Upper Triassic Ammonites from Okinawa-jima Part II : Paleontological Study of the Ryukyu Islands-III

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Upper Triassic Ammonites from Okinawa-jima Part II (Paleontological Study of the Ryukyu Islands-III)

Takeshi ISHIBASHI

Abstract

An ammonoid zone, the *Sandlingites* aff. *oribasus* zone, has been established in the Nakijin Formation with a note on partial revision of stratigraphy of this formation. Discussions of correlation are given with respect to the two ammonoid zones already known as well as the intervening new one. The *Sandlingites* aff. *oribasus* zone in Okinawa is most probably correlated to the *Tropites dilleri* zone of the Triassic Carnian standard zonal scheme in North America. Following Part I selected four species of Upper Triassic ammonoid, *Epiceratites*? *motobuensis* sp. nov., *Helictites* sp., *Thisbites nakijinensis* sp. nov., and *Hypocladiscites subaratus* (MOJSISOVICS) are described in this article.

Introduction

The Triassic ammonoid fauna collected from the Nakijin Formation in Okinawa-jima comprises forty-three species belonging to fourteen families and twenty-seven genera, of which twelve species were described and illustrated as Part I under the same title (ISHIBASHI, 1970).

The stratigraphy of Nakijin Formation was already established by the present author (ISHIBASHI, 1969), but it has made clear that a partial revision is necessary to the stratigraphical succession of the formation based on the later field observation and the paleontological study on the ammonoid faunal assemblage.

The writer wishes to express his sincere thanks to Professors Ryuzo TORIYAMA and Tatsuro MATSUMOTO of Kyushu University for their kind criticism and reading the manuscript of this article. Acknowledgements are also due to Miss Seiko HAYAKAWA for typewriting the manuscript. The financial support was made through the Grant in Aid for Fundamental Scientific Research of the Ministry of Education in 1971.

Notes on Stratigraphy and the Ammonoid Faunal Assemblage

The Nakijin Formation is lithostratigraphically divided into the lower and upper members. According to the facts observed in the field, the greenstone bed at the uppermost horizon is regarded as being intercalated in the limestone of

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the upper member; namely, this greenstone bed is situated between the horizons 2 (LYa) and 6 (HNa-4) in the columnar section (Text-figure 1). This fact is also evidenced by the occurrences of ammonoid fossils. The horizon 11 (HF) in mudstone layer in the greenstone bed yields some ammonoids which indicate rather older age than that of ammonoid fauna obtained from the horizons 1 (Ya) and 2 (LYa) as will be mentioned later.

The ammonoid faunal assemblage of the Nakijin Formation consists of the following species, of which those indicated with an asterisk were described in 1970 and those with two asterisks are described in this paper.

Trachyceratidae
* *Sirenites* sp. cf. *S. nanseni* TOZER
Trachyceras (*Paratrachyceras*) ? sp.
Clydonitidae
Clydonites sp. aff. *C. daubréei* MOJSISOVICS
Clydonites sp.
Sandlingites sp. aff. *S. oribasus* (DITTMAR)
Clionitidae
Traskites ? sp.
Arpaditidae
Drepanites sp.
Edmundites ? sp.
Tibetitidae
Mojsisovicsites ? sp.
Buchitidae
** *Helictites* sp.
** *Epiceratites* ? *motobuensis* sp. nov.
Thisbitidae
** *Thisbites nakijinensis* sp. nov.
* *Thisbites* sp. A
Choristoceratidae
* *Hannaoceras* (*H.*) *henseli* (OPPEL)
Hannaoceras (*H.*) *nasturtium* (DITTMAR)
Tropitidae
* *Discotropites quinquepunctatus* (MOJSISOVICS)
* *Discotropites* sp. cf. *D. plinii* (MOJSISOVICS)
Discotropites sp. B
Discotropites sp. cf. *D. laurae* (MOJSISOVICS)
* *Discotropites* sp.
Paratropites sp. aff. *P. hoetzendorfii* (DIENER)
* *Hoplotropites* sp. cf. *H. arionis* (MOJSISOVICS)
* *Hoplotropites* sp. cf. *H. georgii* (MOJSISOVICS)
Styrites sp.
Styrites ? sp.
Tropiceltitidae
* *Arnioceltites* sp. cf. *A. arietitiformis* (MOJSISOVICS)
* *Arietoceltites arietitoides* (DIENER)

