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Graysonites (Cretaceous Ammonites) from Kyushu*

By

Tatsuro MATSUMOTO

With Notes on Stratigraphy

By

Masahisa AMANO,**
Tatsuro MATSUMOTO, Hakuyu OKADA and Hisakazu OGURI***

Abstract

Examples of *Graysonites*, a Lower Cenomanian ammonite genus of horned Acanthoceratidae, have been obtained from the top member of the Middle formation of the Goshonoura group in Goshonoura Island and from the probably equivalent bed in Shishijima Island, off the west coast of Kyushu. They are mostly *G.* cf. *fountaini* YOUNG and partly indetermined. The specimens are described in detail, with a suggestion that subspecific separation may be possible between Kyushu and Texas. Also the relationship between *Graysonites* and the so-called *Submantelliceras* is discussed.

Notes are given on the stratigraphy around the *Graysonites*-bearing beds, with a discussion of correlation. The Goshonoura group is Cenomanian in the main part and probably ranges down to Upper Albian in the lower part. Whether it ranges up to Turonian or not is questionable.

Part I. Palaeontological Description of *Graysonites* from Kyushu

By

Tatsuro MATSUMOTO

Introduction

In 1952 Mr. Masahisa AMANO of Kumamoto University sent me for study several specimens of ammonites from the Cretaceous of Shishijima Island, off the west coast of the main island of Kyushu. At that time they were regarded as a new species of a probably new genus related to *Mantelliceras*, but they have been left undescribed. This species was listed as "*Mantelliceras*" *shiranuiense, nomen nudum,* in a stratigraphic paper (MATSUMOTO [Editor], 1954, p. 151, table 27).

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When I visited London in 1953–1954, Mr. C. W. WRIGHT showed me plaster casts of two interesting ammonites, from the Main Street formation of Texas, which were sent by Mr. J. P. CONLIN. According to CONLIN's information, they were examples of an ammonite genus which ADKINS (1933, p. 387; ADKINS and LOZO, 1951, p. 154) intended to call *Graysonites*, a nomenclatorially invalid genus at that date. I noticed a close similarity between the specimens from Texas and Kyushu and considered it necessary to validate ADKINS' MS. name when I described the latter. I had, however, to wait until I could study more and better specimens. At the XX International Geological Congress in Mexico (1956) I discussed the question of "*Graysonites*" with Keith YOUNG. Subsequently (MATSUMOTO *et. al.*, 1957, p. 3) the specimens from Kyushu were mentioned as "a few, interesting, horned examples which are related to *Mantelliceras* or *Sharpeiceras*" but were not described. I planned to visit America for further study.

Meanwhile YOUNG (1958) validated *Graysonites* on the basis of the collections of the late Professor ADKINS. When I visited Texas in August 1957, Dr. YOUNG kindly showed me his manuscript as well as the original specimens. His opinions generally coincided with mine.

The main purpose of my visit to the United States was to study the Upper Cretaceous ammonites from California and I fortunately recognized the existence of *Graysonites wooldridgei* YOUNG in the valuable collections of Mr. M. V. KIRK from the Roaring River, northwest side of the Sacramento Valley, California (MATSUMOTO, 1959b. p. 66, pl. 18, fig. 1a–c; text figs. 24–27). It is likewise probable that *Acanthoceras* sp. from the Cenomanian of Pampa de la Culebra, Peru, described by SCHLAGINTWEIT (1911, p. 103, pl. 7, figs. 1, 2) should be assigned to *Graysonites*, because its outer whorl has *Graysonites* like ornament and its smaller whorl was stated to be related to *Sharpeiceras laticlavium* (SHARPE).

Since I came back home more examples of *Graysonites* have been obtained from Hakkaido and Kyushu. In January 1960 I attempted a field collecting in Goshonoura Island, northeast of Shishijima, together with Messrs. Hakuyu OKADA and Hisakazu OGURI. I appreciate the keen observation of these two students in discovering the ammonites which I wanted to obtain.

In this paper I describe the examples of *Graysonites* from the two areas in Kyushu. For the Hokkaido specimens another paper is needed. Messrs. AMANO, OKADA and OGURI join me in describing *Notes on Stratigraphy*, Part II of this paper. Before entering into the description I acknowledge the contributions made by these three Japanese friends and also the kind help given by Mr. C. W. WRIGHT, Dr. Keith YOUNG, Mr. J. P. CONLIN, Dr. J. M. HANCOCK, Dr. Jost WIEDMANN and Professor Wataru HASHIMOTO. Mr. Ikuwo OBATA assisted me in taking photographs. I am indebted to the Ministry of Education whose grant in aid has rendered it possible to undertake this study.

Systematic Description

Order Ammonoidea

Family Acanthoceratidae DE GROSSOUVRE, 1894

Subfamily Mantelliceratinae HYATT, 1903

Genus *Graysonites* YOUNG, 1958

Type-species—*Graysonites lozoi* YOUNG, 1958 (by original designation).

Generic diagnosis.—Inner whorls are similar to those of compressed *Mantelliceras*; the adult resembles that of *Sharpeiceras*, having long and distant ribs, but the two ventrolateral tubercles are united into a strong ventrolateral horn and a lateral tubercle is developed by the strengthening of the upper of the double umbilical bulla or by the shifting of the umbilical bulla. The suture is similar to that of *Sharpeiceras*, as illustrated by SPATH (1925, pl. 37, fig. d for *Sharpeiceras florencae* SPATH) and also to that of *Mantelliceras* of the *martimpreyi* group, as figured by PERVINQUIÈRE (1907, text-fig. 111), having a deep lateral lobe and several auxiliaries.

Remarks.—As I have recently remarked (MATSUMOTO, 1959b, p. 66), *Graysonites* is closely related to *Mantelliceras* and *Sharpeiceras*. More interesting and questionable is the relationship between *Graysonites* and the so-called *Submantelliceras*. Juveniles as small as the type specimens of "*Submantelliceras*" *aumalensis* (COQUAND), "*S.*" *suzannae* (PERVINQUIÈRE) and their allies are not preserved in the available specimens from Kyushu. A few, somewhat larger, but undoubted inner whorls are at hand. They are very similar to *Ammonites martimpreyi* COQUAND, 1862 (see PERVINQUIÈRE, 1907, p. 289, pl. 16, figs. 1–5; 1910, p. 41, pl. 4, figs. 2–10) in lateral view and to *Ammonites aumalensis* COQUAND, 1862 (see PERVINQUIÈRE, 1907, p. 296, pl. 16, figs. 6–11; 1910, p. 42, pl. 4, figs. 11–19) in ventral view. Therefore I am strongly inclined to consider a high pessibility that some, if not all, of the so-called *Submantelliceras* could be immature *Graysonites*. This would be examined more precisely by palaeontologists working on the ammonites from the Mediterranean region. I made an inquiry to Dr. J. WIEDMANN, who answered at first that there was no evidence to prove this idea but has recently informed me (in a letter dated May 18, 1960) that a part of the Mediterranean *Submantelliceras* can be regarded as *Graysonites*.

