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A Monograph of the Collignoniceratidae from Hokkaido Part IV : Studies of the Cretaceous Ammonites from Hokkaido and Saghalien－ＸＸＩ

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A Monograph of the Collignoniceratidae from Hokkaido Part IV

(Studies of the Cretaceous Ammonites from Hokkaido and Saghalien—XXI)

By

Tatsuro MATSUMOTO

Abstract

Part IV contains the systematic descriptions of the subfamily Texanitinae. The hitherto used framework of classification of the Texanitinae is considerably refined. Special attention has been paid on the ontogenetic development of the ornamentation, as well as on other characters. Comparisons of closely allied species are made to know the affinities between various taxa of generic rank. *Protexanites* is regarded as a fundamental genus of the subfamily and is subdivided into three subgenera, with the introduction of two new ones. *Paratexanites,* including the two subgenera, *Paratexanites* and *Parabevahites,* is probably derived from *Protexanites.* The ultimate origin of *Texanites* is in *Protexanites.* In the course of its ontogenetic development, the *Protexanites*- and sometimes *Paratexanites*-like characters are presented in many species. Those with fairly persistent ancestral characters in the inner whorls are grouped into a new subgenus of *Texanites.* Multiplication of the ventral ornament occurs in various lines of descent. A new genus [*Pleurotexanites*], *Australiella, Menabites* including the subgenera *Menabites* (s.s.) and *Berere1la,* and *Delawarella* are directly or indirectly connected with *Protexanites, Bevahites* with *Paratexanites* (*Parabevahites*), and *Submortoniceras* with a certain group of *Texanites.* The described species from Hokkaido are altogether 20, of which 7 are new as listed in the contents below. They are mostly of Coniacian to Santonian ages. In connexion with the descriptions of the species from Hokkaido, comments are generally given on many previously described texanitine ammonites outside Hokkaido, establishing three new species and one new subspecies.

Contents

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Systematic Descriptions

(Continued)

Subfamily Texanitinae COLLIGNON, 1948

The ammonites belonging to the subfamily Texanitinae were comprehensively studied by COLLIGNON (1948), who established seven taxa of generic rank, *Parabevahites, Bevahites, Menabites, Bererella, Australiella, Delawarella* and *Paratexanites,* in addition to *Texanites* SPATH, 1932, and *Submortoniceras* SPATH, 1921. Subsequently *Protexanites* MATSUMOTO, 1955, was introduced as a fundamental genus of the subfamily, whose ultimate origin is probably in *Subprionocyclus* of the Collignoniceratinae. I furthermore pointed out that *Parabevahites* is intimately connected with *Paratexanites.*

The framework of classification established on the basis of COLLIGNON (1948), with the addition by MATSUMOTO (1955), was adopted by WRIGHT (1957) in the *Treatise.* This was acknowledged by YOUNG (1963), who added an aberrant genus, *Defordiceras.* YOUNG (1963) proposed to remove *Reginaites* REYMENT, 1957, from the Peroniceratinae to the Texanitinae. This problem was discussed by myself (MATSUMOTO, 1965, this monograph, part II, p. 239–240). In my scheme *Reymentites, Reginaites* and *Ishikariceras* should be taxonomically grouped with *Peroniceras, Cobbanoceras, Gauthiericeras,* and *Sornayceras* into the Peroniceratinae until the possibly polyphyletic lines of descent could be traced on

sufficient evidence. Although *Jimensites* was proposed by CARRASCO (1967) on the basis of the ammonites from Mexico, it does not seem to be clearly discriminated from *Submortoniceras*.

COLLIGNON (1966) has recently illustrated in an atlas numerous examples of texanitine ammonites from the Santonian of Madagascar, some of which are reviewed in this paper in connexion with the descriptions of the species from Hokkaido.

The species to be described in the present paper are primarily those from the Coniacian and the Santonian of Hokkaido. Several ammonites from South Saghalien may be included in the description, because the same species occur from Hokkaido. For some reasons, probably of unfavourable conditions of facies, Campanian examples are very few in Japan, although they are not absent.

In the following descriptions I generally follow the previous framework of classification, but modify it to some extent. The refinement is attempted mainly for the Coniacian to Santonian genera.

Genus *Protexanites* MATSUMOTO, 1955

Type-species.—*Ammonites bourgeoisi* D'ORBIGNY, 1850, by original designation (MATSUMOTO, 1955, p. 38).

Generic diagnosis.—The size of the adult shell is moderate to fairly large. The coiling is evolute to moderately involute, with a more or less wide umbilicus. The whorl is subquadrangular in costal section and nearly as high as broad or somewhat higher than broad.

The ribs are simple and equally long on the outer whorls of typical species, but in some species they may be bifurcated at the umbilical tubercles or intercalated with shorter ones, especially in comparatively earlier growth-stages. They are rectiradiate or prorsiradiate.

There are three rows of tubercles, the umbilical, the ventrolateral and the ventral ones. The ventral tubercles are clavate, forming the end of the ribs. There is a shallow furrow or a narrow concave zone between the siphonal keel and the train of ventral clavae. The siphonal keel is normally entire but may be weakly undulated in some species.

In a certain group of species a lateral row of tubercles is added to the three rows, but it appears in a limited period of the middle to late growth-stages.

The suture is of typical collignoniceratid type, consisting of E, L, U_2, U_3(=S), U_1 and I. The first lateral saddle is massive, broad and of roughly subquadrate outline. The first lateral lobe (L) is roughly U-shaped, but may approach to V-shape in some species. Minor indentations are not deep.

Subgeneric distinction.—When I (MATSUMOTO, 1955, p. 38) established the genus *Protexanites*, I included in it the species which acquire a row of lateral tubercles in addition to the three rows. It is taxonomically desirable to group them in a subgenus (*Anatexanites* to be defined in p. 239) which is to be distinguished from a trituberculate group, i.e. the subgenus *Protexanites* (s.s.).

There is a new species of *Protexanites*, to be established in p. 246, which is atypical in that its ventrolateral tubercles are weak and unusually delayed to

appear. Another subgenus (*Miotexanites*) is to be established for it.

Protexanites superbus COLLIGNON, 1966, and *Protexanites obatai* COLLIGNON, 1966, are extruded from *Protexanites* to a new genus to be established in p. 232.

Subgenus *Protexanites* MATSUMOTO

Subgeneric diagnosis.—The whorl is provided with three rows of tubercles, umbilical, ventrolateral and ventral, almost throughout the growth-stages, except for the earliest non-tuberculate stage.

Remarks.—The following species are referred to the subgenus *Protexanites*:

P. (*P.*) *bourgeoisi* (D'ORBIGNY, 1850) [type-species]
P. (*P.*) *shoshonensis* (MEEK, 1876)
P. (*P.*) *planatus* (LASSWITZ, 1904)
P. (*P.*) *canaensis* (GERHARDT, 1876)
P. (*P.*) *bontanti* (DE GROSSOUVRE, 1894)
P. (*P.*) *strozzii* (DESIO, 1920)
P. (*P.*) *peroni* sp. nov. (to be defined below)

Comparison and affinity.—The characters of *Protexanites* appear in the early immature shell of almost all the genera of Texanitinae. Addition or multiplication of tubercles occurs in the genera of later ages. In this respect *Protexanites*

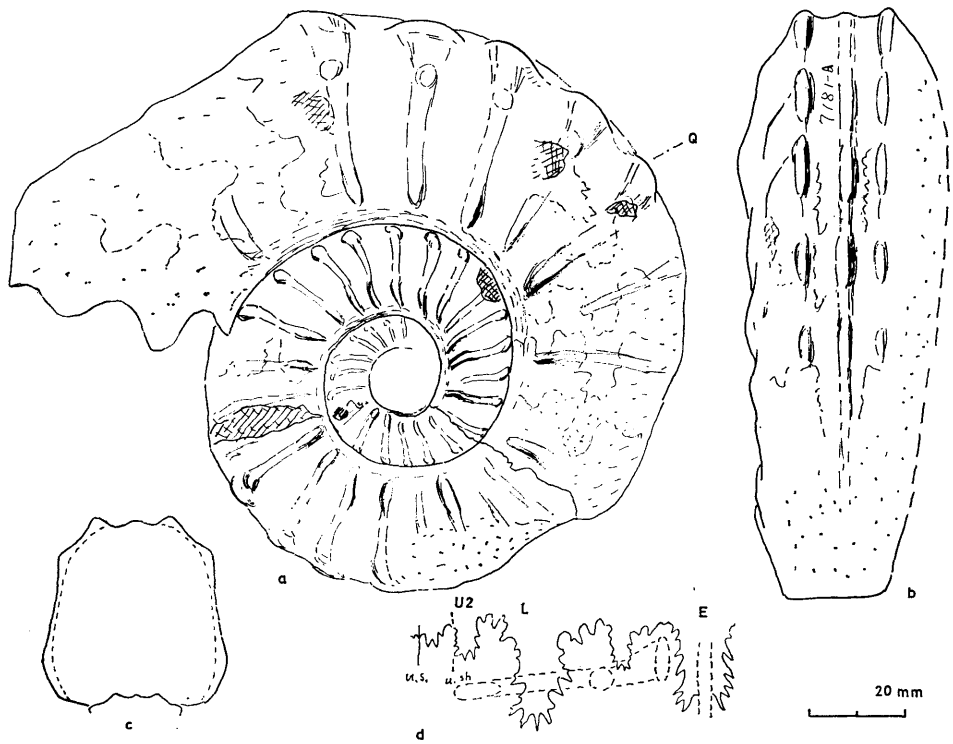

Fig. 1 [75]. *Protexanites* (*Protexanites*) *bourgeoisi* (D'ORBIGNY). Diagrammatic sketch of the lectotype, MNHN. 7181–A1. Lateral (a) and ventral (b) views, whorl-section (c) at Q and external suture (d). (T. M. *delin.*)

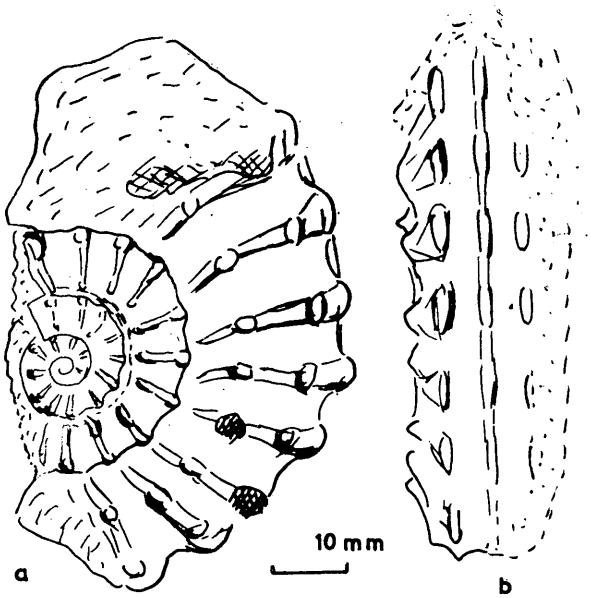

Fig. 2 [76]. *Protexanites* (*Protexanites*) *bourgeoisi* (D'ORBIGNY). Diagrammatic sketch of a coarsely ribbed syntype, MNHN. 7181-A4. Lateral (a) and ventral (b) views. (T. M. *delin.*)

represents the fundamental stock of the subfamily.

The ontogeny of *Protexanites* was revealed by REESIDE (1927) on *P. shoshonensis* and is similarly observable in some examples from Japan. In a shell of fairly early growth-stage, at about 5–10 mm. in diameter, the venter has already a median keel and a train of clavae on each side, with a shallow furrow inbetween. Each ventral clava is situated at the end of a rib which is somewhat projected from the ventrolateral tubercle.

This texanitine feature in the early growth-stages and also the characters in later stages suggest two possible cases as regards the origin of *Protexanites*. One is *Prionocyclus* of the Collignoniceratinae and the other is *Subprionocyclus* of the same subfamily. The ventral keel is minutely serrated and the ribs are strongly projected on the venter in *Prionocyclus*. In *Subprionocyclus* the serrations are coarser and correspond with the ribs, each rib has distinct outer and inner ventrolateral tubercles, of which the outer one is fairly clavate, and the rib is somewhat weakened between the outer ventrolateral tubercle and the median keel, although it is disposed to form a chevron on the venter.

In some species of *Protexanites*, such as in *P. bourgeoisi* and *P. bontanti*, weak undulations corresponding with the ribs are discernible on the ventral keel. This is probably a reminiscence of stronger serrations on the keel of *Subprionocyclus*. The ventral clavae of *Protexanites* can well be interpreted to have come from the outer ventrolateral tubercles of *Subprionocyclus* shifted closer to the siphonal keel. In some species of *Protexanites*, especially frequently on the inner whorls, the ribs show bifurcation or intercalation at or near the umbilical margin. The ribs are more or less prorsiradiate and sometimes sigmoidal. These features

closely resemble those of certain species of *Subprionocyclus*. Thus, *Protexanites bontanti* is allied to *Subprionocyclus neptuni* (GEINITZ).

It should be noted that *P. canaensis* is allied to *Subprionocyclus branneri* (ANDERSON, 1902) (emended by MATSUMOTO 1959, p. 109), from the Upper Turonian of Oregon, in having a closely similar shell-form, ribbing and suture. Of course the latter has a high, distinctly serrate, siphonal keel and more approximated outer and inner ventrolateral tubercles. If the serrated keel of *S. branneri* became entire and low, and also to be bordered by a concave zone on either side, and if the outer ventrolateral tubercles were shifted outward, forming a train of ventral clavae at the end of the ribs, the characteristic features of *P. canaensis* could be led.

I am, thus, inclined to ascribe the origin of *Protexanites* to *Subprionocyclus*, although in the available material the morphological change from a species of *Subprionocyclus* to a species of *Protexanites* has not yet been proved to be completely gradual.

On the other hand there is some similarity between *Protexanites* and *Peroniceras*. When the ventral clavae are narrow and long, the train of the clavae looks like a keel. Therefore someone might consider that the ventral clavae of *Protexanites* were derived from the breaking up of the entire side keel of the tricarinate *Peroniceras* or *vice versa*. Some species of *Protexanites* are younger than those of *Peroniceras* and others are nearly contemporary. *Protexanites* was sometimes misidentified with *Peroniceras*, as exemplified by *Peroniceras amakusense* YABE, 1902 (see MATSUMOTO and UEDA, 1962, p. 172–3). If the preservation were better, *Protexanites* would not be confused with *Peroniceras*. *Peroniceras* is distinctly tricarinate and has a different type of suture, with much deeper and more complex indentations. It is normally polygyral and widely umbilicate.

The specimen from Djebel Aures, Algeria, described by PERON (1896, p. 53) under the name of *Peroniceras czörnigi* is not identified with *Peroniceras czoernigi* (REDTENBACHER, 1873), because it is not tricarinate and because it shows a different type of suture. It represents a species of *Protexanites* which is allied to but distinguishable from *P. canaensis*. I propose here for it, ***Protexanites (Protexanites) peroni*** sp. nov., designating the illustrated specimen of PERON (1896, pl. 11 [5], figs. 7, 8) as the holotype, which I studied at the Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris (Text-fig. 3). This species is characterized by high whorls, with subparallel flanks, simple, distant, rather narrow, somewhat sinuous ribs, bullate umbilical tubercles, prominent ventrolateral tubercles which are spinose on the inner whorl, much clavate ventral tubercles and a fairy prominent ventral keel. The train of the ventral clavae was misunderstood as a keel by PERON, who thought of *Peroniceras*. The suture is of texanitine type.

Protexanites peroni is distinguished from *P. canaensis* by its more compressed, more rapidly growing whorls (with height: breadth about 3 : 2), somewhat narrower umbilicus (34 percent of the diameter in the holotype), more slender, gently flexuous, instead of straight, ribs, and more remarkably bullate umbilical tubercles. In a limited portion, at a diameter of about 50 mm., of the holotype the umbilical bullae are indistinctly doubled, but this is only temporary

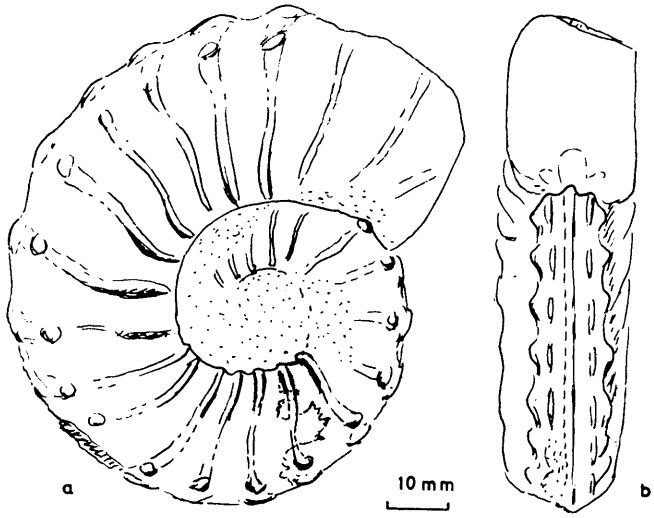

Fig. 3 [77]. *Protexanites* (*Protexanites*) *peroni* sp. nov. Diagrammatic sketch of the holotype. Lateral (a) and frontal (b) views.
(T. M. *delin.*)

and does not seem to be settled as a specific character. The ribs are much weakened at a point between the middle of the flank and the ventrolateral tubercles. I would regard this as a diagnostic character which is particular to *P. peroni* and not seen in *P. canaensis* nor in *P. bourgeoisi.*

Cobbanoceras MATSUMOTO, 1965, another tricarinate peroniceratine genus of Coniacian to Santonian ages, has the same type of suture (i.e. collignoniceratid type) as that of *Protexanites, Prionocyclus* etc., and, accordingly, more similar to *Protexanites,* as I mentioned previously (MATSUMOTO, 1965, p. 219). I remarked, however, with some evidence, that *Cobbanoceras* was probably derived from *Prionocyclus* in parallel with *Gauthiericeras* (see MATSUMOTO, 1965, p. 220). *Prionocyclus* and *Subprionocyclus* are in a sisterhood relation inasmuch as they were commonly originated in *Collignoniceras.* Therefore the resemblance between *Cobbanoceras* and *Protexanites* may be so to speak a cousin relationship. Anyhow, more study is needed to know the real affinity. A search for material from the Lower Coniacian is, I think, especially important.

As is discussed in p. 297, *Australiella* COLLIGNON, 1948, of Santonian to Campanian ages, was probably derived from a certain subgroup of *Protexanites,* acquiring the inflation of whorls and the multiplication of ventral ribs.

Menabites COLLIGNON, 1948, of early to middle Campanian ages, including the subgenera *Menabites* (s. s.) and *Bererella* COLLIGNON, 1948, have trituberculate immature shell and pentatuberculate outer whorls. Their ventral ribs and tubercles are multiplied. They may have descended from *Protexanites* directly or by way of *Australiella.*

COLLIGNON (1966) described two peculiar species under *Protexanites, P. superbus* COLLIGNON (1966, p. 64, pl. 480, figs. 1952 A, B) and *P. obatai* COLLIGNON (1966, p. 66, pl. 481, figs. 1953, 1954), from the middle Santonian of Madagascar,

suggesting that they could represent a new subgenus of *Protexanites*. The distinction is, I think, sufficient for establishing a new genus, ***Pleurotexanites*** nov. *Protexanites superbus* COLLIGNON is here designated as the type-species of *Pleurotexanites*. *P. obatai* COLLIGNON is assigned to the same genus. The generic distinctions are (1) the three rows of tubercles, the umbilical, the ventrolateral [="marginal"] and the ventral [="external" of COLLIGNON], (2) the multiplication of the ventral tubercles, (3) the train of likewise multiplied tubercles on the siphonal line instead of an entire keel and (4) the attenuation of the ribs and tubercles on the last whorl.

Pleurotexanites is probably a speciallized offshoot of *Protexanites* running in parallel with the line of descent from *Protexanites* to *Australiella*.

The similarity between certain species of *Pseudaspidoceras* and *Protexanites* is, I think, a homoeomorphy. *Ammonites salmuriensis* COURTILLER, 1867, for instance, was once referred to *Mortoniceras* by PERVINQUIÈRE (1903, p. 96) because of the presence of a ventral keel. Afterwards, based on the inspection of numerous specimens, PERVINQUIÈRE (1907, p. 314) referred it to *Pseudaspidoceras* HYATT, 1903, of the Mammitinae, because it is closely allied to *Ammonites footeanus* STOLICZKA, 1865, the type-species of *Pseudaspidoceras*, and because he observed that the keel like elevation was a false keel [pseudocarène]. Recently FREUND and RAAB (1969, p. 69, pl. 5, figs. 4–6; text-fig. 14c–j) referred this species to *Protexanites* on the basis of the material from Israel. A nascent keel occasionally appears in otherwise flat venter in a few acanthoceratids, as is discernible in some *Acompsoceras* and even in a few *Acanthoceras*. The same feature probably occurred in some *Pseudaspidoceras*. Because of the close affinity with the non-keeled, unmistakable species of *Pseudaspidoceras* of the Turonian, I should refer *Ammonites salmuriense* to *Pseudaspidoceras*. If the ontogeny were carefully examined, the distinction of this species from the known species of *Protexanites* would become clearer.

Distribution.—The type-species, *P. bourgeoisi*, occurred in the Upper Coniacian of France and Bohemia and also Upper and Lower Coniacian of Spain. Another species, *P. bontanti* also came from the same beds, but in Hokkaido and Saghalien its subspecies ranges up to the Santonian. *P. planatus* and *P. shoshonensis* are from the Upper Coniacian of the North American Gulf Coast and Western Interior province respectively. *P. planatus* occurs also in the Lower Santonian of Madagascar. *P. canaensis* and *P.* aff. *bourgeoisi* were reported from the "Lower Senonian" of Venezuela and Peru. *P. peroni* n. sp. is from the Coniacian of Algeria and *P. strozzii* from the Coniacian of Italy. In Japan *P. planatus* and *P. bontanti* (a new subsp.) occur in the Lower Senonian (i.e. Coniacian and Santonian).

For some reasons the number of collected specimens is not large at every locality for every species.

Protexanites (*Protexanites*) *planatus* (LASSWITZ)
Pl. 30 [34], Fig. 2; Text-fig. 4 [78]

1904. *Schloenbachia quattuornodosa* var. *planata* LASSWITZ, *Geol. Palaeont. Abh.*, [N. F.], Bd. 6, Heft 4, p. 32 [252], pl. 7 [19], fig. 4.
1928. *Mortoniceras quattuornodosum* var. *planatum*. ADKINS *Univ. Texas Bull.* No. 2838, p. 252, pl. 34, fig. 3.
1963. *Protexanites planatus*, YOUNG, *Univ. Texas Publ.* No. 6304, p. 76, pl. 26, figs. 3, 4; pl. 35, fig. 4; pl. 36, figs. 1, 2; pl. 37, figs. 2–4; text-figs. 20a, 25m, 29c.
1966. *Protexanites planatus*, COLLIGNON, *Atlas des fossiles caracteristiques de Madagascar* (Ammonites), fasc. 14 (Santonien), p. 18, pl. 461, fig. 1888.

Material.—Holotype, by monotypy, is the specimen described and illustrated by LASSWITZ (1904, p. 32, pl. 7, fig. 4) and reillustrated by ADKINS (1928, pl. 34, fig. 3). This and other specimens (hypotypes) in subsequent collections from Texas were described precisely by YOUNG (1963).

A small specimen of incomplete preservation, GK. H5633, from Hokkaido supplements the material from Texas in that it shows a suture.

Specific characters.—The shell is of moderate size in the full-grown stage, as exemplified by a specimen with a diameter of about 150 mm. at the end of the body-whorl.

The coiling is rather evolute, with the overlap of the outer whorl at or immediately above the row of ventrolateral tubercles of the inner whorl. The umbilicus is of moderate width, occupying about 30 to 40 percent of the shell diameter.

The whorl is subquadrate in costal section. Its intercostal section is somewhat higher than broad (b : h = 10 : 12–13), subelliptical to thickly ovoid.

The ribs are simple, strong, coarse, sparse, separated by wider interspaces, straight and nearly rectiradiate or slightly prorsiradiate. They are widened and inclined gently forward, but not strongly projected, from the ventrolateral tubercle to the ventral one.

The umbilical tubercles are prominent at the umbilical shoulder and bullate. Occasionally they may be doubled, as exemplified by a few ribs in the holotype. The ventrolateral tubercles are strong, forming a ventrolateral angulation. They are especially prominent on the inner whorls, forming horns or spines which extend outward. The ventral (i.e. external) clavae at the end of the ribs are long and narrow. The ventral keel is distinct and entire. There is a shallow furrow or a concave zone between the siphonal keel and the train of ventral clavae.

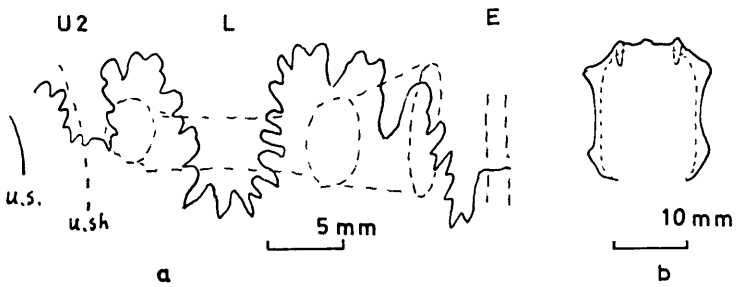

Fig. 4 [78]. *Protexanites* (*Protexanites*) *planatus* (LASSWITZ). External suture (a) and whorl-section (b) of GK. H5635. (T. M. *delin.*)

The suture is of simple collignoniceratid type, having a roughly U-shaped lateral lobe (L), which may be slightly widen upward, and massive lateral saddles on either side of L.

Remarks.—The specimen from Hokkaido agrees well in the essential points of shell-form and ornamentation with the types from Texas, although it is incompletely preserved. The above description of suture depends on that of the Hokkaido specimen observed at whorl-height of 14 mm.

Comparison.—As YOUNG (1963, p. 77) has already remarked, *Protexanites planatus* closely resembles *Protexanites bourgeoisi* (DE GROSSOUVRE, 1894), the type-species. The distinctions which I can point out are that the umbilical tubercles are most prominent at the shoulder in the former but are so at a point at some distance outside the shoulder in the outer whorl of the latter, that the ventrolateral tubercles are stronger and more spinose on the inner whorls of the former, and that the siphonal keel is entire in the former but weakly undulated in the latter. On the average the ribs seem to be stronger, coarser and less numerous in the former than in the latter. There could be variation with respect to these points. In fact a certain example of *P. bourgeoisi* (e.g. No. 7181 A-4, one of the syntypes, mentioned by MATSUMOTO, 1966, p. 203, text-fig. 4) (Text-fig. 2 in this paper) approaches fairly closely to *P. planatus* in its coarse ribbing and prominent ventrolateral tubercles. It can still be referred to *P. bourgeoisi* in view of the presence of weak undulation on the siphonal keel and the outward shift of the umbilical tubercle.

RIVERA (1949, p. 29, pl. 6) reported a specimen from Pongo Renteme, on the Maranón, Peru, under *Texanites* sp. aff. *T. bourgeoisi.* It could be an example of *Protexanites planatus,* but it is difficult to decide so without seeing the specimen itself.

Protexanites shoshonensis (MEEK) (1876, p. 449, pl. 6, figs. 3a, 3c, 6b), which was described precisely by REESIDE (1927, p. 9, pl. 6; figs. 16–23; pl. 7, figs. 1–11; pl. 8, figs. 1–15) on the basis of the specimens from the Cody Shale (Conician) of Oregon basin, Wyoming, closely resembles *P. planatus* in the general aspects of shell-form, ribbing and suture. The clear distinction is in that umbilical tubercles are shifted outward with growth in *P. shoshonensis,* reaching at a point somewhat below the middle of the flank on the outer whorl. On the average the ribs are more crowded on the inner whorl and somewhat more numerous on the outer whorl in *P. shoshonensis* than in *P. planatus.* There is variation in this respect and a variety of *P. shoshonensis,* which was called *P. shoshonensis* var. *crassum* REESIDE (1927, p. 10, pl. 8, figs. 5–15), has the ribs as coarse and as distant as those of *P. planatus.*

P. shoshonensis is closely allied to *P. bourgeoisi,* as was mentioned correctly by REESIDE (1927, p. 10) in view of the resemblance in shell-form, ribbing and suture. The ventral keel is entire or almost entire in the former, whereas it is weakly undulated in the latter. In the early stage of *P. bourgeoisi* the ribs are sometimes bifurcated and may show a gentle sinuosity, whereas in *P. shoshonensis* they are mostly simple and straight throughout life. The umbilical tubercles are bullate in the typical form of *P. bourgeoisi,* whereas they are prominent at a point between the umbilical shoulder and the middle of the flank in *P. shosho-*

nensis. On the average the ventrolateral tubercles are stronger in *P. shoshonensis* than in *P. bourgeoisi*.

There can be some exceptions in the above remarked differences. For instance, one of the syntypes of *P. bourgeoisi*, No. 7181 A-4 mentioned above (Text-fig. 2), has simple, distant ribs throughout life, prominent ventrolateral tubercles and also prominent umbilical tubercles at some distance outside the umbilical margin. It is, thus, closer to *P. shoshonensis* than the typical specimens of *P. bourgeoisi*, although it still retains the diagnosis of *P. bourgeoisi* in the weak undulation of the ventral keel and in the slight flexuosity of the ribs.

To sum up there seem to be some overlap in the variations of the three species, *P. planatus*, *P. shoshonensis* and *P. bourgeoisi*. The three contemporary nominal species might be subspecies of one and the same species. This should be examined by studying statistically more specimens. For the time being they are treated as distinct species, as were done by previous authors. They may have descended from a common ancestor. How they are differentiated is a problem to be worked out in the future. I presume that some of the populations in *Subprionocyclus branneri* (ANDERSON) [?=*S. cristatus* (BILLINGHURST, 1927)] (see MATSUMOTO, 1959, p. 109) or its allied species could be considered as ancestors.

Occurrence.—The occurrences of the specimens of *P.* (*P.*) *planatus* in Texas were described in detail by YOUNG, who summarized the stratigraphic range of this species as Upper Coniacian (YOUNG, 1963, text-fig. 3).

COLLIGNON (1966, p. 18, pl. 461, fig. 1888) illustrated a fragmentary body-whorl, which can be certainly referred to *P.* (*P.*) *planatus*, from the basal part of the Santonian (zone of *Texanites oliveti*).

The Hokkaido specimen was contained in a calcareous nodule from the Upper Yezo Group at about 10 km. point (measured along the abandoned forestry railway) on the main stream of the Ikushumbets. It is associated with *Subptychoceras yubarense*. The age is either Upper Coniacian or Lower Santonian.

Protexanites (*Protexanites*) *bontanti* (DE GROSSOUVRE)

Text-fig. 5 [79]

1894. *Mortoniceras bontanti* DE GROSSOUVRE, Recherches sur la Craie supérieure. II, Les Ammonites de la Craie supérieure, p. 77, pl. 17, figs.
1955. *Protexanites bontanti* MATSUMOTO, *Trans. Proc. Palaeont. Soc. Japan*, N. S., no. 18, p. 38.

Holotype.—The specimen illustrated by DE GROSSOUVRE (1894, p. 77, pl. 17, fig. 2), as originally designated, now preserved in the "Institut de Paléontologie, Muséum National d'Histoire Naturelle," Paris, where I fortunately examined it. A sketch is shown here (Fig. 5).

Specific characters.—The shell is moderate in size. The holotype has the last suture near the end of its available last whorl and would reach about 120 mm. in diameter at the presumed end of the body-whorl.

The whorl is moderately involute and enlarged with a moderate rate in late growth-stages, embracing the umbilicus of moderate width (about 33±2 percent of diameter). It is distinctly higher than broad, with a proportion of about

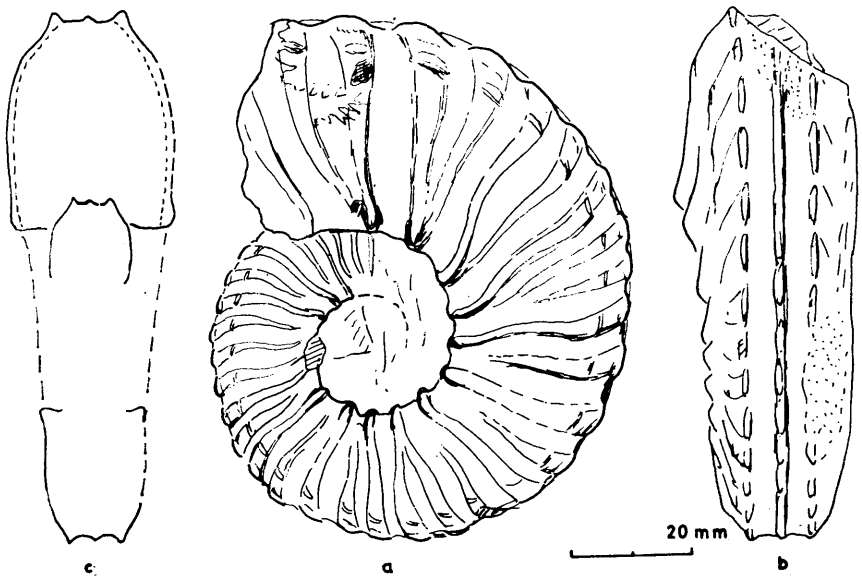

Fig. 5 [79]. *Protexanites* (*Protexanites*) *bontanti bontanti* (DE GROSSOUVRE). Diagrammatic sketch of the holotype. Lateral (a) and ventral (b) views and whorl-section (c). (T. M. *delin.*)

10 : 7–8 between height and breadth in comparatively later growth-stages. The umbilical wall is low but steep and somewhat overhanging. The flanks are only gently convex, converging to a rather narrow venter. The umbilical shoulder is subangular or abruptly rounded, whereas the ventrolateral shoulder is gentle and slant. The ventral area demarcated with the rows of ventral clavae is about half as narrow as, or (in the outer whorl) even slightly less than a half of the whorl-breadth. The whorl is, thus, subtrapezoidal in costal section.