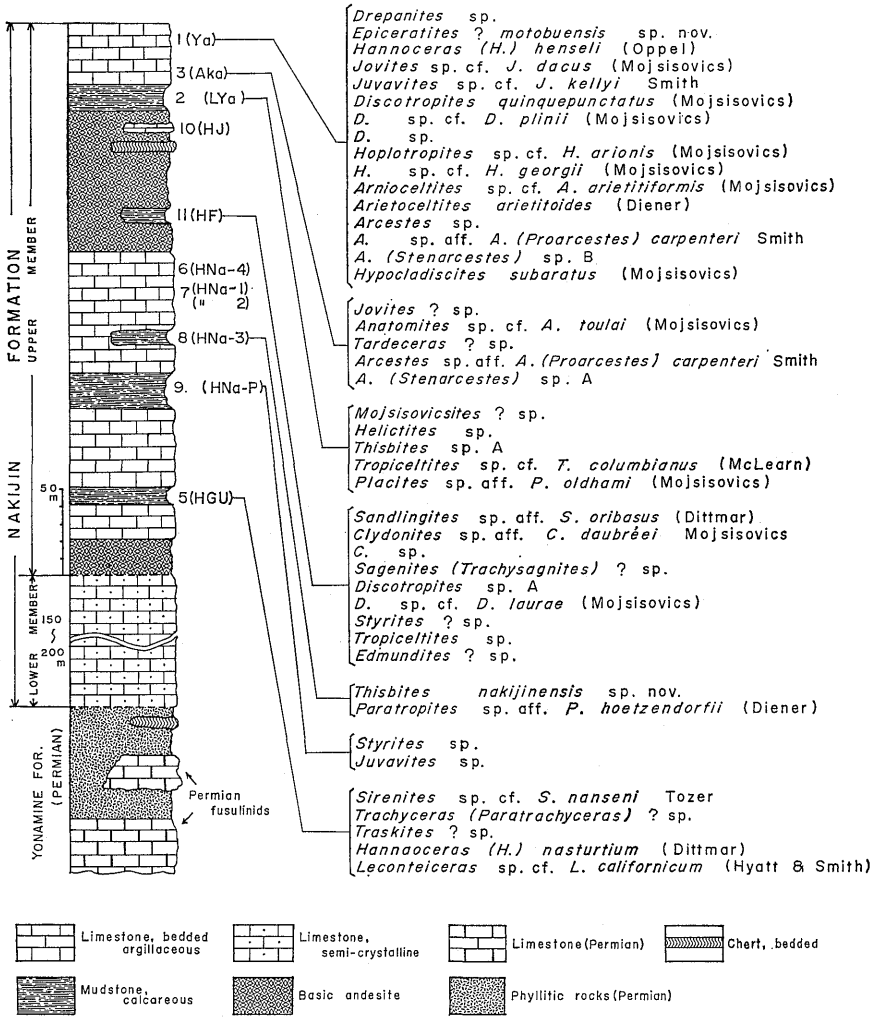


Fig. 1. Generalized columnar section and ammonoid occurrences of the Nakijin Formation.

Tropiceltites sp. cf. *T. columbianus* (McLearn)

Tropiceltites sp.

Haloritidae

* *Jovites* sp. cf. *J. dacus* (Mojsisovics)

Jovites sp.

* *Juvavites* sp. cf. *J. kellyi* Smith

Juvavites sp.

Anatomites sp. cf. *A. toulai* (Mojsisovics)

Tardeceras sp.

Leconteiceras sp. cf. *L. californicum* (Hyatt and Smith)

Sagenites (*Trachysagenites*) ? sp.

Arcestidae

Arcestes (*Proarcestes*) sp. aff. *A.* (*P.*) *carpenteri* Smith

Arcestes (*Stenarcestes*) sp. A
Arcestes (*Stenarcestes*) sp. B
Arcestes sp.
Cladiscitidae
** *Hypocladiscites subaratus* (MOJSISOVICS)
Pinacoceratidae
Placites sp. aff. *P. oldhami* MOJSISOVICS

The faunal assemblage shown above, which indicates the Carnian age of Triassic, has never been known in the Triassic strata of the Japanese Islands. However, it is noted that a similar assemblage is found in the Triassic of Himalayas, California, Sicily, and the European Alps. On the basis of the data obtained from the biostratigraphical distribution of Triassic ammonoids in Canada, TOZER (1967) established thirty-one ammonoid zones, of which five are assigned to the Carnian.

TOZER and SILBERLING (1968) proposed the time-stratigraphic division and correlation of the marine Triassic in North America, which is the most reliable time-stratigraphic division of the Triassic at present. In the Nakijin Formation (ISHIBASHI, 1970) the present author already established two ammonoid zones, *Sirenites* cf. *nanseni* zone and *Juvavites* cf. *kellyi* zone, which are comparable to *Sirenites nanseni* zone and *Tropites welleri* zone of North America respectively. However, in addition to these two zones, a new ammonoid zone is here added on the basis of new ammonoid assemblage. Thus, three ammonoid zones are found in the Nakijin Formation; *Sirenites* cf. *nanseni* zone, *Sandlingites* aff. *oribasus* zone and *Juvavites* cf. *kellyi* zone in ascending order (Table 1).

1. The *Sirenites* cf. *nanseni* Zone

This zone comprises the following species in which *Sirenites* cf. *nanseni* is most characteristic; *Trachyceras* (*Paratrachyceras*) ? sp., *Traskites* ? sp., *Hannaoceras* (*H.*) *nasturtium* (DITTMAR), *Leconteiceras* cf. *californicum* (HYATT and SMITH), *Styrites* sp., and *Juvavites* sp.

