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

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

Takeshi ISHIBASHI

Abstract

This is a serial study on the Upper Triassic ammonites from the Nakijin Formation, Ryukyu Islands. Some selected ammonoids have been described by ISHIBASHI (1970, 1973). In this article 29 species in 11 families are systematically described.

Introduction

Sixteen species of Triassic ammonoids from Okinawa have been described in the Parts I and II under the same title. The remaining specimens collected from the Triassic Nakijin Formation are classified into 29 species of 11 families, which are described here. One of them, *Discotropites sulcatus* (CALCARA), was found in a Triassic formation distributing at the Hedomisaki of northern tip of Okinawa-jima (ISHIBASHI, 1974). This formation is evidently a part of the Nakijin Formation and is stratigraphically correlated with the Lower Member and the *Sirenites* cf. *nanseni* zone to the *Sandlingites* aff. *oribasus* zone of the Upper Member of the type locality in the Motobu area of Okinawa-jima.

This serial study on the Triassic ammonites of Okinawa is completed at this time. Results of the paleontological studies of other kinds of fossils such as pelecypods, gastropods, nautiloids, conodonts (e.g. KOIKE and ISHIBASHI, 1974) etc. found in the same formation will be published elsewhere as separate papers. All specimens described in this series are deposited in the Department of Geology, Kyushu University with the registered numbers using symbol of GK. F.

The writer would like to express his sincere thanks to Professor Tatsuro Matsumoto of Kyushu University for critical reading of manucript. Thanks are also due to Miss Seiko Hayakawa for typewriting the manuscript. This study is financially supported by the Scientific Research Fund from the Ministry of Education of the Japanese Government in 1972.

Description of Species

Superfamily Clydonitaceae MOJSISOVICS, 1879

Manuscript received July 1, 1974

Family Trachyceratidae HAUG, 1894
Genus *Trachyceras* LAUBE, 1869
Subgenus *Paratrachyceras* ARTHABER, 1914
Type-species.—Trachyceras hofmanni BOECKH, 1873

Trachyceras (*Paratrachyceras*)? sp. indet.
Pl. 27, Figs. 3-4

Material.—Two incomplete specimens, GK. F 489-490, are examined here.

Descriptive remarks.—The shell is fairly involute and secondarily compressed. The whorl increases rapidly its height. The ribs are slender, rounded, concave and dense without tubercles and bifurcation. Details of the ventral and umbilical parts are uncertain. The present specimens, through poorly preserved, represent a species which is comparable with *Paratrachyceras* by the above described mode of ribbing without tuberculation.

The present species is also similar to some Carnian species of *Dimorphites* but it has somewhat broader umbilicus and less involute whorl.

It also resembles some species of *Arpadites* in having dense ribs and involute whorl but its ribs are strongly bent forward at the ventrolateral margin. As its ventral part is not preserved, its taxonomic position is uncertain. It is here provisionally assigned to *Paratrachyceras* with a query.

Occurrence.—Horizon 5 (HGU). Locality; the vicinity of Nagatakibaru, Nakijinson, Motobu peninsula, Okinawa-jima. Argillaceous limestone, Upper Member, Nakijin Formation: Lower Carnian [*Sirenites* cf. *nanseni* zone]

Family Clydonitidae MOJSISOVICS, 1879
Genus *Clydonites* HAUER, 1860
Type-species.—Goniatites decoratus HAUER, 1846

Clydonites sp. indet.
Pl. 27, Figs. 9-10

Material.—Slightly deformed two specimens, GK. F 491-492, are concerned with the description below.

Descriptive remarks.—The shell is evolute. The diameter of shell and umbilicus cannot be measured. The ribs are granular with small tubercles which are aligned in a number of rows.

The present species is similar to a certain species of *Sandlingites* but the latter has more sinuous and less dense ribs and less numerous tubereles. It is very close to *Clydonites daubréei* MOJSISOVICS (1893), from the Carnian Hallstätter Limestone but differs its narrower ribs. *Cl. decoratus* (HAUER), illustrated by MOJSISOVICS (1893), is known from the Norian but is very similar to but has slightly broader ribs than *Cl. daubréei*. The present species is the most closely

allied to *Cl. daubréei* in this respect. However no specific name is given to it till more complete specimens come to hand.

Occurrence.—Horizon 11 (HF). Locality; the neighbourhood of Hamamoto Primary School, Motobu-cho, Okinawo-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Clydonites sp. aff. *Cl. daubréei* Mojsisovics

Pl. 27, Figs. 8a-b

Material.—Two external moulds, GK.F 493-494, are examined here.

Descriptive remarks.—The shell is evolute and seems to have a wide umbilicus. The ribs are somewhat rectiradiate considerably dense and granular, having tubercles in numerous rows. The ventral part is not preserved.

The present specimens are secondarily deformed and are unfortunately incomplete for specific determination. The noticeable characteristics remain only whorl volution and whorl side with ribs and tubercles, suggesting a species of *Clydonites*. The present species is closely related to *Clydonites daubréei* Mojsisovics (1893), from the Hallstätter Limestone of the Alps, and *Cl. giacolonensis* Gemmellaro, 1904, from Sicily. These two species have rather fine ribs which are bifurcate at the umbilical shoulder. It is more similar to *Cl. daubréei* in general appearance than to *Cl. giacolonensis*, as the whorl increases more rapidly in height in the latter.

It would be desirable to call the present species *Clydonites* sp. aff. *Cl. daubréei* until better specimen is available.

Occurrence.—Ditto.

Genus *Sandlingites* Mojsisovics, 1893

Type-species.—Ammonites oribasus Dittmar, 1866

Sandlingites sp. aff. *S. oribasus* (Dittmar)

Pl. 27, Figs. 7 and 21-25

Compare.—

1866. *Ammonites oribasus* Dittmar; *Geogn. Pal. Beitr.* in Benecke 1, p. 384, pl. 18, figs. 8-10.
1893. *Sandlingites oribasus* (Dittmar); Mojsisovics, *Abhandl. Geol. Reichsanst.*, **6**, (2) p. 706, pl. 157, figs. 5-7.
1906. *Sandlingites* sp. cf. *S. oribasus* (Dittmar); Diener, *Palaeont. Indica*, [15], **5**, (1), p. 82, pl. 6, fig. 7.
1925. *Sandlingites oribasus* (Dittmar); Diener, *Leitfossilien der Trias*, p. 95, pl. 18, fig. 7.
1927. *Sandlingites oribasus* (Dittmar); Smith, *U. S. G. S., Prof. Paper*, (141), p. 83, pl. 57, figs. 24-27.

Material.—Six specimens, GK.F 495-500, are examined here.

Description.—Shell evolute, widely umbilicate and laterally compressed, with

gradually increasing whorl height; ribs radial or faintly sigmoidal with ventrolateral tubercles; venter narrow, bordered by ventral tubercles; intercoastal space, irregular in width.