The ribs are numerous, 32 or more being counted on the outer whorl, more or less rounded, somewhat prorsiradiate and gently sinuous on the flank and moderately projected on the ventrolateral part. Many of them spring in pairs from the umbilical tubercles and several may be single or inserted. The bifurcation seems to become less frequent toward the body-whorl. The ribs are fairly narrow on the inner whorl and somewhat broadened on the outer whorl. They are separated by interspaces nearly as narrow as the ribs themselves on the main part of the flank, but the interspaces are somewhat narrower than the ribs on the ventrolateral part, since the ribs are broadened outward.

The umbilical tubercles are bullate, rather narrow but prominent at the umbilical shoulder. Owing to the bifurcation or intercalation of the ribs the tubercles of the ventral row are one and a half to twice as numerous as the umbilical ones. The tubercles at the ventrolateral shoulder are clavate, especially distincty so on the outer whorl. The tubercles on the venter are more remarkably clavate. The ventral keel is distinct, bordered on either side by a shallow furrow. It is weakly undulated or entire.

The suture is of collignoniceratid type, with some variability (see description of subspecies).

Measurements.—

Specimen(position)	Diameter	Umbilicus	Height	Breadth	B./H.
Holotype(— 30°)	88.4(1)	29.7(.33)	36.0(.41)	28.0(.31)	0.77
〃 (— 90°)	72.4(1)	22.4(.31)	30.2(.41)	23.6(.32)	0.78
IGPS. 36962	83.0(1)	27.8(.33)	34.8(.42)	—	—
〃 (— 30°)	78.5(1)	26.3(.32)	32.8(.42)	24.0(.31)	0.73
〃 (—210°)	—	—	20.8	17.8	0.85
GK. H5631	—	—	30.5	23.5	0.77

Remarks.—The specimens from Hokkaido and Saghalien are very similar to but distinguishable from the holotype from France. There is also some difference in stratigraphic occurrence. Therefore I treat the former as a new subspecies defined as follows:

Protexanites (*Protexanites*) *bontanti shimizui* subsp. nov.
Pl. 31 [35], Figs. 1–2; Text-fig. 6 [80]

Holotype.—IGPS. 36962, form "Namikawa, Toyohara-gun, South Saghalien," well preserved septate whorls.

Paratypes.—Two fragmentary body-whorls, GK. H5631 from Chikubetsu (Coll. S. HATTORI) and GK. H5632, from loc. R215p, Kotanbetsu (Coll. T. MATSUMOTO), Hokkaido.

Subspecific diagnosis.—This subspecies has essentially the same characters as *Protexanites* (*Protexanites*) *bontanti bontanti* from France, but is distinguishable in the following points. The ventral keel is entirely continuous, without undulation and is nearly as high as the ventral clavae in the former, whereas it is weakly undulated and somewhat lower than the ventral clavae in the latter, in which each undulation of the keel corresponds to and is situated somewhat ahead of each ventral tubercle. The lateral lobe (L) is opened upward, having a V-shaped general outline in the former, whereas it is subrectangular or U-shaped in the latter. Consequently the massive, subquadrate general outline of the first and the second lateral saddles, as seen in the latter, are considerably modified in the former. Furthermore, the suture is generally more finely incised in the former than in the latter.

In the holotype of *P. bontanti shimizu* simple ribs occur more frequently and appear earlier than in that of *P. bontanti bontanti.* Accordingly the umbilical tubercles are about two thirds as numerous as the ventral tubercles (21 : 32) in the former, whereas about a half as numerous as (16 : 32) in the latter. Whether this is subspecific distinction or merely a variation which can occur in both subspecies should be decided by examining more specimens, although I would expect the significance of subspecific distinction from the evolutional point of view.

The ribs are narrower and separated by broader interspaces in the holotype of *P. bontanti shimizu* than in that of *P. bontanti bontanti,* but another example (GK. H5631) has the ribs as broad as those of the French specimen. This is, therefore, a variation which can occur in both subspecies.

Comparison and affinity.—*Protexanites bontanti* resembles in some respects

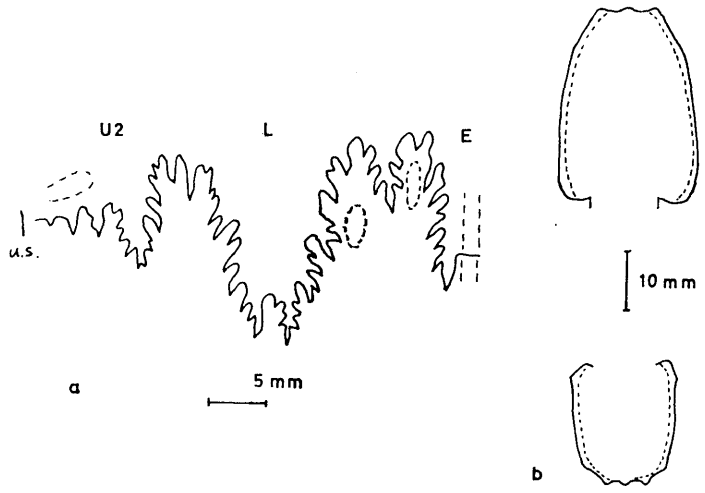

Fig. 6 [80]. *Protexanites* (*Protexanites*) *bontanti shimizui* subsp. nov. External suture (a) and diagrammatic whorl-section (b) of IGPS. 36962. (T. M. *delin.*)

contemporary *Protexanites bourgeoisi* but is distinguished by its more involute, more compressed whorls, distinctly more numerous and somewhat flexuous, instead of straight ribs, which are more frequently bifurcated and intercalated, prominence of the umbilical tubercles at (and not outside) the umbilical shoulder and more distinctly clavate ventrolateral tubercles. Of the six syntypes of *Ammonites bourgeoisi* D'ORBIGNY, which I studied in Paris, a specimen, No. 7181–6, considerably deviates from others in its compressed whorl, more numerous ribs, etc. (see MATSUMOTO, 1966, p. 204) and apparently approaches to *P. bontanti*, but I regard it still as being within the variation of *P. bourgeoisi*.

In view of the common or resembling characters in many respects, *Protexanites bontanti* can be regarded as having a close affinity with *Subprionocyclus neptuni* (GEINITZ, 1849) (emended by MATSUMOTO, 1959, p. 112; 1965, p. 52), a world-wide Upper Turonian species. Of course the ventral keel is high and distinctly serrate in *S. neptuni* as in other species of *Subprionocyclus*. The whorl of *S. neptuni* is on the average more involute, more narrowly umbilicate, and more compressed than that of *P. bontanti*. It is highly possible that the ultimate, if not direct, ancestor of *Protexanites bontanti* can be ascribed to *Subprionocyclus neptuni*. The weak undulation on the keel of *P. bontanti bontanti* may be a remnant of the distinct serration of *S. neptuni*.

In *S. neptuni* I have seen two types of suture, one with a narrow, roughly U-shaped lateral lobe and the other with an-upward opened V shaped lateral lobe. The former resembles the suture of *P. bontanti bontanti* the latter that of *P. bontanti shimizui*.

Protexanites bontanti, including subspecies *shimizui*, is apparently similar in general aspects to certain examples of *Submortoniceras*, e.g. *S. collignoni* (SHIMIZU, 1935) [=*Mortoniceras* (*Submortoniceras*) *woodsi*, COLLIGNON, 1932, p. 35, pl. 5, fig. 2, *non* SPATH]. This is evidently a kind of homoeomorphy, because

Submortoniceras is derived from *Texanites*, occurring in the uppermost Santonian to Middle Campanian. In *Submortoniceras* there are five rows of tubercles which are more or less weakened on the flank of the outer whorl, and the bifurcation or intercalation of ribbing occurs not only near the umbilical margin but also on the outer part of the flank.

SHIMIZU (1935, p. 182) proposed, without clear definition, *Submortoniceras namikawaense* (*nom. nud.*). The specimen labelled with this specific name is not found in SHIMIZU's collection of Tohoku University. IGPS. 36962, from Namikawa, described here, had a label of "*Submortoniceras japonicus* SHIMIZU MS". This specific name has been invalid, because it has not been defined in any paper. It is not revived here to avoid the confusion with *Niceforoceras* (?) *japonicum*, which could be another *Protexanites* [see description of *Protexanites* (*Miotexanites*) *minimus*]. Anyhow, SHIMIZU seems to have misunderstood *Submortoniceras*, including homoeomorphic ammonites which should be removed to *Protexanites*.

Occurrence.—The locality of the holotype is recorded as "Namikawa, Toyohara-gun, Karafuto", in south Saghalien, and the age is indicated only as "Senonian" on the label, without showing evidence. SHIMIZU (1935, p. 173) listed "*Submortoniceras namikawaense* sp. nov." in the same zone as "*Submortoniceras fukazawai* (YABE and SHIMIZU)" [=*Texanites kawasakii* (KAWADA)]. This suggests a Lower Santonian age, if SHIMIZU's *S. namikawaense* was given to the holotype of the present species.

GK. H5631 was collected by S. HATTORI at a 50 m. point from the entrance in the main driftway of the Chikubetsu coal mine, northwest Hokkaido, from the Santonian mudstone of the Upper Yezo Group, associated with *Neopuzosia ishikawai* and *Anagaudryceras yamashitai*.

GK. H5632 came from R215p, a pebble in the Kaminosawa, a branch of the upper reaches of the Kotanbetsu, northwestern Hokkaido, derived from the siltstone of the Upper Yezo Group, together with *Inoceramus* (*Platyceramus*) aff. *mantelli* BARROIS and *Baculites* cf. *uedae* MATSUMOTO and OBATA, which suggest a Santonian age.

Subgenus ***Anatexanites*** nov.

Type-species.—*Mortoniceras fukazawai* YABE and SHIMIZU, 1925.

Subgeneric diagnosis.—The ribs on the whorl of the early growth-stage are trituberculate as those of the subgenus *Protexanites* and the ribs on the whorls of the middle to late growth-stages are quadrituberculate, with a lateral tubercle in addition to other threes. The shell seems to attain to a larger size than that of *Protexanites* (s. s.) in some species.

Remarks.—In our present knowledge the following two species are certainly referred to the subgenus *Anatexanites*:

P. (*A.*) *fukazawai* (YABE and SHIMIZU, 1925) [type-species]

P. (*A.*) *nomii* (YABE and SHIMIZU, 1925)

In addition to them there are two species which should be taken into consideration. One is *Mortoniceras monchicourti* PERVINQUIÈRE (1907, p. 246, pl. 11, fig. 1 and

fig. A), from the Santonian of Tunisia. It has a row of lateral tubercles in addition to three rows, an umbilical, a ventrolateral and a ventral. Therefore, it should be referred to *Protexanites* (*Anatexanites*) defined above. It is, however, considerably different from *P.* (*A.*) *fukazawai* in that its rib is as a rule bifurcated at the umbilical tubercle, that its lateral tubercle is situated above the middle of the flank, being closer to the ventrolateral than to the umbilical one, that its ventral keel is much weakened on the outer whorl and that its whorl grows slowly around a very wide umbilicus.

The other species to be considered is represented by B. M. No. U.3400, from the upper part of the Mungo River Formation, Belangi, Southern Cameroons, which was described by REYMENT (1955, p. 93, pl. 23, fig. 3; text-fig. 46a) under the name of *Texanites* cf. *quattuornodosus* (LASSWITZ). It is, in my opinion, another good example of *Anatexanites*. I propose here, ***Protexanites* (*Anatexanites*) *reymenti*** sp. nov., designating B M. No. U.3400 as the holotype. Its specific diagnosis is (1) a compressed whorl which increases fairly rapidly in height with growth, (2) usually bifurcating, somewhat prorsiradiate and gently sigmoidal ribs, with occasional intercalations, and (3) the tubercles in four rows, i.e. a distinct umbilical, a weak mediolateral, a shortly clavate ventrolateral and a longly clavate ventral one. *Schloenbachia quattuornodosa* LASSWITZ (1904, p. 251 [31], pl. 19 [7], fig. 3), which was presumed to have come from the capitol excavation of Austin, is a doubtful ammonite, which might be an Albian *Mortoniceras*. I hesitate to give further remarks on it, since the original specimen is inaccessible to me.

Protexanites thompsoni JONES, 1966, from the Santonian of California, could be assigned to *P.* (*Anatexanites*), since the quadrituberculate state, with a row of lateral tubercles, is maintained for a considerable time in the middle growth stage. Its last whorl has, however, five rows of tubercles. I should transfer this species to a new subgenus of *Texanites* to be defined in p. 274 of this paper, although it may be a matter of convention to refer such an intermediate species to either of the two.

Comparison and affinity.—The immature shell of *Protexanites* (*Anatexanites*) *fukazawai* closely resembles that of *Protexanites* (*Protexanites*) *bourgeoisi*, as has already been pointed out by MATSUMOTO and UEDA (1962, p. 174). The lateral tubercle begins to appear at the stage of 27 mm. in diameter in an example (GK. H6119, illustrated by MATSUMOTO and UEDA, 1962, pl. 27, fig. 1) of *P.* (*A.*) *fukazawai*. It is at first very faint and gradually becomes to be better discernible but is generally weak and never becomes very prominent even in the adolescent stage. The ribs are predominant over the lateral tubercles.

The holotype of *Protexanites* (*Anatexanites*) *reymenti*, established above, was, according to REYMENT (1955, p. 93), half a whorl larger than a 65 mm. diameter of the present preservation. Therefore it follows that the specimen closely resembles the holotype of *Protexanites* (*Protexanites*) *bontanti* (DE GROSSOUVRE, 1894, p. 77, pl. 17, fig. 2), from the Upper Coniacian of France, in every respect, except that it has a row of weak mediolateral tubercles.

As will be described below, the immature shell of *Protexanites* (*Anatexanites*) *nomii* closely resembles *Protexanites* (*Protexanites*) *canaensis*. Its lateral

tubercle begins to appear at 27 mm. in diameter. Even in the later growth-stages the lateral tubercles are bullate and weak.

On the basis of the above observations and also on stratigraphical grounds, it is almost certainly concluded that *Protexanites* (*Anatexanites*) was derived from *Protexanites* (*Protexanites*) with acquisition of a row of lateral tubercles.

Protexanites (*Anatexanites*) is distinguished from *Texanites* by the presence of only one row of lateral tubercle at about the mid-flank. *Texanites* has two rows of lateral tubercles between the umbilical and ventrolateral rows. The upper lateral tubercles in *Texanites* are derived from the subdivision and separation of the ventrolateral tubercle. In some species of *Texanites*, such as *T. soutoni* (BAILY), the ribs on the outer whorl are predominant over tubercles and the lateral tubercles tend to be absorbed by the ribs. This would give an apparent similarity to *Protexanites* (*Anatexanites*). More remarks on the relation of *Protexanites* and *Texanites* are to be given in the description of *Texanites*, although it is suggested here that some species of *Texanites* may have been derived directly from *Anatexanites*.

It should be, furthermore, noted that *Protexanites* (*Anatexanites*) *reymenti* is similar to some species of *Submortoniceras*, e.g. *S. chicoense* (TRASK) as exemplified by a specimen illustrated by MATSUMOTO, 1959, pl. 34, fig. 2. If a row of upper lateral tubercles were added and if the branching and intercalation of ribs took place more frequently, certain forms of *Submortoniceras* could be led from this kind of *Protexanites* (*Anatexanites*).

Distribution.—So far as the available material is concerned, species of *Texanites* (*Anatexanites*) occur in the Santonian of Japan, Tunisia and Nigeria. Its wider distribution could be expected.

Protexanites (*Anatexanites*) sp. cf. *P.* (*A.*) *fukazawai* (YABE and SHIMIZU)

Pl. 44 [48], Fig. 1

Compare.—

1925. *Mortoniceras fukazawai* YABE and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, 2nd ser., vol. 7, no. 4, p. 130 [6], pl. 30 [1], fig. 1; pl. 31 [2], figs. 1, 2, 6, 7 (*non* fig. 3); pl. 33 [4], figs. 1, 2.
1948. *Texanites fukazawai*, COLLIGNON, *Ann. Géol. Serv. Mines* (Madagascar), fasc. 14, p. 54.
1955. *Protexanites fukazawai*, MATSUMOTO, *Trans. Proc. Palaeont. Soc. Japan*, N. S., no. 18, p. 38.
1962. *Protexanites fukazawai*, MATSUMOTO and UEDA, *Mem. Fac. Sci, Kyushu Univ.*, ser. D. vol. 12, no. 2, p. 173, pl. 27, figs. 1,3.

Material.—A probable example of *P.* (*A.*) *fukazawai* from Hokkaido is a fragmentary specimen, TKU, 30722, collected by K. NAGASE and provided for my study by courtesy of Prof. W. HASHIMOTO.

Lectotype.—The lectotype of *Mortoniceras fukazawai* is IGPS. 8045 (YABE and SHIMIZU, 1925, pl. 30, fig. 1 and pl. 31, fig. 6), as designated by MATSUMOTO and UEDA (1962, p. 173).

Descriptive remarks.—Although the specimen before me is a fragmentary whorl of about 35 mm. in height and 31 mm. in breadth, it shows some characteristic features of *P.* (*A.*) *fukazawai,* such as a subrectangular cross-section, a gently convex flank, moderately strong and fairly crowded ribs which show a slightly concave curvature on the flank, bullate umbilical tubercles, bullate but less prominent tubercles lying a little below the mid-flank and, accordingly, somewhat closer to the umbilical tubercle than to the ventrolateral one, prominent, rounded to shortly clavate ventrolateral tubercles and longer ventral clavae, which are aligned on either side of a low ventral keel separated by a shallow concave zone inbetween.

The specimen IGPS. 7330, from the Togushi, Notoro peninsula, South Saghalien, which was described under the name of *Mortoniceras* aff. *fukazawai* YABE and SHIMIZU (1925, p. 131 [7], pl. 31 [2], fig. 3) is not referable to *Protexanites* (*Anatexanites*) *fukazawai* but is a secondarily depressed, fragmentary whorl of *Texanites,* because it has five rows of tubercles.

Occurrence.—The described specimen was collected at loc. 61307 of K. NAGASE, Ohirake-zawa, upper reaches of the Haboro, Tomamai-gun, province of Teshio, northwestern Hokkaido. The siltstone at this locality is assigned to unit Uy4 of the Upper Yezo Group in the Soeushinai quadrangle (HASHIMOTO et al., 1965), about the middle of the Santonian sequence in this region.

Protexanites (*Anatexanites*) *fukazawai* occurs fairly commonly in the Senonian Himenoura Group of west central Kyushu, forming a zonule covering the upper part of the zone of *Inoceramus amakusensis* and the lower part of the zone of *Inoceramus japonicus,* about the middle of Santonian. For some reasons it is rare in Hokkaido.

Protexanites (*Anatexanites*) *nomii* (YABE and SHIMIZU)

Pl. 32 [36], Figs. 1–2; Text-fig. 7 [81]

1925. *Mortoniceras nomii* YABE and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.,* 2nd ser., vol. 7, no. 4, p. 131 [7], pl. 32 [3], figs. 1, 2, 3.
1935. *Submortoniceras nomii,* SHIMIZU, *Jour. Shanghai Sci. Inst.* sect. 2, vol. 1, p. 191 (listed only).
1948. *Texanites nomii,* COLLIGNON, *Ann. Géol. Serv. Mines* (Madagascar), fasc. 14, p. 54.
1965. *Protexanites nomii,* MATSUMOTO, *Trans. Proc. Palaeont. Soc. Japan,* N. S., no. 18, p. 38.

Material.—Holotype, illustrated by YABE and SHIMIZU (1925, pl. 32 [3], figs. 1–3) is missing. It is said to have been returned to the proprietor, Mr. NÔMI, Chief engineer of the Mitsubishi Mining Company, Oyubari, and then to have been taken by an oversea visitor to somewhere. Its plaster cast, IGPS. 22402, is preserved at the Institute of Geology and Palaeontology, Tohoku University, Sendai. The original specimen is recorded to have been discovered by I. KATO.

A smaller, probably immature specimen, no. 30723 of Tokyo Kyoiku Daigaku [="Tokyo University of Education"], collected by a student Kazuo NAGASE, which is on loan by courtesy of Professor W. HASHIMOTO.

A framentary whorl, IGPS. 36831, which was mislabelled as "*Mortoniceras* sp. nov. aff. *M. soutoni* (BAILY)".

Specific characters.—The shell is large in the full-grown stage, about 220 mm. in diameter in the holotype. The coiling is evolute, with the line of overlap at or immediately outside the row of ventrolateral tubercles. The umbilicus is wide, being about 45 percent of diameter.

The whorl is subquadrangular in cross-section, with parallel and nearly flat to slightly convex flanks, vertical umbilical walls, and subangular umbilical shoulders. The ventrolateral shoulder is obtusely subangular in the costal section and gently rounded in the intercostal section. The whorl is broader than high in the early stage, then nearly as high as broad at the stage of about 30 mm. in diameter, and in the later stages somewhat higher than broad, with a proportion of 10 : 9–8 between height and breadth.

The ribs are simple throughout most growth-stages, mostly straight, strong and more or less rectiradiate. They are less numerous (about 11–15 per whorl) and much distant in the early stage, becoming less numerous and less distant with growth, and on the outer whorl they are fairly numerous, counting 38 in the holotype. Even on the outer whorl the ribs are narrower than the interspaces, although on the body-whorl they acquire a moderate breadth.

The umbilical tubercles are bullate and somewhat elevated at the umbilical shoulder. Those on the inner whorl are comparatively more prominent than those on the outer whorl. Occasionally a few ribs on the outer whorl have a narrower and less elevated umbilical bulla than others.

The ventrolateral tubercles are prominent, being especially so on the inner whorl, where they are rather bluntly spinose. On the outer whorl they are of moderate intensity and nearly rounded or shortly clavate.

The ventral tubercles are clavate. The median ventral keel is rather low and does not exceed the height of the ventral clavae. A groove on either side of the

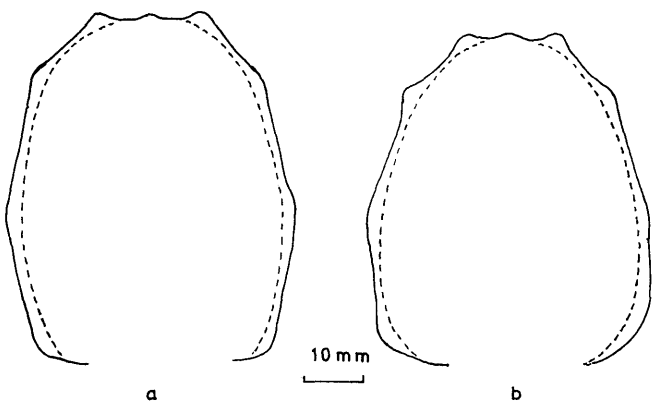

Fig. 7 [81]. *Protexanites* (*Anatexanites*) *nomii* (YABE and SHIMIZU). Diagrammatic whorl-sections of the holotype, IGPS. 22402 (plaster cast) (a) and that of another example, IGPS. 36831 (b).

(T. M. *delin.*)

keel is shallow.

From the ventrolateral tubercle to the ventral clava the rib runs with more projection than the prosiradiate rib on the main part of the flank and is broadened but weakened.

The early inner whorl has no lateral tubercle. A faint tubercle begins to appear at about the middle of the flank at the stage of 27 mm. in diameter. The lateral tubercles on the later whorls are bullate and never become prominent.

The suture is of normal collignoniceratid type, with massive, roughly subquadrate lateral saddles.

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
IGPS. 22402(− 90°)	216.5(1)	96.7(.45)	68.0(.31)	58.6(.27)	0.86
〃 (−360°)	173.5(1)	78.0(.45)	56.6(.32)	46.8(.27)	0.83
IGPS. 36831	—	—	52.4	46.3	0.88
TKU. 30723(−360°)	29.5(1)	13.0(.44)	11.0(.37)	11.0(.37)	1.00

Remarks.—The early inner whorls were not well exposed in the holotype, owing to imperfect cleaning. This is well supplemented by TKU. 30723, which is undoubtedly referred to the present species because of its diagnostic features, although its preserved last whorl is secondarily deformed.

In the holotype the flanks are gently convex in the last whorl and nearly flat in the inner whorl. IGPS. 36831 is as small as the last stage of the septate whorl of the holotype, but it has no septa, and is probably a fragment of a body-whorl. Unlike the holotype it has somewhat convex and upward converging flanks. Its ribs and tubercles are essentially the same as those of the holotype.

Comparison and affinity.—*Protexanites* (*Anatexanies*) *nomii* somewhat resembles *Protexanites* (*Anatexanites*) *fukazawai* (YABE and SHIMIZU, 1925) in the similarly quadrituberculate large shell. In the former the whorl grows more slowly and is more evolute and, accordingly, more widely umbilicate than in the latter. The ribs are more straight, more distinctly prorsiradiate, less numerous and more distant, separated by wider interspaces in the former than in the latter. In *P.* (*A.*) *fukazawai* the ribs are more crowded and show a gently concave curvature on the outer whorl. On the inner whorl of *P.* (*A.*) *fukazawai* there are some intercalated or branched secondary ribs which may show a flexuosity. In *P.* (*A.*) *nomii* the lateral tubercles is at a point nearly midway between the umbilical and ventrolateral tubercles, whereas in *P.* (*A.*) *fukazawai* it is somewhat closer to the umbilical tubercle, being situated a little below the mid-flank.

The shell of *P.* (*A.*) *nomii* up to the middle growth-stage of about 100 mm. or so in diameter is closely allied to that of *P.* (*Protexanites*) *canaensis* (GERHARDT, 1897) (p. 73, pl. 1, fig. 2; text-fig. 2, 2a), from the Lower Senonian of western Venezuela. The distinction is the development of the midiolateral tubercles in the former. *P.* (*A.*) *nomii* attains to a larger size in the full-grown stage than *P.* (*P.*) *canaensis*. It is, thus, highly possible that *P.* (*A.*) *nomii* was derived from *P.* (*P.*) *canaensis*.

Occurrence.—The holotype is recorded to have been collected from the mud-

stone exposed on the cliff at the confluence of the Pankemoyuparo with the Shiyuparo [=Shuyubari], two main tributaries of the Yubari-gawa, Province of Ishikari, central Hokkaido. The exposure is inaccessible now, because it is under the lake of the Hakobuchi dam. The mudstone belongs, according to a geological map, "Oyubari", scale 1 : 50,000, by S. NAGAO, et al. (1954), to the upper part of of Upper Yezo Group, Santonian.

IGPS. 36831 was in a calcareous nodule at the entrance of Sakai-no-sawa, on the Abeshinai, a tributary of the Teshio, Nakagawa-gun, province of Teshio, northwestern Hokkaido. The exposed bed at this locality is referred to unit IIIa (Coniacian) of the Upper Yezo Group, but the nodule may have rolled down the stream from the higher bed belonging to the Santonian part of the same group (see MATSUMOTO, 1942, maps in pls. 10 and 12).

TKU. 30723 was collected at 820-no-sawa [=Ogawa-zawa], upper reaches of the Haboro, Tomamai-gun, province of Teshio, northwestern Hokkaido. The bed is, according to W. HASHIMOTO (letter), referred to unit U3 of the Sankei quadrangle (YAMAGUCHI et al, 1963), Santonian part of the Upper Yezo Group.

Subgenus ***Miotexanites*** nov.

Type-species.—*Protexanites* (*Miotexanites*) *minimus* sp. nov., to be described below.

Subgeneric diagnosis.—A set of an entire, median keel and a row of ventral clavae on either side, with a shallow groove inbetween, is maintained almost throughout the growth-stages, whereas the ventrolateral tubercles are retarded to appear and are weak even on the outer whorl.

The shell seems to be rather small and the ribs are weak on the flank.

Remarks.—In addition to the type-species, the species which I described under *Niceforoceras* (?) *japonicum* MATSUMOTO (1965, p. 71, pl. 11, fig. 1; text-fig. 40) may be another example of *Miotexanites*.

Comparison and affinity.—This subgenus is atypical as compared with the subgenera *Protexanites* and *Anatexanites* in the retarded appearance of the ventrolateral tubercles. It resembles *Niceforoceras* BASSE, 1948, but the latter has more involute whorls and a weakly crenulate keel, being ascribed to the subfamily Collignoniceratinae along with *Subprionocyclus*. In view of some resemblance between the type-species of *Miotexanites* and *Subprionocyclus bravaisianus*, I am rather inclined to ascribe the origin of *Miotexanites* in *Subprionocyclus*. The similairty between *Miotexanites* and *Niceforoceras* may be so to speak a sisterhood relationship. Unfortunately the suture of the type-species of *Niceforoceras* is not clearly known. In spite of the aberration in the ornamentation, *Miotexanites* keeps the suture of normal collignoniceratid pattern.

I presume that *Miotexanites* is a degenerated offshoot which does not seem to have given rise to further texanitine genera.

Distribution.—In our present knowledge *Miotexanites* is very rare, occurring in the Lower Senonian (probably Upper Coniacian to Lower Santonian) of Hokkaido.

Protexanites (*Miotexanites*) *minimus* sp. nov.
Pl. 33 [37], Figs. 1–3; Text-fig. 8 [82]

Holotype.—GK. H5634 [=Mikasa High School Coll. 114], from 11 km. point, main stream of the Ikushumbets.

Specific diagnosis.—The shell, so far known, is small, discoidal and rather evolute. The whorl is somewhat higher than broad, with a proportion of about 10 : 8, in the late stage and still higher in early stages. The venter is gently arched, passing through the slant and blunt ventrolateral shoulders to the slightly convex or nearly flat and parallel flanks. The umbilical shoulder is abruptly rounded. The umbilicus is fairly wide in the late growth-stage but narrower in earlier stages. It is surrounded by a low but steep umbilical wall.

The ribs are numerous but weak, somewhat prorsiradiate on the flank and bent fairly strongly forward on the ventral part. Some of them show a sinuosity on the inner whorl. They are as a rule alternately long and short, but may be irregularly disposed in some part. The longer one has a small but distinct tubercle at the umbilical shoulder. The shorter one arises near the umbilical tubercle of the adjacent longer one or may be occasionally disposed as if it is branched from the latter. The interspaces are nearly as narrow as the ribs but may sometimes become irregular. A few of them are occasionally somewhat deeper than others and look like indistinct constrictions. As the ribs are weak on the flank, the striae or fine riblets are discernible, covering the ribs and the interspaces. Although the ribs are weakened on the main part of the flank, they become to take a moderate intensity on the ventral part and end at the ventral tubercles.

The ventrolateral tubercles are unusually weak but discernible on the outer whorl. The ventral tubercles are moderately distinct and shortly clavate.

The ventral keel is rather narrow, continuous and, almost entire, but occasionally interrupted by a shallow constriction. It is slightly higher than the ventral tubercles in the early growth-stages and as low as the latter in the late stage. It is bordered on either side by a narrow and shallow groove. The ventral area demarcated between the rows of ventral clavae is narrow, being about one third of the breadth in the outer whorl.

The suture is of collignoniceratid type, with a roughly U-shaped outline of the lateral lobe (L). The second lateral saddle is somewhat higher than the first and the auxiliaries are less descending.

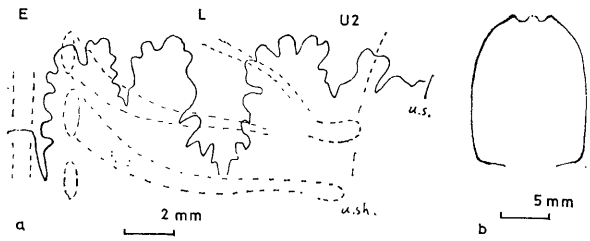

Fig. 8 [82]. *Protexanites* (*Miotexanites*) *minimus* sp. nov. External suture (a) at whorl-height=15 mm. and a diagrammatic whorl-section (b) of the holotype, GK. H5666. (T. M. *delin.*)

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
GK. H5634	52.5(1)	21.3(.40)	19.4(.37)	16.2(.31)	.84
〃 (−180°)	37.0(1)	12.5(.34)	13.8(.37)	11.5(.31)	.83
〃 (−360°)	25.5(1)	8.2(.32)	11.2(.44)	8.4(.33)	.75

Remarks.—Only a single specimen is available, but its characters are sufficiently diagnostic for the distinction from other species.