The absence of Juvavitids is a negative characteristics of the *Tropites dilleri* zone and the lower zones in Canada (TOZER, op. cit.). However, it is known that the juvavitids have been recorded from the Lower Carnian (e.g. MOJSISOVICS, 1893) of the European Alps, and it is a remarkable fact that a determinable

Table 1. Correlation of the Carnian ammonoid zones in Okinawa-jima and North America

Stage	Substage	Okinawa-jima	Standard zones in North America (TOZER, 1967)
Carnian	Upper	?	*Klamathites macrolobatus*
		Juvavites cf. *kellyi*	*Tropites welleri*
		Sandlingites aff. *oribasus*	*Tropites dilleri*
	Lower	*Sirenites* cf. *nanseni*	*Sirenites nanseni*
		?	*Trachyceras obesum*

juvavitid occurs in the bed of locality 12 (HMO) of the Nakijin Formation. This bed contains plenty of bivalve shells, *Halobia styriaca* (MOJSISOVICS) which occurs also in the bed of locality HNa-P. This horizon is considered to be the Lower Carnian in age (KOBAYASHI and ISHIBASHI, 1970). On the paleontological evidence, this horizon is assignable to *Sirenites* cf. *nanseni* zone, though the ammonids are too poorly preserved to discuss precisely.

2. The *Juvavites* cf. *kellyi* Zon

Two horizons 1 (Ya) and 3 (AKa) are referred to this zone. The ammonoid fauna is characterized by the occurrences of arcestids and juvavitids and is correlated to the *Tropites welleri* zone of North America. The species known from this zone are *Juvavites* sp. cf. *J. kellyi* SMITH, *Anatomites* sp. cf. *A. toulai* (MOJSISOVICS), *Tardeceras* sp., *Drepanites* sp., *Epiceratites* ? *motobuensis* sp. nov., *Mojsisovicsites* ? sp., *Helictites* sp., *Thisbites* sp. A, *Hannaoceras* (*H.*) *henseli* (OPPEL), *Jovites* sp. cf. *J. dacus* (MOJSISOVICS), *Jovites* sp., *Discotropites quinquepunctatus* (MOJSISOVICS), *D.* sp. cf. *D. plinii* (MOJSISOVICS), *D.* sp., *Hoplotropites* sp. cf. *H. arionis* (MOJSISOVICS), *H.* sp. cf. *H. georgii* (MOJSISOVICS), *Arnioceltites* sp. cf. *A. arietitiformis* (MOJSISOVICS), *Arietoceltites arietitoides* (DIENER), *Tropiceltites* sp. cf. *T. columbianus* (MCLEARN), *Arcestes* sp. aff. *A.* (*Proarcestes*) *carpenteri* SMITH, *A.* (*Stenarcestes*) sp. A, *A.* (*S.*) sp. B, *A.* sp., *Hypocladiscites subaratus* (MOJSISOVICS) and *Placites* sp. aff. *P. oldhami* MOJSISOVICS.

The ammonoids in this zone are well preserved and rich in numbers and kinds of species, but typical tropitid ammonoids are also absent from this zone in Okinawa as well as in the Carnian strata of the Japanese Islands.

3. The *Sandlingites* aff. *oribasus* Zone

The species collected from this zone are *Sandlingites* sp. aff. *S. oribasus* (DITTMAR), *Clydonites* sp., *C.* sp. aff. *C. daubréei* MOJSISOVICS, *Edmundites* ? sp., *Thisbites nakijinensis* sp. nov., *Tropiceltites* sp., *Sagenites* (*Trachysagenites*) ? sp., *Discotrpites* sp. cf. *D. laurae* (MOJSISOVICS), *D.* sp., *Styrites* ? sp., and *Paratropites* sp. aff. *P. hoetzendorfii* (DIENER).

This zone includes the horizon 8 (HNa-3), 7 (HNa-1), 6 (HNa-4) and 11 (HF) in ascending order. Two ammonoids, *Paratropites* sp. aff. *P. hoetzendorfii* and *Thisbites nakijinensis* n. sp. are found at the horizon 8 (HNa-3). *Paratropites hoetzendorfii* has been known from the Upper Carnian in other Triassic regions.

On the other hand, *Discotropites* is confined to the Upper Carnian, and it is considered that the species of *Discotropites* in this horizon 11 (HF) are rather older in age than those from the uppermost horizon 1 (Ya). The ammonoid assemblage of *Sandlingites* aff. *oribasus* zone is similar to that of *Tropites dilleri* zone of California (TOZER, 1967; SILBERLING and TOZER, 1968). The present assemblage is common in some genera with that found in the Open Bay Forma-

tion of Quadra Island, British Columbia, which is referred to *Tropites dilleri* zone (CARLISLE and SUSUKI, 1965).

On these grounds, the *Sandlingites* aff. *oribasus* zone is established between the *Sirenites* cf. *nanseni* zone and the *Juvavites* cf. *kellyi* zone in the sequence of the Nakijin Formation, and it is most probably correlated to the *Tropites dilleri* zone in North America as shown in Table 1.

Description of Species

Family Buchitidae HYATT, 1900
Genus *Epiceratites* DIENER, 1915

Type-species.—*Ammonites* (*Clydonites*) *elevatus* DITTMAR, 1866

Epiceratites ? *motobuensis* sp. nov.
Pl. 1, Figs. 1–3; Pl. 2, Fig. 1

Material.—Three specimens are examined here. GK.F 470 is incomplete, 210 mm in maximum diameter and 55 mm in width, outer whorl of which is lost. GK.F 471 and GK.F 472 are partial specimens of outer whorl and the latter is immature shell.