The later stages of the type-species of *Submantelliceras* SPATH, 1926, *Ammonites aumalensis* COQUAND, are at present unknown. There is a group of compressed *Mantelliceras* in which the ventrolateral and lower lateral tubercles are not strengthened with increasing diameters. The only species of this group that has been well figured at an adult stage is *Ammonites vicinalis* STOLICZKA (1864, p. 84, pl. 44, figs. 1–8)*. CASEY (1960) has suggested that this species, which was made the type of a

* I once listed this species under *Mantelliceras*, when I discussed the correlation between the Cretaceous deposits of southern India and Japan (MATSUMOTO, 1943, p. 217, 218).

new genus, *Utaturiceras*, of Upper Cenomanian species by WRIGHT (1956), is really a *Submantelliceras* and that *Submantelliceras* may be used as a subgenus of *Mantelliceras*. On the other hand, if *Ammonites aumalensis* COQUAND proved to have in the adult the same type of hypernodosity as *Graysonites lozoi* YOUNG, *Graysonites* would become a subjective synonym of *Submantelliceras*. In that event *Utaturiceras* WRIGHT would then have to be used as a subgenus for those compressed *Mantelliceras* with feeble tubercles in the adult.

Further and larger specimens of *Ammonites aumalensis* are necessary to resolve these doubts and the Japanese material does not help to solve the problem.

1. *Graysonites* cf. *fountaini* YOUNG, 1958

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

Compare.—

1958. *Graysonites fountaini* YOUNG, Jour. Paleont., vol. 32, p. 179, pl. 29, figs. 3, 5, 6,; text-figs. 2c, 3b, 2b(?)

Holotype of *G. fountaini* YOUNG.—BEG. 19054, from the top of the Main Street limestone, at a locality about 6 miles west of Waco, Texas, as designated by YOUNG, 1958, p. 179.

Material.—The specimens to be described here under this heading are as follows*: GK. H 4206 (Pl. 7, fig. 4; Text-fig. 1), GK. H 4207 (Pl. 7, fig. 2; Text-fig. 3) and GK. H 4208 (Pl. 7, fig. 3), all from loc. GS. 138 of OKADA [G. 220′ of MATSUMOTO (1938)], Goshonoura Island (collected by H. OKADA and H. OGURI).

GK. H 4209 (Text-fig. 6) from loc. Sh. 48–26, GK. H 4210 (Pl. 7, fig. 1; Text-figs. 4, 5) and GK. H 4211 (Pl. 6, fig. 1; Text-fig. 2) from loc. Sh. 51–75, Shishijima Island (collected by M. AMANO) and TKD. 30404 (Text-fig. 7), from Shishijima Island (detailed collecting locality unrecorded).

Measurements.—(in millimeters) [c.=costal, ic.=intercostal]

Specimens	Diameter	Height	Breadth (B/H)	Umbilicus	(U/D×100)
Holotype (after YOUNG)	95.0	46.0	26.5 (0.57)	22.0	(23.1)
Holotype (YOUNG's text-fig. 2c)	—	c. 61.0 ic. 58.0	47.0 (0.77) 40.0 (0.69)	—	
Another example from Texas (YOUNG's text-fig. 3b)	—	c. 84.0 ic. 84.0	71.0 (0.84) 62.0 (0.74)	—	
GK. H 4206 (outer whorl)	—	c. 67.0 ic. 66.0	61.0 (0.91) 52.0 (0.78)	—	
GK. H 4206 (inner whorl)	—	23.5	18.0 (0.76)	(approximate)	
GK. H 4207		c. 31.0	22.0 (0.71)	(approximate)	
GK. H 4209		c. 70.0 ic. 67.5	63.7 (0.91) 54.5 (0.80)		

* Symbols of the repositories:

GK : Department of Geology, Kyushu University, Fukuoka (Hakata)

TKD: Geological Institute, Tokyo Kyoiku Daigaku (Tokyo University of Education), Otsuka, Tokyo

GK. H 4210	c. 27.4	23.2 (0.84)	
	ic. 26.0	19.5 (0.75)	
GK. H 4211	c. 66.0	66.5 (1.0)	(distorted ?)
	ic. 64.5	55.0 (0.85)	
TKD. 30404	c. 74.5	63.6 (0.85)	
	ic. 65.4	47.0 (0.68)	
TKD. 30404 (slightly later)	c. 77.8	63.8 (0.82)	
	ic. 71.3	48.3 (0.68)	

Descriptions.—Although the specimens from Kyushu are more or less incompletely preserved, the following characteristic features can be recognized.

(1) The inner whorl is compressed and subtrapezoidal in cross-section, with flattened flanks and a narrow, nearly tabulate venter.

(2) It is ornamented on the flank with somewhat prorsiradiate and gently sigmoidal ribs, which are alternately long and short or bifurcate at the umbilical bullae. The ribs are rather numerous, and are separated by the interspaces as narrow as or slightly broader than the ribs. Each rib has a clavate, moderately strong, marginal (i.e. outer ventrolateral) tubercle and a weaker, submarginal (i.e. inner ventrolateral) tubercle. On the venter the ribs are much weakened or almost obsolete between the marginal tubercles. On some specimens the mid-venter is slightly elevated, but does not form a keel.

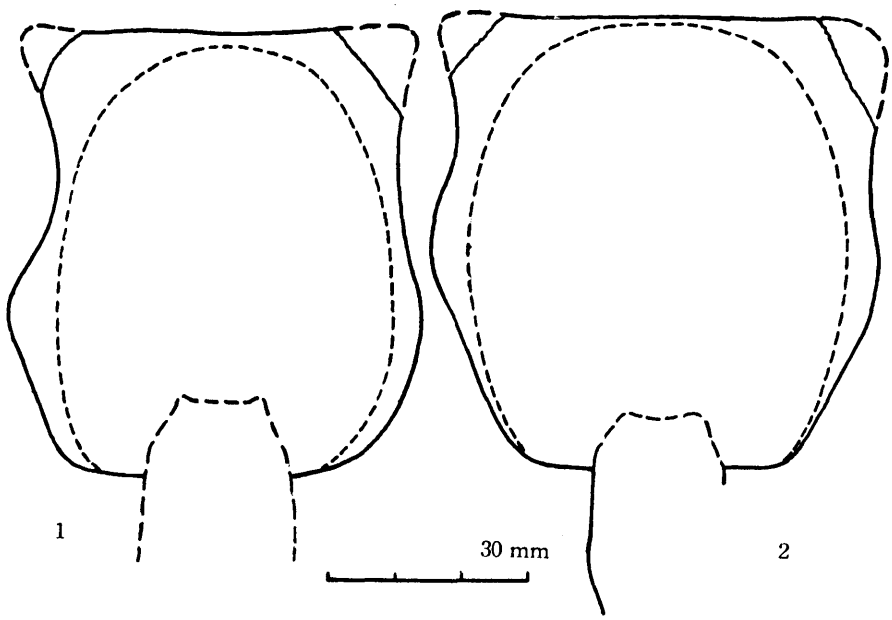
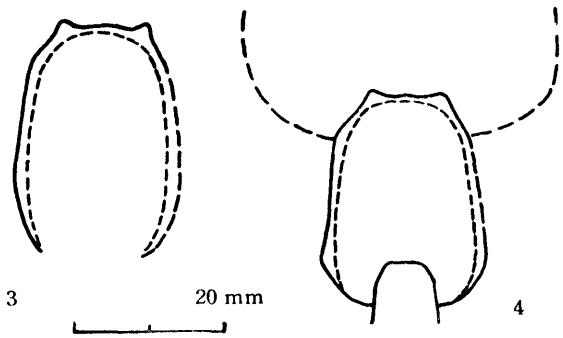