Remarks.—The present specimens are unfortunately deformed but the ornament is well preserved. *Sandlingites* is known from the Carnian and Norian of main Triassic regions of the world, except for Sicily. The Carnian species were reported from the Alps by MOJSISOVICS (1893). Judging from the sculpture of the ventral part the present species is assigned to the genus *Sandlingites* and its observed characters agree with the characteristics of *Sandlingites oribasus*, the type species of genus, reported from the Alps by DITTMAR (1866). One difference between them is that the Okinawa species is more involute than the latter. MOJSISOVICS (1893) described the same species from the Alps but his example is not identical with DITTMAR's, having a dissimilar ventral sculpture which reminds us of *Trachyceras*.

The present specimens closely resemble the specimen of *S.* cf. *oribasus* described from Himalaya by DIENER (1906) in characters of ventral area and ribs but differ in having more involute whorl than the latter. The Okinawa species is provisionally called *Sandlingites* sp. aff. *S. oribasus*.

Occurrence.—Ditto.

Family Clionitidae ARABU, 1932

Genus *Traskites* HYATT et SMITH, 1905

Type-species.—Clionites (*Traskites*) *robustus* HYATT et SMITH, 1905

Traskites? sp. indet.

Pl. 27, Fig. 2

Material.—One poor specimen, GK.F 501, is examined here.

Descriptive remarks.—The shell is evolute with a wide and shallow umbilicus. The ventral part is not discerniable. The radial ribs are coarse with rows of tubercles.

The genus *Traskites* includes four subgenera and is known from North America. The present specimen is too poorly preserved for generic determination, but is tentatively assigned to *Traskites* (s. l.).

It is apparently similar to *Trachyceras* in the sculpture of shell but its whorl is not so involute as in that genus.

Occurrence.—Horizon 5 (HGU). Locality; the vicinity of Nagatakibaru, Nakijin-son, Okinawa-jima. Argillaceous limestone, Upper Member, Nakijin Formation: Lower Carnian [*Sirenites* cf. *nanseni* zone].

Family Arpaditidae HYATT, 1900

Genus *Drepanites* MOJSISOVICS, 1893

Type-species.—*Arpadites* (*Drepanites*) *hyatti* MOJSISOVICS, 1893

Drepanites sp. indet.
Pl. 27, Figs. 26-27

Material.—Two immature specimens, GK.F 502 and 535, are examined here.

Descriptive remarks.—The shell is very involute with sigmoidal and distant ribs, which appear at outer half of whorl. The ventral part and suture are not preserved. In the characters of ribs and volution, the present species is very similar to *Drepanites hyatti* (MOJSISOVICS) of the European Alps. However, it is represented by too small and too poorly preserved shells for precise discussion and has not fine ribs between strong and distant sigmoidal ones.

Drepanites is known from the Norian of Sicily and the Alps but the present specimen is evidently found in the Upper Carnian. *Hyattites salomoni* GEMMELLARO (1904), from the Carnian Sicily, which should be transferred to *Anatomites*, also somewhat resembles the present specimen but differs in having fainter ribs. It would be desirable to give no specific name until the better mature specimens are available.

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].

Genus *Edmundites* DIENER, 1916

Type-species.—*Arpadites rimkinensis* MOJSISOVICS, 1896

Edmundites? sp. indet.
Pl. 27, Fig. 16

Material.—One specimen, GK.F 503, is obtained.

Descriptive remarks.—The shell is evolute with distant, projected and edged ribs on the flank. The ventral part is lost. The secondary fine ribs are not preserved in this specimen. Two prominent keels should be observed on the venter of *Edmundites*, but they are not preserved in the present specimen. From the characters of ribs and whorl volution, the present specimen may be referable to *Edmundites*.

Occurrence.—Horizon 11 (HF). Locality; the neighbourhood of Hamamoto Primary School, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Family Tibetitidae HYATT, 1900

Genus *Mojsisovicsites* GEMMELLARO, 1904

Type-species.—*Mojsisovicsites crassecostatus* GEMMELLARO, 1904

Mojsisovicsites? sp. indet.

Pl. 27, Fig. 12

Material.—One incomplete specimen (GK.F 504) is examined here.

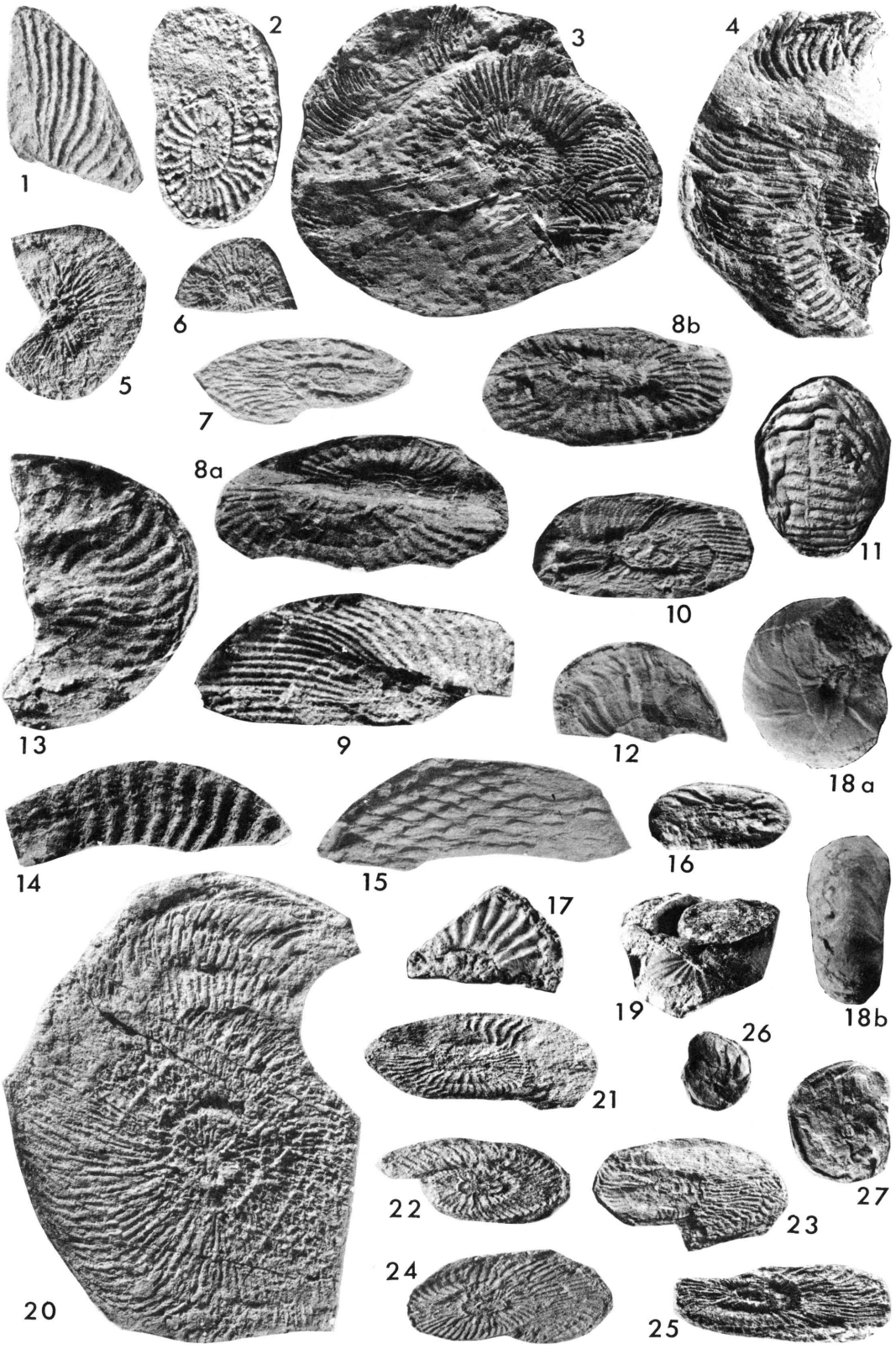
Descriptive remarks.—The material consists of only an outer whorl, but the shell is presumed considerably evolute. The surface of whorl is apparently smooth but such as faint foldings or ribs are visible. The umbilical and ventral areas are lost.