Description.—Shell considerably involute, laterally compressed, with a rather wide umbilicus; whorl increasing gradually its height, ratio of diameter to width, 0. 24 (?) on restored specimens; umbilicus of moderate size occupying about 25 percent of shell diameter; venter rounded in immature shell, but very narrow, fastigate in mature one without a keel and furrows; whorl surface nearly smooth, without ribs and tubercles, but with faint radial lirae on the flank; septa weakly ceratitic.

Remarks.—The present specimens are incomplete, but the ornaments on the flanks, form and a part of suture line are visible. The Pl. 1, Figs. 1a and 1c are presumable features on the basis of whorl volution, which attain ca. 280 mm in diameter and ca. 62 mm in width.

The present specimens apparently resemble some species of Lower Triassic genera, ex. *Proplychitoides, Metadagnoceras* and *Paranorites,* but are evidently not the secondary fossil because of preservation of whorl surface and occurrence of Upper Carnian ammonoids at the same horizon 1 (Ya). Such an Upper Triassic species as the present one which has wholly primitive feature and poor ornaments bewilders the writer to decide definitely the systematic position.

On account of certain characters of venter, whorl section and suture, the present species seems to belong to the family Buchitidae of Upper Triassic. The genus *Epiceratites* in Buchitidae is involute with rounded venter, and weak radial ribs and is known from Carnian to Norian of the Alps and Greece.

Almost all the species of *Epiceratites* are small even in mature stage, with weak radial ribs. *E. venantii* reported by DIENER (1920) from the Northern Alps is the largest and has the diameter of 30 mm which is one-ninth of the Okinawa specimen.

The writer tentatively describes these specimens under the new species of *Epiceratites* though it is questionable whether the present specimens belong to *Epiceratites*. But if better preserved material comes to hand in future, a new genus in Buchitidae may be established.

Occurrence.—Horizon 1 (Ya). Locality; Yamakawa, Motobu-cho, Okinawa-jima. Black argillaceous limestone, Upper Member of the Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Genus *Helictites* MOJSISOVICS, 1879

Type-species.—*Ammonites geniculatus* HAUER, 1855

Helictites sp. indet.
Pl. 2, Fig. 2

Material.—One deformed outer whorl (GK.F 473) is examined.

Descriptive remarks.—The shell is evolute. The ribs are flexuous, crossing over the venter with projection, considerably dense and slender. The inner whorls and suture are lost.

Helictites has a generally subquadrate whorl section. As the present specimen is secondarily deformed, the whorl section is hardly reconstructed. But in the character of volution, ribs and venter, this specimen is though to be assigned to a species of *Helictites*.

Helictites mojsvari, reported by DIENER (1923) from Timor, is somewhat similar to the present species in the point of slender ribs and evolute whorl. *H. sundaicus* DIENER (1923) shows wholly the same character of volution, but differs in having stronger ribs on a venter and bifurcating ones on flanks. The writer puts off to give the specific name until a better material comes to hand.

Occurrence.—Horizon 2 (LYa). Locality; Yamakawa, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Family Thisbitidae SPATH, 1951
Genus *Thisbites* MOJSISOVICS, 1893

Type-species.—*Ceratites* (*Thisbites*) *agricolae* MOJSISOVICS, 1893

Thisbites nakijinensis sp. nov.
Pl. 2, Figs. 3–17

Material.—More than fifteen specimens are examined here. All of them consist of internal and external moulds (GK.F 474–488). The specimen illustrated in Pl. 2, Fig. 3 (GK.F 474) is designated as the holotype.

Description.—Shell evolute; whorl gradually increasing its height, laterally compressed; venter with a low median keel; ribs slender, falcoid, intercalatory, rounded; secondary ribs appear at half height of whorl and has the same width as primary ones on the outer side; longer ribs, constantly thick from umbilical

area to ventrolateral one; the intercostal space broader than ribs; lunulae undeveloped; suture line invisible.

Remarks.—The genus *Thisbites*, which has a keel on venter, is generally classified into two groups; one has projected ribs lacking in tubercles or lunulae, which is represented by *Thisbites borellii* (MOJSISOVICS, 1893), the other group is characterized by *Th. agricolae* and *Th. burtini* which have coarse and falcoid ribs with tubercles or lunulae on ventral shoulders. The present species belong to the former group, but have the curvature of ribs of the latter group.

The present species is characterized by the median keel and very slender intercalatory ribs, and is similar to *Th. ankeri*, one of many species reported by MOJSISOVICS (1893) from the Alps, but differ in the characters of ribs and lunulae. *Thisbites* sp. A, which has already been described from the horizon 2 (LYa) in the Nakijin Formation (ISHIBASHI, 1970), is easily distinguished from the present species by the form volution and character of ribs. The writer now considers that it is better to transfer *Th.* sp. to *Parathisbites*.

Th. orientalus SHIMIZU (1930) from Shikoku, (See ISHIBASHI, 1970, p. 217), is different from the present species by having distant, flexuous ribs which are bent strongly forward near the ventral shoulder.

Th. pyrani, one of five species described by GEMMELLARO (1904) from the Sicilian Triassic, resembles *Th. nakijinensis* in the shell sculpture, but is distinguished by having stronger and more projected ribs.

Some species of *Thisbites* are known from the Himalaya regions (MOJSISOVICS, 1896, 1899; DIENER, 1906) and Timor (WELTER, 1914) but the present species can not be referred to the known species from these areas. On the grounds of above discussion the writer proposes here a new specific name of *Thisbites* for the present specimens.