Fig. 1, 2. *Graysonites* cf. *fountaini* YOUNG. Whorl-sections (partly restored) of the two, probably adult, specimens from Kyushu:

1. GK. H 4206, from loc. GS. 138 of OKADA [included in G. 220′ of MATSUMOTO], Member IIe, Goshonoura group, Goshonoura Island; see also Pl. 7, fig. 4 for a lateral view.
2. GK. H 4211, from loc. Sh. 51-75 of AMANO, Middle formation of the Goshonoura group, Shishijima Island; see also Pl. 6, fig. 1a, b for lateral and ventral views.



Figs. 3-4. *Graysonites* cf. *fountaini* YOUNG. Whorl-sections of the two, probably immature, specimens from Kyushu:

3. GK. H 4207 (partly restored), from loc. GS. 138 of OKADA [included in G. 220′ of MATSUMOTO], Member IIe, Goshonoura group, Goshonoura Island; see also Pl. 7, fig. 2a, b for lateral and ventral views.
4. GK. H 4210 (with a part of the outer whorl), from loc. Sh. 51-75 of AMANO, Middle formation of the Goshonoura group, Shishijima Island; see also Pl. 7, fig. la-c for other views and Text-fig. 5 for suture.

(3) The outer whorl is wider than the inner, with the approximate proportion of height: breadth =10:7-8 in intercostal section and 10:8-9 in costal section. The costal whorl-section is polygonal, nearly tabulate or slightly concave on the venter but somewhat inflated on the flanks; the intercostal section is roughly elliptical. In the adult the overlap of the whorls is less than half of the whorl section.

(4) The adult whorl, at heights over 60 mm, is ornamented with distant, nearly rectiradiate, equal ribs, each of which is provided with a strong but short ventrolateral horn and a lateral bulla. The ribs are broadened and weakened on the venter. The horn is developed from union of the two ventrolateral tubercles, and accordingly, its base is broad on the ventral part and narrowed towards the flank, although its general outline is nodose and subrounded. The lateral tubercle is considerably elevated and elongated towards the umbilical margin. It is developed from the upward shifting of the umbilical bulla, as seen on GK. H 4210.

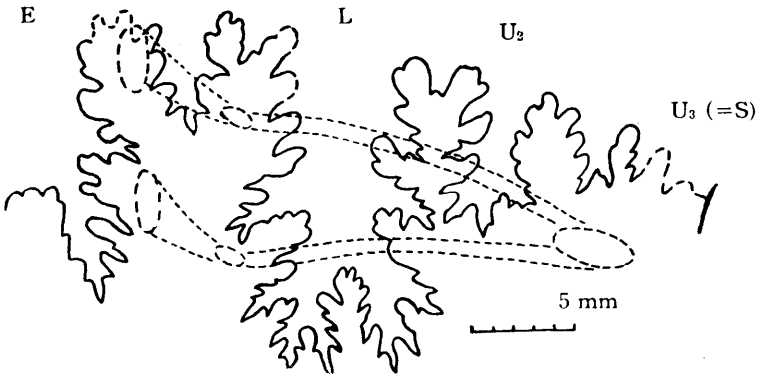


Fig. 5. *Graysonites* cf. *fountaini* YOUNG. Suture of an immature specimen, GK. H 4210, the same specimen as shown in Text-fig. 4 and Pl. 7, fig. la-c. The dotted line indicates the position of the ribs and tubercles.

(5) The suture is moderately digitate. The ventral lobe (E) is fairly deep, with a narrow ventral saddle. The first lateral saddle is large and broad, being asym-

metrically bipartite with a shallow lobule. The first lateral lobe (L) is the deepest, and roughly bipartite; the median foliole at the bottom is lower and tends to be overhung by the paired folioles in the lower part of L. The second lateral saddle is narrower than the first. The second lateral lobe (U_2) is similar to but much smaller than the first. The auxiliaries (U_3 [=S]) are descending. The digitation is moderately fine, leaving somewhat phylloid terminals to some of the folioles.

Remarks.—As is indicated by the above characters the described specimens are most closely allied to the holotype and other examples of *Graysonites fountaini* YOUNG, 1958 (p. 179, pl. 29, figs. 3, 5, 6; text-figs. 2b ?, 2c, 3b) from Texas and are probably to be identified to that species. There are, however, a few questionable points.

For *G. fountaini* from Texas no sutures have been described. This is the first difficulty that prevents precise comparison.

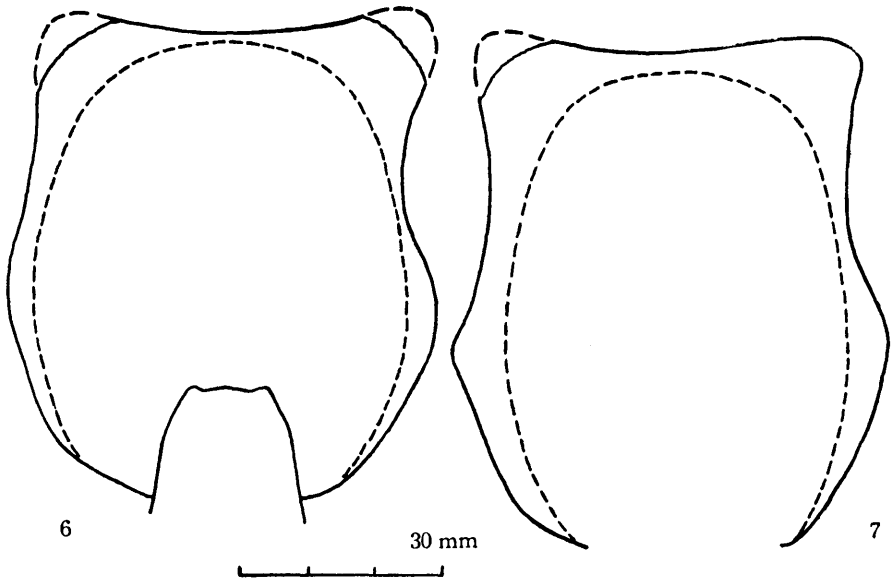
The second question is about the shell form. In spite of the general similarity of the whorl shape, the examples from Kyushu are all somewhat broader than the holotype from Texas. This may be merely due to the secondary compression of the holotype, as YOUNG (1958, p. 181) himself suggested. Among other examples from Texas the large one figured by YOUNG (1958, text-fig. 3b) is very close to ours, but even so some of the large outer whorls from Kyushu are broader than this example (see measurements). One of ours, GK, H 4211 (Text-fig. 2), is nearly as broad as high in costal section, but it may be secondarily distorted. There is apparently some overlap between Texas and Kyushu specimens in the proportion of breadth and height. If a sufficient number of undistorted specimens were available, it might be proved that the Kyushu form was on the average less compressed than the Texas form. The difference would not be, however, great enough for specific distinction, but could be a criterion for subspecific separation.