The present specimen resembles the whorl of *Mojsisovicsites* described by GEMMELLARO (1904) from Sicily. *Stikinoceras kerri*, from Canada, which was originally reported as a subgenus of *Mojsisovicsites* by MCLEARN (1960), seems to have no affinity with the Okinawa specimen, but rather resembles the species of *Thisbites* which develops bifurcating ribs and ventral keel. The present specimen is, thus, provisionally referred to genus *Mojsisovicsites* with a query.

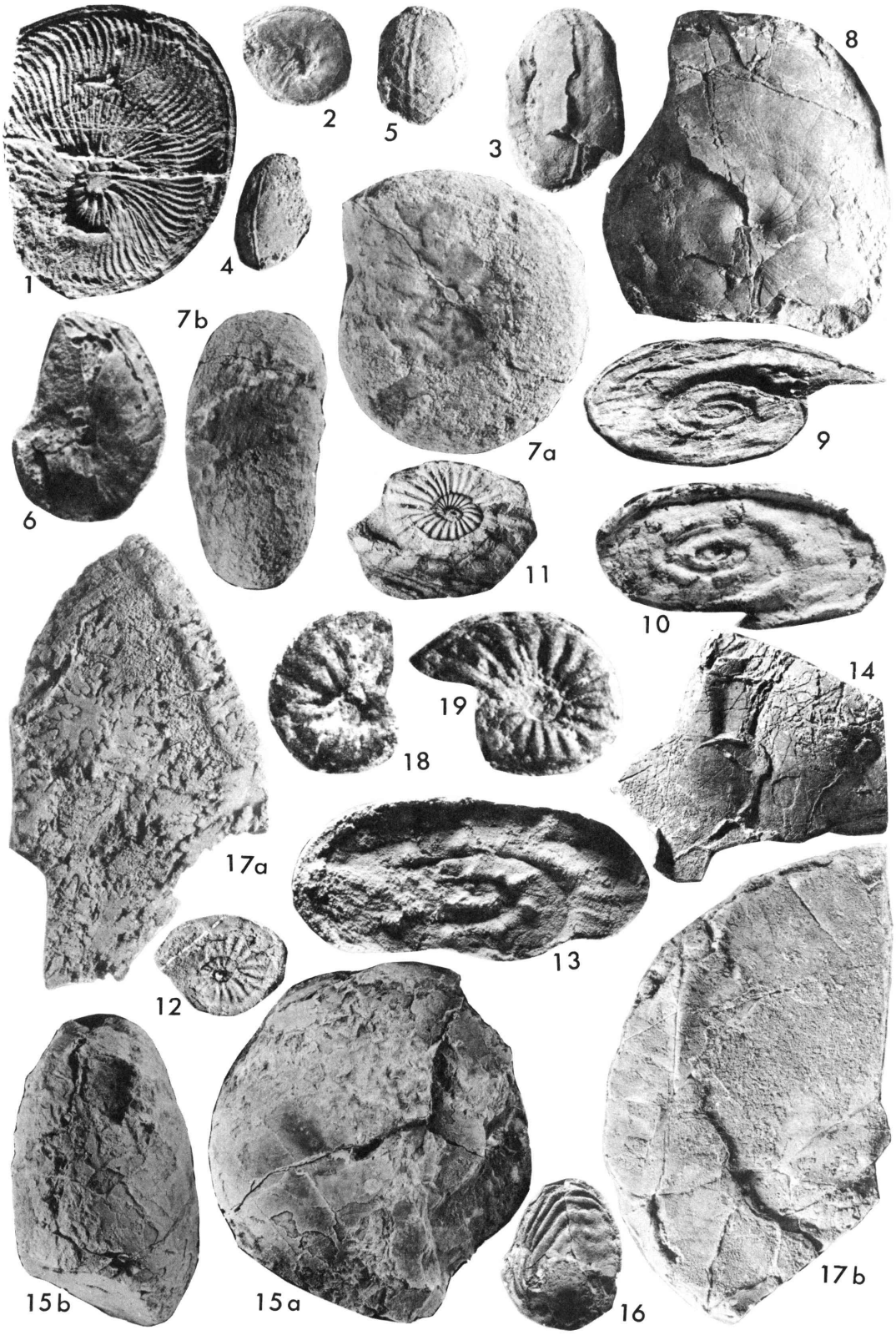
Explanation of Plate 27

(Figures natural size unless otherwise indicated)

Figs. 1 and 14. *Discotropites* sp. B ..... Page 202
1. GK.F 534, 14. GK.F 509×2
Fig. 2. *Traskites*? sp. ..... Page 196
GK.F 501
Figs. 3-4. *Trachyceras* (*Paratrachyceras*)? sp. ..... Page 194
3. GK.F 489, 4. GK.F 490
Figs. 5-6 and 20. *Paratropites* aff. *hoetzendorfii* (DIENER) ..... Page 202
5. GK.F 511, 6. GK.F 522, 20. GK.F 510
Figs. 7 and 21-25. *Sandlingites* aff. *oribasus* (DITTMAR) ..... Page 195
7. GK.F 495, 21. GK.F 496, 22. GK.F 497, 23. GK.F 498, 24. GK.F 499, 25. GK.F 500.
Fig. 8. *Clydonites* aff. *daubréei* MOJSISOVICS ..... Page 195
a. GK.F 493 ×3, b. GK.F 494 ×3
Figs. 9-10. *Clydonites* sp. ..... Page 194
9. GK.F 491 ×5, 10. GK.F 492 ×2
Fig. 11. *Juvavites* sp. ..... Page 206
GK.F 522 ×2 See Pl. 28, Fig. 16
Fig. 12. *Mojsisovicsites*? sp. ..... Page 198
GK.F 504
Fig. 13. *Discotropites* cf. *laurae* (MOJSISOVICS) ..... Page 201
GK.F 508 ×2
Fig. 15. *Sagenites* (*Trachysagenites*)? sp. ..... Page 208
GK.F 527 ×2
Fig. 16. *Edmundites*? sp. ..... Page 197
GK.F 503 ×2
Fig. 17. *Tardeceras* sp. ..... Page 207
GK.F 524
Fig. 18. *Anatomites* cf. *toulai* (MOJSISOVICS) ..... Page 206
GK.F 523 ×2
Fig. 19. *Jovites* sp. ..... Page 205
GK.F 520
Figs. 26-27. *Drepanites* sp. ..... Page 197
26. GK.F 502, 27. GK.F 535