Occurrence.—Horizon 8 (HNa-3). Locality; western area of Nakijin Castle, Nakijin-son, Okinawa-jima. Mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Sandlingites* aff. *oribasus* zone].

Family Cladiscitidae ZITTEL, 1884
Genus *Hypocladiscites* MOJSISOVICS, 1896

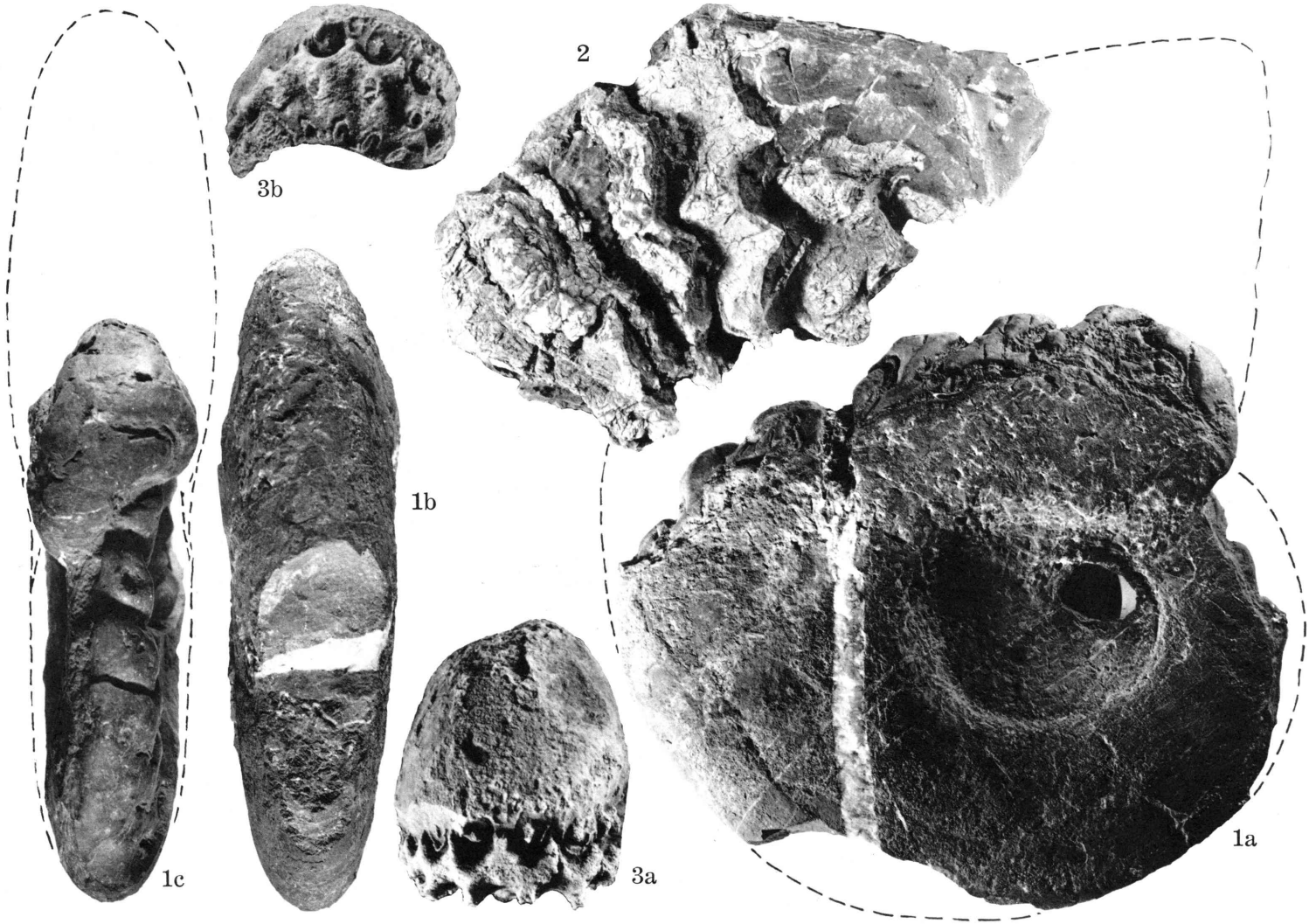
Type-species.—*Arcestes subtornatus* MOJSISOVICS, 1873

Remarks.—*Hypocladiscites* was first proposed by MOJSISOVICS (1896) as a subgenus of *Cladiscites* together with *Paracladiscites*. SPATH (1951) listed *Hypocladiscites* as an independent genus because it includes a considerable number of species. The subsequent workers (KUMMEL, 1957; BAKALOW et al., 1958;

Explanation of Plate 1

Fig. 1–3. *Epiceratites* ? *motobuensis* sp. nov. ..... Page 6

1. GK.F 470, lateral (a), ventral (b) and apertural (c) views, ×1/2. See Pl. 2, Fig. 1 for other view.
2. GK.F 471, a part of outer whorl, ×1.
3. GK.F 472, ventral (a) and apertural (b) views, of an immature shell, ×3.