Comparison and affinity.—This species is similar to *Protexanites canaensis* (GERHARDT) (1897, p. 74, pl. 1, fig. 2a, b, c; text-fig. 2), from the Lower Senonian of Rubio, Venezuela, with respects to the evolute coiling of the outer whorl, somewhat higher whorl and nearly parallel flanks. It is, however, distinguished from this and other species of *Protexanites* by its much weakened, crowded ribs on the flank and unusually retarded and weakened ventrolateral tubercles. The ventral clavae are smaller than in others. The ventrolateral shoulder is more slanting.

P. (M.) minimus is somewhat allied to *Subprionocyclus bravaisianus* (D'ORBIGNY) (1841, p. 308, pl. 91, figs. 3–4) (ROMAN and MAZERAN, 1913, p. 22, pl. 1, figs. 13–17; MATSUMOTO, 1966, p. 360, pl. 40, figs. 1–8), from the Upper Turonian of France and Japan, in its discoidal, compressed shell, numerous, prorsiradiate ribs, which are projected on the venter, and the mode of disposition of longer and shorter ribs, although the ribs are unusually weakened on the flanks of *P. (M.) minimus*. Thus, the ultimate, if not direct, origin of *Protexanites (Miotexanites) minimus* could possibly be sought in such a species as *Subprionocyclus bravaisianus*. Incidentally *Protexanites (Protexanites) strozzii* (DESIO) (1920, p. 204, pl. 12, fig. 8) seems to be closer to *S. bravaisianus* in the distinctness of ventrolateral tubercles. It has a wider umbilicus and stronger ribs than *P. (M.) minimus*.

Niceforoceras columbianum BASSE (1948, p. 694, pl. 25, fig. 2), from the Coniacian of Colombia, a probable derivative of a species of *Subprionocyclus*, resembles *P. (M.) minimus*, but its whorl is involute and its ventral keel is weakly serrate. The species which was called *Niceforoceras* (?) *japonicum* MATSUMOTO (1965, p. 71, pl. 11, fig. 1; text-fig. 40), from Hokkaido has an entire ventral keel and is, in the present knowledge, better ascribed to *Protexanites (Miotexanites)*. Its shell has a narrower umbilicus and its inner ventrolateral tubercles seem to be still more delayed to appear. The auxiliaries of its suture are strongly descending.

Occurrence.—The holotype was obtained in a calcareous nodule from the mudstone of the Upper Yezo Group, at 11 km. point (measured on the abandoned forestry railway) along the main stream of the Ikushumbets, Ishikari Province, Hokkaido. This part of the Upper Yezo Group is probably Coniacian or Lower Santonian.

Genus Paratexanites COLLIGNON, 1948

Type-species.—*Mortoniceras zeilleri* DE GROSSOUVRE, 1894, by original designation (COLLIGNON, 1948, p. 45).

Generic diagnosis.—The shell is large or moderate in size, rather evolute,

with a more or less wide umbilicus. The whorl is typically subquadrate and in some species subrectangular in section. The ventral keel is continuous, smooth or weakly undulated, bordered on either side by a furrow or a narrow, concave, smooth zone.

On the outer whorls the ribs are simple, rectiradiate or slightly prorsiradiate. On the inner whorl they are also mostly simple, but some of them may be bifurcated or alternated with shorter ones and may be gently flexuous. The ribs are provided with the tubercles in four rows, the umbilical, the lower and the upper ventrolateral, and the ventral ones. The last three are rather approximated as compared with the distance between the umbilical and the lower ventrolateral tubercles, although the distance may vary as the shell grows. The umbilical tubercles are prominent and may be shifted upward or become bullate on the outer whorl.

The suture is of typical collignoniceratid pattern, consisting of E, L, U_2, U_3 (=S), U_1, I, with massive, lateral saddles and less deeply indented lobes.

Subgeneric distinction.—The lower and the upper ventrolateral tubercles are approximated on the inner whorls, but in more or less late growth-stages they tend to be separated. In some species the separation is so remarkable that the three tubercles, lower and upper ventrolateral and ventral ones, become nearly equidistant and independent. In others the lower and upper ventrolateral tubercles are kept to be close to each other, sometime standing on the commonly elevated base, even on the outer whorl. The former is represented by *Mortoniceras zeilleri* GROSSOUVRE itself and the latter by *Ammonites serratomarginatus* REDTENBACHER, 1873, and also by *Ammonites emscheris* SCHLÜTER, 1876 (emended below). The latter species group had already received the subgeneric name *Parabevahites* COLLIGNON, 1948 (p. 63 [=18]), with designation of *A. serratomarginatus* as the type-species. Although *Parabevahites* was originally established as a subgenus of *Bevahites* COLLIGNON, 1948, it is more closely allied to *Paratexanites* (s. s.), as I discussed previously (MATSUMOTO, 1955). Therefore it is better to assign *Parabevahites* to a subgenus of *Paratexanites*, as WRIGHT (1957, p. L432) did. Incidentally the two names were established in a paper of one and the same title by COLLIGNON (1948), but they were written in different pages in different numbers of *Annales géologiques du services de Mines*— : *Parabevahites* in p. 63 [=18] of Fascicule n° XIII and *Paratexanites* in p. 45 [=102] of Fascicule n° XIV. On the assumption that the dates of issue of the two numbers were simultaneous, WRIGHT's (1957) designation of the subgenus *Parabevahites* under the genus *Paratexanites* would be legitimate. If the issue of Fascule n° XIII had preceded that of Fascule n° XIV, I should designate the subgeneric name *Paratexanites* under the generic name *Parabevahites*, but no documentation is available to show such precedency in the date of issue.

Remarks.—Aside from the type-species, there have been some confusion as regards the generic or subgeneric assignment of several species. I should give here some remarks on the basis of my study of the original specimens.

DE GROSSOUVRE (1894, p. 67) included in his *Mortoniceras zeilleri* a part of "*Ammonites texanus*" of SCHLÜTER (1867, p. 32, pl. 6, figs. 1a, 1b only, *non* ROEMER, 1852), from the Emscher Marl of Westphalia, Germany. This was,

however, misled by an incorrect illustration of SCHLÜTER. The original specimen of this particular figure, GIB. No. 26, which I examined at the University of Bonn, does have five rows of tubercles. The tubercles of the lower lateral row are distinct only for a limited period of the middle growth-stage and weak or indistinct in other parts. The upper lateral and ventrolateral tubercles are rather clavate and not so rounded as in SCHLÜTER's sketch. This specimen is a secondarily compressed example of a species of *Texanites*, which is fairly close to *T. sanushibensis* (YABE and SHIMIZU) described in another page. The exclusion of this specimen from *Paratexanites* should, of course, imply the designation of the French specimen (DE GROSSOUVRE, 1894, pl. 14, fig. 1a, 1b) as the **lectotype** of *Mortoniceras zeilleri*.

Ammonites emscheris SCHLÜTER, 1876, is rather complex. Of the syntypes, which SCHLÜTER took into consideration for the establishment of this species, the one illustrated by SCHLÜTER, 1876 in his pl. 42, figs. 8–10 is designated here as the **lectotype** of *A. emscheris*. This is indeed a good example of *Paratexanites* (*Parabevahites*), since its ventrolateral tubercles are doubled even in the late growth-stage. But it is a fragmentary outer whorl. As the characters of the inner whorls are not known, *Paratexanites* (*Parabevahites*) *emscheris* cannot be said to be a well defined species, unless further collections from the type-locality could fulfill the deficiency. Contrary to DE GROSSOUVRE (1894, p. 69), however, I would not regard *P.* (*Parabevahites*) *emscheris* (SCHLÜTER, 1876) as a synonym of *P.* (*Parabevahites*) *serratomarginatus* (REDTENBACHER, 1873) (see also discussion in page 262).

SCHLÜTER (1876, p. 155) included in his *Ammonites emscheris* a magnificent specimen, from a glauconitic marl of Stoppenberg (probably), Westphalia, Germany, which was described by himself under *Ammonites texanus* (SCHLÜTER, 1872, p. 41, in part, pl. 12, figs. 1, 2, 3) (*non* ROEMER, 1852). This is GIB. No. 42, which I studied at the University of Bonn. It is not identical with *Paratexanites* (*Parabevahites*) *emscheris*, because its whorl is not so broad and its two ventrolateral tubercles are not so approximated as in that species. I propose here ***Paratexanites* (*Paratexanites*) *rex*** sp. nov., designating GIB. No. 42 (Text-fig. 9 [83] of this paper) as its holotype. This species is characterized by a large evolute shell (e.g. about 280 mm. in diameter in the holotype), high whorls having a subrectangular costal section with proportion of height to breadth about 10 : 7, nearly parallel flanks, abrupty rounded umbilical shoulders, steep and nearly vertical umbilical wall, sloping ventrolateral shoulders on the intercostal part, a narrow ventral area, with the breadth between the rows of ventral clavae somewhat narrower than a half of the whorl-breadth, simple, thick, rectiradiate ribs separated by much wider interspaces throughout most of growth-stages, umbilical bullae which are elevated at some distance above the umbilical margin in the lower part of the flank, promient, angular to subangular, very thick, inner ventrolateral tubercles, somewhat clavate, outer ventrolateral tubercles, fairly large ventral clavae which are much higher than the low keel at the middle of the venter, and the suture of normal collignoniceratid type, in which the second lateral saddle is somewhat higher than the first. The ribs are especially thickened at and near the ventrolateral shoulder. Therefore the three

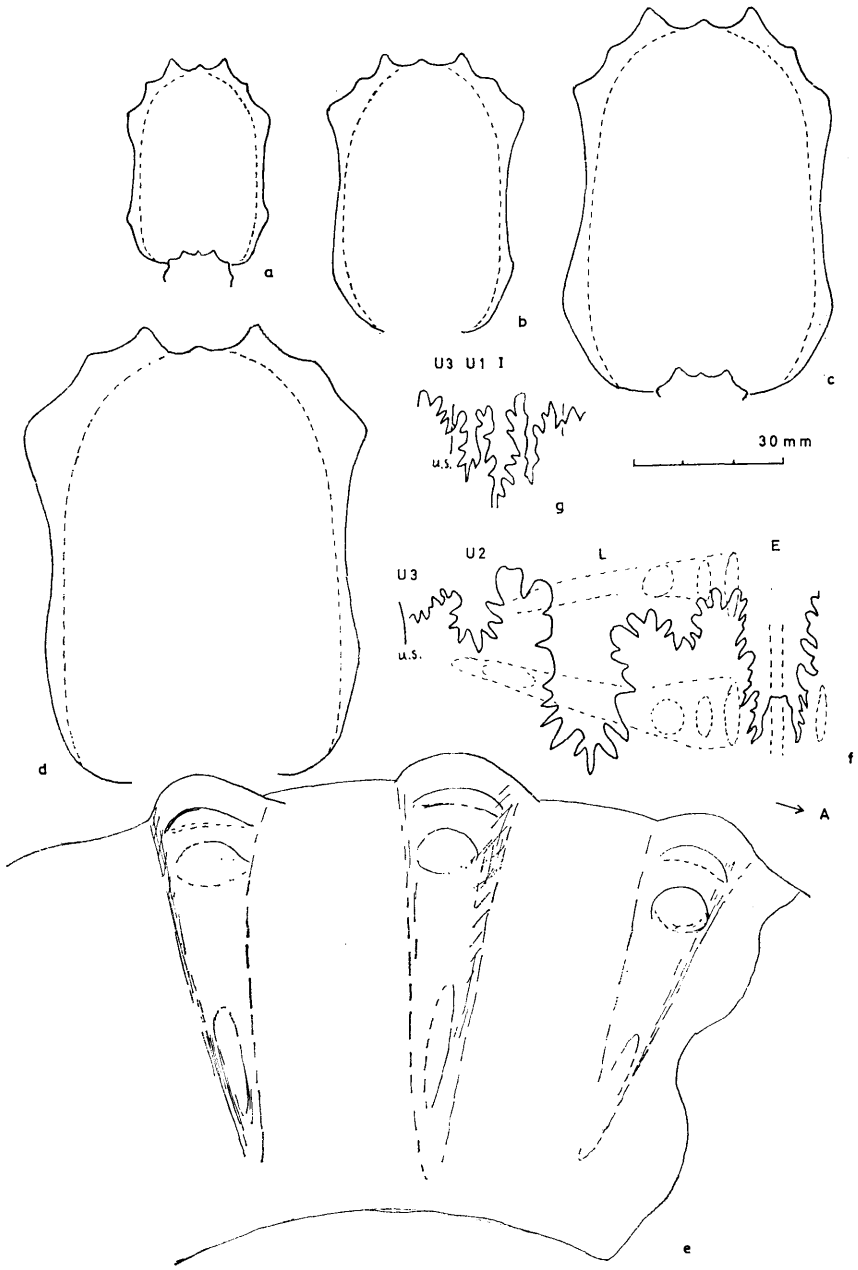

Fig. 9 [83]. *Paratexanites* (*Paratexanites*) *rex* sp. nov. Whorl-sections (a–d) at various growth-stages, laterial view of a part of the outer whorl (e), external suture (f) at the stage of d–e and internal suture (g) near the stage of b. Holotype, GIB, No. 42 [=*Ammonites texanus* of SCHLÜTER 1872, pl 12, figs. 1, 2] [=*Ammonites emscheris* SCHLÜTER, 1876, one of the syntypes]. (T. M. *delin.*)

tubercles, inner and outer ventrolateral and ventral, look as if they rest on a thick common base. They are nearly equidistant in the middle growth-stage, but in the last-stage the outer ventrolateral tubercle is somewhat closer to the ventral tubercle than to the inner ventrolateral one.

A fragmentary specimen, from the glauconitic marl of Stoppenberg, Germany, which was described at first under *Ammonites texanus* by SCHLÜTER (1867, p. 32, in part, pl. 6, fig. 3) and later transferred to *Ammonites emscheris* by himself (SCHLÜTER, 1876, p. 155) is preserved at the University of Bonn, with the register number GIB. No. 26a. It is a poorly preserved, secondarily deformed specimen (Text-fig. 10), which was too much restored in SCHLÜTER's figure. It is regarded as a fragmentary inner whorl of *Paratexanites* (*Paratexanites*) *rex* and not an example of *Mortoniceras desmondi* (DE GROSSOUVRE, 1894), because it has distinctly clavate ventral tubercles and because its outer ventrolateral tubercle is not approximated to the ventral one.

The original specimen of *Mortoniceras desmondi* DE GROSSOUVRE, 1894, from the calcareous sandstone at the Coniacian-Santonian boundary of the Bobinettes, near Montignac, France, was not illustrated and, accordingly, I was unable to examine it. Judging from DE GROSSOUVRE's description, it is rather peculiar in that the ventral tubercles are not clavate and that they are approximated to the outer ventrolateral tubercles. Without seeing the specimen itself, I cannot tell the correct systematic position of this species.

A fragmentary septate specimen, from the middle part of the Santonian in Madagascar, which was illustrated under *Parabevahites* cf. *emscheris* by COLLIGNON (1966, p. 80, pl. 488, figs. 1966) is indeed similar to *Paratexanites* (*Paratexanites*) *emscheris* (SCHLÜTER) but has, according to COLLIGNON, a minute tubercle at the middle of the flank. I would rather point out that it is indistinguishable from the inner whorl of *Texanites* (*Plesiotexanites*) *stangeri* ("var. *sparsicosta* of SPATH), as will be discussed later.

Comparison and affinity.—*Paratexanites* resembles *Protexanites* but is distinguished by the two, instead of one ventrolateral tubercles on each rib.

The ontogenetic development shows that the two ventrolateral tubercles in the genus *Paratexanites* are developed by the doubling of, or the addition to, a

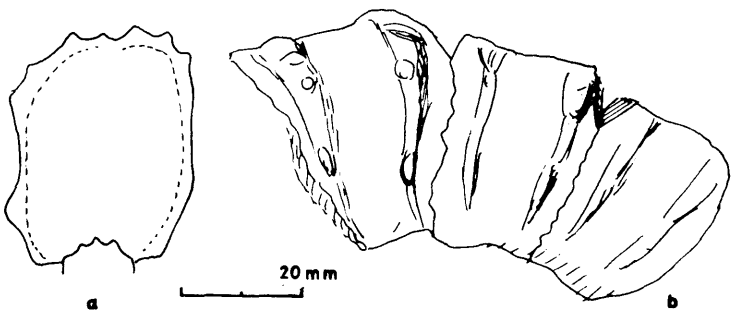

Fig. 10 [84]. *Paratexanites* sp. cf. *P.* (*Paratexanites*) *rex* sp. nov. Whorl-section (a) and lateral view (b) of GIB. No. 26a [=*Ammonites texanus* of SCHLÜTER, 1867, pl. 6, fig. 3] [*Ammonites emscheris* SCHLÜTER, 1876, one of the syntypes]. (T. M. *delin.*)

single ventrolateral protuberance. For this reason it is strongly suggested that *Paratexanites*, including the subgenera *Paratexanites* and *Parabevahites*, came from *Protexanites*.

In fact, as YOUNG (1963, p. 79) pointed out, *Paratexanites* (*Paratexanites*) *zeilleri* (DE GROSSOUVRE) is allied to *Protexanites bourgeoisi* (D'ORBIGNY) and *Paratexanites* (*Parabevahites*) *sellardi* YOUNG is so to *Protexanites planatus* (LASSWITZ). As will be described in later pages, there are two new species of *Paratexanites* (*Paratexanites*) (i.e. *P.* (*P.*) *compressus* and *P.* (*P.*) *mikasaensis*) which are closely allied to *Protexanites bontanti* (DE GROSSOUVRE) and to *Protexanites canaensis* (GERHARDT) respectively. Again, a new subspecies of *Paratexanites* (*Parabevahites*) *serratomarginatus* (REDTENBACHER), to be defined in later pages, is related to *Protexanites bourgeoisi*.

The available data of stratigraphic occurrences show, however, that the two allied species were nearly contemporary (as in the case of *Pro. bourgeoisi* and *Para. serratomarginatus*) or even a species of *Paratexanites* (e.g. *P. zeilleri* from the base of the Chalk of Villedieu) apparently occurs in older bed than that of *Protexanites* (e.g. *P. bourgeoisi* from the middle part of the Chalk of Villedieu).* With regard to *Pro. planatus* and *Para. sellardsi*, YOUNG (1963, text-fig. 3) assumed a longer stratigraphic range of the former, which appeared earlier than the latter but disappeared simultaneously.

Speaking precisely, the true ranges of the closely allied coupled species should be more carefully examined and more study might be required to trace the true lineage or to follow the line of evolution from a population to another. In our actual state, ammonites of *Protexanites* and *Paratexanites* do not occur so abundantly and so successively in the hitherto known stratigraphical sequences as to meet these requirements.

Precise remarks are hardly given as regards the relation between *Paratexanites* (s. s.) and *Parabevahites*. On the grounds of ontogeny *Parabevahites* could be interpreted as having caenogenetically evolved from *Paratexanites* (s. s.) or *Paratexanites* (s. s.) could be led from *Parabevahites* through acceleration. It is also possible to presume that they were derived from a common ancestor deviating to some extent from each other. The available lines of evidence seem to suggest that there was the last case for some species, but the first case could be considered for other species, since some species of *Parabevahites* seem to have appeared at a higher stratigraphical level than those of *Paratexanites* (s. s.).

The double tubercles at the ventrolateral shoulder of the subquadrangular whorl of *Parabevahites* seem to have been inherited by the genus *Bevahites* of the Campanian. The latter acquired, in addition to the characters of *Parabevahites*, a row of lateral tubercles and multiplied ventral tubercles.

Distribution.—Species of *Paratexanites* (including the subgenera *Paratexanites* and *Parabevahites*) are recorded to occur in the Coniacian to the Middle Santonian of Europe (Germany, France, Spain and Austria), northern Africa (Tunisia), South Africa, Madagascar, North America (Texas) and Japan.

* WIEDMANN (1960) added new information about the occurrence of the two genera in Spain.

Subgenus *Paratexanites* COLLIGNON, 1948

Paratexanites (Paratexanites) orientalis (YABE)

Pl. 34 [38], Fig. 2; Pl. 35 [39], Figs. 1–2; Text-figs. 11 [85]–12 [86]

1925. *Mortoniceras orientale* YAEB *in* YABE and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, 2nd. ser. vol. 7, no. 4, p. 129 [5], pl. 31 [2], fig. 4, 5; pl. 33 [4], fig. 16.
1948. *Parabevahites orientalis*, COLLIGNON, *Ann. Géol. Serv. Mines* (Madagascar), fasc. 14, p. 53.
1955. *Paratexanites orientalis*, MATSUMOTO, *Trans. Proc. Pal. Soc. Japan*, N. S., no. 18, p. 41.

Material.—Holotype, by original designation, IGPS. 7329 (YABE and SHIMIZU, 1925, p. 129, pl. 31, figs. 4, 5; pl. 33, fig. 16). Other examples, GK. H5505, from loc. Ik 1301b, Ikushumbets, 7 km point along the forestery railroad; unnumberred specimen in MURAMOTO's collection from the Ichi-no-sawa, Ikushumbets, now preserved in the Muramoto Museum, Yayoi, Mikasa, Hokkaido.

Specific characters.—The whorl is evolute and widely umbilicate. It is much broader than high in the immature stages, with a broad subrectangular section, and becomes in the adult stage to be less depressed and to have a more arched venter, with sloping ventrolateral shoulders.

In early growth-stages the two ventrolateral tubercles are approximated, lying on a common major protuberance. They become to be separated and independent in comparatively late growth-stages, resulting in the nearly equidistant disposition of the rounded inner ventrolateral, somewhat clavate outer ventrolateral, and much clavate ventral tubercles. The entire keel at the mid-venter scarcely exceeds in height the ventral tubercles. The ribs are much distant, fairly strong, nearly rectiradiate or slightly concave. They are less numerous on the inner whorl than on the outer whorl. The umbilical tubercles are rounded and situated at the umbilical shoulder on the inner whorls. They are shifted upwards and bullate on the outer whorl.

Measurements.—

Specimen [Part]	Diameter	Umbilicus	Height	Breadth	B./H.
IGPS, 7329	106.0	50.3(.47)	33.5(.31)	35.0(.31)	1.05
[—1/2vol.]	80.0	36.0(.45)	25.3(.32)	32.3(.40)	1.27
GK. H5505	81.3	36.2(.45)	26.7(.33)	31.2(.38)	1.17
[—1/2vol.]	—	—	19.5	24.2	1.24
MURAMOTO's	67.5	26.7(.39)	25.4(.38)	30.0(.44)	1.18

Remarks.—The holotype is the largest, having a diameter of about 115 mm., but is still septate at its anterior end. Its inner whorls, below 50 mm. in diameter, are not well preserved, but the characters of the corresponding stages are observable on two other specimens.

As is suggested by the figures of the above measurements, some variation seems to exist in the ratio of height to bread of the whorl, even if the shells of the same size are compared. In other words, a characteristically depressed whorl changes to a less depressed one at more or less late growth-stage, depending on individuals. The true extent of variation should be determined by collecting

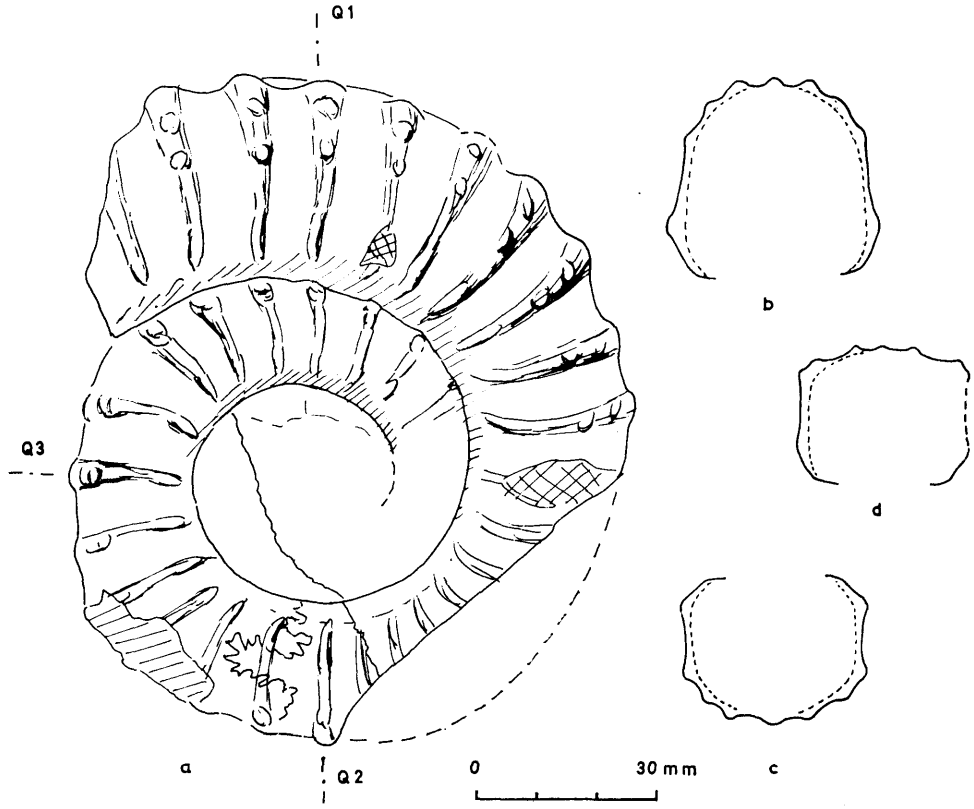

Fig. 11 [85]. *Paratexanites* (*Paratexanites*) *orientalis* (YABE). Sketch of lateral view (a) and diagrammatic whorl-sections (b, c, d) at Q1, Q2, Q3 of the holotype, IGPS. 7329. (T. M. *delin.*)

and measuring more specimens.

Similarly the stage at which the approximated ventrolateral tubercles begin to be separated seems to vary to some extent, for example, at the diameter of about 80 mm. in the holotype and at that of about 60 mm. in GK. H5505 and another specimen.

The number of the ribs per whorl is, for example, 14 in the diameter of 50 mm., 16 in that of 65 mm. (of MURAMOTO's specimen), 20 in that of 80 mm. (of GK. H5505), and 25 in that of 110 mm. (holotype).

Comparison.—This species is closely allied to *Paratexanites* (*Paratexanites*) *zeilleri* (DE GROSSOUVRE) (1894, p. 67, pl. 14, fig. 1), from the Coniacian limestone at the base of the "craie de Villedieu," and also to *Paratexanites* (*Paratexanites*) *umkwelanensis* (CRICK) (1907, p. 228, pl. 15, fig. 9) (MATSUMOTO, 1955, p. 14, text-fig. 2), from the Senonian of South Africa, but is distinguished by much broader whorls in the immature stages. In the latter two species the clavate ventral tubercles are more elevated, exceeding distinctly the height of the ventral keel, but in *P. orientalis* the ventral tubercles are not so prominent, being nearly as high as or only slightly higher than the ventral keel (compare text-fig. 2 of MATSUMOTO, 1955, and pl. 14, fig. 1b of GROSSOUVRE, 1894, with Figs. 11–12 of

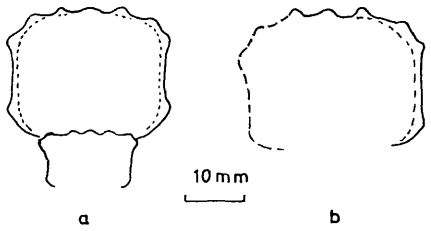

Fig. 12 [86]. *Paratexanites* (*Paratexanites*) *orientalis* (YABE). Diagrammatic whorl-sections of GK. H5505 (a) and MURAMOTO's specimen (b). (T. M. *delin.*)

this paper). The ribs are almost always rectiradiate on the flank in *P.* (*P.*) *zeilleri* and *P.* (*P.*) *umkwelanensis*, but some of the ribs of *P.* (*P.*) *orientalis* show a gently concave curvature.

The distinction between *P.* (*P.*) *zeilleri* and *P.* (*P.*) *umkwelanensis* seems to be little. So far as the holotypes of the named species are concerned, the former has slower rate in the growth of whorls and has a broader umbilicus. If a sufficient number of individuals were available, the distinction between the French and the South African groups might be demonstrated as subspecific.

Occurrence.—The locality of the holotype is recorded as "the Shiyûparo [=Shuyubari], one of the main branches of the Yubari, Ishikari Province, in the text of YABE and SHIMIZU, 1925, p. 130 [6], but as "the Kikumezawa, near its junction with the Ikushumbets, Sorachi-gun, Hokkaido the Upper Ammonites Beds" in the explanation of plate 31 [2], figs. 4, 5 [rect.]. The second locality is close to loc. Ik 1301b, where GK. H5505 was obtained, Ikushumbets, 7 km. point along the forestery railroad, the zone of *Inoceramus mihoensis*, Upper Coniacian, of the Upper Yezo Group. Another specimen of the MURAMOTO Collection is probably from the same zone exposed along the stream of the Ichi-no-sawa, a tributary of the Ikushumbets.

Paratexanites (*Paratexanites*) *compressus* sp. nov.

Pl. 36 [40], Figs. 4, 5; Text-fig. 13 [87]

Material.—Holotype, GK. H5511, from loc. Ik 882, Inari-zawa, a tributary of the Ikushumbets, Ishikari Province, collected by N. KAMBE. Paratype, GK. H5531, from loc. 12-0404, Hobets, Iburi Province, collected by W. HASHIMOTO.

Specific characters.—The shell is small and compressed. The coiling is comparatively less evolute than in other species of the genus, the outer whorl embracing about one third of the inner one. The whorl is distinctly higher than broad, with flattened flanks and a narrow venter. It grows fairly rapidly in height. The umbilicus is shallow and of moderate size, bordered by a low but steep or rather overhanging wall.

The ribs are comparatively numerous and fairly crowded, separated by somewhat narrower interspaces. They are more or less flattened, becoming broad and low in the late growth-stage. Some of them spring in pairs from the

umbilical tubercles; others are single and alternated with slightly shorter ones. Some of them are gently sinuous on the flank and all of them are curved forward at the ventrolateral shoulder.

The umbilical tubercles are small but distinct, highest at the umbilical shoulder and bullate for a short distance along the rib. The outer and inner ventrolateral tubercles are approximated in the early stage, but sooner or later, after the shell diameter of 30 mm. or so, they are separated, the inner ones being shifted inward on the flank and the outer ones situated at the ventrolateral shoulder. They are more or less clavate; the outer ones are more clavate and more distinct than the inner ones. The ventral tubercles are the most clavate and the highest.

The median keel is narrow, continuous and smooth, but may be weakly undulated on some specimens. The interspace between the keel and the ventral clavae looks like a furrow. The top of the keel is nearly as high as or slightly lower than that of the ventral tubercles.

The first lateral lobe (L) is fairly deep and has a subrectangular general outline. The first lateral saddle (between E and L) is subquadrate and bipartite.

Measurements.—

Specimen (Part)	Diameter	Umbilicus	Height	Breadth	B./H.
GK. H5511 (−1/2vol.)	41.5(1)	12.7(.31)	18.2(.43)	13.0(.31)	0.7
GK. H5531*	57.5(1)	20.0(.35)	23.5(.41)	15.6(.27)	0.66

* secondarily compressed

Comparison and affinity.—This species is clearly distinguished from *Paratexanites* (*Paratexanites*) *zeilleri* (DE GROSSOUVRE, 1894) by its less evolute and more compressed whorls and more crowded, somewhat flexuous, sometimes bifurcating, flatter ribs. Its umbilical tubercles are elevated at the umbilical shoulder instead of above the shoulder and its ventrolateral tubercles are thinner and more clavate than those of the latter species.

The holotype and the paratype (GK. H5531) of the present species closely resemble the holotype of *Protexanites bontanti* (DE GROSSOUVRE) (1894, p. 77, pl. 17, fig. 2), from the Upper Coniacian of France, in every respect, except for the presence of two instead of one rows of ventrolateral tubercles. This fact, as well as the stratigraphic occurrence, suggests that *Paratexanites compressus* may have been derived from *Protexanites bontanti*.

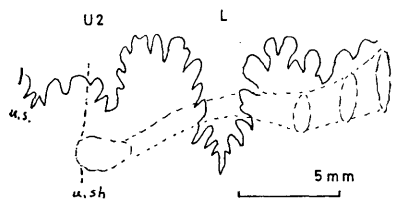

Fig. 13 [87]. *Paratexanites* (*Paratexanites*) *compressus* sp. nov. External suture of GK. H5531, excluding the unexposed ventral lobe (E). Dotted lines show the relative position of a rib and tubercles.
(T. M. *delin.*)

Occurrence.—The holotype came from loc. Ik 882, Inari-zawa, a branch in the upper reaches of the Ikushumbetsu, Ishikari Province, central Hokkaido. The locality is in the Santonian part of the Upper Yezo Group. The paratype came from loc. 12-0404 of Prof. W. HASHIMOTO, Upper Yezo Group, Iburi Province, central Hokkaido.