The third point to be considered is the ornament. In general a close similarity is recognized in the ornament between Kyushu and Texas representatives. On the outer whorl of ours, as seen on GK. H 4206 and GK. H 4209, the lateral tubercle (i.e. the upward shifted umbilical bulla) is more prominent than on the holotype and other examples of *G. fountaini* from Texas, being as strong as that of *G. adkinsi* YOUNG (1958, p. 176, pl. 29, figs. 1, 7; text-figs. 2a, e, f, 3a, e). The strength of the tubercle, however, seems to vary even in the Japanese specimens. In connection with this I have recognized a fact that a specimens from Kyushu, GK. H 4206 (Text-fig. 1), has prominent lateral tubercles on one side but bluntly elevated bullae on the other side. This is probably an accidental individual feature.

The most elevated point of the umbilical bullae is somewhat shifted upwards on the outer whorl. It is at about the lower one third of the flank in the holotype (see YOUNG, 1958, text-fig. 2c), but in some of ours. e.g. GK. H 4209 and GK. H 4211, it is shifted closer to the mid-flank than in the holotype. The feature may indeed

vary with growth-stages, but if the average of the adult whorls were considered, again a difference justifying subspecific separation might be found.

From the above observations the specimens of Kyushu could possibly be separated subspecifically from those of Texas. At present the available material from both sides is insufficient for the establishment of subspecies. Until more and better specimens are obtained I call the described specimens *Graysonites* cf. *fountaini* YOUNG.



Figs. 6–7. *Graysonites* cf. *fountaini* YOUNG. Cross-section of the two fragmentary body-whorls from Kyushu:
6. GK. H 4209, from loc. Sh. 48-26 of AMANO, Middle formation of the Goshonoura group, Shishijima Island.
7. TKD. 30404, from Shishijima (without precise locality data).

Another point which should be remarked is the concavity of the venter on the outer whorl. In the two specimens from Kyushu, GK. H 4206 (Pl. 7, fig. 4; Text-fig. 1) and GK. H 4211 (Pl. 6, fig. 1a, b; Text-fig. 2), which probably represent adult shells, a nearly tabulate or only slightly concave venter is shown even between the ventrolateral horns, as in the holotype of *G. fouutaini*. In the other group, which is represented by two fragmentary body whorls, GK. H 4209 (Text-fig. 6) and TKD. 30404 (Text-fig. 7), the costal section is somewhat concave between the ventrolateral horns, as in another Texas example (YOUNG, 1958, pl. 29, fig. 5; text-fig. 2b) which was referred by YOUNG to *G. fountaini* with a query. This difference may be merely a variation between individuals, but it might be more significant than that. Until better and more specimens are obtained I tentatively describe these two varieties under *G. fountaini*.

Occurrence.—Rather rare at loc. GS. 138 of OKADA which is included within the

exposure G. 220′ of MATSUMOTO (1938, p. 29, table 7 and a map in p. 47), a sea-cliff locally called Kami-Nagahama*, latitude 32°18′20″ N., longitude 130°19′8″ E., Member IIe of the Goshonoura group, southwestern part of Goshonoura Island, Amakusa-gun, Kumamoto Prefecture, Kyushu.

Two localities** at locs. M. AMANO's Sh. 48–26, 32°15′10″ N., 130°13′21.8″ E., and M. AMANO's Sh. 51–75, 32°15′10″ N., 130°13′14.4″ E., on the southwestern coast of Shishijima Island, Izumi-gun, Kagoshima Prefecture, Kyushu.

A still another locality, without precise record, in Shishijima Island: the specimen is in the rock matrix lithologically quite similar to that of the second locality.

All the specimens are in a black or dark grey, calcareous, fine-sandy siltstone or silty fine-grained sandstone.

2. *Graysonites* sp. indet. *a*

Pl. 8, fig. 1; Text-fig. 8

Material—A single, fragmentary, outer whorl, GK. H4212, from loc. Sh. 48–26, Shishijima Island, Kyushu (M. AMANO Collection).

Measurements.—

Specimen		Height	Breadth (B/H)
GK. H 4212	costal	71.0	58 (+2) (0.84)
	intercostal	65.0	50.0 (0.77)

Descriptive remarks.—The outer whorl, which is not septate, is somewhat higher than broad, roughly elliptical in intercostal section, and polygonal and inflated in costal section. It has very distant, slightly prorsiradiate, nearly straight, equal ribs, each of which is provided with bluntly elevated, umbilical bulla, a prominent bullate tabercle at the mid-flank and a clavate horn at the ventrolateral margin.

This specimen is similar to the outer whorl of the preceding species, but its venter is not tabulate but concave between the marginal horns, the horn is not nodose but conspicuously clavate, and umbilical bullae are recognized in addition to the lateral tubercles.

It is as broad as the outer whorl of *Graysonites adkinsi* YOUNG (1958, p. 176, pl. 29, figs. 1, 7; text-figs. 2a, e, 3a, e) from Texas, but in *G. adkinsi* the ventral clavi persist long in addition to the ventrolateral tubercles and the long umbilical bullae are not doubled and do not show the prominent lateral tuberbles seen in the present specimen. So far as the ornament is concerned, it is closer to *Graysonites lozoi* YOUNG (1858, p. 172, pl. 27, figs. 1–11; text-fig. 1b, c, d, f) than to *G. adkinsi* YOUNG. It is not so compressed as the holotype of *G. lozoi*, but the latter is secondarily

* 上長浜（熊本県天草郡御所浦村）

**獅子島西南岸（鹿児島県出水郡東長嶋村獅子島樫ノ浦東方 106.2m 丘陵の裏側の海岸）

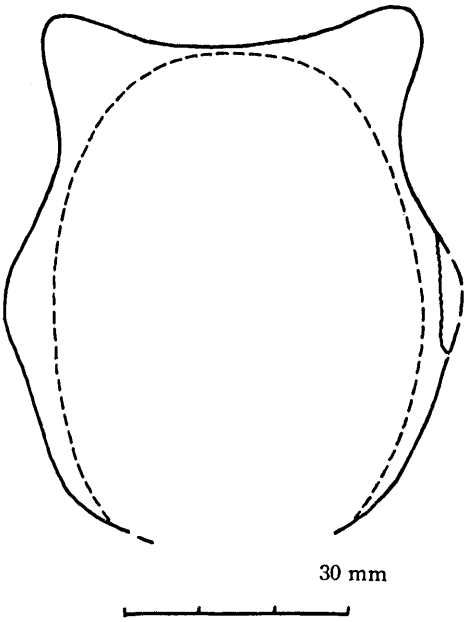


Fig. 8. *Graysonites* sp. indet. *α*, aff. *G. lozoi* YOUNG. Cross-section of a fragmentary body whorl: GK. H 4212, from loc. Sh. 48-26 of AMANO, Middle formation of the Goshonoura group, Shishijima Island; see also Pl. 8, fig. 1a, b for ventral and lateral views.

distorted. The specimen from Kyushu is best compared with another example of *G. lozoi* from Texas (YOUNG, 1958, pl. 27, figs. 5, 11; text-fig. 1d). While the former is broadest between the lateral tubercles, the latter has the ventrolateral horns extending beyond the breadth between the lateral tubercles. This may be merely a difference in growth-stage.