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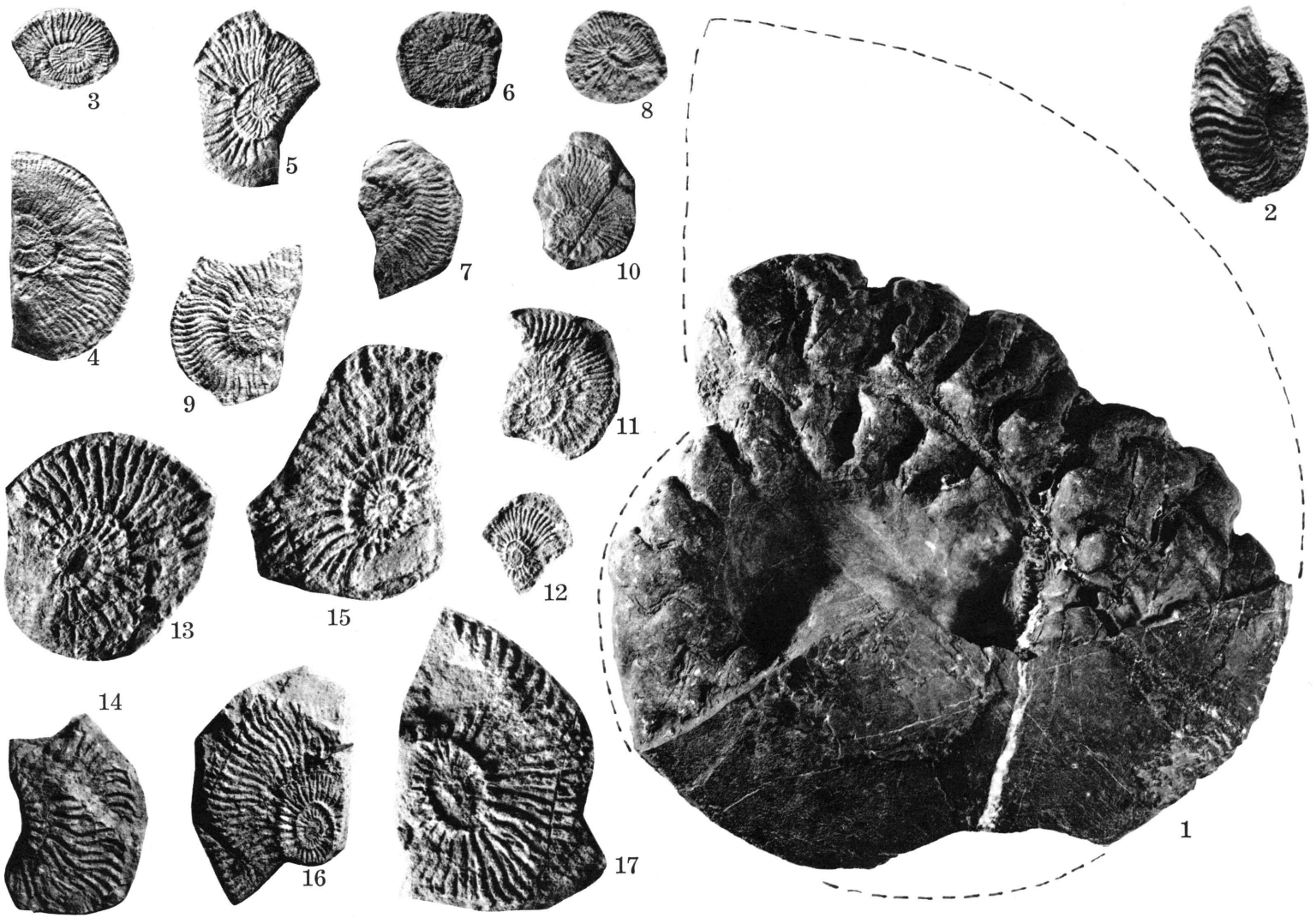

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POPOV, 1961; SHEVYREV, 1968) similarly treated it as an independent genus.

The genus *Hypocladiscites* contains now ten species, which are characteristically known from the Carnian from various parts of the world. Its shell is large in mature stage, discoidal, involute, laterally compressed, narrowly rounded on a venter, and is provided with concentric striations on the flanks and the venter. *Procladiscites,* from the Middle Triassic, is smaller than *Hypocladiscites* and has a subrectangular whorl section. *Paracladiscites,* from the Carnian and Norian stages, is similar to *Hypocladiscites* in whorl-section but has no striation. The precursor of *Hypocladiscites* is probably *Procladiscites,* which prospered in the Anisian, as MOJSISOVICS (1896, 1899) mentioned.

Hypocladiscites subaratus (MOJSISOVICS)