Paratexanites (*Paratexanites*) *muramotoi* sp. nov.
Pl. 37 [41], Fig. 1; Text-fig. 14 [88]

Holotype.—The illustrated specimen (Pl. 37, Fig. 1; Text-fig. 14) of T. MURAMOTO's collection, now preserved at Kyushu University, with register number H5645.

Specific characters.—The shell at 48 mm. in diameter is still septate. The coiling is rather evolute, with a line of overlapping at the row of ventrolateral tubercles. The whorl grows at a moderate rate, embracing an umbilicus of moderate width (u./d.=0.39). It is higher than broad in the measurable later stages, although the proportion of breadth to height cannot be accurately shown owing to the secondary compression. The whorl section is subrectangular, with flattened flanks.

The ribs are simple, fairly distant, separated by wider interspaces, counting 20 in the outer whorl and 15 in the next inner one. They are nearly rectiradiate or slightly prorsiradiate on the main part of the flank and at the ventrolateral shoulder bent abruptly forward in the early growth-stages, with outward broadening, and gradually so in the late growth-stage.

The umbilical tubercles are distinct at the umbilical shoulder and bullate. On the inner whorl up to 25 mm. in diameter the ventrolateral tubercles are prominent and somewhat spinose. At a stage between 25 mm. to 30 mm. in diameter on several ribs the ventrolateral tubercle is doubled, consisting of approximated outer and inner ones, of which the outer one is somewhat clavate. In the succeeding stage the outer ventrolateral tubercle is clavate and distinct but the inner one is gradually separated from the outer ones into the upper lateral part and at the same time much weakened, being about to fade away on the observable last part. The ventral tubercles are longly clavate throughout the ornate stages, forming a train on either side of a smooth ventral keel of moderate intensity, with a shallow groove inbetween.

The suture is of collignoniceratid type. The second lateral saddle is taller than the first. In the late growth-stages a roughly U-shaped general outline of the first lateral lobe (L) tends to be somewhat narrowed in the lower part and somewhat broadened in the upper part, showing an intermediate shape between U and V in its general outline.

Remarks.—Although a single specimen is available at present, the observed characters are so diagnostic that it deserves description under a new specific name. More specimens, including a body-whorl, should be searched for in the future.

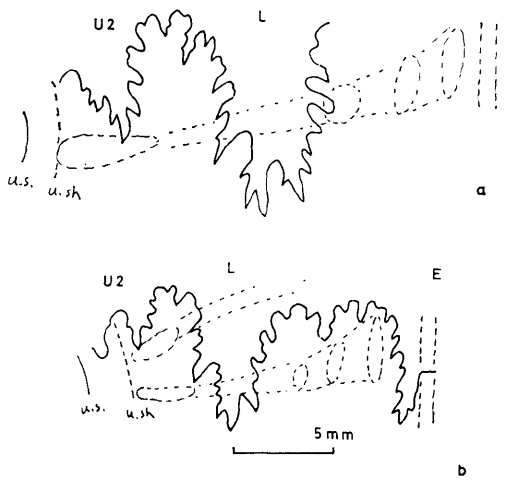

Fig. 14 [88]. *Paratexanites* (*Paratexanites*) *muramotoi* sp. nov. External sutures of the holotype, GK. H5645, at whorl-height of 18 mm. (a) and 12.5 mm. (b). b is about a half whorl earlier than a.
(T. M. *delin.*)

Comparison and affinity.—The species is interesting in that a distinct doubling of the ventrolateral tubercle like that of *Parabevahites* appears for a short time and soon the inner and outer ventrolateral tubercles are as much separated as those of typical *Paratexanites*. The inner ventrolateral tubercles are, however, shifted inward on the upper part of the flank and are unusually subdued.

The immature shell up to 25 mm. in diameter resembles in every respect that of *Protexanites* (*Protexanites*) *planatus* (LASSWITZ) and the shell up to 30 mm. in diameter is very similar to that of *Paratexanites* (*Parabevahites*) *sellardsi* YOUNG. The characters in later stages enable us to distinguish this species from these allied species.

Protexanites (*Protexanites*) *planatus* has a single row of strong ventrolateral tubercles throughout most of the growth stages. It has coarser ribs and thicker whorls.

In *Paratexanites* (*Parabevahites*) *sellardsi* the double ventrolateral tubercles persist to the late growth-stages.

Occurrence.—The holotype came from a fallen block at YYO53p of T. MURAMOTO, Isojiro-zawa, near Oyubari, below the confluence with its right tributary. It occurred along with *Gaudryceras tenuiliratum*. According to the geological map of Oyubari the most probably source is the lower part of the Upper Yezo Group (Coniacian to Lower Santonian).

Paratexanites (*Paratexanites*) *mikasaensis* sp. nov.
Pl. 37 [41], Figs. 2–3; Text-fig. 15 [89]

Holotype.—GK. H5510 [=T. MURAMOTO Coll. 593], from 17 km point, main

course of the Ikushumbets, Ishikari Province.

Specific characters.—The size of the shell is moderate. The whorl is rather evolute, somewhat higher than broad, subrectangular in cross-section.

The ribs are nearly rectiradiate, or slightly prorsiradiate and gently convex, on the flank and bent forward at the ventrolateral shoulder. They are mostly simple, with occasionally intercalated shorter ones, and separated by interspaces as narrow as or somewhat broader than the ribs themselves.

The umbilical tubercles are bullate, rather narrow but distinctly elevated at the umbilical shoulder. The inner ventrolateral tubercles are nodulous and prominently pointed. The outer ventrolateral tubercles are clavate and low. The ventral tubercles are much clavate, narrow but distinct. These three tubercles are nearly equidistant or the outer ventrolateral tubercles are slightly closer to the ventral tubercles. The keel at the middle of the venter is continuous, entire and rather low, being slightly lower than the top of the ventral clavae. There are shallow grooves between the keel and the trains of ventral clavae.

The suture is of collignoniceratid type. The first lateral lobe (L) is somewhat narrowed at its stem and tends to be expanded in the lower part by diverging branches. The elements are moderately incised in the late growth-stages.

Measurements.—

Specimen (Part)	Diameter	Umbilicus	Height	Breadth	B./H.
GK. H5510 (– 30°)*	79.0(1)	31.0(.38)	31 (.38)	27 (.38)	0.87
(–210°)	47.0(1)	20.3(.43)	18.5(.39)	16.3(.35)	0.88
(–300°)	—	—	16.0	13.4	0.84
*P. canaensis***	81 (1)	34 (.42)	32 (.40)	25 (.31)	0.78

* body whorl is secondarily depressed

** measurements by GERHARDT (1897, p. 74) for comparison

Remarks.—Only a single specimen is available at present and its body-whorl is somewhat deformed, but the specific characters are sufficiently diagnostic for the distinction from other species.

Comparison and affinity.—This species is distinguished from *Paratexanites (Paratexanites) zeilleri* (DE GROSSOUVRE), the type-species, by its more compressed whorls and more crowded ribs. The umbilical tubercles are highest at

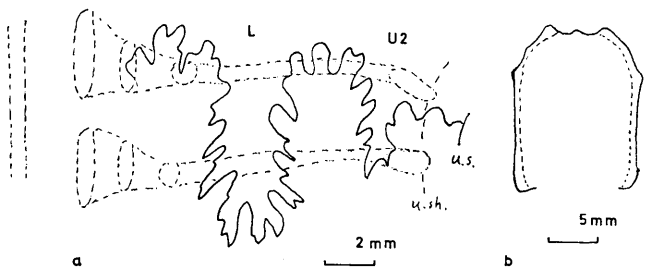

Fig. 15 [89]. *Paratexanites (Paratexanites) mikasaensis* sp. nov. External suture (a) (excluding the unexposed ventral lobe) at whorl-height= 16mm. and diagrammatic whorl-section (b) of the holotype, GK. H5510. (T. M. *delin.*)

the umbilical shoulder in this species but at the point at some distance above the umbilical shoulder in *P.* (*P.*) *zeilleri.* The outer ventrolateral tubercles are unusually low and indistinct in the present species.

The holotype of *Paratexanites* (*Paratexanites*) *mikasaensis* considerably resembles the illustrated syntype of *Protexanites canaensis* (GERHARDT) (1897, p. 74, pl. 1, fig. 2a, b, c; text-fig. 2), from the Lower Senonian of Rubio, Venezuela, but is distinguished by the addition of low, outer ventrolateral tubercles. In the former the proportion of breadth to height (B./H.) is slightly larger and the ribs are less distant and somewhat more numerous than in the latter, but the differences in these respects are by no means great. It is, therefore, strongly suggested that *Paratexanites mikasaensis* may have been derived from such a species as *Protexanites canaensis.*

On the immature whorl of about 25 mm. diameter of the holotype of *P. mikasaensis* the outer ventrolateral tubercles are extremely feeble but not approximated to the more prominent inner ones. In other words the outer ventrolateral tubercle did not originate in the doubling of a single inner ventrolaterla tubercle but is added at some distance from the latter. This exemplifies one of the ways of developing two rows of ventrolateral tubercles in *Paratexanites.* It is considerably different from the case of *Paratexanites orientalis* and that of *Paratexanites compressus.*

Occurrence.—The holotype was collected from a nodule in the mudstone of the Upper Yezo Group at 17 km point in the upper reaches of the main stream of the Ikushumbets, Ishikari Province, central Hokkaido. Judging from this locality and the associated fragment of *Inoceramus* sp. cf. *I. yubarensis* NAGAO and MATSUMOTO or *I. amakusensis* NAGAO and MATSUMOTO, an age of upper K5α to lower K5β, i.e. approximately Upper Coniacian to Lower Santonian is suggested for the described ammonite.

Subgenus *Parabevahites* COLLIGNON, 1948

Paratexanites (*Parabevahites*) *serratomarginatus* (REDTENBACHER)

Pl. 36 [40], Figs. 1–3; Text-fig. 16 [90]

1873. *Ammonites serrato-marginatus* REDTENBACHER, *Abh. K. K. Geol. Reichsanst.*, Bd. 5, Heft 5, p. 110 [20], pl. 25, fig. 2a–d.
1894. *Mortoniceras serrato-marginatum,* DE GROSSOUVRE, *Recherches sur la Craie supérieure,* II, p. 69, pl. 16, fig. 1a–b.
1907. *Mortoniceras serrato-marginatum,* PERVINQUIÈRE, *Etudes paléontologie tunisienne,* I, p. 242.
1948. *Bevahites* (*Parabevahites*) *serrato-marginatus,* COLLIGNON, *Ann. Géol. Serv. Mines* (Madagascar) fasc. no. 13, p. 83 [38].

Types.—REDTENBACHER (1873, p. 110) established this species on seven specimens from the Marl of Glanegg, East Alps, of which two syntypes of different growth-stages were illustrated. They are preserved, according to the author, in the Museum of Carolino-Augusteum in Salzburg. As I have had no opportunity to look at the specimens, I depend on the description and illustration of

REDTENBACHER.

Material.—Three specimens from Hokkaido are before me:—GK. H5558, GK. H5628 and GK. H5629.

Specific characters.—The coiling of the shell is not much involute, about a quarter to one third (in height) of the inner whorl being embraced by the outer whorl.

The whorl is as high as broad or somewhat higher than broad, subquadrate to subrectangular in cross-section, with gently convex flanks. The umbilicus is of moderate width and surrounded by a low but steep, nearly vertical or slightly overhanging wall.

The ribs are considerably numerous, about 30 or more per whorl. They are fairly crowded in the immature stages, sometimes with bifurcated or inserted ones. On the outer whorl the ribs are mostly simple and become less crowded, being separated by interspaces which are as narrow as or somewhat broader than the ribs themselves. Each rib is gently broadened outward. It is slightly prorsiradiate on the flank and curved gently forward on the ventrolateral part.

The umbilical tubercles are bullate and most prominent at the umbilical shoulder. The inner ventrolateral tubercles are rather thin and shortly clavate. The outer ventrolateral tubercles are clavate, distinct, and are more approximated to the inner ventrolateral tubercles than to the ventral one. The last one is most remarkably clavate. The keel at the middle of the venter is rather narrow and entire, scarcely exceeding in height the top of the ventral clavae, and bordered on either side by a furrow between it and the row of ventral clavae.

The external lobe (E) is rather narrow and nearly as deep as the first lateral lobe (L). The first lateral saddle (between E and L) is large and squarish in the general outline, occupying the area of the three rows of outer tubercles, and divided by a moderately deep lobule into a broader outer branch and a narrower and more incised inner one. The first lateral lobe (L) is deep, somewhat widened above, narrowed in the middle and expanded to branches at the inner and outer corners of the bottom and has a bipartite lobule at the very bottom. The second lateral saddle is as narrow as the inner branch of the first lateral saddle. The second lateral lobe (U_2) is small and narrow. It is disposed somewhat obliquely immediately outside the umbilical shoulder. Minor incisions are

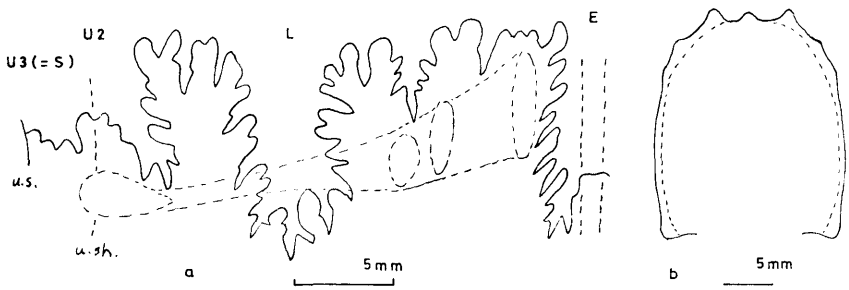

Fig. 16 [90]. *Paratexanites* (*Parabevahites*) *serratomarginatus* (REDTENBACHER). External suture (a) at whorl-height=22 mm. and diagrammatic whorl-section (b) of GK. H5628. (T. M. *delin.*)

comparatively deeper than in other species of *Paratexanites*.

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
REDTENBACHER 1873, p. 111	40	15 (.38)	15 (.38)	15 (.38)	1.0
GK. H5628	69	27 (.39)	27.5(.39)	25.0(.36)	0.91
〃 (−360°)	31	11.5(.37)	12.5(.40)	12.5(.40)	1.0
GK. H5629	—	—	16.2	14.2	0.88
GK. H5558	—	—	11.8	11.2	0.95
GROSSOUVRE, 1894 pl. 16, f. 1	127	51 (.40)	47 (.37)	47 (.37)	1.0

Remarks.—The three specimens from Hokkaido agree in every respect of the diagnosis with the syntypes from the Alps. The suture was incompletely described by REDTENBACHER. Its characteristic features described above are based mainly on those observed on the outer whorl of GK. H5628 from Hokkaido (Text-fig. 16).

Comparison and affinity.—This species was interpreted too comprehensively by DE GROSSOUVRE (1894, p. 69), who included *Ammonites emscheris* SCHLÜTER, 1876, from northern Germany, as a synonym. *Ammonites emscheris* SCHLÜTER (1876, p. 115, pl. 42, figs. 8–10) in a revised sense (see p. 249 of this paper) is indeed an example of *Paratexanites* (*Parabevahites*), but is distinguished from *P.* (*P.*) *serratomarginatus* in several unmistakable points. In *P.* (*P.*) *emscheris* the ribs are thicker, stronger, much more distant and rectiradiate, the umbilical tubercles are shifted outward from the umbilical shoulder to the lower lateral part, the inner ventrolateral tubercles are rounded, very strong and have a common base with the approximated, clavate outer ventrolateral tubercles, and the ventral tubercles are distinctly higher than the top of the median keel. The whorl-section is more quadrate in *P.* (*P.*) *emscheris* than in *P.* (*P.*) *serratomarginatus*.

The specimen from the "Couche à *Ostrea auricularis*", middle part of the Chalk of Villedieu, Touraine, France, illustrated by GROSSOUVRE (1894, p. 69, pl. 16, fig. 1a, b; text-fig. 31) under *Mortoniceras serrato-marginatum* is not quite identical with the illustrated syntypes of *P.* (*P.*) *serratomarginatus* from the eastern Alps in the stronger and more rounded inner ventrolateral tubercles which are more approximated to the outer ones, forming double ventrolateral major protuberances. In the French specimen the ventral keel shows weak undulations which correspond in number to the radial ribs, but in the Alpine specimens the keel is continuous and not undulated. Probably there would be difference in the details of sutures (see below).

Although REDTENBACHER dealt with seven specimens from the same bed, he recognized no specimens which deviate significantly from the illustrated syntypes.

DE GROSSOUVRE considered the difference as being due to the change in growth-stage. The inner whorl of the Villedieu specimen is indeed similar to the REDTENBACHER's specimens, but still the above described difference in the ventrolateral tubercles is recognized.

The described three specimens from Hokkaido agree with the syntypes of

REDTENBACHER and can be distinguished from the GROSSOUVRE's in the same way as remarked above. One of the three is as large as the earlier part of the outer whorl of the GROSSOUVRE's specimen, but its umbilical tubercles are elevated at the umbilical shoulder and do not show any tendency of shifting upward; its inner ventrolateral tubercles are thinner, weaker and more shortly clavate than the distinct outer ventrolateral ones, being never so strongly elevated as in the French specimen. Moreover, the first lateral lobe (L) of the latter is not narrowed at the middle part as in that of the Hokkaido specimen and minor incisions are shallower in the suture of the French one (compare Fig. 16 of this paper with Fig. 31 of DE GROSSOUVRE, 1894, p. 70).

With respect to the shell-form and the mode of ribbing no significant differences are found between the two groups of individuals under consideration, although there is some variation.

For the reasons of the above comparison, I am inclined to separate the Villedieu specimens as a distinct subspecies, proposing here a name of ***Paratexanites (Paratexanites) serratomarginatus grossouvrei***, subsp. nov., with the illustrated specimen of DE GROSSOUVRE (1894, pl. 16, fig. 1a, b), from the middle part of the Villedieu Chalk, designated as the holotype of the subspecies. DE GROSSOUVRE (1894) treated more specimens from other localities of France, but I have had no opportunity to examine them.

I cannot decide whether the large fragment from Skoenberg, Zululand, South Africa, mentioned by COLLIGNON (1948, p. 84 [39]) is referable to *P. (P.) serratomarginatus serratomarginatus* or *P. (P.) serratomarginatus grossouvrei* or otherwise, without seeing the specimen. I think it doubtful whether the specimens, from the Middle Santonian of Madagascar, illustrated by COLLIGNON (1966, p. 76, pl. 486, figs. 1962, 1963; p. 80, pl. 488, figs. 1967–1969) under *Parabevahites serrato-marginatus* or *Parabevahites* cf. *serratomarginatus* could be truly referred to the named species, because the illustrations seem to show a lateral row of tubercles. They may be inner whorls of a new subgenus (*Plesiotexanites*) of *Texanites* to be established in p. 267.

I cannot give good comments on the specimens from Tunisia described by PERVINQUIÈRE (1907, p. 242) under *Mortoniceras serrato-marginatum* without illustration. He mentioned, however, that one of them, from Dyr et Kef, is exactly conformable with the types from the Gosau Beds.

It is interesting to note that *P. (P.) serratomarginatus grossouvrei* is closely allied to *Protexanites bourgeoisi* (D'ORBIGNY) (DE GROSSOUVRE, 1894, p. 73, pl. 13, fig. 2; pl. 14, figs. 2–5), from the Coniacian of France, but is distinguished by the double ventrolateral tubercles in the former. The resemblance between the lectotype of the former with that of the latter (MATSUMOTO, 1966, p. 202, pl. 26, fig. 1a, b; text-fig. 1a, b) is especially remarkable. Presumably *Paratexanites (Parabevahites) serratomarginatus grossouvrei* may have been derived from *Protexanites bourgeoisi*. However, typical examples of the latter species occur from the same middle Villedieu Chalk as the former. Therefore, the two species could possibly have been derived from a common, not yet described ancestor of Lower Coniacian age, which, in turn, could have originated in *Subprionocyclus branneri* (ANDERSON, 1902) [=*Prionotropis cristatus* BILLINGHURST, 1927] (see

MATSUMOTO, 1959, p. 109; MATSUMOTO, 1965, p. 50).

It is, furthermore, interesting to see that in a number of syntypes of *Prot. bourgeoisi,* from France, there is a rare example (mentioned as an extreme variant by MATSUMOTO, 1966, p. 205, text-fig. 6) which is more similar to *Parat. (Parabevahites) serratomarginatus serratomarginatus,* except for the double ventrolaterla clavae in the latter.

Occurrence.—The Ikushumbets, a fallen nodule at "8 km point", i.e. approximately Ik 1301, near the boundary of K5α (Coniacian) and K5β (Santonian). Loc. Ik 2112, Go-no-sawa, Pombets, a tributary of the Ikushumbets, zone of *Inoceramus uwajimensis,* K5α (Coniacian). Another in a pebble obtained at loc. R215p, Kami-no-sawa, a branch of the upper reaches of the Kotanbetsu, northwestern Hokkaido.

Paratexanites (Parabevahites) sp. cf. *P. (P.) sellardsi* YOUNG
Pl. 30 [34], Fig. 1; Pl. 42 [46], Fig. 1; Text-fig. 17 [91]

Compare.—

1963. *Paratexanites (Parabevahites) sellardsi* YOUNG, *Univ. Texas Publ.* No. 6304, p. 79, pl. 32, fig. 7; pl. 36, figs. 3–5; pl. 37, fig. 1; pl. 39, fig. 4; pl. 49, fig. 3; text-fig. 17

Material.—Two small specimens, GK. H5630, collected by a student of Mikasa High School, and GK. H5525, collected by K. MATSUNO and K. TANAKA, Geological Survey of Japan, and transferred to Kyushu University.

Description.—The two specimens commonly show relatively evolute whorls, encircling an umbilicus of moderate width, a subquadrangular costal section which is nearly as high as broad at the shell diameter of 30 mm. or so, somewhat broader than high in younger stages and a little higher than broad in later stages, fairly distant simple ribs, about 20 per whorl, which are nearly rectiradiate or slightly prorsiradiate from the umbilical margin to the ventrolateral tubercle and projected there considerably toward the ventral clavae, with some outward

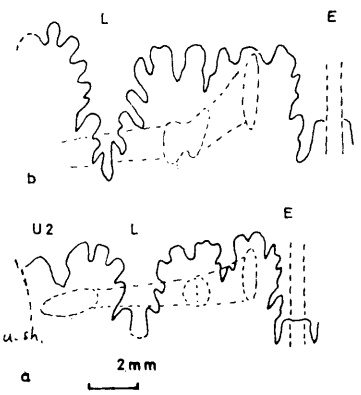

Fig. 17 [91]. *Paratexanites (Parabevahites)* sp. cf. *P. (P.) sellardsi* YOUNG. External suture (a) at whorl-height=8 mm. and (b) at about 90° later (part). (T. M. *delin.*)

broadening, small but distinct tubercles at the umbilical shoulder, prominent tubercles at the ventrolateral shoulder, which are doubled in the stages later than the diameter of 25 mm. or so, and longly clavate ventral tubercles, an entire siphonal keel which does not exceed the ventral clavae in height and are separated by a furrow from the train of the ventral clavae, and the suture of the collignoniceratid type as figured in Text-fig. 17.

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
GK. H5630 (c)	30.0(1)	11.2(.37)	10.9(.36)	10.5(.35)	.96
〃 (−180°) (c)	23.0(1)	8.5(.37)	7.8(.34)	8.8(.38)	1.1
〃 (ic)	—	—	7.2	7.2	1.0
GK. H5525 (c)	33.3(1)	11.8(.36)	13.5(.40)	13.5(.40)	1.0
〃 (− 90°) (c)	25.6(1)	8.7(.34)	10.4(.40)	11.1(.43)	1.1
Holotype (YOUNG, 1963)	85.0	(.46)	(.33)	(.30)	1.0

Comparison and affinity.—The characters of the two specimens from Hokkaido are essentially similar to those of the holotype and the paratype of *Paratexanites* (*Parabevahites*) *sellardsi* YOUNG, from the lower part of the Austin Chalk of Texas. In the large Texas specimens the immature inner whorls as small as the Hokkaido specimens are not well preserved. Therefore I hesitate to conclude definitely the specific identity. The holotype has a comparatively wider umbilicus than the present specimens. Anyhow, we should search for larger specimens from Hokkaido.

It is interesting to note that the two specimens have a row of prominent ventrolateral tubercles in the early growth stages with diameters ranging from about 3 mm. to 25 mm. The immature shell is, thus, almost indistinguishable from that of *Protexanites* sp., e.g. *Protexanites planatus* (LASSWITZ). Later than the stage of 25 mm. diameter the ventrolateral tubercles are doubled, consisting of a longer outer clava and a shorter inner node resting on a common major ventrolateral protuberance. Even at this stage the umbilical tubercles are not shifted upward and most elevated at the umbilical shoulder.

On the grounds of above observation, as well as on those of the general similarity, I would agree with YOUNG (1963, p. 79) in concluding the close affinity between *Paratexanites* (*Parabevahites*) *sellardsi* and *Protexanites planatus*. Taking also the stratigraphic occurrences into consideration, it is strongly suggested that *Paratexanites* (*Parabevahites*) *sellardsi* was probably derived from *Protexanites planatus*.

Incidentally the Hokkaido specimens show that the whorl in the initial stage below 2 mm. diameter is nearly smooth, loosely coiled, and embraces a comparatively small protoconch, as in other better studied examples of the Collignoniceratidae.

Occurrence.—A pebble at 16 km point in the upper reaches of the Ikushumbets (a little above the confluence with the Samata-zawa), probably derived from the Upper Yezo Group (Coniacian and Santonian). Another pebble in the Chikubetsu area, Upper Yezo Group.

The holotype of *P.* (*P.*) *sellardsi* came, according to YOUNG (1963, p. 80),

probably from the lower part of unit B of the Austin Chalk, Texas. Another example is said either from the same horizon or a horizon in the upper part of unit A of the Austin Chalk. The suggested age is Upper Coniacian (YOUNG, 1963, p. 22, fig. 3).

Genus *Texanites* SPATH, 1932

Type-species.—*Ammonites texanus* ROEMER, 1852, by original designation (SPATH, 1932, p. 379, footnote).

Generic diagnosis.—The size of the adult shell is moderate to very large. Coiling is rather evolute, with a moderate to very wide umbilicus. In the type-species and many other species the whorl is higher than broad in the late growth-stages, with a subrectangular section. In some species, e.g. *T. roemeri, T. quadrangulatus* and *T. ralijaonai,* the whorl is nearly as high as broad, with a subquadrate section. The flanks are typically flattened and subparallel or slightly converging, but in a few species, e.g. *T. americanus,* they are moderately convex on the outer whorl.

In many species the ribs are mostly simple, equally long and nearly rectiradiate or slightly prorsiradiate, or gently concave, but in a few species they tend to be gently flexuous. The ribs may vary in intensity, breadth, density and distance from a species to another and to some extent with growth. In some species, e.g. *T. dichotomus, T. venustus* and *T. shiloensis,* bifurcations and intercalations occur fairly frequently on the inner whorls, but scarcely so on the outer whorl. In some other species the ribs are rather occasionally bifurcated or intercalated on the immature whorls.

There are five rows of tubercles, the umbilical, the inner (or lower) and the outer (or upper) lateral, the ventrolateral and the ventral. In early immature stages the trituberculate state like that of *Protexanites* may be seen, with or without intervening quadrituberculate stage. The intensity, the shape and the disposition of the tubercles vary from a species to another and may change with growth. In the last whorl of some species, e.g. *T. soutoni,* the lateral tubercles tend to be absorbed by the ribs.

The venter shows a typical texanitine character, i.e. a siphonal keel bordered on either side by a groove and then by a row of ventral clavae which normally form the end of the ribs.

The suture is fundamentally of collignoniceratid type, with massive lateral saddles of subquadrangular outline and the roughly U-shaped first lateral lobe in the typical species, e.g. *T. texanus, T. hispanicus, T. hourcqui* and *T. oliveti.* The lobules which subdivide the first lateral saddle and those which form branches in the lower part of the lateral lobe (L) may be moderately deep on the outer whorl of a large shell, e.g. *T. soutoni.* In some species, e.g. *T. quinquenodosus,* the lobes and the saddles are more deeply and finely indented. In still other species, e.g. *T. quadrangulatus* and *T. ralijaonai,* the lower part of L is expanded by the branching and its upper part tends to be constricted.

Subgeneric distinction.—On account of the ontogenetic development of the

tubercles the following two subgenera can be distinguished in the genus *Texanites*, as defined below:

Subgenus *Texanites* SPATH, 1932,

in which the quinquetuberculate state begins at an early growth-stage (e.g. 10–20 mm. in diameter) and characterizes almost all the later whorls.

Subgenus ***Plesiotexanites*** nov.,

with the type-species *Mortoniceras kawasakii* KAWADA, 1929, emended below,

in which the quinquetuberculate state appears at a later growth-stage and the trituberculate state like that of *Protexanites* characterizes the inner whorls for a considerable period. A quadrituberculate state may intervene between the two stages. Even on the quinquetuberculate outer whorl the tubercles are so disposed that the shell looks like *Protexanites* or *Paratexanites*. Namely the lateral tubercles tend to be absorbed by the ribs or the third and the fourth tubercles are closely set and even tend to be united to an elevation at the ventrolateral shoulder.

Speaking precisely only a few species of the genus *Texanites* have been subject to the careful examination of the ontogenetic development of the shell. Unfortunately the hitherto available specimens of *Texanites texanus* (ROEMER), the type-species, are too incomplete for the inspection of the ontogeny. *Texanites gallicus* COLLIGNON, 1948, which was at one time (COLLIGNON, 1948, p. 75) regarded as a variety of *T. texanus* and later (YOUNGN, 1963, p. 81) as a subspecies of *T. texanus* and then (COLLIGNON, 1966, p. 78) separated as a closely allied species, is based on better preserved specimens. Although its holotype (DE GROSSOUVRE, 1894, p. 80, pl. 17, fig. 1, designated by COLLIGNON, 1948, p. 42 [99]) does not clearly expose the inner whorls below 30 mm. in diameter, its smaller syntypes (DE GROSSOUVRE, 1894, pl. 16, figs. 2–4) do show five rows of tubercles in the immature shells of at least 15 to 40 mm. in diameter. The tubercles are nearly equidistant in lateral view.

COLLIGNON (1948, p. 56, pl. 7, figs. 1–3) described the ontogeny of some examples from Madagascar (e.g. *Texanites hourcqui, T. dichotomus* and *T. interpositus*), in which he distinguished (1) smooth, stage, (2) stage with simple ribs, umbilical tubercles and a nascent siphonal keel, (3) stage with bifurcated ribs and five rows of tubercles, and (4) stage with isolated ribs and five rows of tubercles. I doubt whether these four stages are always maintained in every species of *Texanites*. Anyhow, in the specimens which were treated by COLLIGNON the five rows of tubercles appear in considerably early growth-stage.

I expect that the way of ontogenetic development of the ornamentation may vary to some extent among different species of *Texanites*. I have observed in a species allied to *Texanites quinquenodosus* a stage with trituberculate simple ribs in a very early stage below 13 mm. in diameter, then a stage with doubled ventrolateral tubercles, which is soon followed by the main stages characterized by five rows of tubercles. As the trituberclate stage is very short as compared with that of *Texanites* (*Plesiotexanites*) *kawasakii*, I should refer this species

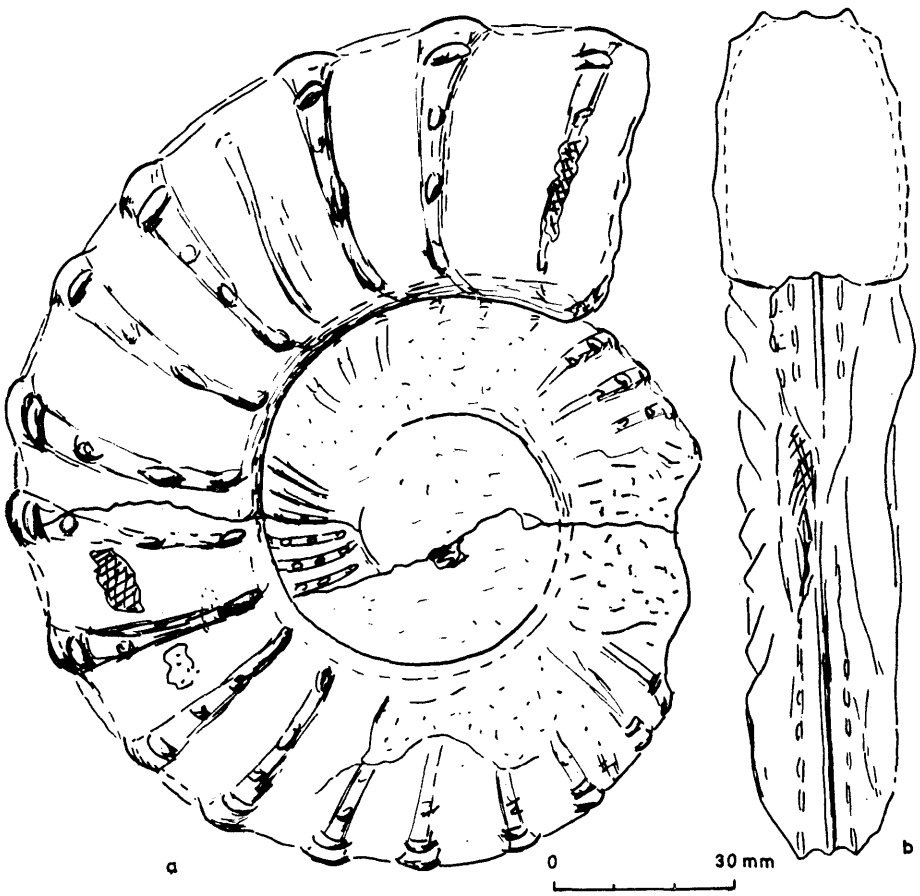

Fig. 18 [92]. *Texanites* (*Texanites*) *texanus* (ROEMER). Sketch of the lectotype, GIB. No. 45a. Lateral (a) and frontal view (b). See COLLIGNON, 1948, text-fig. 1 for the photograph of the same specimen. (T. M. *delin.*)

and probably also *T. quinquenodosus* to the subgenus *Texanites* (*Texanites*).