T. ISHIBASHI: Upper Triassic Ammonites



T. ISHIBASHI: Upper Triassic Ammonites

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

Family Choristoceratidae HYATT, 1900

Genus *Hannaoceras* TOMLIN, 1931

Subgenus *Hannaoceras* TOMLIN, 1931

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

Hannaoceras (*Hannaoceras*) *nasturtium* (DITTMAR)

Pl. 28, Figs. 11-12

1866. *Ammonites* (*Clydonites*?) *nasturtium* DITTMAR; *Geogr. Pal. Beiträge*, in BENECKE, **1**, p. 358, pl. 14, figs. 24-37.

1879. *Choristoceras masturtium* DITTMAR; BRANCA, *Palaeontographica*, **26**, p. 42, pl. 5, fig. 6.

1893. *Polycyclus nasturtium* DITTMAR; MOJSISOVICS, *Abhandl. Geol. Reichsanst.*, **6**, (2), p. 535, pl. 132, figs. 27-36.

1973. *Hannaoceras* (*Hannaoceras*) *nasturtium* (DITTMAR); WIEDMANN, *Atlas of Palaeobiogeography* (Ed. A. HALLAM), p. 238, 245, pl.1, fig. 1a-b, Elsevier, Amsterdam.

Explanation of Plate 28

(Figures natural size unless otherwise indicated)

Fig. 1. *Discotropites sulcatus* (CALCARA) ..... Page 200
GK.F 507

Figs. 2-3. *Tropiceltites* cf. *columbianus* (MCLEARN) ..... Page 204
2. GK.F 516, 3. GK.F 517

Figs. 4-5. *Styrites* sp. ..... Page 203
4. GK.F 514, 5. GK.F 513

Figs. 6-7. *Arcestes* (*Proarcestes*) aff. *carpenteri* SMITH ..... Page 209
6. GK.F 530 ×2, 7. GK.F 529 ×3

Fig. 8. *Arcestes* (*Stenarcestes*) sp. B ..... Page 211
GK.F 532

Fig. 9. *Styrites*? sp. ..... Page 204
GK.F 515

Figs. 10 and 13. *Tropiceltites* sp. ..... Page 205
10. GK.F 519 ×2, 13. GK.F 518 ×2

Figs. 11-12. *Hannaoceras* (*Hannaoceras*) *nasturtium* (DITTMAR) ..... Page 199
11. GK.F 505, 12. GK.F 506

Fig. 14. *Arcestes* sp. ..... Page 209
GK.F 528

Fig. 15. *Arcestes* (*Stenarcestes*) sp. A ..... Page 210
GK. F 531

Fig. 16. *Juvavites* sp. ..... Page 206
GK.F 521 See Pl. 27, Fig. 11

Fig. 17. *Placites* aff. *oldhami* (MOJSISOVICS) ..... Page 211
a. GK.F 533a inner part ×2, b. GK.F 533b shell part

Figs. 18-19. *Leconteiceras* cf. *californicum* (HYATT et SMITH) ..... Page 207
18. GK.F 525 ×2, 19. GK.F 526 ×2

Material.—Fairly well preserved two specimens, GK.F 505 and 506, concern with the description.

Description.—Shell evolute, with a considerably broad umbilicus; whorl gradually increasing its height; outer whorl indented for about one-third height by inner whorl; ribs approximated, rectiradiate, strong and rounded, becoming stouter outward, passing over the venter, irregularly hypertrophous with very wide interspace on outer whorl; venter rounded without furrow and keel.

Remarks.—The genus *Hannaoceras* is one of Triassic heteromorph ammonoids (WIEDMANN, 1973) and the present species is not so loosely uncoiled but has characteristic form of ribs on the outer whorl. The stout ribs separated by wide interspace are well shown on the outer whorl of GK.F 505 (Pl. 28, Fig. 11).

Hannaoceras (*H.*) *nasturtium* was originally described by DITTMAR (1866) from the Hallstätter Limestone and reported by MOJSISOVICS (1893) from the same locality. It occurred in the *Tropites subbullatus* zone, Upper Carnian, of the Alps with *H.* (*H.*) *henseli* (OPPEL). The present specimens occurred in the *Sirenites* cf. *nanseni* zone (upper Lower Carnian) together with *Sirenites* cf. *nanseni*, *Leconteiceras* cf. *californicum* and others. On the other hand *H.* (*H.*) *henseli* was evidently yielded from the *Juvavites* cf. *kellyi* zone (middle Upper Carnian) in Okinawa.

The present specimens, which show characteristic ribbing as mentioned above are very similar to the specimens illustrated by MOJSISOVICS (1893, pl. 132, fig. 33) and DITTMAR (1866, pl. 14, fig. 36). Two indeterminable ammonoids have been reported by NEWTON (1925) from Kuala Nevang, Kedah, Malaysia. One of them (p. 78, pl. 3, fig. 2) was suggested by him to resemble *Balatonites* sp., but SPATH (1951) referred it to *Hannaoceras* (*H.*) *nasturtium*. NEWTON described that "possessing distant, straight, radial ribs, which appear to exibit obscure evidence of nodulations." Judging from this description and the illustration, this Malaysian specimen is hardly referred to *Hannaoceras*.

Occurrence.—Horizon 5 (HGU). Locality; the vicinity of Nagatakibaru, Nakijinson, Okinawa-jima. Argillaceous limestone, Upper Member, Nakijin Formation: Lower Carnian [*Sirenites* cf. *nanseni* zone].

Superfamily Tropitaceae MOJSISOVICS, 1875

Family Tropitidae MOJSISOVICS, 1875

Genus *Discotropites* HYATT et SMITH, 1905

Type-species.—*Ammonites sandlingites* HAUER, 1850

Discotropites sulcatus (CALCARA)

Pl. 28, Fig. 1

1845. *Ammonites sulcatus* CALCARA; *Cenno sui Molluschi viv. e foss. della Sicilia*, p. 43, pl. 4, fig. 26.

1904. *Eutomoceras sulcatum* (CALCARA); GEMMELLARO, *Giornale Sci. Nat. Econ., Palermo* **24**, p. 80, pl. 8, figs. 1-4, pl.19, fig. 14.
1974. *Discotropites sulcatus* (CALCARA); ISHIBASHI, *Jour. Geol. Soc. Japan*, **80**, (7), p. 329, fig. 3.