Pl. 3, Figs. 1a–d; Text-figure 2B

1896. *Cladiscites* (*Hypocladiscites*) *subaratus* MOJSISOVICS; *Denkschr. Akad. Wiss. Wien,* **63**, p. 657, pl. 20, fig. 2a–2c.
1901. *Cladiscites* (*Hypocladiscites*) *subaratus* MOJSISOVICS; *Palaeont. Indica,* [15], **3**, Pt. 1, p. 102, pl. 20, fig. 2a–2c.
1905. *Cladiscites* (*Hypocladiscites*) *subaratus* MOJSISOVICS; FRECH in NOETLING, *Lethaea Geognostica II, Das Mesozoicum,* pl. 18, fig. 6a–6b.
1908. *Cladiscites* (*Hypocladiscite*) *subaratus* MOJSISOVICS; DIENER, *Palaeont. Indica,* [15], **1**, Pt. 1, p. 14, pl. 4, fig. 3.
1911. *Cladiscites* (*Hypocladiscites*) cf. *subaratus* MOJSISOVICS; WANNER, *Neues Jahrb. f. Min., Geol. u. Paläont.,* **32**, p. 191, pl. 7, fig. 8.
1914. *Cladiscites* (*Hypocladiscites*) *subaratus* MOJSISOVICS; WELTER, *Paläont. von Timor,* **1**, p. 175, text-figs. 49–50.
1921. *Cladiscites* (*Hypocladiscites*) cf. *subaratus* MOJSISOVICS; DIENER, *Denkschr. Akad. Wiss. Wien,* **97**, p. 32, figs. 9–12.
1927. *Cladiscites* (*Hypocladiscites*) *subaratus* MOJSISOVICS; *Arthaber, Jaarb, Mijnw. Nederl. Ind.,* 55, Pt. 2, p. 36, pl. 3, figs. 3–5.

Material.—A single specimen (GK.F 469), fairly well-preserved, is examined here. It is about 140 mm in diameter and 44 mm in width.

Description.—Shell large for the genus, involute, discoidal and laterally compressed, with flattened sides. Whorl rapidly increasing its height; outer whorl completely embracing the inner one, and indented about one-third of its height by the latter. Umbilicus almost closed, but distinct. Venter rounded,

Explanation of Plate 2

Fig. 1. *Epiceratites* ? *motobuensis* sp. nov. ..... Page 6
GK.F 470, lateral view, ×1/2.

Fig. 2. *Helictites* sp. indet... ..... Page 7
GK.F 473, ventrolateral view, ×2.

Fig. 3–17. *Thisbites nakijinensis* sp. nov. ..... Page 7
Fig. 3 (Holotype), GK.F 474; Fig. 4, GK.F 475; Fig. 5, GK.F 476; Fig. 6, GK.F 477; Fig. 7, GK.F 478; Fig. 8, GK.F 479; Fig. 9, GK.F 480; Fig. 10, GK.F 481; Fig. 11, GK.F 482; Fig. 12, GK.F 483; ×1: Fig. 13, GK.F 484; Fig. 14, GK.F 485; Fig. 15, GK.F 486; Fig. 16, GK.F 487; Fig. 17, GK.F 488; ×2.

with rounded ventral shoulders. Surface of whorl ornamented with the spiral striations. Striation counted ten in 10 mm. Intercostal space between striations about 0.8 mm in depth and 0.5 mm in width near the ventral part of the last whorl; spiral striation around umbilicus rather fainter and finer than on the flank and the ventral part.

Remarks.—Hypocladiscites subaratus was originally described by MOJSISOVICS (1896) on the specimens collected from the Himalaya region. The holotype is well-preserved and is laterally flattened, increasing the width near the aperture. DIENER (1908) also described the same species from the same region. His specimen has a part of living chamber, and a round ventral part, and is slightly more compressed in comparison with the holotype and the Okinawa specimen.

Some well-preserved specimens were reported under the same name from Timor and Rotti Islands of Portuguese Indonesia by WANNER (1911), WELTER (1914) and ARTHABER (1927).

Although the specimen at hand is represented by only single, it is sufficiently well-preserved for examination. The ventral part of the last whorl is partly lost but the ventral sculpture is observable on the inner whorl (Pl. 3, Fig. 1d). The suture line is indistinct because of recrystallization of calcite. The specimen has the same whorl section, sculpture and other characteristics as those of the holotype from Himalaya. WELTER (1914) described *H. subaratus* along with its two subspecies on the basis of a large number of specimens collected from Timor.