It may be a matter of degree to judge that the quinquetuberculate state appears early or late in growth-stage. In the present circumstances, under which the ontogeny of the shell is not always known for all the species of *Texanites*, I can only indicate better defined examples to show what sort of ammonites can be referred to the subgenus *Texanites* (s. s.) and what else to the subgenus *Plesiotexanites*. The names of the species will be indicated in the description of respective subgenera. Those of uncertain assignement will be also given with some remarks.

Comparison and affinity.—In shell-form, ribbing and sutures *Texanites* is fundamentally similar to *Protexanites* and *Paratexanites*, although there may be minor differences among species. The distinction is the five rows of tubercles in *Texanites* as compared with three or four rows in *Protexanites* and *Paratexanites*.

How two or one more row was added can be studied through the examination of the ontogeny. The answer is not simple and various modes of development have been observed, as will be explained in more detail in the description of the respective subgenera.

On the grounds of the observations to be described in later pages it is generally concluded that *Texanites* was probably derived from *Protexanites* directly or by way of *Paratexanites*, depending on species.

Submortoniceras SPATH, 1921, with type-species *S. woodsi* (SPATH, 1921), is similar to *Texanites* in the quinquetuberculate state in the main part of the growth stages. It has generally more involute, more compressed whorls, with a high trapezoidal section, and more numerous, less rectilinear ribs than *Texanites*, with frequent branching or intercalation at or near the umbilical tubercle and also on the flank. On the outer whorl of *Submortoniceras* the tubercles on the flank are weakened and may finally disappear and the ribs are also weakened.

Certain species of *Texanites*, e.g. *T. sanushibense* (YABE and SHIMIZU), *T. shiloense* YOUNG, *T. venustus* COLLIGNON and *T. dichotomus* COLLIGNON, have characters which could lead to *Submortoniceras*. The ontogenetic development of some species of *Submortoniceras* is similar to that of certain species of *Texanites*, showing a change from a *Protexanites* like trituberculate state through a *Paratexanites* like quadrituberculate one to the quinquetuberculate one. Taking also account of the stratigraphic occurrences, it is concluded that a certain group of *Texanites* probably gave rise to *Submortoniceras*.

Distribution.—The genus *Texanites* shows a world-wide distribution, being especially common in the Santonian of the Gulf Coast (Texas and adjacent areas), Madagascar, South Africa, Europe and Japan. A few species occur in the Lower Campanian. The first appearance of *Texanites* is said to have been in the Coniacian on the grounds of the occurrence of *Texanites pseudotexanus* (DE GROSSOUVRE) from the Emscher Marl of Germany.

Certain species have been recorded from the widely separated regions, for instance, *Texanites oliveti* (BLANCKENHORN) from the Lower to Middle Santonian of southwestern Asia, northern Africa, western Africa (?), Madagascar and Japan, *Texanites quinquenodosus* (REDTENBACHER) from the Santonian of the Alpine region of Europe, Angola, Madagascar and Japan (?), *Texanites gallicus* COLLIGNON from the Middle and Upper Santonian of Europe, Madagascar, Gulf Coast of North America and northern South America, *Texanites hourcqui* COLLIGNON from the Santonian (probably middle part) of Madagascar and Peru and *Texanites stangeri* (BAILY) from the Santonian of South Africa, Madagascar, Japan and the Gulf Coast. Other species are recorded to occur in a particular province, although the available information is by no means sufficient.

Subgenus *Texanites* SPATH, 1932

Remarks.—The subgeneric diagnosis is primarily in that the five rows of tubercles begin to appear at an early growth-stage and characterize almost all the later whorls with a regular diposition. Some species have a very large shell but others are of moderate size. The subgenus includes several species which

have moderately complex sutures in the late growth-stages. Ribs are normally simple, but bifurcation and/or intercalation occasionally occur on the inner whorls of some species and more frequently so in a limited number of species. There is a considerable extent of differences among species with respect to the size of umbilicus, rate of growth of whorls, shape of whorl-section, proportion of breadth to height, density, straightness or curvature, and strength of ribs and shape, size, intensity and mode of disposition of tubercles.

The species which are certainly referred to the subgenus *Texanites* are *T. texanus* (ROEMER, 1852), from the Lower to Middle Santonian of the Gulf Coast, Morocco, Syria and Italy (?), *T. gallicus* COLLIGNON, 1948, from the Middle and Upper Santonian of France, Madagascar, Venezuela and the Gulf Coast, *T. hispanicus* COLLIGNON, 1948, from the Santonian (probably upper part) of Spain and Madagascar, *T. quinquenodosus* (REDTENBACHER, 1873), from the Santonian (probably upper part) of the Alpine region, Angola and Madagascar, *T. pseudotexanus* (DE GROSSOUVRE, 1894), from the Emscher Marl of Germany, *T. roemeri* (YABE and SHIMIZU, 1923), from the Gulf Coast, *T. hourcqui* COLLIGNON, 1948, from the Middle Santonian of Madagascar and Peru, *T. venustus* COLLIGNON, 1948, from the Middle to Upper (?) Santonian of Madagascar, *T. dichotomus* COLLIGNON, 1948, from the Upper Santonian of Madagascar, and *T. interpositus* COLLIGNON, from the Upper Santonian of Madagascar.

The following species have a large adult shell, but, owing to the unfavourable condition of preservation, the characters of their immature stages are not pre-

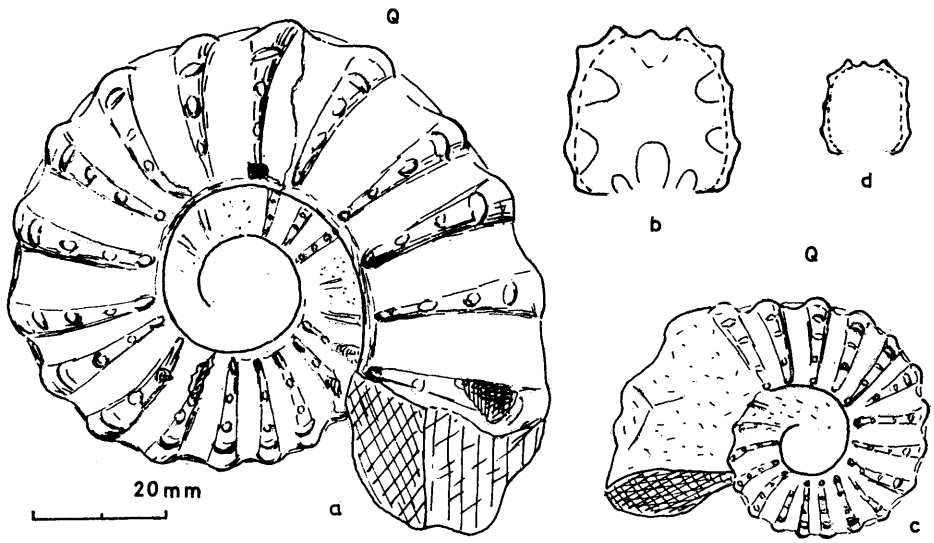

Fig. 19 [93]. *Texanites* (*Texanites*) *roemeri* (YABE and SHIMIZU). Diagrammatic sketch of the syntypes. Lateral view (a) and whorl-section (b) at Q of the lectotype, GIB. No. 45d: lateral view (c) and whorl-section (d) at Q of a smaller syntype, GIB. No. 45c. See COLLIGNON, 1948, text-fig. 3 (reduced to 2/3) for the photograph of a.

(T. M. *delin.*)

cisely known. They are in this paper provisionally referred to the subgenus *Texanites*, as they are directly or indirectly allied to some of the above mentioned species of undoubted *Texanites* (s. s.).

Texanites oliveti (BLANCKENHORN, 1905) (see TAUBENHAUS, 1920), from the Lower to Middle Santonian of southwestern Asia, northern Africa, Gabon (?), Madagascar and Japan, which is allied to *Texanites* (*Texanites*) *texanus twiningi* but has more prominent tubercles of which umbilical ones on the outer whorl are shifted upward above the inclined umbilical wall

Texanites mikobokensis COLLIGNON, 1966, from the Upper Santonian of Madagascar, which is allied to *T.* (*T.*) *gallicus* but has a less rectangular whorl-section and stronger tubercles persisting up to the late growth-stage

Texanites rarecostatus COLLIGNON, 1966, from the Middle Santonian of Madagascar, which is similar to *T. oliveti* but has a thicker whorl

Texanites americanus (LASSWITZ, 1904) (emend, YOUNG, 1963), from the Lower (to Middle ?) Santonian of the Gulf Coast, which is allied to *T. rarecostatus* but has more evolute whorls, more inflated flanks, stronger ribs and more prominent tubercles

Texanites quadrangulatus COLLIGNON, 1966, from the Upper Santonian of Madagascar, which is allied to *T.* (*T.*) *gallicus* but is distinguished by a quadrate whorl-section, a longer distance between the umbilical and lower lateral tubercles and a particular pattern of the lateral lobe (L), which is constricted in the upper part and expanded in the lower part with divergent branches

Texanites lonsdalei YOUNG, 1963, from the Lower Campanian (?) of Texas and Madagascar, which is allied to *T.* (*T.*) *roemeri* (YABE and SHIMIZU, 1924) but more compressed and densely costate

Comparison and affinity.—In many species of *Texanites* (*Texanites*) the five rows of tubercles appear at an early growth-stage. Therefore their affinities with the possibly ancestral species are not always so definitely traced through the ontogenetic development as in the species of *Texanites* (*Plesiotexanites*).

It can be generally assumed that *Texanites* (s. s.) may have evolved from *Plesiotexanites*, acquiring the quinquetuberculate state with acceleration. The actual line of descent from a species to another may not be so simple as the above assumption. If we take account of the stratigraphic ranges of the species, it can also be considered that at least some species of *Texanites* (s. s.) and those of *Plesiotexanites* may have evolved almost simultaneously from some species of *Protexanites* directly or by way of *Paratexanites*. Deviation or differentiation may have occurred more frequently than progressive evolution.

In the following lines I try to consider possible lines of descent for selected species of *Texanites* (*Texanites*).

Texanites (*Texanites*) *quadrangulatus*, a Middle to Upper Santonian species, is allied to Upper Coniacian *Protexanites* (*Protexanites*) *bourgeoisi* in various respects, except for the number of tubercles and the details of the lateral lobe.

It may have been derived from an unknown Lower Santonian species of *Texanites* (*Plesiotexanites*), which is allied to but more coarsely ribbed than Middle Santonian *T.* (*P.*) *transitorius*. That hypothetical species could be derived from *Protexanites bourgeoisi* in parallel with but deviating from, or possibly by way of, *Paratexanites* (*Parabevahites*) *serratomarginatus grossouvrei* defined in page 263.

Texanites (*Texanites*) *gallicus*, one of the typical species of *Texanites* of Middle to Upper Santonian ages, could be led from such a species as *T.* (*Plesiotexanites*) *transitorius*, with accelerated development of nearly equidistant five rows of tubercles. *T.* (*Pl.*) *transitorius* could, in turn, be derived from such a species as *Protexanites* (*Protexanites*) *canaensis* in the same way as *T.* (*Plesiotexanites*) *kawadai* was derived from *Protexanites* (*Protexanites*) *planatus*.

Texanites (*Texanites*) *quinquenodosus*, of Upper Santonian age, may have descended from *Texanites* (*Plesiotexanites*) *pacificus* (to be defined below) or a related species, of Lower to Middle Santonian, which, in turn, may have been derived from Coniacian to Lower Santonian *Paratexanites* (*Parabevahites*) *serratomarginatus*.

Texanites (*Plesiotexanites*) *sanushibensis*, which is presumably a derivative of *Protexanites bontanti* by way of *Paratexanites* (*Partaexanites*) *compressus*, could be a possible source of certain species of compressed and finely ribbed *Texanites* (*Texanites*), such as *T.* (*T.*) *venustus* and *T.* (*T.*) *hispanicus*. These species have bifurcated or intercalated ribs on the inner whorls and could be ancestors of some species of *Submortoniceras*.

Texanites americanus closely resembles *Paratexanites* (*Paratexanites*) *zeilleri* of a preceding age in various aspects of the shell, but its outer tubercles are not disposed in such a way as those of the latter species and regular, nearly equidistant five rows of tubercles characterize this species in most of the growth-stages. No intermediate species of *Plesiotexanites* has been found.

Texanites (*Texanites*) *quinquenodosus* (REDTENBACHER)

1858. *Ammonites texanus*, VON HAUER, *Beitr. Paläont. Österr.*, Bd. 1, Heft 1, p. 10, pl. 2, figs. 4–6 (*non* ROEMER, 1852).
1873. *Ammonites quinquenodosus* REDTENBACHER, *Abh. K. K. Geol. Reichsanst.*, Bd. 5, p. 108 [18], pl. 24, fig. 3a–b.
1903. *Mortoniceras texanus*, ZURCHER, *Bull. Soc. Géol. France*, 4 ser., vol. 3, p. 686.
1923. *Mortoniceras quinquenodosum*, YABE and SHIMIZU, *Japan. Jour. Geol. Geogr.*, vol. 2, no. 2, p. 30 (in part).
1942. *Texanites quinquenodosus* var. *evoluta* HAAS, *Amer. Museum Novitates*, No. 1182, p. 18, fig. 12.
1948. *Texanites quinquenodosus*, COLLIGNON, *Ann. Géol. Serv. Mines* (Madagascar), fasc. 13, p. 69 [24], text-fig. 2.
1966. *Texanites quinquenodosus*, COLLIGNON, *Atlas des fossiles caracteristiques* (Ammonites), fasc. 14, p. 128, pl. 510, fig. 2021.

Types.—REDTENBACHER (1873, p. 108) established *Ammonites quinquenodosus* on a number of specimens. The one illustrated by REDTENBACHER (1873,

pl. 24, figs. 3a, b), from the Gosau Beds, St. Wolfgang, Austria, is designated here as the lectotype.

Remarks.—No examples which can be precisely identified with this species have been obtained from Hokkaido, but there is a group of specimens which is closely allied to it. Before entering into the description of that group, the specific characters of *Texanites quinquenodosus* itself are given for comparison.

Specific characters.—The size of the shell is moderate. The coiling is fairly evolute, with a line of overlap nearly at the row of ventrolateral clavae. The umbilicus is moderately wide, occupying about 36 to 40 percent of the diameter.

The outer whorl is fairly higher than broad in the typical form. The inner whorl may be only slightly higher than broad or nearly as high as broad. The whorl-section is subrectangular, with nearly parallel, flattened flanks.

The ribs are mostly simple, equally long, rectiradiate or slightly prorsiradiate, and numerous, counting 32 on the outer whorl of the lectotype. They have a moderate breadth and are rather crowded, but regularly disposed. The interspace may be somewhat wider than the rib, or nearly as wide as the rib, or somewhat narrower than the rib, depending on individuals and on growth-stages. In the lectotype the ribs are more crowded on the inner whorl than on the outer whorl.

Five rows of tubercles are distinct. The tubercles at the umbilical edge are prominent and pointed. The inner lateral tubercles are nearly halfway between the umbilical and the outer lateral tubercles and are nodose or very shortly clavate. The outer lateral are clavate and the ventrolateral tuberces are more remarkably clavate. They are stronger than the inner lateral ones and the distance between them is somewhat shorter than that between the inner and the outer lateral tubercles. The ventral tubercles are very longly clavate, forming a train on either side of the siphonal keel, with a furrow of moderate depth between them. The top of the keel is nearly as high as that of the ventral clavae on the outer whorl, but slightly lower on the inner whorl.

The suture is fundamentally of collignoniceratid type but the lobes are comparatively narrower and more finely incised and the saddles are less massive than those of typical texanitine suture as represented by that of *T. hispanicus* COLLIGNON (see COLLIGNON, 1966, pl. 510, fig. 2022).

Texanites (*Texanites*) sp. aff. *T.* (*T.*) *quinquenodosus* (REDTENBACHER)

Pl. 42 [46], Fig. 3; Pl. 46 [50], Figs. 1–3

Material.—GK. H5635, from the main stream of the Ikushumbets (9–10 km point); GK. H5642, from the Kumaoi-zawa, a tributary of the Ikushumbets (Coll. T. TAKAHASHI); G. H5636, from loc. R373, and GK. H5637 from loc. R378, both in the Sakasa-gawa, upper reaches of the Haboro (Coll. H. OKADA, T. NISHIDA and T. MATSUMOTO); GK. H5514, from loc. CK 76, Deto-futamata, a tributary of the Haboro (listed as *Parabevahites* sp. in UEDA et al., 1962).

Descriptive remarks.—The above five specimens are small and more or less imperfectly preserved, but some of them show interesting features of ontogenetic development.

They closely resembles the typical specimens of *Texanites quinquenodosus* (REDTENBACHER), but there are two points which should be remarked.

One is that the ribs are considerably projected on the ventral part and accordingly the ventral clava is somewhat ahead of the ventrolateral tubercle. In typical examples of *T. quinquenodosus* such a projection is not recorded and the ventral clava is illustrated on the almost straight extension of a nearly rectiradiate or slightly prorsiradiate rib of the flank.

This point might be a minor feature which could be within the extent of variation of *T. quinquenodosus*, but I would expect a significance of at least a subspecific separation. We should settle this question on the basis of more specimens from Japan and also from Europe.

The other point is that the ontogenetic development in early stages is observed as below in the Hokkaido specimens. I rather expect that a similar, if not the same, way of development would be found in the typical form of *T. quinquenodosus*, although nobody has examined its ontogeny.

The earliest whorl of the diameter of about 2 mm. is smooth and in the following stage up to the diameter of 20 or 25 mm. there are distant, trituberculate, simple ribs, on which the tubercles at the umbiliacl shoulder are pointed, those at the ventrolateral shoulder are prominent and the external ones are narrow and clavate. The train of the ventral clavae is fairly close to the siphonal keel and there is a moderately deep furrow between them.

In the next stage, about 25 to 30 mm. in diameter, the ventrolateral tubercles are doubled, consisting of clavate outer one and more prominent inner one. This *Parabevahites* like quadrituberculate state occurs for a short period.

This is followed soon by a distinctly quinquetuberculate state. In its early substage, with a diameter of 30 mm. or so, the mediolateral tubercle appears as a weak elevation, the inner ventrolateral tubercle is reduced in prominence and becomes independent of the outer ventrolateral tubercle. Soon the mediolateral tubercle becomes more distinct, the inner ventrolateral is shifted inward to be better called the outer lateral tubercle and is somewhat clavate, and the ribs become to be less distant and to have moderate intensity and breadth.

Thus the typical ornamentation of *T. quinquenodosus* is developed fairly rapidly in a comparatively earlier growth-stage. On this account this ammonite species from Hokkaido and probably also *T. quinquenodosus* itself are better ascribed to the subgenus *Texanites* rather than *Plesiotexanites*.

Occurrence.—The two specimens from the Sakasa-gawa, upper reaches of the Haboro, came from the lower part of the zone of *Inoceramus amakusensis*. The one from loc. CK 76, Deto-futamata of the Haboro was from unit B1, again the lower part of *Inoceramus amakusensis*. The two specimens from the Ikushumbets area are also referable to the same zone. Accordingly the available evidence indicates the occurrence of *T.* (*T.*) sp. aff. *T. quinquenodosus* in the Lower Santonian of Hokkaido.

Subgenus ***Plesiotexanites*** nov.

Type-species.—*Mortoniceras kawasakii* KAWADA, 1929, emended below.

Remarks.—The subgeneric diagnosis given in page 267 is rather comprehensive. The way of developing the quinquetuberculate state from the trituberculate state is not always the same among different species, as is explained below.

Comparison and affinity.—In *Texanites* (*Plesiotexanites*) *kawasakii* the trituberculate state like that of *Protexanites planatus* (LASSWITZ) continues for a considerable period of the immature shell up to a diameter of about 50(±5) mm. in typical examples. Then for a short period in the succeeding stage on three or four ribs the strong, ventrolateral protuberance becomes doubled like that of immature *Paratexanites* or mature *Parabevahites* and nearly at the same time an incipient lateral tubercle appears. In the succeeding stage, e.g. later than a diameter of about 80 mm., the inner ventrolateral tubercle is separated from the stronger outer one and gradually shifted inward to occupy such a position which can well be called the outer lateral tubercle. Thus the five rows of tubercles like those of typical *Texanites* are formed.

Texanites stangeri (BAILY, 1855), from the Santonian of South Africa, Madagascar, Japan and Texas, is certainly referred to the subgenus *Plesiotexanites*. Its early immature shell is trituberculate. Then on the whorl with diameters of several centimeters the strong ventrolateral tubercle is doubled as that of immature *Paratexanites* (*Paratexanites*) or that of *Paratexanties* (*Parabevahites*). In the succeeding stage the inner and outer ventrolateral tubercles are gradually separated and a weak tubercle is added on the middle of the flank. Thus, the shell of *T. stangeri* up to a certain immature stage is similar to that of *Paratexanites* (*Parabevahites*) *emscheris* (SCHLÜTER) and the middle aged shell of *T. stangeri* is similar to the adult shell of *P.* (*Paratexanites*) *orientalis* (YABE), except for the presence of the lateral row of tubercles later than a certain stage in *T. stangeri*. On the large outer whorl of *T. stangeri* the third row of tubercles is shifted inward and it can be called the outer lateral row rather than the inner ventrolateral. In other words the disposition of the five rows of tubercles becomes to be quite similar to that of typical *Texanites*. In the last part of the outer whorl the lateral tubercles are weakened and tend to be absorbed by the ribs. The text-figures 23a–c, which show diagrammatic cross sections of representative specimens of *T. stangeri* may illustrate the above explained mode of developing tubercles.

If the above observation is kept in mind, the ammonite from the Middle Santonian of Madagascar, which was provisionally called *Parabevahites* cf. *emscheris* by COLLIGNON (1966, p. 80, pl. 488, fig. 1966), can be rather regarded as a fragmentary inner whorl of *Texanites* (*Plesiotexanites*) *stangeri* (var. *sparcicosta* of SPATH). COLLIGNON was right in pointing out the presence of a minute lateral tubercle.

For a similar reason the ammonites illustrated under *Parabevahites* (?) *transitorius* COLLIGNON (1966, p. 80, pl. 488, figs. 1970 A, B), from the Middle Santonian of Madagascar, are probably an outer and an inner whorls of a species of *Texanites* (*Plesiotexanites*), which seems to be fairly close to *T.* (*P.*) *kawasakii* but has a more persistent *Parabevahites* like disposition of the outer three rows of tubercles. Again, the ammonite described under *Parabevahites dubius* COLLIGNON (1966, p. 133, pl. 513, fig. 2026), from the Upper Santonian of Mada-

gascar, may be an inner whorl of a species of *Texanites* (*Plesiotexanites*), although its still outer whorl as well as its better preserved immature whorls are keenly needed for the confirmation.

The ammonite from the Mungo Formation of Cameroons, which was described under the name of *Submortoniceras* (?) aff. *soutoni* by REYMENT (1955, p. 95, pl. 33, figs. 1a, b; text-fig. 46b), is not identified with the named species but is probably an incompletely preserved example of *Texanites* (*Plesiotexanites*), because it has in its middle part of the septate outer whorl fairly closely set three outer tubercles as in those of *Texanites* (*Plesiotexanites*) *transitorius* and *T.* (*P.*?) *dubius*.

In a new species from the Santonian of Hokkaido, e.g. *Texanites* (*Plesiotexanites*) *pacificus* sp. nov. to be established below, the ontogenetic development is similar to, but not quite identical with, that of *T.* (*Plesiotexanites*) *kawasakii*. Its shell in the middle growth-stage is somewhat allied to that of *Paratexanites* (*Parabevahites*) *serratomarginatus* (REDTENBACHER), but it has a row of weak lateral tubercles. On the whorls of the late growth-stages the third tubercle is separated from the fourth, shifting inward, and can be called the outer (or upper) lateral row.

The specimens, from the Middle Santonian of Madagascar, which were illustrated under the name of *Parabevahites serrato-marginatus* by COLLIGNON (1966, p. 76, pl. 486, figs. 1962, 1963), indeed have double ventrolateral tubercles as those of the named species but seem to have also a row of incipient lateral tubercles. Three other fragmentary specimens, from the Middle Santonian of Madagascar, which were called *Parabevahites* cf. *serrato-marginatus* by COLLIGNON (1966, p. 80, pl. 488, figs. 1967–1969), have a row of more distinct lateral tubercles and their two ventrolateral tubercles tend to be separated as a shell grows. These specimens are probably inner whorls of a species of *Plesiotexanites*, although I cannot decide definitely without seeing the specimens themselves. Anyhow it is an undeniable fact that there are certain species of *Texanites* (*Plesiotexanites*) which can be interpreted to have been derived from such a species as *Paratexanites* (*Parabevahites*) *serratomarginatus*.

Texanites ralijaonai COLLIGNON, 1966, from the Upper Santonian of Madagascar, is considerably allied to *Protexanites planatus* (LASSWITZ) in the general aspects of the shell and still more closely allied to *Paratexanites* (*Parabevahites*) *sellardsi* YOUNG in the approximated disposition of the third and the fourth tubercles up to a large mature stage.

Texanites angolanus HAAS, 1942, including a variety called *berryi*, from Angola, another large but compressed species, is noteworthy in that its third and fourth rows of tubercles are disposed in such a way as to be better called the inner and outer ventrolateral tubercles as in those of *Paratexanites* for a considerable duration in the middle to late growth-stages.

Whether the row of mediolateral tubercles in these two species appeared as late as those of *T.* (*Plesiotexanites*) *stangeri* or much earlier cannot be decided, because their immature shells are not well preserved. Anyhow they strongly suggest that this kind of *Texanites* probably descended from *Paratexanites*. Incidentally *T. ralijaonai* has an advanced type of suture in that the lateral lobe

(L) has expanded branches in the lower part.

Mortoniceras omeraense REESIDE, 1927, from the Santonian of New Mexico, is also particular in that the outer lateral and the ventrolateral tubercles are considerably approximated even in the late growth-stages. Its lower lateral (i.e. second) tubercles seem to be very weak on the inner whorl (with diameters from 25 to 40 mm. in the paratype), but the characters of still inner whorls are not clearly exhibited. This species is certainly referred to the genus *Texanites*. I suspend to decide its subgeneric assignement, although the possibility of *Plesiotexanites* could be considered.

In the course of developing tubercles with growth, the inner lateral [=originally mediolateral] tubercle is added simply near the middle of flank, whereas the outer lateral tubercle is derived from the inward shifting of the inner element of the doubled or bipartite ventrolateral tubercle. In the type-species of *Plesiotexanites*, *T.* (*P.*) *kawasakii*, the doubling of an originally single ventrolateral tubercle takes place almost simultaneously with the appearance of the mediolateral tubercles and the separation of the two ventrolateral tubercles, with the inward shifting of the inner one, goes on comparatively rapidly.

In such species as *T.* (*P.*) *stangeri* the doubling of the ventrolateral tubercle takes place somewhat earlier than the appearance of the lateral tubercle.

In still other species, to the contrary, the division and then separation of the ventrolateral tubercles may be much delayed as compared with the appearance of the lateral tubercle. In such a case the shell up to the middle growth-stage would be quite similar to the shell of *Protexanites* (*Anatexanites*).

Protexanites thompsoni JONES, 1966, from the Santonian of California, is interpreted to display the last mentioned case. If we stress its development up to the middle growth-stage, with the trituberculate early stage followed by the addition of the mediolateral tubercles, it could be referable to *Protexanites* (*Anatexanites*). If the particularity of the additional one row of tubercles is considered it could as well require a new subgenus. I should, however, refer it to *Texanites* (*Plesiotexanites*), at least for the time being. The last whorl of this species has five rows of tubercles, of which the outer lateral tubercle is delayed to appear and continues to be approximated with the ventrolateral tubercle up to the last part.

As is described in detail below, a new species from Hokkaido [*Texanites* (*Plesiotexanites*) *yezoensis* sp. nov., described in p. 294] is another example which shows at first the *Anatexanites* characters and then a row of outer lateral tubercles is added later, if not so much delayed as in *T.* (*Pl.*) *thompsoni*.

Texanites shiloensis YOUNG, 1963, from the Upper Santonian of Texas, is interesting not only in that it resembles *Submortoniceras tequesquitense* YOUNG, 1963, from the Lower Campanian of Texas, in its shell-form and weakened tubercles on the flanks but also in that its immature shell below 30 mm. in diameter is closely allied to such species as *Protexanites* (*Miotexanites*) *minimus* MATSUMOTO in its compressed whorl, crowded, fine, often bifurcating ribs and trituberculate early stage, followed by quadrituberculate stage in which the submarginal tubercle is extremely weak. The lower lateral tubercles are delayed

to appear and weak throughout later stages. This species should, thus, be referred to *Texanites* (*Plesiotexanites*). It is, at the same time, somewhat allied to *Submortoniceras*. On its outer whorl bifurcated or intercalated ribs do not occur so frequently as in typical species of *Submortoniceras*.

The specimen illustrated under *Ammonites texanus* by SCHLÜTER (1867, p. 32, pl. 6, fig. 1a, 1b only), from the Emscher Marl in the shaft of Herne, Westphalia, Germany, now preserved at the Geological and Palaeontological Museum of the University of Bonn, with register number 26 b, is secondarily much compressed but shows interesting features, which are not illustrated in SCHLÜTER's figure.

On the whorl of middle growth-stages, with diameters from 50 to 125 mm., lower lateral tubercles are discernible, but they are distinct for a limited part with a shell diameter of 70 mm. or so. On other parts they are very faint and on the immature whorl below 50 mm. and on the preserved last part, with diameter of 130 mm. or so, the ribs are devoid of the lateral tubercles. More or less clavate outer three rows of tubercles and the bullate umbilical tubercles are constantly distinct. In other words *Paratexanites* like aspects are exhibited in immature stages and also at the last stage, whereas *Texanites* like quinquetuberculate state is presented only in the middle growth-stages.

I regard this as another example of *Plesiotexanites* and on the grounds of above particularity this specimen represents a new species, for which I propose ***Texanites* (*Plesiotexanites*) *schlueteri*** sp. nov., designating the above specimen (GIB. No. 26 b) as the holotype (see a diagrammatic sketch of Fig. 20).

In addition to the above described tubercles this species is characterized by fairly evolute whorls, with a fairly wide umbilicus (39 percent of the shell diameter), nearly rectiradiate or slightly prorsiradiate, sometimes somewhat concave, simple ribs, which are narrow on the inner whorl but considerably broadened on the outer whorl and separated by somewhat broader interspaces. As the holotype is secondarily compressed the original proportion of breadth to height is not known.

Mortoniceras sanushibense YABE and SHIMIZU, 1925, from the Santonian of Hokkaido, is similar to *Protexanites* (*Protexanites*) *bontanti shimizui* in the general aspects of the shell and still closer to such species as *Paratexanites* (*Paratexanites*) *compressus* in the disposition of the three outer tubercles. In the holotype a weak lateral tubercle begins to appear at about the diameter of 30 mm. and the five rows of tubercles characterize the later whorl. It is, thus, regarded as an example of *Plesiotexanites* and was probably derived from such a species as *Protexanites bontanti* through a certain species of *Paratexanites* (s. s.).

It should also be noted that *Texanites* (*Plesiotexanites*) *sanushibensis* is somewhat similar to a certain species of *Submortoniceras*, as will be described in detail below (p. 293).