Material.—A well preserved specimen, GK.F 507, is examined here, which is ca. 45 mm in diameter.

Description.—Shell evolute, discoidal, laterally compressed; whorl gradually increasing its height, deeply indented to one-half of its height by the latter; ribs concave, faciculate, gently sinuous, some of them dichotomous, umbilicus narrow, about a quarter of diameter, with umbilical tubercles, more stronger in early whorl; venter acute with a distinct keel.

Remarks.—*Discotropites sulcatus* was first described by CALCARA in 1840 as *Ammonites sulcata*. After that some authors reported as a species of *Ammonites* and then *Trachyceras* from Sicily (GEMMELLARO, 1904, p. 80). Some explanations are cited from GEMMELLARO's description, though these references are inaccessable here.

On account of the main characteristics *D. sulcatus* is assigned to the group of *D. sandlingites* (SMITH, 1927) but the umbilical knot suggests its linking up with the group of *D. theron* which corresponds to the *punctati* of MOJSISOVICS (1893). The characters of whorl volution and ribs are somewhat similar to those of *Paratropites*. *Paratropites* cf. *scaphitformis* reported by DIENER (1906), from the Himalaya region, seems to be similar to the present species in whorl volution and the ventral keel but is different in the umbilical knot. *Discotropites sandlingites* has comparatively slender ribs among the species of *Discotropites*, but in *P.* cf. *scaphitformis* the ribs are gradually broaden from umbilicus to venter and the umbilical knots are not observed. *Discotropites sulcatus* may be a primitive species of the genus on the basis of the characteristic shell-form, ribbing and suture-line (GEMMELLARO, 1904, pl. 8, fig. 3; pl. 19, fig. 14) as well as the stratigraphic horizon.

Occurrence.—Locality A-1, Hedo area, Kunigami-son, Okinawa-jima. Argillaceous limestone, Upper Member, Nakijin Formation: Lower Carnian [*Sirenites* cf. *nanseni* zone].

Discotropites sp. cf. *D. laurae* (MOJSISOVICS)

Pl. 27, Fig. 13

Compare.—

1893. *Eutomoceras laurae* MOJSISOVICS; *Abhandl. Geol. Reichsanst.*, **6**, (2), p. 294, pl. 131, figs. 13, 16-18; pl. 193, fig. 3.
1904. *Eutomoceras laurae* MOJSISOVICS; GEMMELLARO, *Giornale Sci. Nat. Econ., Palermo* **24**, p. 91, pl. 8, figs. 13-14.
1927. *Discotropites laurae* (MOJSISOVICS); SMITH, *U. S. Geol. Surv., Prof. Pap.* (141), p. 42, pl. 11, figs. 8-22.

Material.—A half of whorl is obtained (GK.F 508).

Descriptive remarks.—The present specimen is incomplete but preserves some characters of *Discotropites*. The whorl is very involute with projected and fine ribs. The strong tubercles are arranged at the ventrolateral shoulder. Two rows of weak tubercle-like elevations are on the flank.

The present specimen is probably identified with *Discotropites laurae* which was described by MOJSISOVICS (1893) from the Hallstätter Limestone of Austria. One of the latter specimens (pl. 131, fig. 13) has two rows of clear tubercles on the flank. The other specimens have only a row of ventrolateral tubercles.

SMITH (1927) described *D. laurae* from California and stated that the Californian species is folded in the series between *D. gemmellaroi* and *D. sengeri*. The ventrolateral tubercles are apparently undeveloped in the Californian species.

The present form is unfortunately incomplete and cannot be precisely identified with the Alpine one. An example of *D. laurae* from Sicily reported by GEMMELLARO (1904) has evidently tubercles at the ventrolateral shoulder and on the flank and is very similar to the Okinawa specimen.

Occurrence.—Horizon 11 (HF). Locality; the neighbourhood of Hamamoto Primary School, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Sandlingites* aff. *oribasus* zone].

Discotropites sp. indet. B

Pl. 27, Figs. 1 and 14

Material.—Two fragmentary outer whorls, GK.F 509 and 534, are examined here.

Descriptive remarks.—The present specimens are so badly preserved that the precise identification cannot be done. But the characteristic ribbing indicates that they may be a part of *Discotropites*.

It has sharp and fine ribs where many rudimentary knots or fine striae are developed. These characters suggest that the present species may be included in the group of *Discotropites mojsvarensis* classified by SMITH (1927) and is similar to *D. gemmellaroi*, one of the *theron* group. It is also somewhat similar to *D. sandlingites* MCLEARN (1960), from Canada, which has fine ribs and striae, but it is too badly preserved for accurate comparison. *Discotropites* sp. described by the present author in Part I (ISHIBASHI, 1970, p. 204, pl. 26, fig. 10) is evidently different from the present one.

Occurrence.—*Ditto.*

Genus *Paratropites* MOJSISOVICS, 1893

Type-species.—*Ammonites saturnus* DITTMAR, 1866

Paratropites sp. aff. *P. hoetzendorfii* (DIENER)

Pl. 27, Figs. 5-6 and 20

1969. *Paratrachyceras* sp. B; ISHIBASHI, *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **19**, (3), p. 377 listed.

Material.—Three specimens, a mature (GK.F 510) and two immatures (GK.F 511-512), are examined here.

Descriptive remarks.—The shell is involute with a narrow umbilicus. The ribs are fine, approximated and projected. The venter and suture-line are not preserved.

The present species is similar to *Discotropites*, but its ribs of the former are more slender than those of any species of *Discotropites*. The tropitid keel or venter is not preserved in the present specimens but the characters of ribs and volution seem to suggest a species of *Paratropites*.

The present species is closely allied to **Paratropites hoetzendorfii* DIENER (1916), from Bosnian Triassic, in the fine ribs and whorl volution, but as it is represented by poorly preserved specimens, the comparison cannot be done with precision.

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].

Genus *Styrites* MOJSISOVICS, 1893

Type-species.—*Styrites tropitiformis* MOJSISOVICS, 1893

Styrites sp. indet.

Pl. 2, Figs. 4-5

Material.—Two specimens showing the venter (GK.F 513) and the ventrolateral part (GK.F 514) are examined here.

Descriptive remarks.—The present specimens have no ribs ornaments on the flank. A distinct low and narrow keel without furrow is on the venter. *Styrites* is similar to some species of *Tropiceltites* in characters on the flank. The specimens referred to *Tropiceltites* sp. have been obtained from localities 2 and 4 (see P. 205, Pl. 28, Figs. 10 and 13). The present specimens are different from them which have ribs and a higher keel.

Microtropites tubercularis (MOJSISOVICS) described from the Alps resembles the present species in size and characters of ventral keel but the former has ventrolateral tubercles on the last whorl and fine rudimental ribs. The present specimens are here described as a species of *Styrites*.

Occurrence.—Horizon 2 (Lya). Locality; Yamakawa Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian

* This species was indicated as *P. kittlii* in the explanation of plate but it was described under the name of *P. hoetzendorfii* (DIENER, 1916, p. 369, pl. 1, figs. 1-4).

