightly above loc. Y6014.

**Etymology:** This species is dedicated to Dr. Masayuki Noda who is contributing much in the Cretaceous palaeontology and stratigraphy.

**References**


Miller, A. K. (1947): Tertiary nautiloids of the
Tatsuro MATSUMOTO


Explanation of Plate 9

Fig. 1. Eutrephoceras nodai sp. nov. ........................................ Page 22
Holotype, GK. H5924 [= M. Noda Coll. from loc. Y6014a], ventral (a), left lateral (b) and frontal (c) views, ×4/5 (Scale bar = 20 mm).
757. Cretaceous Nautiloids


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北海道産白亜紀オウムガイ類一I. 現在採うことのできる材料に基づき、北海道産白亜紀オウムガイ類を記載・図示していくが、今後はその1としてチューロニアンとユニアシアン産の3種を新種として記載した。種の記載に当たって新属（Kummeloceras）を提唱し、これは*Cenoceras* から直接由来したもので、Nautilaceae の根幹をなす。これらは派生した*Pseudocopnoceras*, *Eutrephoceras* などとともに *Eutrephoceratidae* を構成する。*Nautilus* は *Cimomia* などとともに鏡合線がしゅう曲を示す類で、Hercoglossidae は Nautilidae とシノニムであり、白亜紀にも *Nautilus* に帰属可能の種があることを指摘した。記載した3種のうち、*K. yamashitai* (チューロニアン) は *K. splendens* (Blanford), *K. yezoense* (ユニアシアン) は *K. fleuriausianum* (d'Orbigny), *Eutrephoceras nodai* (チューロニアン) は *E. indicum* (d'Orbigny) にそれぞれ類似するが、差異も明確にあり新種とした。

松本達郎