Anyhow the present specimen is too incompletely preserved for accurate identification.

Occurrence.—Only a fragmentary specimen from loc. Sh. 48-26 of M. AMANO, latitude 32°15′10″ N., longitude 130°13′21.8″ E., southwestern coast of Shishijima Island, equivalent of the middle part of the Goshonoura group (Coll. M. AMANO). The rock matrix of the specimen is dark grey, calcareous, silty sandstone, with some green minerals.

3. *Graysonites* sp. indet *β*

Pl. 8, fig. 2, Text-fig. 9

Material.—GK. H 4213, from Shishijiza, M. AMANO Collection.

Description remarks.—This is a water worn fragment, probably at middle growth-stage. The whorl is wholly septate. The sutures are simplified by the erosion, but exhibit fairly well the characteristic pattern.

The whorl is somewhat higher than broad, subelliptical in intercostal section and broadest in the lower part. It is ornamented with distant, rectiradiate ribs, each of which is provided with double umbilical bullae and lower and upper ventrolateral tubercles. Unfortunately the peripheral part is much eroded but from the large base the lower ventrolateral tubercle is judged to have been originally strong.

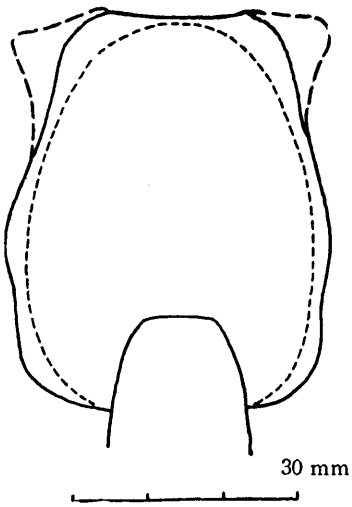


Fig. 9. *Graysonites* sp. indet. *β*. Cross-section (partly restored) of a separate whorl: GK. H 4213, pebble at loc. Sh. 48-26 of AMANO, probably derived from the Middle formation of the Goshonoura group, Shishijima Island; see Pl. 8, fig. 2 for a lateral view.

The poor preservation prevents precise identification, but the close similarity between the present specimen and the one from the Del Rio Clay of Texas which was illustrated by YOUNG as *Graysonites* n. sp. (1958, pl. 28, figs. 5, 6; text-figs. 1a, 2d) cannot be overlooked.

Occurrence.—Obtained as a pebble at loc. Sh. 48-26, southwestern coast of Shishijima, Izumi-gun, Kagoshima Prefecture.

Summary of Palaeontological Results

(1) *Graysonites* cf. *fountaini* YOUNG and two other indeterminable species of *Graysonites* have been confirmed to exist in the middle part of the Goshonoura group of Kyushu.

(2) They are probably identical or at least very closely allied to species described from the lower part of Lower Cenomanian of Texas.

(3) There is the possibility of subspecific separation of the Texas and Kyushu representative of *G. fountaini* YOUNG, but for the definite establishment of subspecies more material is needed from both regions.

(4) *Graysonites*, like many other genera of the Acanthoceratidae, has a wide distribution.

(5) There is close similarity between immature *Graysonites* and some of the so-called *Submantelliceras*.

Part II. Notes on Stratigraphy

By

Masahisa AMANO, Tatsuro MATSUMOTO, Hakuyu OKADA and Hisakazu OGURI*

Goshonoura Island

Goshonoura Island belongs to the Amakusa Archipelago off the west coast of the main island of Kyushu, being located at about 15 km. northwest of Minamata, an industrial city in the southwestern part of Kumamoto Prefecture. It is elongated from northeast to southwest, about 9 km. in length, 3 km. in maximum breadth and 442 m. in the highest altitude.

Fossiliferous Cretaceous rocks are displayed from the vicinity of Kumamoto City southwestward, through the Amakusa Archipelago, down to the Koshiki Islands. Goshonoura Island is one of the best outcropping areas of them. The Cretaceous stratigraphy of this region was outlined in English in a recent compilation (MATSU-

* All the authors are responsible for general stratigraphic discussions. For the local stratigraphy of Shishijima Island AMANO is primarily responsible and for that of Goshonoura Island MATSUMOTO, OKADA and OGURI have responsibility.

MOTO [Editor], 1954, pp. 144-154). The geology of Goshonoura Island was described in Japanese by MATSUMOTO (1938), with an appendix (in English) of preliminary notes on some of the important elements of the fauna. Subsequent collecting by various persons has added more palaeontological material but no significant alteration is needed for the stratigraphy.

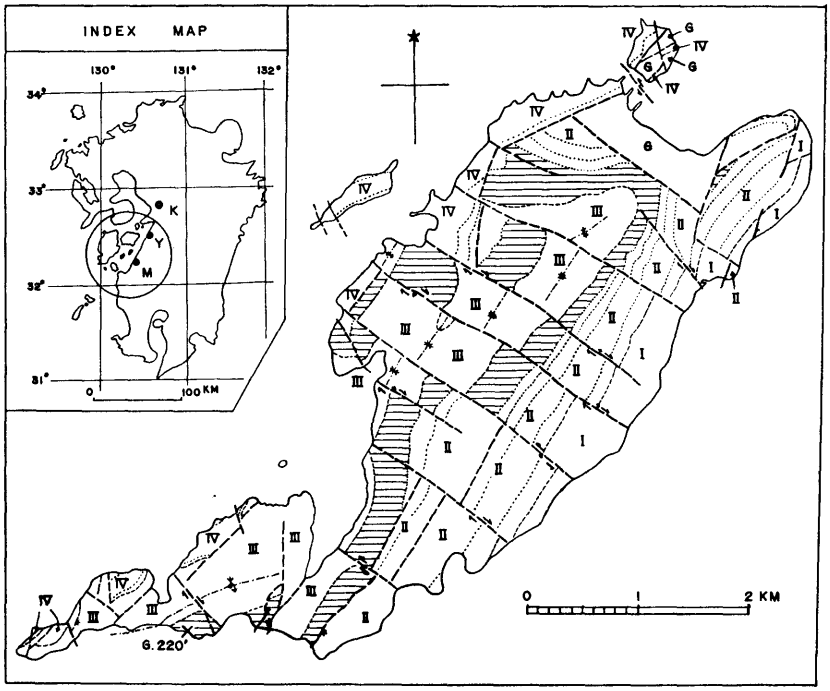


Fig. 10. Outline geological map of Goshonoura Island, showing the locality of *Graysonites* (×)

Outcrop of Member IIe is indicated with ruled areas; boundary of members with dotted line; that of formation with fine broken line. I, II, III: Lower, Middle and Upper formations of the Goshonoura group; IV: Himenoura group; G: Granite.