[*Juvavites* cf. *kellyi* zone].

Styrites? sp. indet.
Pl. 28, Fig. 9

Material.—One specimen, GK.F 515, is examined here.

Descriptive remarks.—The present specimen is secondarily deformed and not well preserved but the following characters are observed. The whorl is evolute with a broad umbilicus. There is no rib and no tubercle on the whorl. A keel-like mound is observed on ventral area, but it may be formed by deformation. Though it is not satisfactory to decide the taxa, these characters may suggest to be belonged to the genus *Styrites*.

Occurrence.—Horizon 9 (HNa-P). Locality; 200 m west of Nakijin Castle, Nakijin-son, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Lower Carnian [*Sirenites* cf. *nanseni* zone].

Family Tropiceltitidae SPATH, 1951
Genus *Tropiceltites* MOJSISOVICS, 1893

Type-species.—*Tropiceltites rotundus* MOJSISOVICS, 1893

Tropiceltites sp. cf. *T. columbianus* (McLEARN)
Pl. 28, Figs. 2-3

Compare.—

1940. *Styrites columbianus* McLEARN; *Can Field-Naturalist*, 54, (4), pl. 1, figs. 3.
1947. *Styrites columbianus* McLEARN; McLEARN, *Geol. Surv. Canada, Paper* 47-14, p. 12, App., pl. 3, fig. 1.
1960. *Tropiceltites columbianus* (McLEARN); McLEARN, *Geol. Surv. Canada, Memoir* 311, p. 76, pl. 8, figs. 6a-b.

Material.—Two specimens are here examined. One (GK.F 516) preserves the flank and the other (GK.F 517) is depressed, showing the venter.

Description.—Shell small in size, moderately evolute, laterally compressed; ribs distant, rectiradiate, strong and nodose at the umbilical shoulder and weak on the flank of the outer whorl, tending to disappear at the late stage; venter with a keel.

Remarks.—The present specimens are closely similar to *Tropiceltites columbianus* McLEARN (1960), from the Pardonet Formation of Canada. But the latter has clearer nodes at the umbilical shoulder and strong, wide ribs on the inner whorl. The characters of the outer whorl are observed in *T. inflatocostatus* MOJSISOVICS (1893), from the Alps, but its ribs are slender and undevelop at the umbilical shoulder. As the present specimens are deformed secondarily, the definite identification is suspended till the better preserved specimens come in hand.

Occurrence.—Horizon 2 (Lya). Locality; 2 (GK.F 516), 4 (GK.F 517), Yamakawa, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper, Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Tropicelties sp. indet.
Pl. 28, Figs. 10 and 13

Material.—Two specimens collected from the calcareous shale at locality 11 (HF). One is GK.F 518 and the other is GK.F 519, the rubber cast made from the mould.

Descriptive remarks.—The shell is evolute. The whorl slowly increases its height encircling a wide umbilicus with nodes at the umbilical shoulder. On the outer whorl these nodes are developed to low and faint ribs. These characters suggest that the present species belongs to *Tropiceltites*, though a keel on the venter is not preserved. SPATH (1951) stated that some species of *Tropiceltites* are very similar to those of *Styrites* or *Tropites*. Indeed the specimen GK.F 518 has only a row nodes on umbilical shoulder and may be identified to *Styrites*, but the writer considers that it belongs to the *Tropiceltites* on the basis of the characters of whorl volution and nodes.

Occurrence.—Horizon 11 (HF). Locality; the neighbourhood of Hamamoto Primary School, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Sandlingites* aff. *oribasus* zone].

Family Haloritidae MOJSISOVICS, 1893
Subfamily Haloritinae MOJSISOVICS, 1893
Genus *Jovites* MOJSISOVICS, 1893
Type-species.—*Tropites dacus* MOJSISOVICS, 1875

Jovites sp. indet.
Pl. 27, Fig. 19

Material—One incomplete specimen, GK.F 520, is examined here.

Descriptive remarks.—The whorl is subglobose, very involute with radial, faint ribs. The venter is wide and round. The outer volution is excentric. The present species is considered as a member of Haloritinae or Lobitidae, but may belong to such a genus as *Jovites*, *Bacchites* or *Halorites* of Haloritidae though the information of whorl features is very poor. Almost all the species of *Halorites* are known from the Norian and *Bacchites* is different from *Jovites* in having globose shell and incipient ribs.

The present specimen resembles the specimen from the same formation described as *Jovites* sp. cf. *J. dacus* (MOJSISOVICS) (ISHIBASHI, 1970, p. 212, pl. 28, figs. 11-13) but the former is too poorly preserved for precise identification.

Occurrence.—Horizon 3 (AKa). Locality; the hill of 74 m in height, Ishikawa, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Genus *Juvavites* MOJSISOVICS, 1879

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

Juvavites sp. indet.

Pl. 27, Fig. 11; Pl. 28, Fig. 16

Material.—A deformed specimen showing the ventrolateral part (GK.F 521) and another showing the venter (GK.F 522) are examined here.

Descriptive remarks.—One (GK.F 522) has strong radial ribs which interrupts on the venter. It is very similar to the specimens described from horizon Ya at the top of this formation but it has stronger and more dense ribs. The other (GK.F 521) has also strong and radial ribs which apparently cross over the venter. When the specimen was deformed, the interruption of the ribs may have been obliterated. Its whorl is presumed as evolute. A faint keel-like ridge on the venter may have been formed when it was deformed.

Occurrence.—Horizon 9 (HNa-P). Locality; HMO, Motobu High School, Motobu-cho, Okinawa-jima. Calcareous siltstone, Upper Member, Nakijin Formation: Lower Carnian [*Sirenites* cf. *nanseni* zone].

Genus *Anatomites* MOJSISOVICS, 1893

Type-species.—*Juvavites* (*Anatomites*) *rotundus* MOJSISOVICS, 1893

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

Pl. 27, Fig. 18

Compare.—

1893. *Juvavite* (*Anatomites*) *toulai* MOJSISOVICS; *Abhandl. Geol. Reichsanst.*, **6**, (2), p. 134, pl. 92, figs. 8-9.

1904. *Juvavites* (*Anatomites*) *toulai* MOJSISOVICS; GEMMELLARO, *Giornale Sci. Nat. Econ., Palermo* **24**, p. 234, pl. 29, figs. 32-33 and 36.

Material.—The specimen, GK.F 523, obtained from limestone is well preserved and is 9 mm in diameter and 4.2 mm in width.

Description.—Shell very involute, laterally compressed with irregular, flexuous periodic constrictions that cross the venter; ribs not developed; venter round without keel or furrow; umbilicus small, about 0.7 mm in diameter; suture not preserved.