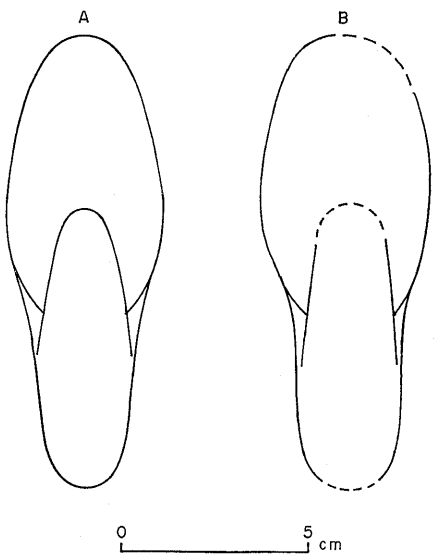
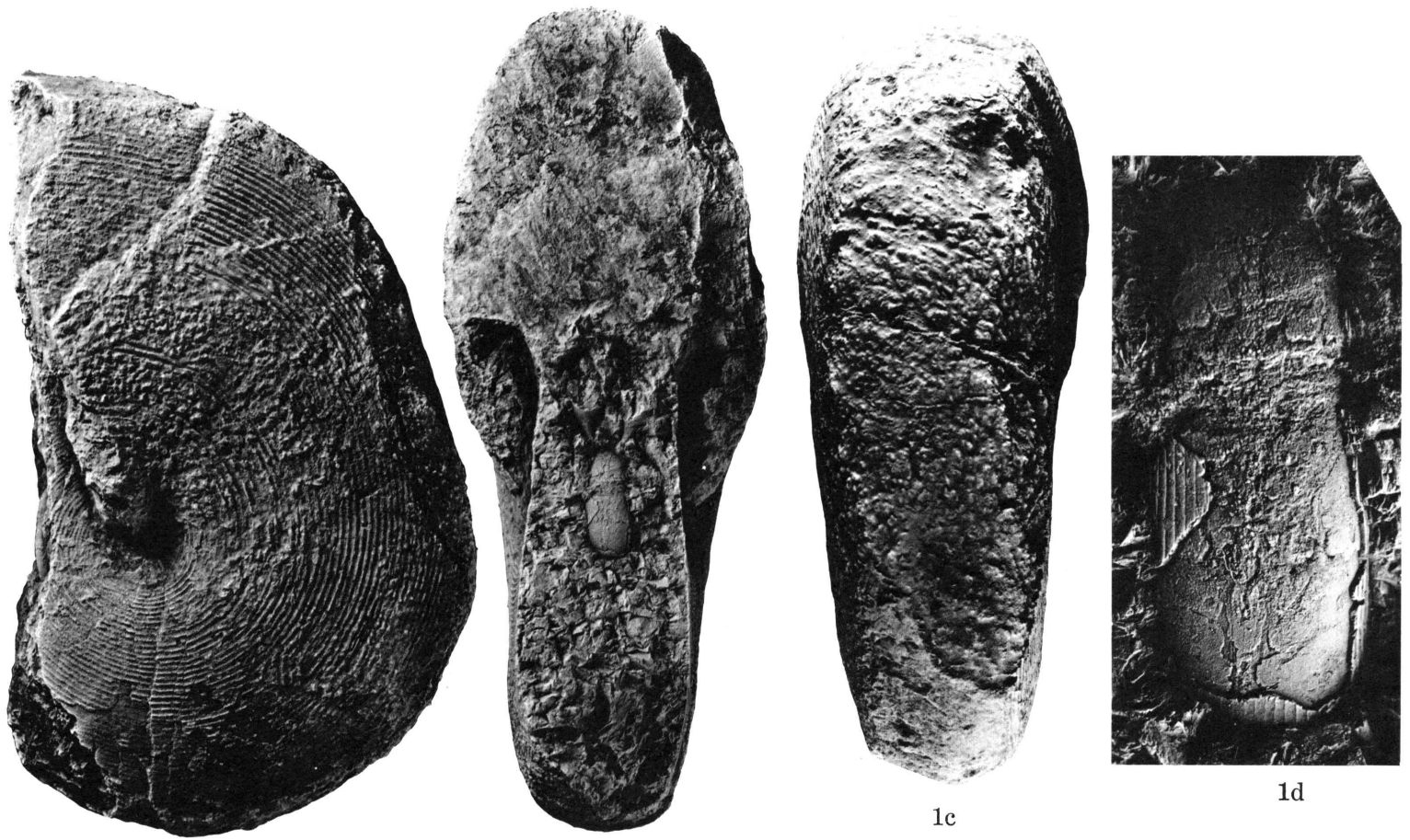


Fig. 2. Whorl sections of *Hypocladiscites subaratus*
A: The holotype from Himalaya (MOJSISOVICS, 1896)
B: The present specimen restored from a slightly deformed condition.

Explanation of Plate 3

Fig. 1a–1d. *Hypocladiscites subaratus* (MOJSISOVICS) .....Page 9
GK.F 469, lateral (a), frontal (b), and ventral (c) views, ×1. Venter of the inner whorl (d), enlarged from Fig. 1b.



1a 1b 1c 1d

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However, it was unfortunate that he only showed figures of whorl sections (p. 176, 178), without giving their photographs. Of the two whorl sections illustrated by him (p. 175, figs. 49 and 50), one (fig. 49) collected from Bihati has a typical pattern of *H. subaratus,* but the other (fig. 50) from Nifoekoko has a rectangular whorl section, and is rather closer to that of *H. subaratus planatus* or *H. subtornatus* (MOJSISOVICS, 1873, p. 30, figs. 5 and 6; pl. 32, fig. 8).

ARTHABER (1927) also reported *H. subaratus* and its variety *planata* together with a large number of the Triassic ammonoids from Timor. He mentioned that WELTER's two subspecies *H. subaratus planatus* and *H. subaratus compressus* were only slightly different from each other at individual level. *H. subaratus* var. *planata* described by him is slender than *H. subaratus* in whorl section and has a round to rectangular venter.

DIENER (1919) reported *H.* cf. *subaratus* from Hallstätter-kalk of the Alps. This specimen was illustrated with a whorl section and three patterns of suture line, but its sculpture was not observable. It is rather compressed, narrower in whorl section than other specimens reported from Himalaya, Timor and Okinawa. ARTHABER (1927) added this specimen to *H. subaratus* in his synonymy list.

To sum up there is probably variation to some extent in the degree of compression and roundness of a venter in this species. On this ground the Okinawa specimen is assigned to *H. subaratus.*

Occurrence.—Horizon 1 (Ya) Locality; Yamakawa, Motobu-cho, Motobu Peninsula, Okinawa-jima. Black argillaceous limestone, Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* Zone].

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The references cited in Part I are not repeated here. The following supplementary list of referencs should be added to the bibliography.

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