Map of Kyushu (upper left) indicates with black spots the location of Goshonoura and Shishijima Islands near the center of a circle; Cities of K: Kumamoto, Y: Yatsushiro; M: Minamata.

Goshonoura Island is made up primarily of the Goshonoura group and the overlying Himenoura group. The former occupies the main area of the island, forming a syncline, and its type exposures are in this island; the latter is only narrowly exposed in the northwestern part of the island, and its type exposures are in one of the twin members of the main island of Amakusa—Amakusa-Kamishima, where UEDA and FURUKAWA (1960) have recently performed a renewed stratigraphical study. In addition there is a small outcrop of granitic rocks, a portion of the basement complex, which is at present in fault relationship with the Goshonoura group but is overlain by the Himenoura group with a distinct unconformity. The contact be-

tween the Himenoura and Goshonoura groups is not well exposed; in the northwestern part of the island a high-angled thrust is presumed along the boundary, on the northwestern side of which runs the lower member of the former group, but a disconformity, at least apparently, is observable in the southwestern extremity of the island.

The ascending stratigraphic sequence of the Goshonoura* group itself may be concisely summarized as follows, depending on the previous work (MATSUMOTO, 1938; 1954).

I. Lower formation, 200 m. Coarse-grained arkose predominant, sometimes conglomeratic. In the lower part (Member Ia) they are rather massive or thick bedded, often cross-laminated and intercalating lenticular red-beds. In the upper part (Member Ib) the stratification is better developed, sometimes with thin coaly seams and siltstones; prolific fossiliferous layers occur at several horizons.

II. Middle formation, 500–550 m. Sandstones of shallow sea environments, containing molluscan fossils (the so-called *Trigonia* sandstone). This is subdivisible in five members, IIa to IIe. Members IIa and IIc are relatively more coarse-grained than other, with some pebbly and cross-laminated beds. Member IId contains some red-beds and layers with brackish fossils. Members IIb and IIe are very fine- to medium-grained sandstones, generally silty and sometimes calcareous, bluish grey to dark grey in colour, rich in trigonians and other molluscan fossils; ammonites are occasionally found.

III. Upper formation, approximately 200 m. Sandstones of various coarseness, silty rocks and local fanglomerates, containing many fossiliferous layers of mainly brackish water origin, a fresh water *Trigonioides* bed and several red-beds.

For the details of the stratigraphic sequence, facies, and faunas the reader may refer to the previous papers (YEHARA, 1923; NAGAO, 1930; MATSUMOTO, 1938, 1954; AMANO, 1956; KOBAYASHI and NAKANO, 1957; NAKANO, 1958; OTA, 1959).

MATSUMOTO (1938) concluded that the main part of the Goshonoura group, represented by the Middle formation [II], is Gyliakian, being probably correlated to Cenomanian, that the group could possibly range down to Upper Albian in its lower part and up to Turonian in its upper part and that the Himenoura group is Senonian. No objections have been raised to this conclusion by subsequent authors.

The specimens of *Graysonites* cf. *fountaini* YOUNG described in Part I of this paper were discovered at loc. G. 220′ in a dark coloured, calcareous silty, fine-grained sandstone. Among the associated species there are ammonites, *Desmoceras kossmati*

* *Goshonoura* is sometimes simplified as *Goshora*, but the original proposal of the formational name is Goshonoura (MATSUMOTO, 1938), as adopted by *Lexique Stratigraphique International* (1958).

MATSUMOTO and *Mariella* n. sp. (?) aff. *M. oehlerti* (PERVINQUIÈRE) (identified by MATSUMOTO). They are more numerous than *G. fountaini*. Loc. G. 220′ is in the southwestern part of Goshonoura Island, where the geologic structure is somewhat complicated than in the main part. It is, however, certainly assigned to Member IIe, being about 70 meters below the base of the Upper formation [III].

The original specimens of *Graysonites fountaini* YOUNG came from the zone of *Graysonites adkinsi*, i.e. the lower part of the Del Rio clay and the top of the Main Street limestone, which is to be referred to the lower part of the Lower Cenomanian in terms of the international scale. *Graysonites wooldridgei* YOUNG, which originally came from the same zone of *G. adkinsi* in Texas, has recently been confirmed as occuring in the probable lower Lower Cenomanian in California (MATSUMOTO, 1959). In Hokkaido HASHIMOTO and INOMA (1960) have recently found an important faunule of the *Desmoceras kossmati* zone near Shumarinai, in which *Graysonites* spp., *Mantelliceras* (?) sp. (immature) of *martimpreyi* group and *Mariella* n. sp. (?) aff. *M. oehlerti* (PERVINQUIÈRE) are identified among other interesting species. For this faunule another paper is needed, but from a preliminary study its age is most probably lower Lower Cenomanian. As has been mentioned in Part I, some of the Mediterranean species which were once referred to *Submantelliceras* are very possibly immature *Graysonites*. A possible representative of *Graysonites* is in the Cenomanian of Peru (see Part I, p. 3). Thus *Graysonites* is becoming important as a world-wide indicator of the lower part of the Lower Cenomanian.

In conclusion Member IIe belongs to the zone of *Desmoceras kossmati* (see MATSUMOTO, 1959a) and is most reasonably to be referred to the lower Lower Cenomanian. As *Desmoceras kossmati* was found also in Member IIb, the Middle formation of the Goshonoura group may be mainly Lower Cenomanian. Unfortunately the Upper and Lower formations of the tripartite Goshonoura group have no ammonites, containing brackish and some fresh water fossils. From the stratigraphic sequence the Upper formation is regarded as representing the rest of the Cenomanian *plus* (?) the Turonian and the Lower formation is considered as ranging down to the Albian. The Upper formation is thinner than the Middle. Therefore whether it represents the Cenomanian alone (excluding the lower part) or both the Cenomanian and the Turonian is questionable. In other words there might be a stratigraphic gap between the Goshonoura and Himenoura groups, or, as the Upper Goshonoura contains numerous, minor erosional planes, the time range of the deposition of its whole thickness might be relatively long as compared with the Middle Goshonoura.

How far the lower limit of the Goshonoura group goes down into Lower Cretaceous is likewise questionable. From the fauna and the general geological condition, the Lower Goshonoura is probably not older than the Middle Albian Yatsushiro formation of the mainland of Kyushu.

Shishijima Island

Shishijima Island, which belongs administratively to Kagoshima Prefecture, is situated at about 12 km.* southwest of Goshonoura Island, and has similar physiographical and geological features to those of Goshonoura Island. It is elongated from northeast to southwest, about 7 km. in length, 4 km. in breadth and 393 m. at the highest peak.

A geological map was published, with an explanatory text, by NOTOMI (1930), who correlated the Cretaceous strata of Shishijima with those of Goshonoura Island. A refined stratigraphy is now being investigated by one of us (M.A.) who will eventually publish the results. In this paper only a local stratigraphic information about the *Graysonites* bearing beds is given.