Remarks.—*Anatomites toulai* has been originally described as a species of group *Juvavites* (*A.*) *intermittens* by MOJSISOVICS (1893) and is characterized by having no ribs. *A. sigismundi* and *A. edithae* reported together with *A. toulai*

from the Hallstätter Limestone have similarly and no strong ribs but fine ribs appear gradually on the surface. Certain other species [Ex. *A. alterneplicatus* (HAUER) and *A. crasseplicatus* (MOJSISOVICS)] in the group of *A. intermittens* have a tendency to decline the ribs in mature shell, their whorl is globose having higher ratio than that of *A. toulai*.

A. toulai described by GEMMELLARO (1904) has considerably growing ribs and is rather allied to *A. edithae*. The present specimen may be immature shell but is probably identified to *A. toulai*.

Occurrence.—Horizon 3 (AKa). Locality; the hill of 74 m in height, Ishikawa Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Genus *Tardeceras* HYATT et SMITH, 1905

Type-species.—*Tardeceras purvum* HYATT et SMITH, 1905

Tardeceras sp. indet.

Pl. 27, Fig. 17

Material.—An incomplete specimen (GK.F 524) is examined.

Descriptive remarks.—The shell is evolute with distant and rectiradiate ribs on the flank. The ribs are strong, gradually broaden from the umbilical shoulder to the ventral one.

The present specimen is preserved so badly that the ventral part and details of shell are not examined. Judging from the character of the rib, the present specimen is similar to a dwarf form of *Tardeceras parvum* HYATT et SMITH, from Hosselkus Limestone of California, but the umbilical nodes and venter are not observed in the present specimen. A similar feature of whorl side is noticeable in *Miltites fuchsi* (MOJSISOVICS, 1893, p. 338, pl. 92, figs. 18a-b) and *M. christinae* (*Ibid*., p. 342, pl. 92, figs. 6a-b). The ribs of these species are more rounded than those of *Tardeceras* and the Okinawa specimen. The present specimen may be referable to *Tardeceras*.

Occurrence.—*Ditto*.

Genus *Leconteiceras* SMITH, 1914

Type-species.—*Leconteia californica* HYATT et SMITH, 1905

Leconteiceras sp. cf. *L. californicum* (HYATT et SMITH)

Pl. 28, Figs. 18-19

Compare.—

1905. *Leconteia californica* HYATT et SMITH; *U. S. G. S. Prof. Paper*, (40), p. 36, pl. 29, figs. 3-21.

1908. *Leconteia californica* HYATT et SMITH; FRECH, *Lethaea Geognostica*, pl. 66, fig. 1a-c.
1914. *Leconteiceras californicum* (HYATT et SMITH); SMITH, *U. S. G. S. Prof. Paper*, (83), p. 38.
1927. *Leconteiceras californicum* (HYATT et SMITH); SMITH, *U. S. G. S. Prof. Paper*, (141), p. 66, pl. 29, figs. 3-21.

Material.—Two small specimens (GK.F 525; GK.F 526) which show the flank are examined at present.

Descriptive remarks.—The shell is very involute, globose, deeply indented by the inner whorls. The ribs are rectiradiate, strong and round on the flank. The umbilicus is very narrow (Fig. 18: 2.5 mm, Fig. 19: 2.8 mm in diameter). The ventral area and suture-line are not preserved.

The genus *Leconteiceras* was established by HYATT and SMITH (1905) under the name of *Leconteia* but this name was preoccupied as a name of Coleptera. Two species of *Leconteiceras* have been known, *L. californicum* and *L. occidentale*, from California. *Leconteiceras* sp. was reported by CARLISLE and SUSUKI (1965) from the Vancouver Island of Canada.

L. occidentale resembles such species of *Hannaoceras* as *Hannaoceras* (*H.*) *nasturtium* and *H.* (*H.*) *henseli*. *H.* (*H.*) *henseli* is known from the upper horizon 1 (Ya) and *H.* (*H.*) *nasturtium* was collected from the same horizon together with the present species.

The present specimens are probably referable to *L. californicum*, though their ventral part is not observed. *L. californicum* is known from the *Tropites dilleri* zone and its corresponding strata in North America but the present specimens are found in the *Sirenites* cf. *nanseni* zone in Okinawa.

Occurrence.—Horizon 5 (HGU). Locality; the vicinity of Nagatakibaru, Nakijin-son, Okinawa-jima. Argillaceous limestone, Upper Member, Nakijin Formation: Lower Carnian [*Sirenites* cf. *nanseni* zone].

Subfamily Sagenitinae SPATH, 1951

Genus *Sagenites* MOJSISOVICS, 1897

Subgenus *Trachysagenites* MOJSISOVICS, 1893

Type-species.—*Ammonites erinaceus* DITTMAR, 1866

Sagenites (*Trachysagenites*)? sp. indet.

Pl. 27, Fig. 15

Material.—A part of outer whorl (GK.F 527) is examined.

Descriptive remarks.—The present specimen has no perceptible ribs but numerous regular rows of tubercles on the flank. The tubercles originally aligned in spiral seem to have been secondarily deformed. The species characterized by this kind of tubercles are found in *Sagenites*, *Halorites*, *Diplosirenites*, *Sirenites*,

Trachyceras and so on. For the reasons that there is no perceptible rib and that the tubercles are of almost equal size this specimen may be referred to *Sagenites* (*Trachysagenites*). *S. theodori* Mojsisovics, 1893, from the Norian of the Alps, is similar to the present species in the characters of tubercles but differs in having distinct ribs. *Sagenites* (*Trachysagenites*) *herbichi* Mojsisovics, 1893, from the Carnian of the Alps, shows considerably similar type of tubercles of the ventrolateral area.

Occurrence.—Horizon 11 (HF). Locality; the neighbourhood of Hamamoto Primary School, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Sandlingites* aff. *oribasus* zone].

Superfamily Arcestaceae Mojsisovics, 1875
Family Arcestidae Mojsisovics, 1875
Genus *Arcestes* Suess, 1865

Type-species.—*Ammonites galeiformis* Hauer, 1850

Arcestes (s. 1.) sp. indet.
pl. 28, Fig. 14

Material.—GK.F 525, which consists of only one-sixth of whorl, is examined.

Descriptive remarks.—The shell is involute and laterally compressed with smooth surface. The umbilicus is narrow.

The present specimen is so poorly preserved that exact identification is difficult. It could be considered to belong to *Arcestes* (s. 1.) on account of the sphaerocone whorl, narrow umbilicus and smooth surface. This specimen occurs with *A.* (*Stenarcestes*) sp. B from the horizon 1.

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

Subgenus *Proarcestes* Mojsisovics, 1893

Type-species.—*Arcestes bramantei* Mojsisovics, 1869

Arcestes (*Proarcestes*) sp. aff. *A.* (*P.*) *carpenteri* Smith
Pl. 28, Figs. 6-7

Compare.—

1927. *Arcestes* (*Provrcestes*) *carpenteri* Smith; *U. S. G. S., Prof. Paper,* (141), p. 68, pl. 23, figs. 1-11.

Material.—Two specimens are examined here. GK.F 529 (Fig. 7) is 15 mm in diameter and 8 mm in width. GK.F 530 (Fig. 6) is about 18 mm in diameter.