Submortoniceras candelariae YOUNG, 1963, from the Lower Campanian of Texas, is not a typical example of *Submortoniceras* in that it shows less frequent bifurcation or intercalation of the ribs and because its ribs are not weakened on the outer whorl. According to YOUNG (1963, p. 102), it has only four rows of tubercles in the middle growth-stages of 140 mm. or so. This disposition of the

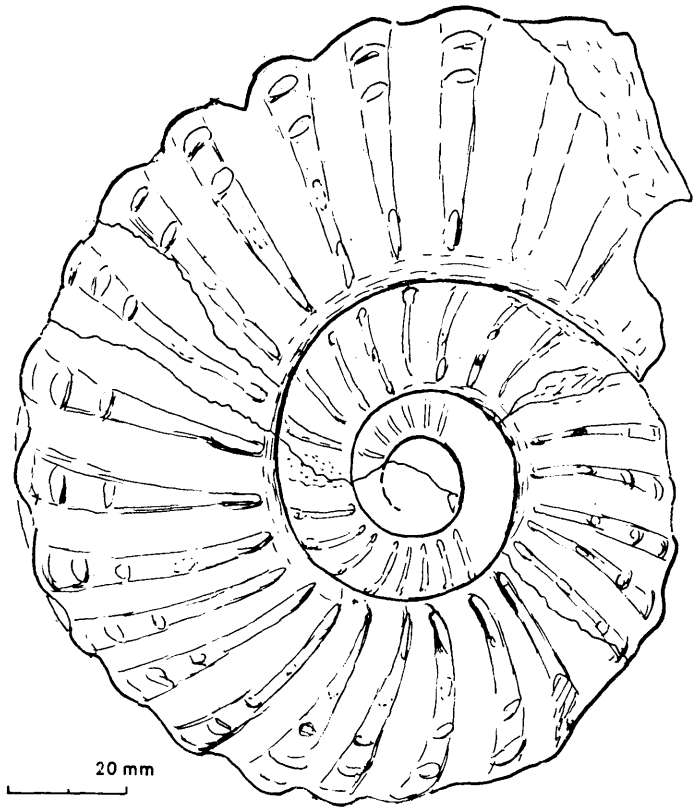

Fig. 20 [94]. *Texanites (Plesiotexanites) schlueteri* sp. nov. Sketch of the holotype, GIB. No. 26b [=*Ammonites texanus* of SCHLÜTER, 1867, pl. 6, fig. 1] (T. M. *delin.*)

tubercles is similar to that of *Paratexanites*. The Texas species is better to be transferred to *Texanites* (*Plesiotexanites*), although it has some features which are common to those of *Submortoniceras*. On its large outer whorl the third and the fourth tubercles are fused into a large ventrolateral tubercle and the second tubercle is absorbed by the prominent ribs. This is similar to the feature observed on the outer whorl of *Texanites soutoni*.

Ammonites soutoni BAILY, 1855, from the Santonian (probably middle part) of South Africa, Madagascar and Japan (northeast Honshu), was assigned to *Submortoniceras* by SPATH (1953, p. 52) and YOUNG (1963, p. 91) but to *Texanites* by COLLIGNON (1948, 1966) and myself (MATSUMOTO, 1955, p. 42, text-fig. 3). This species is characterized by a large size, numerous, gently flexuous, moderately strong, mostly single ribs, that tend to absorb the lateral tubercles on the outer whorl showing an ancestral *Protexanites* like feature, but is somewhat similar to such species as *Texanites* (*Texanites*) *venustus* in the observable characters of the middle growth-stages, showing occasional bifurcation of the ribs and fairly distinct, but not strong, tubercles in five rows. The characters of its still younger immature stages are not known. Therefore I cannot confirm its possible assignment to *Plesiotexanites*. Anyhow, it should be referred to the genus

Texanites and not to *Submortoniceras*.

Summarizing the above explained observations, it is certainly concluded that the species of *Plesiotexanites* are directly or indirectly connected with those of *Protexanites*. Certain species seem to be directly allied to the species of *Protexanites* (*Protexanites*), certain others to those of *Paratexanites* (*Paratexanites*) or *Paratexanites* (*Parabevahites*), and a few others to those of *Protexanites* (*Anatexanites*) or *Protexanites* (*Miotexanites*), depending on the mode of developing tubercles, as well as on the aspects of other characters.

Texanites (*Plesiotexanites*) *kawasakii* (KAWADA)

Pl. 38 [42], Figs. 1–2; Pl. 39 [43], Fig. 1; Pl. 40 [44], Fig. 1–2; Pl. 41 [45], Fig. 1; Pl. 42 [46], Fig. 4; Pl. 43 [47], Figs. 1–2; Text-figs. 21 [95]–22 [96]

1929. *Mortoniceras kawasakii* KAWADA, *Jour. Geol. Soc. Japan.* vol. 36, Engl. p. 4, pl. 14, figs. 2–4.
1959. *Texanites* cf. *kawasakii*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, ser. D. special vol. 1, p. 124, pl. 28, fig. 2.
1962. *Texanites kawasakii*, MATSUMOTO and UEDA, *Mem. Fac. Sci., Kyushu Univ.*, ser. D. vol. 12, no. 2, p. 170, pl. 26, fig. 1; pl. 27, fig. 2.
1964. *Texanites kawasakii*, MATSUMOTO, *Kaseki* [Fossils], no. 8, p. 72, text-fig. 4A.

Material.—Holotype, by monotypy, is GT. I-553 [=MM 7701], from the Santan-gawa, Naibuchi area, South Saghalien (Coll. M. KAWADA). In addition to it fairly well preserved specimens as listed below are available.

GT. I-551 [=MM 7702] and GT. I-552 [=MM 7703] from the same Santan-gawa, South Saghalien (Coll. M. KAWASAKI)

IGPS. 36830, from "loc. 118, h'" of the Miho, Naibuchi area (no record of the collector)

GK. H5517, from loc. 481-12, GK. H5518, from loc. 547, and GK. H5519, from loc. 585, in the valley of the Sankebetsu, the Chikubetsu-tanko quadrangle, northwestern Hokkaido (collected by K. MATSUNO and donated to Kyushu University by courtesy of Dr. K. TANAKA of the Geological Survey of Japan)

GK. H5520, from loc. Sk 30, the Sankebetsu, the Sankei quadrangle, adjacent to the south of Chikubetsu-tanko quadrangle, northwestern Hokkaido (collected by K. TANAKA of the Geological Survey of Japan and donated to Kyushu University)

GK. H5512, from loc. Ck 79, Deto-futamata, unit B 2, and GK. H5513, from loc. Ck 80, Deto-futamata, unit C, Chikubetsu area, northwest Hokkaido (Y. UEDA Coll.)

GK. H5639, from loc. R 424d, Sakasa-gawa, Kami Haboro area (Sankei quadrangle) (Coll. H. OKADA, T. NISHIDA and T. MATSUMOTO)

GK. H5507, from a small stream called the Takadano-sawa, tributary to the Kikumezawa (found by K. YONEKAWA, presented to Kyushu University through T. M.), and another smaller specimens, from loc. Ik 1506c, in the collection of T. MURAMOTO, Ikushumbets area, central Hokkaido

Remarks.—The holotype is a small, probably immature specimen, but a larger specimen, GT. I-551 in KAWASAKI's collection from the type locality (Santan-gawa) and several other large specimens in the subsequent collections clearly show the same characters as the holotype in their immature stages. In other words the ontogenetic change of charaters has been revealed. In this respect the definition of *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA) is revised to a large extent in this paper as compared with the original description of KAWADA (1929).

Specific characters.—The full-grown shell is fairly large, with a diameter of about 230 mm. in a typical example (GK. H5517) which has a body-chamber of about a half volution.

The coiling is rather evolute throughout the growth-stages, with a line of overlap immediately outside the row of ventrolateral tubercles. The umbilicus is moderately wide, about 40±4 percent of the shell diameter.

The nuclear shell of about 3 mm. in diameter consists of smooth, rounded whorls. The shell of the succeeding, still immature stages up to the diameter of 45 (in some individuals) to 60 mm. (in some others), consists of subquadrate whorls, which are at first broader than high but later nearly as high as broad. The whorl has distant, nearly rectiradiate or slightly prorsiradiate, strong, simple ribs, each of which is trituberculate, having a small but sharply pointed tubercle at the umbilical shoulder, a very prominent, strongly spinose tubercle at the ventrolateral shoulder and a narrow but distinct clava at the ventral end of the rib. The ventrolateral spines are disposed as if they are leaned on the steep umbilical wall of the next whorl. The ventral clavae are at first very close to the siphonal keel, being separated by a narrow furrow, then they are somewhat shifted sideward to have a shallow and moderately broadened groove on either side of the keel. The ribs are lowered but broadened between the ventrolateral tubercle and the long ventral one, sometimes showing a doubled or loop formed appearance. There are 15 to 18 ribs per whorl in this stage.

Then comes a critical stage at which a prominent change occurs in shell-form and ornamentation. This stage is rather short, from 40 to 55 mm. in diameter in some individuals or from 60 to 85 mm. in some others. At first the prominent ventrolateral tubercle is doubled and at the same time appears a nascent mediolateral tubercle. Then the doubled ventrolateral tubercle is differentiated into a stronger, somewhat clavate outer ventrolateral (or "marginal") tubercle and a much weaker, inner ventrolateral (or "submarginal") one. They are at first approximated but gradually separated as the shell grows. The mediolateral tubercle gradually becomes distinct. The umbilical tubercle is still strong but tends to decrease its sharpness. The rib is nearly rectiradiate or slightly prorsiradiate and begins to show a slightly concave curvature, being gently inclined forward towards the venter. The ribs are not so widely separated as in the preceding stage, although the interspaces are somewhat wider than the ribs themselves. The whorl becomes higher than broad.

In the succeeding stage, which may be called the middle growth-stage, up to the diameter of 100 or 120 mm., typical *Texanites* characters are best displayed. The whorl is somewhat higher than broad and subquadrangular in section. Ribs

are numerous, about 15 in a half whorl, nearly rectiradiate to slightly prorsiradiate and may be slightly concave. Five rows of tubercles are distinct. They are nearly equidistant but of unequal intensity and shape. The umbilical tubercle is bullate and highest at a point at some distance above the umbilical shoulder. Accordingly it looks to be doubled in some specimens (e.g. GT. I-551), having two points of prominence at the umbilical shoulder and at the highest part. The

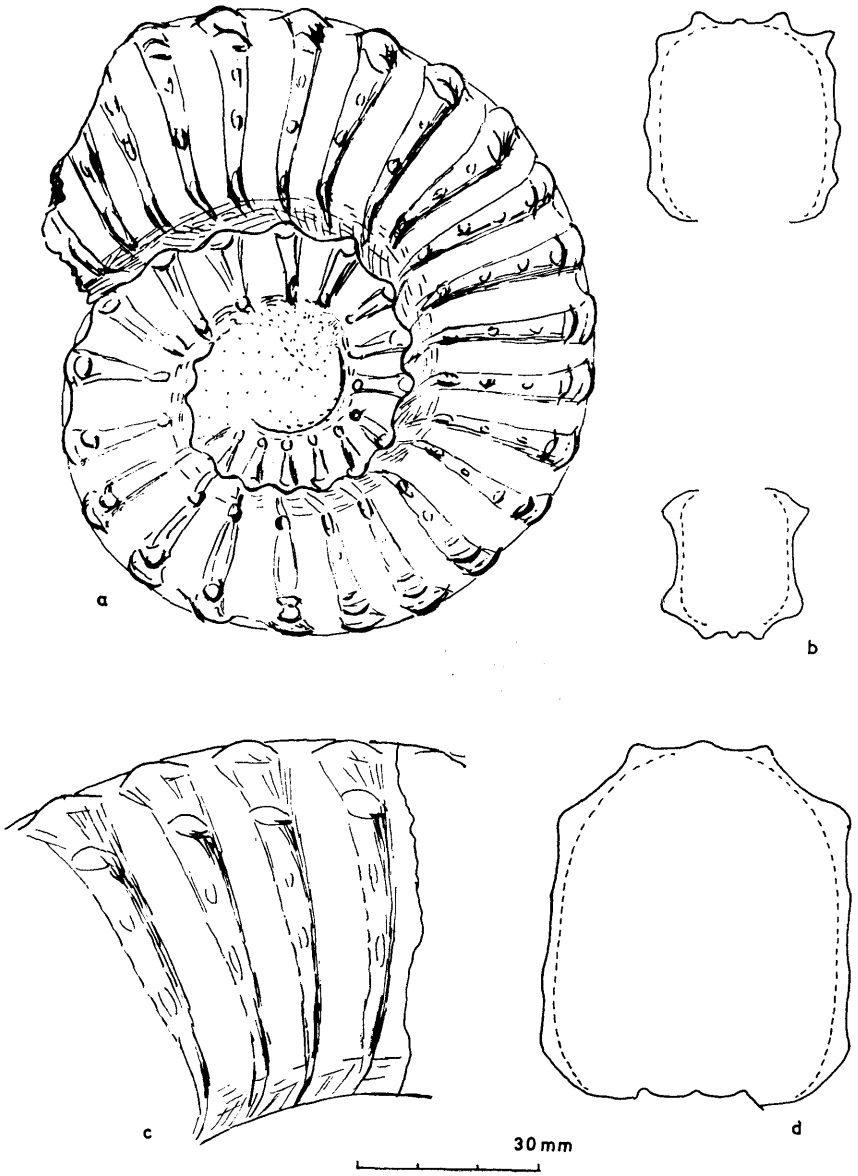

Fig. 21 [95]. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA). Diagrammatic illustration of the inner whorl (a, b) and a part of the outer whorl (c, d) of GK. H5517. Lateral view (a, c) and whorl-sections (b, d). (T. M. *delin.*)

mediolateral, or rather to say inner lateral tubercle is small but distinct, nodose at first and then tending to be somewhat bullate. The inner ventrolateral tubercle is shifted inward and better to be called the outer lateral tubercle. It is the weakest of all. The outer ventrolateral tubercle is distinctly elevated and somewhat clavate. The ventral tubercle is narrow and longly clavate.

In the rest, probably adult stage, which includes the last half of the septate whorl and the body-whorl of a half volution, the whorl is somewhat higher than broad, with the proportion of 10 : 8.5–9 between height and breadth, broadest at about the lower lateral tubercle, and has gently inflated flanks and a moderately arched venter. The ribs are numerous, about 15 to 20 in a half whorl, somewhat more crowded than in the preceding stages, somewhat rounded and separated by concave interspaces which are nearly as broad as or somewhat broader than the ribs. They show a gently concave curvature, gradually projected towards the venter. In this stage the ribs are predominant over tubercles on the flank and the inner and outer lateral tubercles tend to be absorbed by the ribs, although they are discernible as faint elevations. The umbilical tubercles are bullate and disposed as if they are a part of the rib, but it is elevated at a point at some distance outside the umbilical shoulder. On the ventrolateral part the ribs are lowered and weakened, and accordingly the tubercles predominate over the ribs. The ventrolateral tubercles and the ventral clavae continue to be strong. The five rows of tubercles are nearly equidistant but the distance between the third and the fourth rows is slightly shorter than that of others.

The suture is of *Collignoniceras* type. The external lobe (E) is narrow, deep, and parallel sided. The first lateral saddle is broad, massive and subdivided by a lobule of moderate depth. The lateral lobe (L) is fairly broad, bipartite and opened upward (e.g. anteriorly). The second lateral saddle is asymmetric and semi-dome in rough outline. U_2 is small and situated at the umbilical shoulder even in the adult stage.

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
GT. I-553	43.0(1)	18.2(.42)	13.0(.30)	16 (.37)	1.2
GT. I-551 (middle stage)	86.1(1)	36.3(.42)	32.8(.38)	31.0(.36)	.9
GK. H5517	225 (1)	100 (.44)	74 (.33)	64 (.28)	.85
〃 (− 45°)	—	—	63.6	58.0	.88
〃 (−360°)	104 (1)	45.0(.43)	35.4(.34)	31.4(.30)	.88
GK. H5507	143 (1)	59.6(.42)	48.7(.34)	41.0(.29)	.86
GK. H5513	23.0(1)	9.2(.40)	7.7(.34)	9.8(.42)	1.3
〃 (ic)	—	—	7.6	7.7	1.0

Comparison and affinity.—The present species was confused with *Protexanites* (*Anatexanites*) *fukazawai* (YABE and SHIMIZU, 1925) by SHIMIZU (1935) who considered that the holotype of *Mortoniceras kawasakii* is merely an immature shell of *Mortoniceras fukazawai*. *P.* (*A.*) *fukazawai* has only one row of indistinct lateral tubercles but *Texanites kawasakii* has two rows of lateral tubercles of which those of the lower lateral row are fairly distinct in the middle growth stage. Even in the trituberculate immature stage the two species are distinguish-

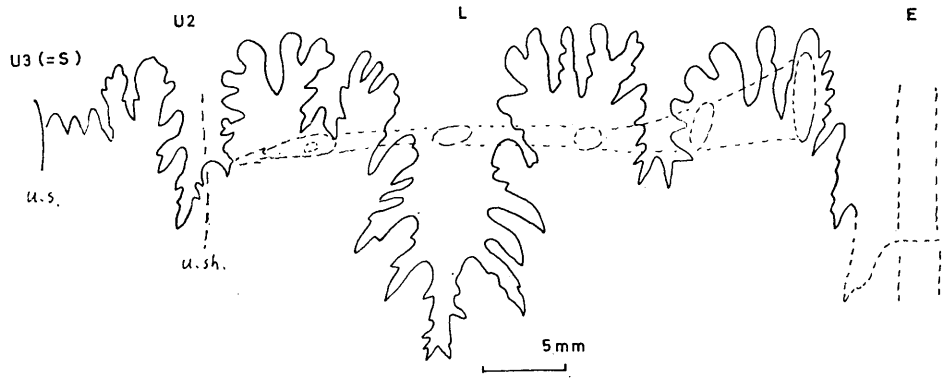

Fig. 22 [96]. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA). External suture at whorl-height=34 mm. of GK. H5517. (T. M. *delin.*)

able. *P.* (*A.*) *fukazawai* has less distant, sometimes branching and sometimes gently flexuous ribs, resembling the immature shell of *Protexanites* (*Protexanites*) *bourgeoisi*. The previous misidentification may have come from the similarity of the adult whorl between the two species which commonly have predominant ribs over tubercles on the flank of the outer whorl and the same type of sutures. The ribs are more numerous and more crowded in *P.* (*A.*) *fukazawai* than in *T.* (*Pl.*) *kawasakii*.

The specimen IGPS. 7330, from the middle course of the river Togushi, west coast of Notoro peninsular, South Saghalien, described under *Mortoniceras* aff. *fukazawai* by YABE and SHIMIZU (1925, p. 131 [7], pl. 31 [2], fig. 3) is a secondarily depressed whorl which has the same type of ornamentation as the whorl of the middle growth stage of *T.* (*Pl.*) *kawasakii*.

The trituberculate immature shell of *T.* (*Pl.*) *kawadai* closely resembles that of *Protexanites* (*Protexanites*) *planatus* (LASSWITZ) of the preceding age. In *P.* (*P.*) *planatus* the trituberculate distant ribs persist to the moderately large adult shell, whereas in *T.* (*Pl.*) *kawadai* a row of mediolateral tubercles are added, a row of outer lateral tubercles are differentiated from the ventrolateral tubercles and the ribs become to be less distant in the middle to late growth-stages. It is possible to presume that *T.* (*Pl.*) *kawasakii* may have derived from *Protexanites planatus*.

The incompletely preserved specimens from member IV of the Redding Cretaceous, California, which I reported previously (MATSUMOTO, 1959, p. 124, pl. 28, fig. 2) are comparable with the shell of the middle growth-stage of the present species.

The fragmentary outer whorl and the inner whorl of *Parabevahites* (?) *transitorius* COLLIGNON (1966, p. 80, pl. 488, fig. 170 A, B), from the Middle Santonian of Madagascar, respectively resemble the middle-aged whorl and the immature one of *Texanites* (*Plesiotexanites*) *kawasakii*. The dimensions measured by COLLIGNON are also quite similar to ours. The distinction may be a more persistent *Paratexanites* like disposition of the outer three rows of tubercles in the Madagascar species. Anyhow, its outer whorl has five rows of tubercles

and this species is a good example of *Plesiotexanites* in Madagascar.

Occurrence.—The type locality is in the Santan, a tributary of the Naibuchi, mudstone of zone Mh 6, Santonian, South Saghalien.

On the evidence of the occurrences in the Chikubetsu-Sankei-Haboro area and in the Ikushumbets area this species occurs in the Upper Urakawan, and seems to characterize the part ranging from the upper part of the zone of *Inoceramus amakusensis* and to the lower part of the zone of *Inoceramus japonicus*.

In the Amakusa area, Kyushu, this species occurs in member I-c of the Himenoura Group, upper part of the zone of *Inoceramus amakusensis*.

If the Santonian is tripartite in Japan, *T.* (*Pl.*) *kawasakii* can be said to occur commonly in the middle part of Santonian, although its true range may be longer.

Texanites (*Plesiotexanites*) *stangeri* (BAILY)

Pl. 41 [45], Figs. 2–4; Text-fig. 23 [97]

1855. *Ammonites stangeri* BAILY, *Quart. Jour. Geol. Soc. London,* vol. 11, p. 455, pl. 11, fig. 2.
1906. *Mortoniceras stangeri,* WOODS, *Ann. S. Afr. Mus.,* vol. 4, p. 338, pl. 44, fig. 1.
1921. *Mortoniceras stangeri,* SPATH, *Ann. S. Afr. Mus.,* vol. 12, p. 297, text-fig. D–1.
1922. *Mortoniceras stangeri,* SPATH, Trans. *Roy. Soc. S. Afr.,* vol. 10, pt. 3, p. 137, pl. 9, fig. 2.
1922. *Mortoniceras stangeri* var. *sparsicosta,* SPATH, *Ibid.,* p. 138, pl. 5, fig. 1.
1922. *Mortoniceras stangeri* var. *densicosta,* SPATH, *Ibid,* p. 138, pl. 5, fig. 2.
1963. *Texanites stangeri,* YOUNG, *Univ. Texas Pub.* No. 6304, p. 88, pl. 45, figs. 1–3; text-fig. 25p.
1963. *Texantes stangeri densicostatus,* YOUNG, *Ibid.,* p. 86, pl. 42, figs. 3, 4; pl. 43, figs. –4; pl. 47, figs. 5, 6; pl. 48, figs. 2, 5, 6; pl. 71, figs. 1–4; text-figs. 25 c e g h, 34c.
1966. *Texanies stangeri* var. *densicosta,* COLLIGNON, *Atlas des fossiles caracteristiques de Madagascar* (Ammonites), fasc. 14, p. 72, pl. 484, fig. 1958; p. 132, pl. 512, fig. 2024.
1966. *Parabevahites* cf. *emscheris,* COLLIGNON, *Ibid.,* p. 80, pl. 488, fig. 1966.

Holotype.—B. M. C. 73333 [=Geol. Soc. Coll. No. 11366], from the cliffs near the Umtafuna and Umzanbani River; Natal, South Africa, illustrated by BAILY (1855, pl. 11, fig. 2). BAILY (1855, p. 455) mentioned that there were four specimens of *Ammonites stangeri,* but his description of the species evidently depended on the figured specimen.

Material.—In addition to the holotype, I had fortunately opportunities to study the specimens from South Africa described by SPATH (1922) and from Texas described by YOUNG (1963).

An example from Hokkaido is GK. H5521, from the Chikubetsu-tanko quadrangle, Coll. K. MATSUNO of the Geological Survey and donated to Kyushu University by courtesy of Dr. K. TANAKA.

Specific characters.—The shell is very large at the full-grown stage, with a

diameter of about 320 mm. in the holotype. It is evolute and widely umbilicate, consisting of slowly enlarging whorls.

The whorl is broader than high in immature stages, nearly as high as broad and subquadrate in section in the middle growth-stage and somewhat higher than broad, with a gently arched venter in the late growth-stage.

The ribs are typically strong and fairly distant, separated by wider interspaces, but there is a considerable extent of variation in the coarseness and density. They are nearly rectiraditae to somewhat prorsiradiate and mostly simple, but sometimes there may be bifurcations or intercalations on the inner whorl.

In the early immature stage, on the whorls with diameters from several millimeters to 35±5 mm., the ribs are trituberculate. The umbilical tubercles are small but pointed, with a rounded base. The tubercles at the ventrolateral shoulder are prominent and especially strong on the coarsely ribbed shell. The ventral clavae at the end of the ribs are narrow and long, forming a train which is separated by a moderately deep furrow from the siphonal keel of moderate intensity. They are situated somewhat ahead of the ventrolateral tubercles, since the ribs are broadened and projected on the venter.

In the next stage, up to the shell diameter of 50±10 mm., the ribs are quadrituberculate. The umbilical tubercles are pointed at the shoulder. The ventrolateral protuberance is thick and doubled consisting of a clavate outer one and nodose inner one resting on a common major base. The two tubercles are going to be separated as the shell grows. The ventral clavae at the end of the broadened ribs are narrow and long. Their top is nearly as high as the siphonal keel. Sooner or later in the last substage of this stage an incipient, faint, mediolateral tubercle begins to appear.

On the whorls of the main, middle growth-stage, up to a considerably large size, there are five rows of distinct tubercles. When the shell is coarsely ribbed the tubercles are strong. The umbilical tubercles are fairly prominent above the steep umbilical wall, showing an angulation or subangulation in the costal section. The mediolateral tubercles are nodose but weaker than others. They are nearly halfway between the umbilical and the inner vetrolateral tubercles or somewhat closer to the latter. The two rows of ventrolateral tubercles are gradually separated and become independent. They are moderately strong and in the coarsely ribbed, subquadrate variety the inner ventrolateral tubercles are spinose. In the relatively compressed individuals they are so disposed as to be better called the outer lateral tubercles. The outer ventrolateral tubercles are distinctly clavate. The ventral clavae are narrow and long but more interrupted than on the inner whorls. The groove between the keel and the row of the ventral clavae is broadened and has a flatter bottom than in the preceding stage.

In the last part of the outer whorl the tubercles are weakened, the umbilical tubercles are bullate and the lateral tubercles tend to be absorbed by the ribs.

The suture is of collignoniceratid type. The external lobe (E) is narrow and parallel sided. The first lateral saddle is broad, massive and subquadrate in rough outline, covering the breadth of the three outer rows of tubercles. The first lateral lobe (L) is deep and narrowly U-shaped, having asymmetrically

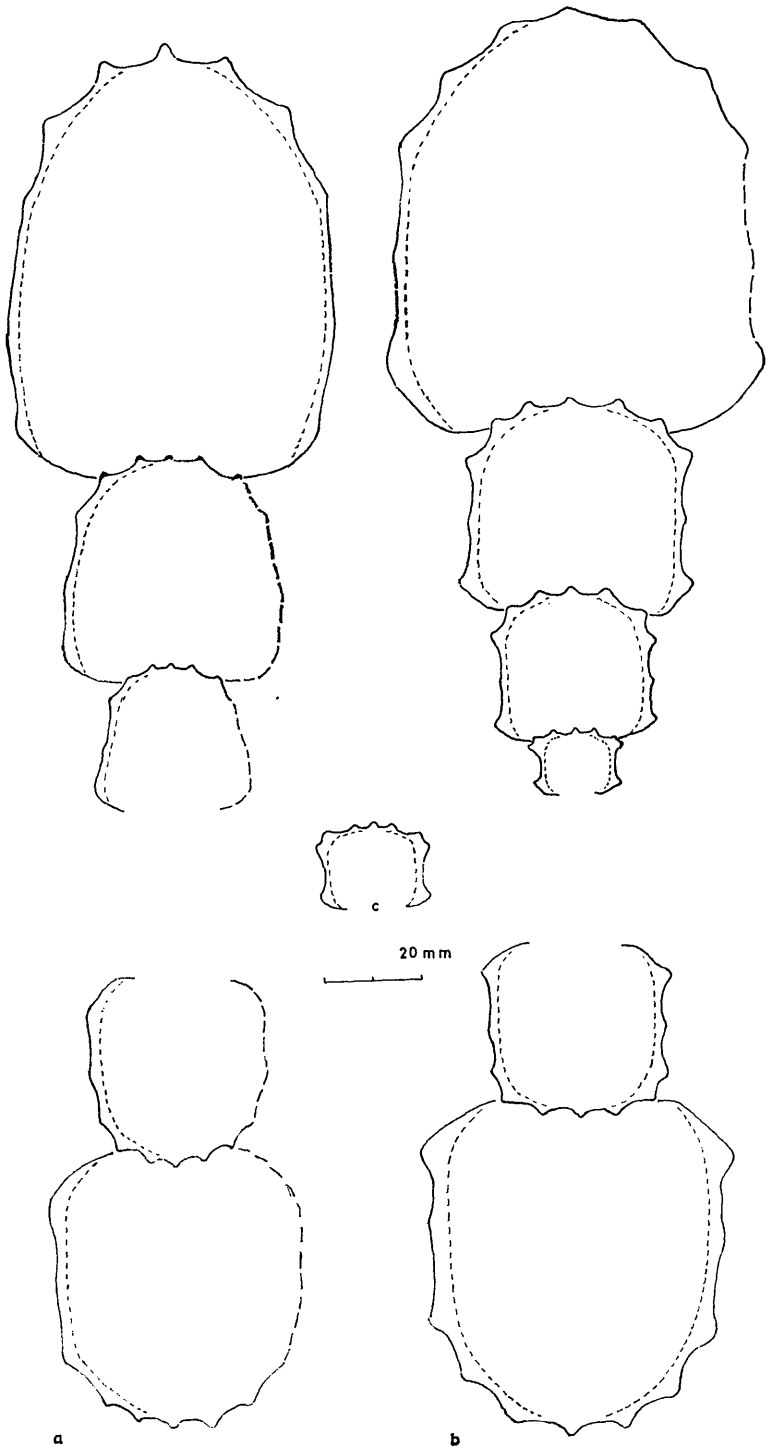

Fig. 23 [97]. *Texanites* (*Plesiotexanites*) *stangeri* (BAILY). Diagrammatic whorl-sections of the three specimens from South Africa; holotype, BM. C73333 (a), typical example of SPATH's "variety *sparsicosta*", BM. C19444 (b) and a fragmentary whorl, BM. C35627 (c). (T. M. *delin.*)

disposed branches of moderate depth in the lower part. The second lateral saddle is narrower than the first but broader than L. The second lateral saddle U_2 is much smaller than L, somewhat oblique and at or near the row of umbilical tubercles.

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
BM. C73333 [11366]	320(1)				
〃 (−180°)	298(1)	155.5(.52)	86.4(.29)	65.0(.21)	.75
〃 (−540°)	163(1)	82.0(.50)	45.0(.27)	45.0(.27)	1.0
BM. C19444	295(1)	152.5(.52)	85.0(.29)	74.0(.25)	.87
〃 (−180°)	225(1)	112.0(.50)	58.0(.25)	59.0(.26)	1.02
〃 (−360°)	163(1)	85.0(.52)	43.0(.26)	46.0(.28)	1.07
GK. H5521	—	—	27.0	27.0	1.00
〃 (inner whorl)	30.5(1)	12.3(.40)	10.8(.35)	14.4(.47)	1.33

Remarks.—SPATH (1922) recognized a considerable variation in this species. He described the two extreme forms under varieties *sparsicosta* and *densicosta*, mentioning that there are gradations between them through the typical form.

YOUNG (1963) considered these varieties as having a subspecific significance. There is, however, no evidence that they were geographically separated or they change along with the stratigraphical sequence. Therefore I would regard them as mere varieties as SPATH did.

The specimen from Hokkaido, GK. H5521, resembles the inner whorls of the specimen BM. C19444, which SPATH described as variety *sparsicosta*. Its inner whorl shows the characters of still immature shell which is not preserved in SPATH's specimen. The inner whorl about 30 mm. in diameter is broader than high, subquadrangular or even coronate in costal section. It has thirteen, distant ribs, which are broadened toward the venter. The ribs are trituberculate. The umbilical tubercles are small but pointed, with a rounded base. The ventrolateral tubercles are very strong and have a spirally elongated elliptical base. The ventral tubercles are narrow and clavate. They are so elongated that they look as if they formed a keel, but the keel like elevation is not continuous. In other words the venter is not tricarinate as in *Peroniceras*, contrary to KOSSMAT's (1895, p. 190) observation.

Comparison and affinity.—*Texanites* (*Plesiotexanites*) *stangeri* (BAILY) resembles *Texanites* (*Plesiotexanites*) *kawasakii* but is distinguished in its more evolute, more widely umbilicate shell, more predominant tubercles in the middle growth-stage and its *Parabevahites* like quadrituberculate stage intervening between the trituberculate earlier and the quinquetuberculate later stages. The sutures of the two species are not identical. The lateral lobe (L) is narrowly U-shaped in *T.* (*Pl.*) *stangeri* but is broad and widely opened upward in *T.* (*Pl.*) *kawasakii*. U_2 is delayed to shift outward in *T.* (*Pl.*) *kawasakii*.