The localities with *Graysonites* are on the southwestern coast of the island, as indicated on the map (Text-fig. 11). The observable comformable sequence in the neighbourhood of these localities is as follows in ascending order:

I. Unit of sandstones, 200 m. or more.
Massive, medium-grained sandstones predominant, sometimes conglomeratic in the lower part and sometimes silty in the upper part, containing marine mollusca. *Acanthotrigonia pustulosa* (NAGAO), *Acanthotrigonia ogawai* (YEHARA), *Pterotrigonia dilapsa* (YEHARA), *Nipponitrigonia kituchiana* (YOKOYAMA), *Crassatellites nagaoi* (MATSUMOTO) *Anthonya* sp. and *Pholadomya* sp. are identified among others.

II. Unit of siltstones, about 150 m.
Dark, bluish grey siltstone or silty very fine-sandstones predominant, with some fine- to medium-grained sandstones and shales. Trigonians and other marine shells are common.

III. Unit of sandstones, 300 m. or more.
Massive, medium-grained sandstones predominant in the main part; pebble conglomerates at the base and in several other places; silty beds are intercalated in the lower and upper parts. Molluscan fossils contain some brackish elements.

From the lithological and faunal similarity the above sequence is certainly an extension of the Goshonoura group. The specimens of *Graysonites* described in this paper came from the upper part of Unit II. In the corresponding (if not exactly the same) beds at other localities (see Text-fig. 11) one of us (M. A.) discovered other ammonites, *Desmoceras* sp., *Stoliczkaia* spp. and *Mariella* sp.

Preliminarily Unit II is correlated to Members II b-e of the type Goshonoura group. Although the above described sequence is not complete, Unit III may approximately correlated to Formation III and Unit I to Member IIa *plus* a part of

* measured between the centers of the two islands.

Formation I of Goshonoura. The ammonite bearing beds in Unit II is probably an extension of Member IIe in the Goshonoura group. We do not discuss in this paper relationships between the Goshonoura and Himenoura groups in Shishijima Island, although there is the same question as in Goshonoura Island.

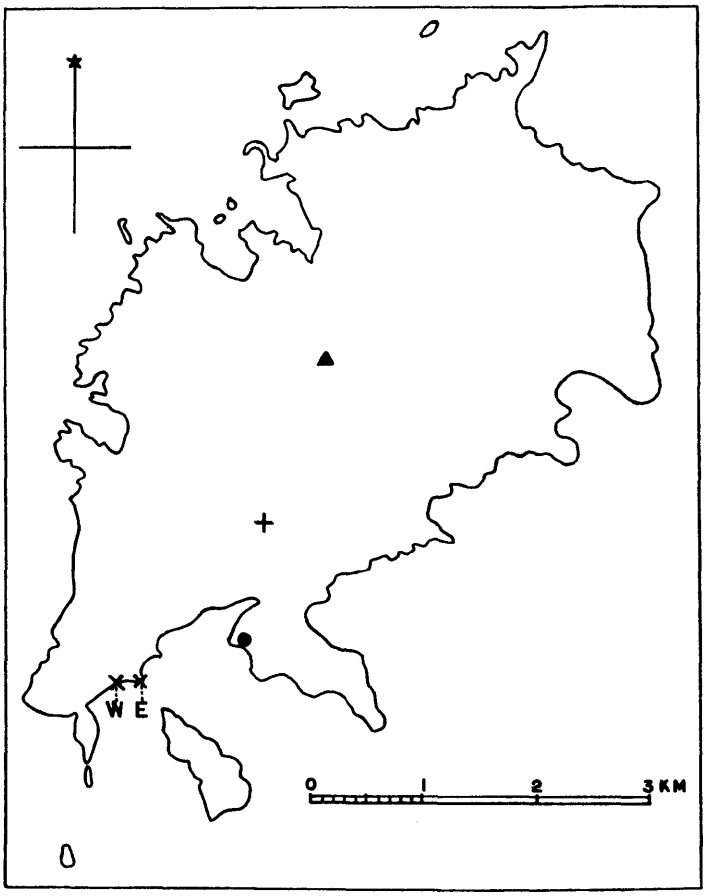


Fig. 11. Map of Shishijima, showing ammonite localities in the Goshonoura group:
× *Graysonites* (E=loc. Sh. 48-26, W=loc. Sh. 51-75 of AMANO);
+ *Stoliczkaia*; ▲ *Mariella*; ● *Desmoceras*.

The two localities of *Graysonites*, Sh. 48-26 and Sh. 51-75, are not much separated, but apparently the former is stratigraphically somewhat lower than the latter. As minor faults are observed between the two localities, the same fossiliferous bed might be repeatedly exposed there. Incidentally *Tendagurium seikaianum* AMANO which has been recently described by one of us (AMANO, 1958) is regarded as occuring in the bed (of Unit I) much lower than the *Graysonites* bearing bed.

Works Cited

ADKINS, W. S. (1933): Mesozoic systems of Texas. *In* SELLARD, E. H., ADKINS, W. S., and PLUMMER, F. B.: The Geology of Texas, **1**, (2). *Univ. Texas Bull.*, **3232**, 239–518.

ADKINS, W. S. and LOZO, Frank E. (1951): Stratigraphy of the Woodbine and Eagle Ford, Waco area, Texas. *In* LOZO, Frank E. [Editor]: The Woodbine and adjacent strata of the Waco area of central Texas—A symposium for the 1951 field trip sponsored by the East Texas Geological Society. *Fondren Sci., Ser.* **4**, 101–161, pls. 1–6.

AMANO, Masahisa (1956): Some Upper Cretaceous fossils from southwestern Japan (Part I). *Kamamoto Jour. Sci.*, [B-1], *Geol.*, **2**, (1), 63–93, incl. pls. 1–2.

——— (1958): On the *Tendagurium* from the lower bed of the Goshonoura group in Shishijima, Kagoshima Prefecture, Kyushu, Japan. *Ibid.*, **3**, (1), 17–20, pl. 1.

CASEY, Raymond (1960): Cenomanian ammonite zones. *Geol. Mag.*, **97**, (2), 173–174.

COQUAND, H. (1862): Géologie et paléontologie de la région sud de la Province de Constantine. *Mém Soc. Emul. Provence Marseille* **2**, 1–320, pls. 1–35.

HASHIMOTO, Wataru, and INOMA, Akitoshi (1960): Cretaceous of the northern part of Horokanimura, Uryu-gun, Hokkaido (abstract). *Jour. Geol. Soc. Japan*, **66**, (778), 464 [in Japanese].

KOBAYASHI, Teiichi, and NAKANO, Mitsuo (1957): On the Pterotrigoniinae. *Jap. Jour. Geol. Geogr.*, **28**, (4), 219–238, pls. 16–17.

MATSUMOTO, Tatsuro (1938): Geology of Goshonoura Islands, Amakusa, with special reference to the Cretaceous stratigraphy. *Jour. Geol. Soc. Japan*, **45**, (532), 1–47, pls. 1–3 [in Japanese with English appendix].