Descriptive remarks.—The shell is involute, with a narrow umbilicus, laterally

compressed, with a rounded venter, and smooth on the surface, without ribs or tubercles. The periodic constrictions which are generally developed in arcestid ammonites are not clearly observed in the present specimens.

Arcestes (*Proarcestes*) *carpenteri* SMITH, 1927, from the Hosselkus Limestone of California, has very faint periodic constrictions and is characterized by the compressed whorl. The present specimens are also laterally compressed for the subgenus. The periodic constriction is not visible on GK.F 529, but faint ornament is observed in GK.F 530. The present species is closely allied to *A.* (*P.*) *carpenteri* but its definite specific name is not given till the better material comes to hand.

Occurrence.—Horizons 1 (Ya) (GK.F 530) and 3 (Aka) (GK.F 529). Locality; 1 (GK.F 530) Yamakawa, argillaceous limestone, and 3 (GK.F 529) Ishikawa, calcareous mudstone, Motobu-cho, Okinawa-jima. Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi* zone].

Subgenus *Stenarcestes* MOJSISOVICS, 1895

Type-species.—Ammonites subumbilicatus HAUER, 1846

Arcestes (*Stenarcestes*) sp. indet. A

Pl. 28, Fig. 15

Material.—An incomplete specimen, GK.F 531, is examined here. It is 52 mm in diameter and 30 mm in width.

Descriptive remarks.—The shell is very involute and laterally compressed. The outer whorl deeply embracing the inner. The venter is rounded without notable ventral shoulders. The umbilicus is very narrow and apparently closed. The very fine radial striae are discernible but the constrictions are invisible. The suture-line is partially visible on the ventral area.

A. (*S.*) sp. of NAKAZAWA (1959), from the Norian Nariwa Group, Okayama Prefecture, West Japan, is only one species of *Stenarcestes* ever known from the Japanese Islands. This is distinguishable from the present species by its acute venter. The present species is closely related to *A.* (*S.*) *malayicus* WELTER, 1914, from Timor in the mode of volution and whorl section, but the former has apparently more simple suture-line than the latter. *A.* (*S.*) *rotulaeformis* reported by GEMMELLARO (1904) from Sicily is similar to the Okinawa species but the former is more compressed and has larger umbilicus. The writer puts off to decide the specific name because of the insufficient material.

Occurrence.—Horizon 3 (AKa). Locality; the hill of 74 m in height, Ishikawa, Motobu-cho, Okinawa-jima. Calcareous mudstone, Upper Member, Nakijin Formation: Upper Carnian [*Juvavites* cf. *kellyi zone*].

Arcestes (*Stenarcestes*) sp. indet. B

Pl. 28, Fig. 8

Material.—GK.F 532, showing the flank of a whorl, is examined.

Descriptive remarks.—The shell is laterally compressed and very involute. The outer whorl abruptly increases its height. The ventral area is not preserved. The umbilicus is narrow and nearly closed, although secondarily depressed by deformation. There are no rib and constriction. The fine and radial striae are observed on the flank. The suture-line is not preserved.

The present specimen is somewhat similar to the preceeding specimen in the mode volution but it is more compressed and increases its whorl-height at the late growth-stage. It resembles the specimen reported as *A.* (*S.*) aff. ***planus*** by GEMMELLARO (1904) from Sicily in the growth of whorl, nearly closed umbilicus and radial striae. These two specimens have an apparently more compressed and higher outer whorl than the holotype of *A.* (*S.*) ***planus*** MOJSISOVICS, 1875, though they are incompletely preserved. The specific name is not given in the present state.

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

Superfamily Pinacocerataceae MOJSISOVICS, 1879

Family Pinacoceratidae MOJSISOVICS, 1879

Genus *Placites* MOJSISOVICS, 1896

Type-species.—*Pinacoceras platyphyllum* MOJSISOVICS, 1873

Placites sp. aff. *P. oldhami* MOJSISOVICS

Pl. 28, Fig. 17

Compare.—

1896. *Placites oldhami* MOJSISOVICS; *Denkschr. Akad. Wiss. Wien*, 63, p. 664, pl. 19, fig. 2.
1899. *Placites oldhami* MOJSISOVICS; MOJSISOVICS, *Palaeont. Indica*, [15], 3, pt. 1, p. 111, pl. 19, fig. 2.
1905. *Placites oldhami* MOJSISOVICS; FRECH, *Lethaea Geognostica*, pl. 19, fig. 1a-b.
1906. *Placites polydactylus* var. *oldhami* MOJSISOVICS; DIENER, *Palaeont. Indica*, [15], 5, (1), p. 165, pl. 14, figs. 7-9.
1909. *Placites* cf. *polydactylus* var. *oldhami* MOJSISOVICS; DIENER, *Palaeont. Indica*, [15], 6, (2), p. 20, pl. 4, fig. 4.

Material.—The specimen consists of shell part (GK.F 533b) and inner part on which a suture-line is exposed (GK.F 533a).

Descriptive remarks.—The shell is compressed and involute with a narrowly arched venter. The surface of the whorl is smooth. A part of the suture is preserved on the specimen, which shows ammonitic pattern.

Placites is eminent in the Norian but *Pl. oldhami*, *Pl. perauclus* and *Pl. placodes* are known from the Carnian of Himalaya, Timor and the Alps regions. The suture-lines of *Pl. perauclus* and *Pl. placodes* are more complex than those of *Pl. oldhami* and the present specimen. The present specimen has a larger shell and slightly more complex suture pattern than the holotype of *Pl. oldhami*.

Pl. aff. *oxyphyllus*, from the Takagochi Formation of Kyushu (ISHIBASHI, 1972), somewhat resembles the Okinawa specimen, but it differs in having deeper lobules on the external saddle. Also the present specimen shows a similar pattern of suture to that of *Pl. polydactylus* var. *oldhami* DIENER (1906), from the Himalaya, which was emended as *Pl. oldhami* by himself (1915). Here the direct identification is refrained because of insufficient material.

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

Concluding remarks

The Upper Triassic ammonites from the Nakijin Formation in Okinawa-jima, comprising forty-four species of fourteen families and twenty-seven genera, have been described and illustrated in a series of papers entitled the Upper Triassic Ammonites from Okinawa-jima Parts I-III. The faunal assemblage is found in the Triassic of the Japanese Islands for the first time, though a similar assemblage is known in the Triassic of the European Alps, Sicily, California, British Columbia, Arctic region and the Himalaya.

The ammonoid faunal assemblage indicates the Carnian age and three ammonoid zones have been established in the Nakijin Formation; *Sirenites* cf. *nanseni* zone, *Sandlingites* aff. *oribasus* zone and *Juvavites* cf. *kellyi* zone in ascending order. These three zones are comparable to *Sirenites nanseni* zone, *Tropites dilleri* zone and *Tropites welleri* zone of North America respectively.

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(The references cited in Parts I and II are not repeated here)

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