The quadrituberculate late immature shell of *T.* (*Pl.*) *stangeri* is closely allied to the shell of the corresponding size of *Paratexanites* (*Parabevahites*) *emscheris* (SCHLÜTER).

The shell of the succeeding, middle growth stages resembles that of *Paratexanites* (*Paratexanites*) *orientalis* (YABE) or the middle aged shell of *Paratexanites*

(*Paratexanites*) *umkwelanensis* (CRICK), but the mediolateral tubercles do not appear at any stage in the latter two species.

Occurrence.—Texanites (*Plesiotexanites*) *stangeri* occurs fairly commonly in the Upper Cretaceous of Pondoland, South Africa. The age of the Pondoland Beds was not clearly settled by SPATH's work (1922). The same species (densicostate variety) is recorded by YOUNG (1963) as occurring in the Lower Santonian and by COLLIGNON (1966) in the Middle and the Upper Santonian. Therefore the species seems to have a long range throughout the Santonian.

As the Hokkaido specimen was obtained in a rolled nodule of the Chikubetsu area, its precise horizon is not known. It is associated with *Inoceramus naumanni* and fragments of a large *Inoceramus*. It may have come from somewhere in the Santonian.

Texanites (*Plesiotexanites*) *pacificus* sp. nov.
Pl. 42 [46], Fig. 2; Pl. 45 [49], Figs. 1–2;
Pl. 46 [50], Fig. 4; Text-fig. 24 [98]

Material.—Holotype, GK. H5506, from loc. CK 52, Sankebetsu, Haboro-Chikubetsu area (coll. Y. UEDA). Paratype, GK. H5644, from the 13.5 km. point (along the abandoned forestry railway), under reaches of the Ikushumbets (coll. S. GOTO, who was a school-boy of the Mikasa High School, 1955). A probably immature example, GK. H5640, from the 10 km. point, main stream of the Ikushumbets.

Specific characters.—The holotype is about 100 mm. in diameter at the end of the body-whorl but the paratype is about 140 mm. at the end of the septate whorl.

The shell is compressed and discoidal, consisting of fairly evolute whorls, which enlarge rapidly in height. The line of overlap is at or immediately outside the row of ventrolateral tubercles. The umbilicus is of moderate width, about 38±3 percent of the shell diameter, and surrounded by a low but steep wall which may be overhanging in the outer whorl.

In the immature stage, up to the diameter of 30 mm. or so, the whorl is nearly as high as broad and subquadrate in costal section, except for the rounded earliest stage. In the rest, main growth-stages the whorl is higher than broad, showing the proportion of height to breadth about 10 : 7.5 in the outer whorl. It is rather trapezoid in section, broadest in the lower part, having gently convex, slightly convergent flanks, sloping ventrolateral shoulders and a flat venter which is narrower than a half of the breadth of the whorl. The siphonal keel is of moderate breadth and height, nearly as high as the ventral clavae on the inner whorl but somewhat lower than the highest point of the ventral clavae on the outer whorl.

The earliest two and a half whorls are smooth and rounded. A rib begins to appear at the shell diameter of about 3 mm. Up to the shell of about 30 mm. in diameter, for about two and a half whorls, the ribs are rigid, coarse, distant, and separated by somewhat wider interspaces. They are trituberculate.

The umbilical tubercles are at first faint but soon become distinct and pointed. The ventrolateral tubercles are prominent from the beginning. The ventral clavae

at the end of the ribs are narrow and long. They are located somewhat ahead of the ventrolateral tubercles, since the ribs are projected and broadened on the venter.

The whorl with diameters of 30 to 35 mm. is a critical stage when the shell shows a rapid change in the shell-form and ornamentation. The whorl becomes more compressed, the ribs become to be more crowded, somewhat curved and less elevated, the ventrolateral tubercle becomes to be less prominent and more clavate, and an incipient, weak, lateral tubercle appears. A faint, inner ventrolateral (i.e. submarginal) tubercle appears later than the lateral one.

In the succeeding main, middle to late, growth-stages, the ribs are numerous, crowded, separated by narrower interspaces, and somewhat flattened on the outer part of the flank. There are 32 ribs per whorl in the holotype at the diameter of 105 mm., of which a few are slightly shorter than others and intercalated. They are gently concave, with a gentle projection towards the venter. Five rows of tubercles are distinctly discernible in these stages. The umbilical tubercles are bullate, rather narrow, and elevated at the shoulder. There may be minor, blunt dentations on the bullae. The inner lateral tubercles are weak and separated from the umbilical tubercles with a considerable distance. The outer lateral tubercles, which have been shifted inward from the inner ventrolateral or submarginal position, are also weak and somewhat clavate. The outer ventrolateral tubercles are clavate and distinct. They are shifted outward as the shell grows and on the outer whorl they are closer to the ventral clavae than to the outer lateral. Accordingly the three rows of tubercles, the second, the third and the fourth, are nearly equidistant on the flank of the outer whorl, although the third and the fourth tubercles are closer on the inner whorl. The ventral tubercles are narrow and longly clavate, keeping to show a texanitine venter. The groove between the train of the ventral clavae and the siphonal keel becomes shallow and flat.

In the last stage the inner and outer lateral tubercles tend to be absorbed by the ribs and, thus, an apparently trituberculate state reappear, although the umbilical and ventrolateral tubercles are not prominent at this stage.

The suture is of typical collignoniceratid type. The external lobe (E) is

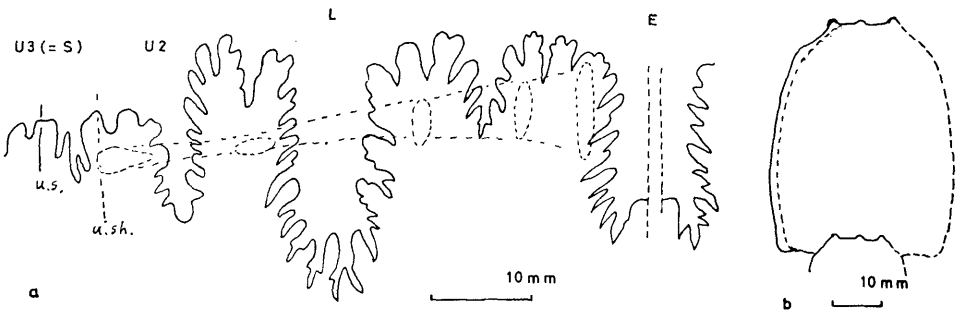

Fig. 24 [98]. *Texanites* (*Plesiotexanites*) *pacificus* sp. nov. External suture (a) at whorl-height=44 mm. and a diagrammatic whorl-section (b) of GK. H5644, paratype. (T. M. *delin.*)

narrow, moderately deep and parallel sided. The first lateral saddle is massive, broad, subquadrate in a rough outline and rather shallowly and nearly symmetrically bipartite. The first lateral lobe (L) is narrow, deep and U-shaped. Its minor incisions are not deep. The second lateral lobe (U_2) is much smaller than L, slightly oblique and situated immediately outside the umbilical shoulder. The second lateral saddle between L and U_2 is high, of moderate breadth and somewhat asymmetric, being taller toward the umbilical side.

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
GK. H5506	106.0(1)	38.5(.36)	36.5(.34)	27.5(.26)	.75
〃 (−90°)	82.0(1)	31.0(.38)	30.4(.37)	23.2(.28)	.76
GK. H5644	137.0(1)	56.0(.41)	46.0(.33)	35.0(.26)	.76
GK. H5640 (−180°)	26.6(1)	11.0(.41)	9.7(.36)	10.3(.39)	1.06

Comparison and affinity.—This species is similar to *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA), emended in this paper, in the characters of immature stages and in the mode of developing tubercles. Even in the trituberculate immature stage the former seems to have less depressed whorls and more numerous and less distant ribs. The trituberculate state persists for a longer period in *T.* (*Pl.*) *kawasakii*. In the main growth-stages the distinction is clearer. *T.* (*Pl.*) *pacificus* has more compressed whorls, a somewhat narrower and shallower umbilicus, more numerous, crowded, flatter ribs, which are more projected on the ventrolateral part, less pointed and more clavate lateral and ventrolateral tubercles and a narrower lateral lobe (L).

In the stage when the mediolateral tubercles begin to appear the shell of the present species is similar to the immature shell of *Protexanites* (*Anatexanites*) *fukazawai* (YABE and SHIMIZU), but soon one more row of tubercles is added in *T.* (*Pl.*) *pacificus*.

In the stage when the inner ventrolateral tubercles begin to appear the shell of the present species resembles that of *Paratexanites* (*Parabevahites*) *serratomarginatus* (REDTENBACHER) of the corresponding size. The former has, however, already a row of lateral tubercles, although they are indistinct. The distinction of the two species in the main, later stages is unmistakable.

Occurrence.—The type locality, CK 52, an exposure in the stream of the Sankebetsu, is assigned to Member B2 of the Upper Yezo Group in the Haboro-Chikubetsu area, northwestern Hokkaido (see UEDA et al., 1962, in which this species was erroneously listed as *Texanites texanus*). In Member B2 the upper range of *Inoceramus amakusensis* is overlapped with the lower range of *Inoceramus japonicus*. Therefore Member B2 is probably assigned to the middle part of Upper Urakawan, i.e. approximately Middle Santonian.

Two other localities of the paratypes in the upper reaches of the Ikushumbets, central Hokkaido, are not so precisely allocated in the stratigraphical sequence as in the type locality, but they are in the upper part of the Upper Yezo Group in this area, which is referable to the Santonian.

Texanites (Plesiotexanites) sanushibensis (YABE and SHIMIZU)
Pl. 34 [38], Fig. 1; Text-fig. 25 [99]

1925. *Mortoniceras sanushibense* [*recte*] YABE and SHIMIZU, *Sci. Rep. Tohoku Imp. Univ.*, 2nd ser., vol. 7, no. 4, p. 132 [8], pl. 33 [4], figs. 3–5.
1935. *Submortoniceras sanushibense*, SHIMIZU, *Jour. Shanghai Sci. Inst.*, sect. 2, vol. 1, p. 191 (listed).
1948. *Texanites sanushibensis*, COLLIGNON, *Ann. Géol. Serv. Mines* (Madagascar), fasc. 14, p. 54 [111].

Holotype.—IGPS. 8039, from the upper reaches of the Sanshibe, a tributary of the Hobetsu, province of Iburi, central Hokkaido (found by Kanjiro NISHIKAWA).

No material in the subsequent collection is available.

Specific characters.—As the holotype is wholly septate, the size and other characters of the full-grown shell is not known. If we assume an additional half volution as its body-whorl, the shell would be about 100 mm. in diameter.

The preserved part is characterized by a moderate degree of involution, a moderate rate in growth of whorls and a moderate size of the umbilicus (33 percent of the shell diameter). The whorl is higher than broad, with the proportion of height to breadth about 10 : 8.7 to 9.0. The later part of the outer whorl has a subtrapezoid section, being broader in the dorsal part, and has slightly inflated and gently converging flanks. The earlier part has nearly parallel flattened flanks.

There are 23 ribs in the preserved last whorl. Many ribs are simple, but some of them spring in pairs from the umbilical tubercle. Four pairs are discerned in the last volution, but the ribs in the last quarter are all simple. The ribs are somewhat prorsiradiate, some are gently flexuous, and those on the last quarter are slightly concave. They are rather narrow in the early part but moderately broad in the late part. They are separated by wider interspaces.

In the earlier shell, with diameter below 30 mm., the lateral tubercles are

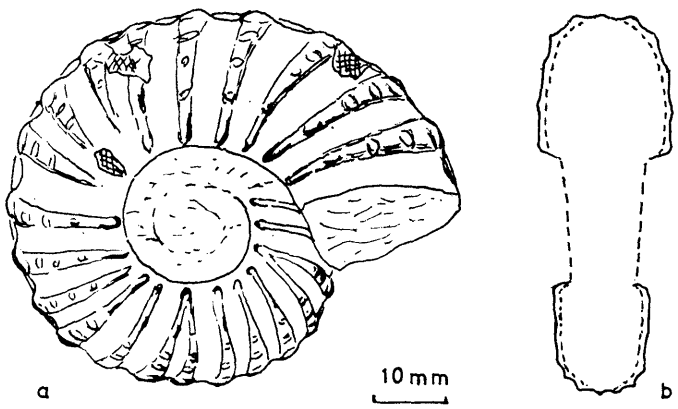

Fig. 25 [99]. *Texanites (Plesiotexanites) sanushibensis* (YABE and SHIMIZU). Sketch in lateral view (a) and a diagrammatic whorl-section (b) of the holotype, IGPS. 8039. (T. M. *delin.*)

not developed and the three outer tubercles are more or less clavate and nearly equidistant, being much separated from the tubercle at the umbilical margin. In the succeeding stage a nascent lateral tubercle appears at about the middle of the tubercle. It is bullate and superimposed on the moderately strong rib. Gradually the lateral tubercle becomes more distinct and at the same time the inner ventrolateral tubercle is gradually shifted inward, so that it can be better called the outer lateral tubercle. The outer ventrolateral tubercle is more distinct than the inner and is clavate. The ventral tubercles are most remarkably clavate and are nearly as high as or slightly higher than the siphonal keel. The umbilical tubercles are bullate.

The suture is simple and of typical collignoniceratid type, having a massive, subquadrate first lateral saddle and a roughly U-shaped lateral lobe (L).

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
IGPS. 8039	60.0(1)	20.0(.33)	23.0(.38)	20.0(.33)	.87
〃 (— 90°)	49.5(1)	16.5(.33)	20.0(.40)	17.8(.36)	.88
〃 (—270°)	—	—	15.3	13.9	.90

Comparison and affinity.—This species is allied to *Protexanites bontanti* in shell-form, ribbing and sutures and more closely so to *Paratexanites compressus* in the disposition of the tubercles in the quadrituberculate immature stages. It is distinguished by the development of the mediolateral tubercles and shifting of the inner ventrolateral tubercles to the outer lateral in the later growth-staegs. Possibly it can be led from *Protexanites bontanti* by way of *Paratexanites compressus.*

SHIMIZU (1935, p. 198) mentions that there is a species which resembles the present species but has only four rows of tubercles, proposing *Submortoniceras bibaiense* sp. nov. for it. This is a *nomen nudum* and I cannot decide whether it is referable to *Paratexanites* or *Anatexanites* or otherwise without seeing the specimen. The specimen with a label of this specific name has not yet been detected in SHIMIZU's collections deposited in Tohoku University.

Texanites (Plesiotexanites) schlueteri, defined in p. 278, is apparently similar to the present species in the weakness of the lateral tubercles and the disposition of the ribs, but is more evolute, more widely umbilicate and its ribs are all simple, without branched or intercalated ones. The disappearance of the lateral tubercle in the last part of the whorl is characteristic of *T. (P.) schlueteri.*

The present species is somewhat similar to a certain species of *Submortoniceras,* e.g. *S. elimatum* COLLIGNON, 1948 from the Campanian of Madagascar, in the general aspects of shell-form, but in *Submortoniceras* the shell is generally more involute, with a narrower umbilicus, and the ribs have more numerous intercalatories or bifurcations and in the later stages they are much weakened or almost smoothed.

Occurrence.—Rare in the probable Santonian of Hokkaido. The type-locality is recorded as the upper reaches of the Sanushibe, a tributary of the Hobetsu, Iburi Province. In the upper reaches of the Sanushibe the upper part (probably Santonian) of the Upper Yezo Group is exposed.

Texanites (Plesiotexanites) yezoensis sp. nov.
Pl. 44 [48], Fig. 2

Material.—Holotype, GK. H5646 [=T. MURAMOTO collection No. M30111p], from loc. Ik-M1550p, Ikushumbets. Paratypes, Hokkaido University Palaeontological Collection [GH] No. 3122 and No. 3123, from the Ikushumbets area (R. SAITO coll.) and No. 7954 from the Yubari area (K. OTATUME coll.).

Specific characters.—The shell attains to a fairly large size, presumably about 270 mm. in a restored diameter of the holotype. It is evolute, consisting of rather slowly enlarging whorls which embrace a moderately wide umbilicus (38 to 40 percent of the shell diameter).

The whorl is compressed. The inner whorl has a rather flattened flank and a steeply inclined or nearly vertical umbilical wall, whereas the outer whorl has a gently inflated flank, which passes to an inclined umbilical wall through a rounded umbilical shoulder.

The ribs are mostly simple and fairly narrow on the inner whorl and moderately broad, strong and rounded on the outer whorl. They are nearly rectiradiate, sometimes slightly prorsiradiate, and separated by slightly broader concave interspaces. There are 27 ribs in a whorl of the holotype at the diameter of 150 mm. In these middle growth-stages the ribs are club shaped, broadening outward. On the outer whorl the ribs are predominant over tubercles.

The trituberculate early stage is not clearly exhibited. On the whorl of 30 to 50 mm. in diameter there are four rows of tubercles, a bullate umbilical, a distinct mediolateral, a prominent ventrolateral and a clavate external tubercles. This is similar to a certain species of *Protexanites (Anatexanites)*, e.g. *P. (A.) nomii*. Then appears a faint outer lateral tubercle which is at first fairly approximated to the strong ventrolateral tubercle but gradually shifted inward. On the middle to late growth-stages, the four rows of tubercles on the outer half of the whorl, i.e. the second to the fifth, are nearly equidistant but of unequal intensity and shape. The mediolateral tubercle is moderately distinct and nodose or shortly bullate; the outer lateral weak and shortly clavate to nodose; the ventrolateral strong and distinctly clavate; the external longly clavate.

The umbilical tubercles are bullate and become less distinct on the outer whorl where they tend to be absorbed by the ribs. The distance between the umbilical and the mediolateral tubercles is somewhat longer than that between others of the outer rows.

The suture is modified from the typical texanitine type to have a widely opened lateral lobe (L), as in that of *Protexanites (Anatexanites) fukazawai* (see YABE and SHIMIZU, 1925, pl. 33 [4], fig. 1).

Measurements.—

Specimen	Diameter	Umbilicus	Height	Breadth	A./H.
Holotype (next inner)	148.0(1)	60.0(.40)	53.0(.36)	44 (.30)	.83
GH. 3122	95.0(1)	36.8(.39)	35.5(.37)	25.5(.27)	.72

Comparison and affinity.—The present species is allied to *Protexanites (Anatexanites) nomii* (YABE and SHIMIZU) in having common characters in the

immature shell before the appearance of the outer lateral tubercle. In the middle to late growth-stages the former is quinquetuberculate, while the latter persists to be quadrituberculate. In the former the mediolateral tubercles are considerably distinct from a fairly early stage but in the latter they are weak. In both species the ribs on the outer whorl are predominant over tubercles.

In the mode of developing tubercles with growth and also in the widely opened lateral lobe in sutures the present species resembles *Texanites* (*Plesiotexanites*) *thompsoni* (JONES, 1966) (see p. 277 of this paper), from the Santonian of California, but is distinguished in the earlier appearance of the outer lateral [i.e. inner ventrolateral] tubercles, which are separated distinctly from the ventrolateral ones on the outer whorl, more prominence of the mediolateral tubercles, more convex flanks of the outer whorl, with a gently inclined umbilical wall, and somewhat more distant ribs.

The holotype and another moderately large specimen (GH. No. 3123) are apparently similar to the specimen of Adkins, WSA-71, from the Gulf Coast, described under *Texanites roemeri* by YOUNG (1963, p. 84, pl. 43, fig. 1), in the general aspects of the shell, especially the club-shaped ribs and the weak outer lateral [="submarginal"] tubercles which are in the middle growth-stage closer to the ventrolateral tubercles than to the mediolateral. In the ADKINS' specimen the umbilical tubercles are strong at the umbilical shoulder and the umbilical wall is vertical and not inclined as in the Hokkaido specimen.

Incidentally I have some doubt about the specific identity of the above mentioned YOUNG's figured specimen with the lectotype of *Texanites roemeri* (YABE and SHIMIZU, 1923) [=*Ammonites texanus* ROEMER, 1852, pl. 3, fig. 1e; COLLIGNON, 1948, p. 70, text-fig. 3, 3a, 3b [×2/3]) University of Bonn, Palaeontological Collection No. 45d] (Text-fig. 19a, b of this paper). The latter and another smaller syntype [No. 47c] (COLLIGNON, 1948, p. 70, text-fig. 4 [×1]) (Text-fig. 19c, d of this paper) show subquadrate whorl-sections and nearly equidistant, five rows of tubercles throughout the visible parts (diameters from 20 mm. to 80 mm.) of the growth-stages. The outer lateral tubercles are somewhat weaker than others but considerably separated from the ventrolateral tubercles. (ADKINS' specimen does not show this character on both the inner and outer whorls.) The inner lateral tubercles are prominent and situated somewhat below the mid-flank. Thus, the mode of tuberculation of *T. roemeri* is of typical *Texanites* (s. s.). Thus, if we compare the young shells of the corresponding size, *Texanites* (*Plesiotexanites*) *yezoensis* is unmistakably distinguished from *Texanites* (*Texanites*) *roemeri*.

As I have not seen the original material of LASSWITZ (1904), I hesitate to give comments on the large specimen illustrated by LASSWITZ (1904, pl. 7, fig. 2, 2b), which is said to be an example of *Texanites roemeri*. Its suture is considerably deeply indented and has narrow lateral lobe, being quite different from the suture of *T.* (*Pl.*) *yezoensis*.

Texanites (*Texanites*) *pseudotexanus* (DE GROSSOUVRE) (1894, p. 84), based on the specimen, No. 87 at the University of Bonn, illustrated under *Ammonites texanus* by SCHLÜTER (1876, p. 155, pl. 41, figs. 1, 2, which were too much beautifully restored), from the Emscher Marl of Westphalia, Germany, closely resembles

T. (*T.*) *roemeri* in the mode of ribbing and tuberculation, but is much more high-whorled and has gently convex flanks. The whorl is however, secondarily compressed in the specimen from the Emscher Marl. Its septal suture is much eroded and cannot be compared with the illustrated suture (LASSWIZ, 1904, pl. 7, fig. 2) of *T.* (*T.*) *roemeri*. Anyhow *T.* (*T.*) *pseudotexanus* is entirely distinguished from *T.* (*Pl.*) *yezoensis* and also considerably different from a larger specimen of YOUNG's *T. roemeri*.

Occurrence.—The holotype was obtained at loc. Ik-M1550p, a small stream running to the Ikushumbets, where upper part of the Upper Yezo Group is exposed. GH. 3122 and 3123 were from the Kikume-zawa, a tributary of the Ikushumbets, where also the upper part (mainly Santonian) of the Upper Yezo Group is exposed. GH. 7954 was found below a railway bridge near the entrance of the Ponhorokabetsu, Yubari, where also the upper part of the Upper Yezo Group is exposed. The age of the species is Santonian, although its precise range is yet uncertain.

Texanites sp. cf. *Texanites* (*Plesiotexanites*) *shiloensis* YOUNG

Pl. 47 [51], Fig. 1; Text-fig. 26 [100]

Compare.—

1963. *Texanites shiloensis* YOUNG, *Univ. Texas Publ.*, No. 6304, p. 89, pl. 46, figs. 1–4; pl. 54, figs. 4–7; pl. 70, figs. 5, 6, 8; text-fig. 24d.

Material.—GK. H5508, a single imperfectly preserved specimen from the Inari-zawa (loc. 37558p), Ikushumbets, collected by T. MURAMOTO.

Description.—In the above specimen about a half whorl of the following dimensions (in mm.) is preserved:

Diameter	Umbilicus	Height	Breadth	B./H.
124.0(1)	46.4(.37)	46.5(.375)	33.6(.27)	.72

The whorl is compressed, having a low but steep umbilical wall, a subangular umbilical shoulder, flattened, nearly parallel flanks, sloping umbilical shoulders and a narrow and flat ventral area, on which there is a low keel.

There are numerous, crowded, simple ribs, with only occasional intercalations or bifurcations. The ribs are low and flattened on the main part of the flank. They are gently concave and prorsiradiate, showing a weak projection on the ventrolateral part.

The umbilical tubercles are narrowly bullate and distinctly elevated at the umbilical shoulder, hanging over the umbilical wall. The lower and the upper lateral tubercles are very weak. The ventrolateral tubercles are weak but better discernible and clavate. The ventral tubercles are very narrow, longly clavate, and separated from the siphonal keel by a shallow, moderately broad groove, which is flattened at the bottom. The three rows of tubercles from the first to the third are nearly equidistant.

This whorl is septate and a line of overlap of a still outer whorl runs just inside the row of ventrolateral (i.e. the fourth) tubercles.

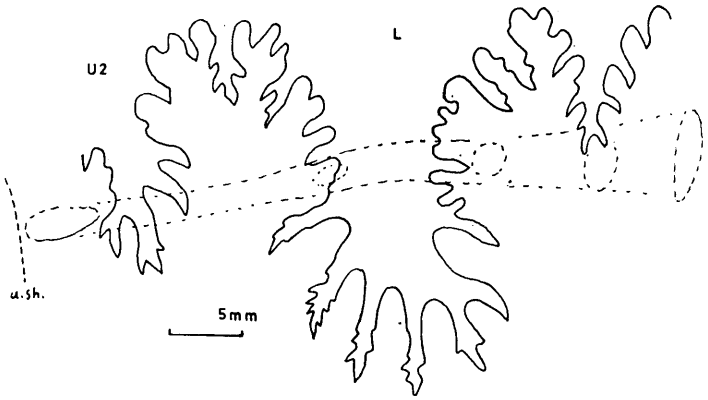

Fig. 26 [100]. *Texanites* sp. cf. *T.* (*Plesiotexanites*) *shiloensis* YOUNG. External suture on flank at whorl-height=46 mm. of GK. H5508. (T. M. *delin.*)

The suture is fairly similar to that of *Texanites* (*Plesiotexanites*) *pacificus*, having the broad and massive first lateral saddle, the narrow and deep, U-shaped, first lateral lobe (L), the tall second lateral saddle and the small, somewhat oblique, second lateral lobe (U_2) which is situated outside the umbilical shoulder. It is, however, distinctive, in having diverging branches in the lower part of L.

Comparison.—This specimen is well comparable with the shell of the middle growth-stage of *Texanites shiloensis* YOUNG, 1963. I have here a plaster cast (GK. H9271=UT. 18123) of the paratype, UT. 1696 (YOUNG, 1963, pl. 46, figs. 2–4) from Texas. This is a large shell, about 235 mm. in diameter. The described specimen from Hokkaido is very close to its next inner whorl of the same size.

The described specimen is somewhat similar to the outer whorl of *Texanites* (*Plesiotexanites*) *pacificus* but is more compressed and has flatter, nearly parallel flanks, more numerous, more crowded, less elevated ribs and weaker tubercles. The small immature shell of *Texanites* (*Plesiotexanites*) *shiloensis* is much different from that of *T.* (*Pl.*) *pacificus* in its more compressed, more involute whorls, finer, denser, more numerous ribs with stronger projection toward the venter and weaker tubercles.

Occurrence.—The described specimen was obtained from a rolled nodule in the Inari-zawa, a branch of the upper reaches of the Ikushumbets. Therefore its precise stratigraphic position is uncertain. As the upper part of the Upper Yezo Group is exposed along this stream, the suggested age is Santonian.

In the Cretaceous sequence of Texas *T.* (*Pl.*) *shiloensis* occurs commonly in the Dessau limestone of the Austin Chalk, ranging from Upper Santonian to lower Lower Campanian.

Genus *Australiella* COLLIGNON, 1948

Type-species.—*Mortoniceras australe* BESAIRIE, 1930.

Generic diagnosis.—The shell is small or of moderate size. Its coiling is rather evolute, but the whorl enlarges fairly rapidly, embracing a narrow or

moderately wide umbilicus. The whorl is typically depressed to subquadrate in section, broader than high or nearly as high as broad, with a broadly arched venter, more or less inflated flanks and a steep or nearly vertical, high umbilical wall.

The whorl is ornamented with nearly rectiradiate or somewhat prorsiradiate, mostly simple, rather distant ribs on the flank. Each rib has a smaller umbilical and a larger, typically very prominent, ventral tubercle, which may be spinose on the inner whorls. At the ventrolateral tubercle the rib is divided into normally two, occasionally three, minor ventral ribs. Sometimes there may be intercalated ribs. The ventral tubercles at the end of the ventral ribs are nodose or shortly clavate. They are much smaller than and two to three times as numerous as the ventrolateral tubercles. The siphonal keel is typically entire but may sometimes have weak undulations which correspond in number and position to the ventral tubercles on either side. The groove between the keel and the row of ventral tubercles is shallow and flat.

The suture is of collignoniceratid type, with the massive first lateral saddle and the U-shaped first lateral lobe (L).

Remarks.—The following species are referred to the genus *Australiella*;

A. australis (BESAIRIE, 1930) [type-species]
A. austinensis YOUNG, 1963
A. besairiei (COLLIGNON, 1938)
A. pattoni YOUNG, 1963
A. welderi YOUNG, 1963
A. moreti (COLLIGNON, 1948)
A. antsirasiraensis (COLLIGNON, 1948)
A. subaustralis (COLLIGNON, 1948)

There is only a single specimen from Hokkaido which could represent a new species but the material is insufficient to establish it.

Mortoniceras vinassai VENZO, 1936 (p. 88, fig. 1; pl. 3, fig. 12), from Zululand, was referred to *Australiella* by COLLIGNON (1948, p. [101]). I should follow HOEPEN (1955, p. 364) in regarding it as a species of *Forresteria*.

Comparison and affinity.—*Australiella* was established by COLLIGNON (1948, p. 64 [19]) as a subgenus of *Menabites* COLLIGNON, 1948. It was later treated as a distinct genus by YOUNG (1963, p. 75, 115), with whom I am agreeable. The two genera are, however, closely allied to each other. The immature shell of *Menabites* has only three rows of tubercles, of which the ventrolateral ones are prominent and the ventral ones are small and multiplied. In other words it is quite similar to the shell of *Australiella*. In *Australiella* the trituberculate state persists up to the adult stage, whereas in *Menabites* the trituberculate earlier stage is followed by the pentatuberculate later stage. The outer whorl of *Menabites* is generally more compressed and more densely ribbed, taking more typically the texanitine aspects.

As *Australiella* begins to appear in the Santonian, *Menabites* is probably derived from *Australiella*. Incidentally I think it better to keep *Berellela* COLLIGNON, 1948, as a subgenus of *Menabites*, because it has *Australiella* like inner whorls and pentatuberculate outer whorls. In *Berellela* tubercles are predomi-

nant over ribs and in *Menabites* (s. s.) ribs are as strong as or even predominant over tubercles.

Delawarella COLLIGNON, 1948, which was originally established as a subgenus of *Menabites* on the type-species *Ammonites delawarensis* MORTON, 1830, and its allied species, should be treated as an independent genus, because the outer ventrolateral tubercles begins to appear in an earlier growth-stage than in *Menabites* and because it has some diagnostic features such as a rounded venter, more involution of whorls, reduction of tubercles and even ribs in the late growth-stage.

The immature shell of *Delawarella* is considerably similar to *Australiella,* having a trituberculated, inflated whorl on which the ventrolateral tubercles are prominent and ventral tubercles are multiplied. As the shell grows a row of rather clavate tubercles is added between the ventrolateral and the ventral rows and later another row of small mediolateral tubercles between the rows of more prominent ventrolateral and umbilical ones. The ribs are more or less projected on the ventral part beyond the ventrolateral tubercles. In addition to the bifurcation or intercalation of ribs at the ventrolateral part there may be occasionally intercalated or bifurcated ones near the umbilical margin. The ribs in the middle growth-stages are thus considerably dense. In the late growth-stage the tubercles tend to be absorbed by the ribs, which in turn tend to be weakened. The resulted similarity of *Delawarella* and *Submortoniceras* is, however, superficial, contrary to my previous view (MATSUMOTO, 1959c, p. 125). *Delawarella* is closely related to *Australiella*. In some species of *Delawarella,* e.g. *D. danei* YOUNG, 1963, the resemblance is maintained even in the mature stage.

The ontogenetic development of *Australiella* has not been satisfactorily studied. Therefore at what stage the ventral tubercles begin to be multiplied is not precisely known. It could be expected that there would be a *Protexanites* like simply trituberculate stage in some early immature stage of *Australiella.* In certain species of *Protexanites,* e.g. *P. planatus* (LASSWITZ), the ventrolateral tubercles are considerably prominent and tend to be spinose. On the grounds of these points and on the stratigraphic occurrence, the origin of *Australiella* can possibly be ascribed to a certain species group of *Protexanites.*

Pleurotexanites, established in the preceding page on the type-species *Protexanites superbus* COLLIGNON, 1966, from the Santonian of Madagascar, is somewhat similar to *Australiella* in the trituberculate state and also the multiplication of the ventral tubercles. In *Pleurotexanites* the whorl is not so depressed and the ventrolateral tubercles are not so prominent as in *Australiella.* Moreover, *Pleurotexanites* has a moderately large adult body-whorl on which the ribs and the tubercles are much weakened or even obsolete on the venter. *Pleurotexanites* and *Australiella* were probably in a sisterhood relationship, having been derived commonly from *Protexanites* but deviating from each other in shell-form and ornament.