——— (1943): Fundamentals in the Cretaceous Stratigraphy of Japan, Part III. *Mem. Fac. Sci. Kyushu Imp. Univ.*, [D], **2**, (1), 186–237.

——— (1959a): Zonation of the Upper Cretaceous in Japan. *Mem. Fac. Sci., Kyushu Univ.*, [D], **9**, (2), 55–93, pls. 6–11.

——— (1959b): Upper Cretaceous ammonites of California, Part II. *Ibid.*, Special Vol. **1**, 1–172, pls. 1–41.

MATSUMOTO, Tatsuro [Editor] (1954): *The Cretaceous System in the Japanese Islands*, i–xiv, 1–324, pls, 1–36, Tokyo (for 1953).

MATSUMOTO, Tatsuro, SAITO, Rinji and FUKADA, Atsuo (1957): Some Acanthocerotids from Hokkaido. *Mem. Fac. Sci., Kyushu Univ.*, [D], **6**, (1), 1–45, pls. 1–18.

NAGAO, Takumi (1930): On Some Cretaceous fossils from the Islands of Amakusa, Kyushu, Japan. *Jour. Fac. Sci., Hokkaido Imp. Univ.*, [4], **1**, 1–25, pls. 1–3.

NAKANO, Mitsuo (1958): Scabrotrigonians in Japan. *Jour. Sci., Hiroshima Univ.*, [C], **2**, (3), 227–233, pl. 29.

NOTOMI, Shigeo (1930): Amakusa. *Expl. Text Geol. Map Japan*, scale 1 : 75,000, **304**, 1–90, map [in Japanese with English abstract (1)–(5)].

OTA, Yoshihisa (1959): *Trigonioides* and its classification. *Trans. Proc. Palaeont. Soc. Japan*, [N.S.], **34**, 97–104, pls. 10–11.

PERVINQUIÈRE, L. (1907): Études de paléontologie tunisienne. Céphalopodes des terrains secondaires. *Carte géol. Tunisie*, 1–428, pls. 1–27.

——— 1910: Sur quelques ammonites du Crétacé algérien. *Mém. Soc. géol. France Paléont.*, **27**, (2–3), Mém. no. 42, 1–86, pls. 1–7 [10–16].

SCHLAGINTWEIT, Otto (1911): Die Fauna des Vracon und Cenoman in Peru. *In* STEINMANN, Gustav: Beiträge zur Geologie und Palaeontologie von Südamerika, 17. *N. Jb. Min. Geol. Paläont.*, **33**, 43–135, pls. 5–7.

SPATH, L. F. (1925): On Upper Albian Ammonoidea from Portuguese East Africa, with an appendix on Upper Cretaceous ammonites from Naputoland. *Ann. Transv. Mus.*, **11**, (3), 179–200, pls. 28–37.

——— (1922): On the zones of the Cenomanian and the uppermost Albian. *Proc. Geol. Assoc.*, **37**, 420–432.

STOLICZKA, Ferd. (1863–66): The fossil Cephalopoda of the Cretaceous rocks of Southern India. Ammonitidae with revision of the Nautilidae, etc. *India Geol. Surv. Mem., Palaeontologia*

Indica, **1**, [3], 41–216, pls. 26-94.

UEDA, Yoshiro and FURUKAWA, Nobutsune (1960): On the Himenoura group of the Amakusa-Kamishima and adjacent islets, Kumamoto Prefecture. *Sci. Rep. Fac. Sci., Kyushu Univ., Geol.*, **5**, (1), 14-35, [in Japanese with English abstract].

WRIGHT, C. W. (1958): Notes on the Cretaceous ammonites, III. *Utaturiceras* gen. nov. and the Metoicoceratinae. *Ann. Mag. Nat. Hist.*, **9**, 391-393.

YEHARA, Shingo (1923): Cretaceous Trigoniae from Southwestern Japan. *Jap. Jour. Geol. Geogr.*, **2**, (3), 61–84, pls. 8–13.

YOUNG, Keith (1958): *Graysonites*, a Cretaceous ammonite in Texas. *Jour. Paleont.*, **32**, (1), 171–182, pls. 27–29.

Tatsuro MATSUMOTO

Graysonites (Cretaceous Ammonites) from Kyushu

Plates 6–8

Plate 6

Explanation of Plate 6

(Figures of natural size)

Fig. 1. *Graysonites fountaini* YOUNG . . . . . Page 44

Lateral (a) and ventral (b) views of a relatively thick-whorled and coarsely ribbed variety. GK. H 4211, from loc. Sh. 51-75 of Amano, southwestern coast of Shishi-jima Island, equivalent of the Middle formation of Goshonoura group, Izumi-gun, Kagoshima Prefecture (M. AMANO Coll.).

Photos by Ikuwo OBATA, without whitening.

1a

1b

T. MATSUMOTO: *Graysonites* from Kyushu

Plate 7

Explanation of Plate 7

(All figures of natural size)

Figs. 1–4. *Graysonites* cf. *fountaini* YOUNG . . . . . Page 44

1. Ventral (a) and lateral (b) views of an inner whorl, and the other side view (c) of an example of middle growth-stage. (The outer whorl is detached away from fig. 1a, b.) GK. H 4210, from loc. Sh. 51-75, southwestern coast of Shishijima Island, Izumi-gun, Kagoshima Prefecture (Coll. M. AMANO).
2. Lateral (a) and ventral (b) views. Another immature example, GK. H. 4207, from loc. GS. 138 of OKADA (included in loc. G. 220′ of MATSUMOTO), Member IIe, of the Goshonoura group, Kumamoto Prefecture (Coll. H. OKADA and H. OGURI).
3. Venter of a fragmentary, inner whorl. GK. H 4208, from loc. GS. 138, same as above (Coll. H. OKADA and H. OGURI).
4. Side view of a fragmentary adult shell. GK. H 4206, from loc. GS. 138, same as above (Coll. H. OKADA and H. OGURI).

Photos by Ikuwo OBATA, without whitening.

T. MATSUMOTO: *Graysonites* from Kyushu

Plate 8

Explanation of Plate 8

(All figures of natural size)

Fig. 1. *Graysonites* sp. indet. *α* . . . . . Page 49

Ventral (a) and lateral (b) views of a fragmentary specimen, which is allied to *Graysonites lozoi* YOUNG. GK. H 4212, from loc. Sh. 48-26, southwestern part of Shishijima Island, Izumi-gun, Kagoshima Prefecture (Coll. M. AMANO).

Fig. 2. *Graysonites* sp. indet. *β*. . . . . Page 50

Side view of a highly water worn specimen, which resembles *Graysonites* n. sp. of YOUNG (1958, pl. 28, figs. 5, 6). GK. H. 4213, a rolled block obtained at loc. Sh. 48-26, southwestern part of Shishijima Island, Izumi-gun, Kagoshima Prefecture (Coll. M. AMANO).

Photos by Ikuwo OBATA, without whitening.

1a

1b

2

T. MATSUMOTO: *Graysonites* from Kyushu