Distribution.—Species of *Australiella* commonly occur in the Lower to Middle Campanian of Madagascar and Texas but are also known in the Santonian of Texas and Japan.

Australiella sp. aff. *A. pattoni* YOUNG
Pl. 43 [47], Fig. 3; Text-fig. 27 [101]

Compare.—

1963. *Australiella pattoni* YOUNG, *Univ. Texas Publ.* No. 6304, p. 116, pl. 65, figs. 4, 5; pl. 66, figs. 1, 2, 5, 6; pl. 68, figs. 1–3, 6, text-figs. 24b, 26h, 33a c, 34d g.

Material.—GK. H5439, from the upper reaches of the Ikushumbets (MURAMOTO Coll. No. 2155).

Description.—The above specimen is small, about 50 mm. in diameter, and somewhat secondarily deformed. The umbilicus is deep, occupying about 36 percent of the diameter. The whorl is subquadrate in the costal section and more rounded and nearly as high as broad in the intercostal section.

There are distant, coarse ribs, counted 14 in the preserved last whorl and less numerous in the inner whorl. The tubercles at the umbilical shoulder are small, nodate and well pointed. Those at the ventrolateral shouder are large, prominent, spinose and even horn-like on the preserved last part, projecting sideward and somewhat upward. The external tubercles are small, nodate or shortly clavate, usually two per rib but there may be an intervening additional one. The siphonal keel is not strong and has undulations which correspond to the ventral tubercles in number and position. The furrow between the keel and the row of ventral tubercles is very shallow and has a flat bottom.

The suture is only partly exposed.

Remarks.—The specimen from Hokkaido, which shows the above described characters, is closely allied to *Australiella pattoni* YOUNG from the Lower Campanian *Submortoniceras tequesquitense* zone of Texas, but is not quite identical in that the Texas species is described to have a more compressed whorl throughout growth-stages. The undulations on the ventral keel are less distinct, if not absent at all, in *A. pattoni*.

The Hokkaido specimen is not so depressed and not so coarsely ornamented as *Australiella austinensis* YOUNG, 1963, from the Santonian (?) of Texas. The holotype of this Texas species shows undulations on the ventral keel (see YOUNG, 1963, pl. 65, fig. 6).

Occurrence.—The described specimen came from the 17 km. point in the upper reaches of the Ikushumbets, along with *Gaudryceras* cf. *tenuiliratum* YABE, upper part of the Upper Yezo Group, probably Santonian.

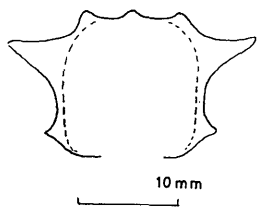

Fig. 27 [101]. *Australiella* sp. aff. *A. pattoni* (YOUNG). Restored whorl-section of GK. H5439. (T. M. *delin.*)

Genus *Defordiceras* YOUNG, 1963

Type-species.—*Defordiceras hazzardi* YOUNG, 1963.

Generic diagnosis.—See YOUNG, 1963, p. 118.

Remarks.—This peculiar ammonite genus has been represented only by a single specimen of *D. hazzardi* YOUNG (1963, p. 119, pl. 69, figs. 3–5; text-fig. 21 bf), from the probable Santonian of Texas. The generic characters given by YOUNG are almost specific characters.

One of the diagnostic characters is the absence of the ventral keel on the outer whorl. As the ventral keel tends to be weakened on the outer whorl of many texanitine ammonites, it could be expected that the inner whorl of *Defordiceras* might have a faint trace of the keel. This point cannot be ascertained in the holotype of *D. hazzardi* without breaking the specimen.

A specimen from Hokkaido described below shows this character, although it is not identified with *D. hazzardi*. If it is assignable to *Defordiceras*, *Defordiceras* can well be included in the subfamily Texanitinae as a specialized offshoot.

Another point which YOUNG mentioned is the remarkable difference in the ornamentation between the earlier and later whorls. The inner whorl of *D. hazzardi* has dense, often bifurcated ribs with reduced tubercles, whereas the outer whorl is more convex and has sparse, strong, trituberculate ribs, with rows of tubercles above the umbilical shoulder (or, as YOUNG said, in the lower lateral part), at the ventrolateral shoulder and on the venter on either side of the siphonal zone. Should this remarkable change with growth be taken as a generic diagnosis, the Hokkaido ammonite to be described below could not be referred to *Defordiceras* but would represent another allied genus. For the time being I describe it under *Defordiceras* with a query, taking rather comprehensively the scope of the genus.

Distribution.—*Defordiceras* is known by a single rare species from the Santonian of Texas. Another species provisionally referred to *Defordiceras* occurs in the Santonian of Hokkaido.

Defordiceras (?) *japonicum* sp. nov.

Pl. 30 [34], Fig. 3; Pl. 47 [51], Fig. 2

Material.—Holotype, GK. H5638, from loc. R371, Sakawa-gawa, a branch in the upper reaches of the Haboro (Coll. H. OKADA, T. NISHIDA and T. MATSUMOTO), a fragmentary immature whorl. Paratype, GK. H5504, from loc. CK 109, Pisshirizawa, Deto-futamata, a tributary of the Haboro (Coll. Y. UEDA), a fragmentary body-whorl.

Specific characters.—The inner whorl is subquadrate in section, somewhat broader than high in the costal section and nearly as high as broad in the intercostal section. It has fairly distant, coarse, nearly rectiradiate or slightly prorsiradiate, trituberculate, simple ribs. The umbilical tubercle is somewhat bullate and most elevated at a point immediately outside the umbilical shoulder. The ventrolateral tubercle is prominent, somewhat projected laterally and has a clavate base. The ventral tubercle at the end of the broadening ventral rib is

narrow and longly clavate. The siphonal area between the rows of ventral clavae is rather narrow, nearly flat, but has a faint and narrow, reduced keel immediately above the siphuncle. The broadened and lowered ribs seem to cross the siphonal zone.

The suture of the inner whorl is of collignoniceratid type. The external lobe (E) is narrow, deep and nearly parallel sided. The first lateral saddle is massive, broad and asymmetrically divided by a lobule of moderate depth. The lateral lobe (L) is on the middle of the flank, narrow, roughly U-shaped, and somewhat broadened upward. The second lateral saddle is taller and narrower than the first. U_2 is much smaller than L and situated at or immediately inside the umbilical shoulder.

The body-whorl, which is represented by the paratype, is somewhat higher than broad (with height=42 mm., breadth=36 mm., b/h=0.85 in the intercostal section) and subrectangular in cross section, with nearly parallel flanks. The ribs are simple, of moderate intensity, distant, separated by wider interspaces, nearly rectiradiate or slightly prorsiradiate on the flank and somewhat projected on the ventrolateral part. The umbilical tubercles are bullate and indistinct. The ventrolateral tubercles are prominent and rather rounded at the base. The ventral tubercles are distinctly clavate and fairly high. The area between the rows of ventral clavae is flat and moderately broad. There is no keel on the venter.

Remarks.—The above description is on the assumption that the two fragmentary specimens respectively represent the inner and outer whorls of one and the same species. This assumption is acceptable, if we consider the inner and outer whorls of the corresponding size in the better known species of *Protexanites* as a comparable case.

Comparison and affinity.—This species is considerably different from *Defordiceras hazzardi* YOUNG in its coarsely ornamented inner whorl and the subrectangular, instead of oval, section of its outer whorl on which the ventral zone between the rows of ventral tubercles are flat and not crossed by the ribs. Someone might consider that a new genus should be established for this species. In fact the assignment of the present species to *Defordiceras* is quite provisional, depending on the common characters in the absence of the siphonal keel, the trituberculate ribs and the similarity of sutural pattern. Anyhow, we need more material from both Japan and Texas to settle the question more definitely.

D. (?) *japonicum* is closely allied to *Protexanites* (*Protexanites*) *planatus* (LASSWITZ) in many respects and is distinguished by the reducing and final loss of the siphonal keel in the former. Taking also their stratigraphic occurrences into consideration, it is suggested that the former may have been derived from the latter.

Occurrence.—The holotype came from loc. R371 of the upper reaches of the Haboro, together with *Inoceramus yokoyamai, I.* (*Platyceramus*) aff. *mantelli,* etc. The paratype was found in a rolled nodule at loc. CK 109, a branch of the Haboro, the same Chikubets-Haboro area, northwestern Hokkaido. It came probably from unit B1 or A of UEDA et al. (1962), the zone of *Inoceramus amakusensis–I.* (*Platyceramus*) *yubarensis.* The suggested age for the present species is, therefore, Lower Santonian.

Acknowledgements

I am indebted to the same persons whose names were recorded in Part I of this monograph. In the study of the Texanitinae I have been much enlightened by the admirable works by General Maurice COLLIGNON and Professor Keith YOUNG among many others. I am especially grateful for the kind help of Mr. Tatsuo MURAMOTO, Dr. Keisaku TANAKA and Professor W. HASHIMOTO who have provided me with valuable specimens to the present study. Dr. Itaru HAYAMI and Miss Yuko WADA have assisted me to a large extent in preparing the plates of photographs and typescript.

The following symbols are used, as in Parts I–III, for denoting the institutions and museums at which the described specimens are registered:

BM.:	British Museum (Natural History), London
GH.:	Department of Geology and Mineralogy, Hokkaido University, Sapporo
GIB.:	Geologisch-Palaeontologisches Institut, Universität Bonn
GK.:	Department of Geology, Kyushu University, Fukuoka
GT.:	Geological Institute, University of Tokyo
IGPS.:	Institute of Geology and Palaeontology, Tohoku University, Sendai
MNHN.:	Muséum National d'Histoire Naturelle, Paris
TKU.:	Department of Geology and Mineralogy, Tokyo Kyoiku University, Tokyo
UT.:	Department of Geology, University of Texas, Austin

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The references cited in Part IV are mostly listed in the bibliography of Part I and partly in the additional ones in Parts II and III. For brevity they are not repeated here. The following is a supplemental list of references which should be added to the bibliography.

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Tatsuro MATSUMOTO

A Monograph of the Collignoniceratidae from Hokkaido
Part IV

Plates 30 [34]—47 [51]

Kyushu University (I. HAYAMI) photos, with whitening,
unless otherwise stated.

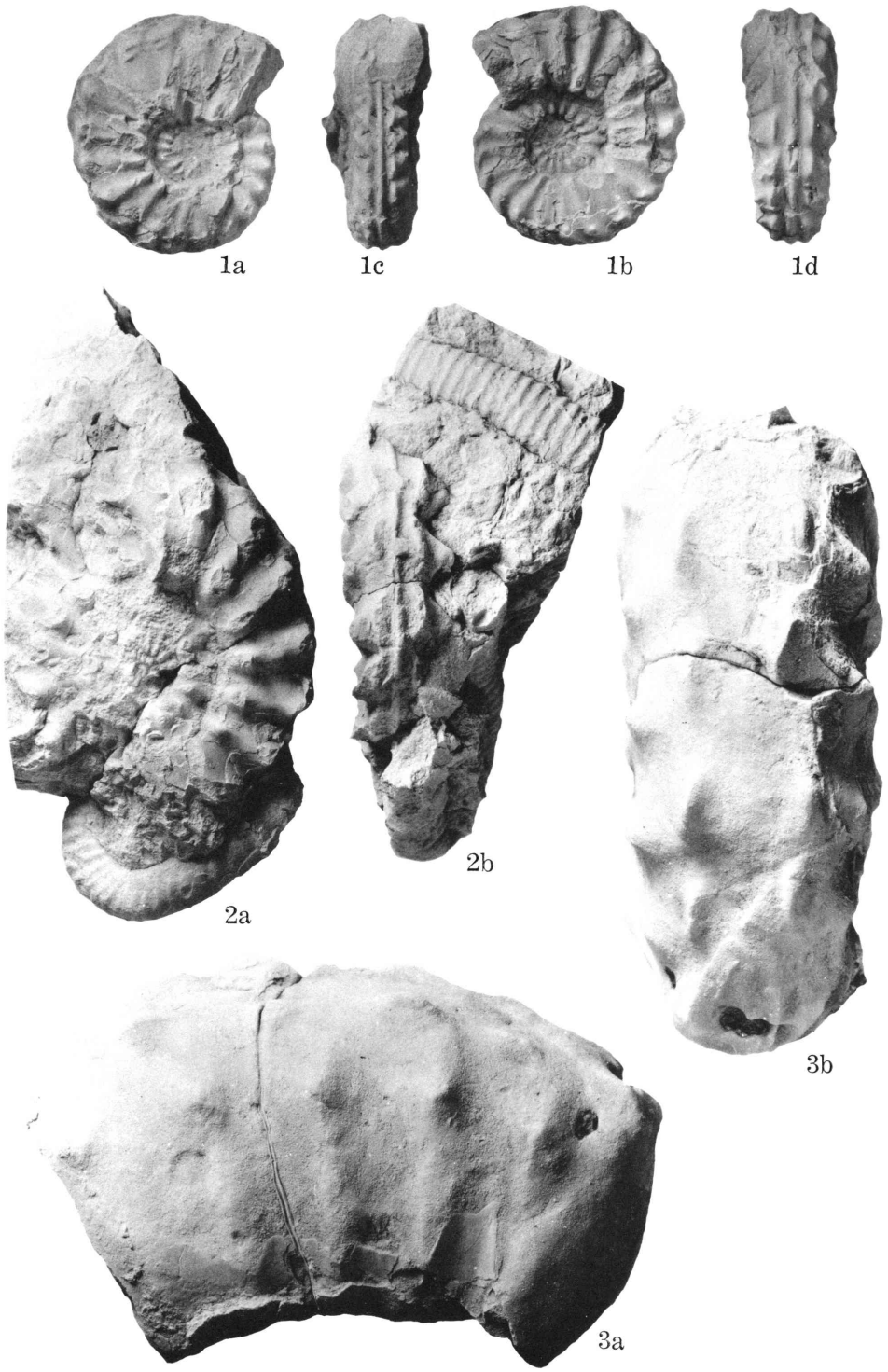
Plate 30

Explanation of Plate 30 [34]

Fig. 1. *Paratexanites* sp. cf. *Paratexanites* (*Parabevahites*) *sellardsi* YOUNG ..... Page 264
An immature example, GK. H5525, from the Chikubetsu area, Hokkaido (Coll. K. MATSUNO-K. TANAKA). Two lateral (a, b), apertural (c) and ventral (d) views, ×1.

Fig. 2. *Protexanites* (*Protexanites*) *planatus* (LASSWITZ)..... Page 232
An example, GK. H5633, from the 10 km. point, main stream of the Ikushumbets, central Hokkaido. Lateral (a) and ventral (b) views, ×1.

Fig. 3. *Defordiceras* (?) *japonicum* sp. nov..... Page 301
A fragmentary outer whorl, GK. H5504, from loc. CK 109 p, Deto-futamata, Chikubetsu-Haboro area, northwestern Hokkaido (Coll. Y. UEDA). Lateral (a) and ventral (b) views, ×1.



T. MATSUMOTO: Collignoniceratidae [Pl. 34]

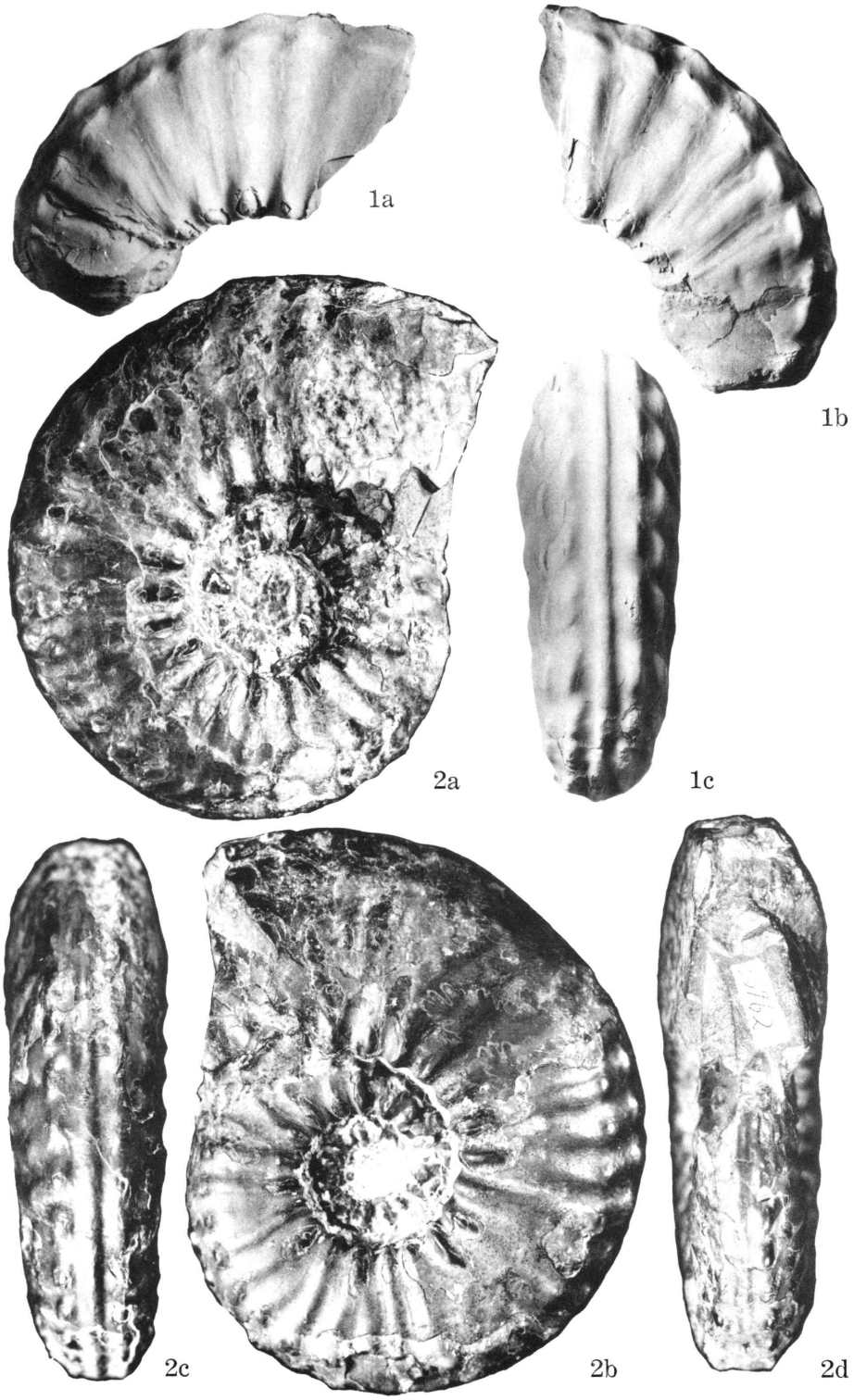
Plate 31

Explanation of Plate 31 [35]

Figs. 1–2. *Protexanites* (*Protexanites*) *bontanti shimizui* subsp. nov. ..Page 237

1. A fragmentary body-whorl, GK. H5631, from the Chikubetsu coal mine, Hokkaido (Coll. S. HATTORI). Two lateral (a, b) and ventral views.

2. Holotype, IGPS. 36962, from Namikawa, near Toyohara, South Saghalien (Coll. S. SHIMIZU). Two lateral (a, b) ventral (c) and frontal (d) views, ×1. Tohoku University (K. KUMAGAI and S. OTOMO) photos without whitening.



T. MATSUMOTO: Collignoniceratidae [Pl. 35]

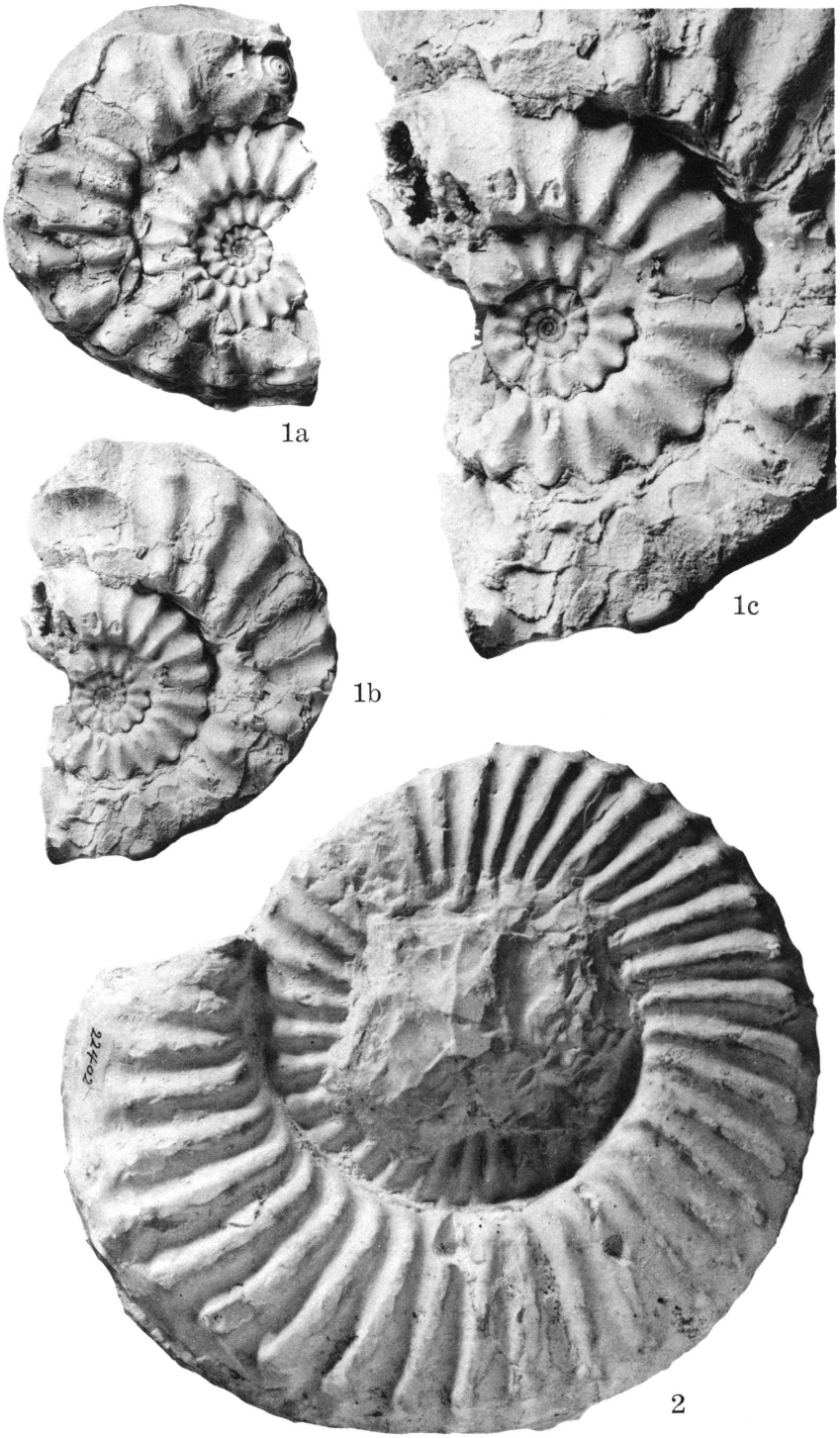
Plate 32

Explanation of Plate 32 [36]

Figs. 1-2. *Protexanites* (*Anatexanites*) *nomii* (YABE and SHIMIZU)....Page 242

1. An immature example, TKU. 30723, from the upper reaches of the Haboro, northwestern Hokkaido (Coll. K. NAGASE-W. HASHIMOTO). Two lateral views (a, b), ×1, and an enlarged lateral view (c), ×2.

2. Plaster model of the holotype, IGPS. 22402. Lateral view, ×1/2. Tohoku University (S. OTOMO) photo. See YABE and SHIMIZU, 1925, pl. 32 (3), figs. 1, 2 for the other side view and the ventral view of the holotype itself. Inner whorls are better displayed in the illustration of YABE and SHIMIZU, but the characters of the last part are better shown in this figure.



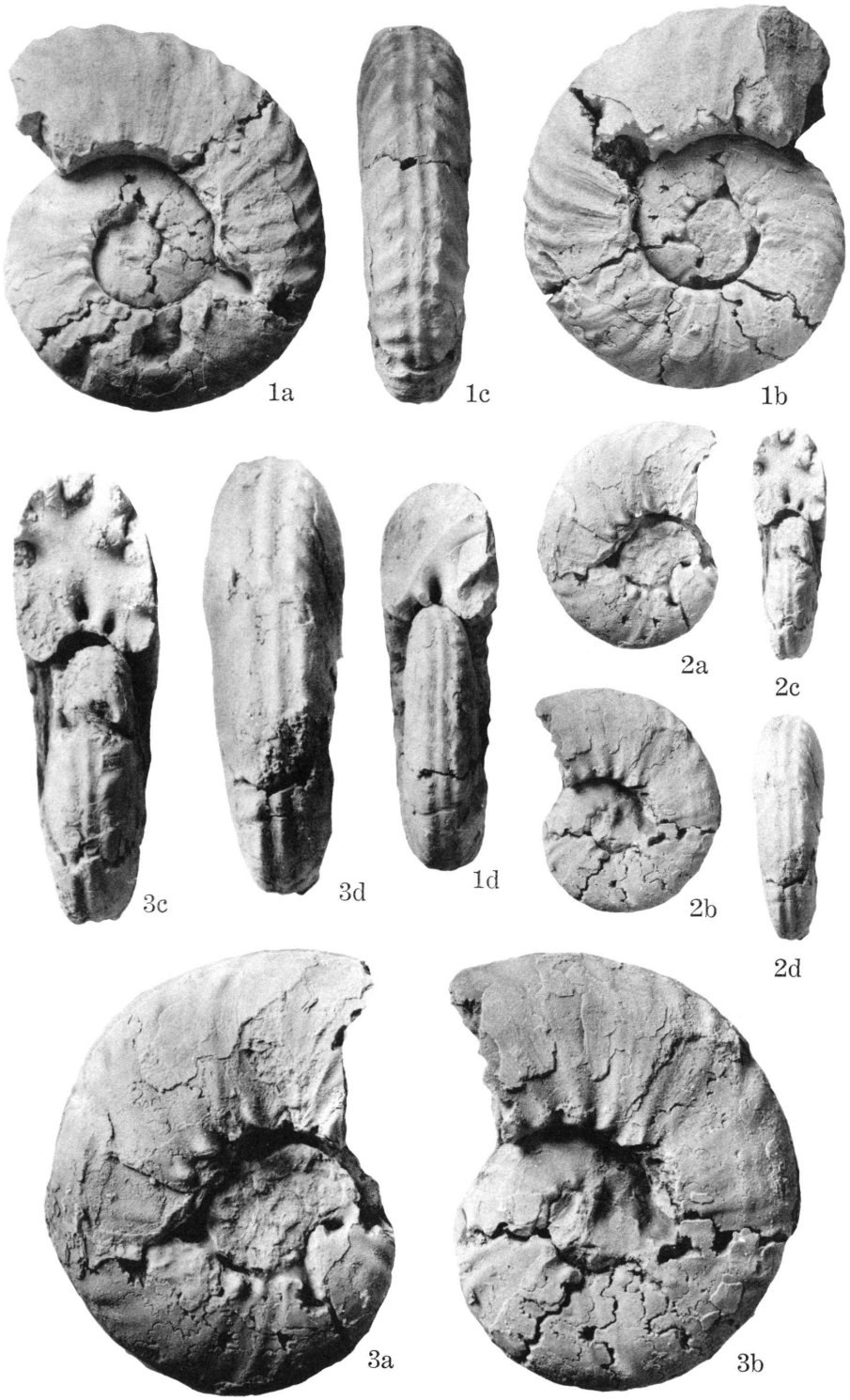
T. MATSUMOTO: Collignoniceratidae [Pl. 36]

Plate 33

Explanation of Plate 33 [37]

Figs. 1–3. *Protexanites* (*Mitotexanites*) *minimus* sp. nov. ..... Page 246

1. Holotype, GK. H5666, from the 11 km point, main stream of the Ikushumbets, central Hokkaido. Two lateral (a, b), ventral (c) and apertural (d) views, ×1.
2. Inner whorl of the same holotype. Two lateral (a, b), apertural (c) and ventral (d) views, ×1.
3. Inner whorl of the same holotype, enlarged. Two lateral (a, b), apertural (c) and ventral (d) views, ×2.



T. MATSUMOTO: Collignoniceratidae [Pl. 37]

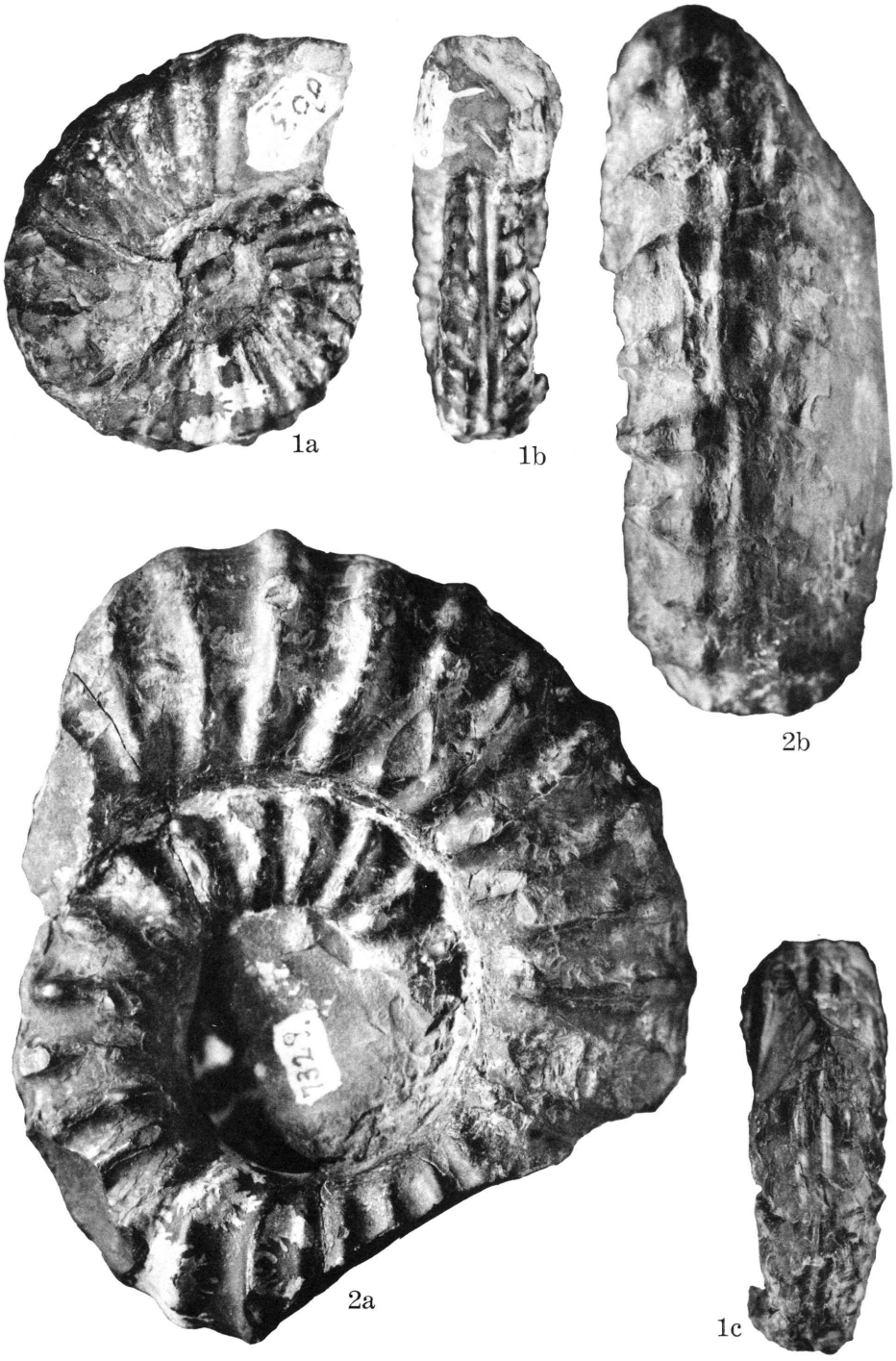
Plate 34

Explanation of Plate 34 [38]

Fig. 1. *Texanites* (*Plesiotexanites*) *sanushibensis* (YABE and SHIMIZU) ..... Page 292
Holotype, IGPS. 8039, from the Sanushibe, a tributary of the Hobetsu, Iburi Province, southern central Hokkaido. Lateral (a), apertural (b) and ventral (c) views, ×1.

Fig. 2. *Paratexanites* (*Paratexanites*) *orientalis* (YABE) ..... Page 253
Holotype, IGPS. 7329, from central Hokkaido. Lateral (a) and ventral (b) views, ×1.

Tohoku University (K. KUMAGAI and S. OTOMO) photos, without whitening.



T. MATSUMOTO: Collignoniceratidae [Pl. 38]

Plate 35

Explanation of Plate 35 [39]

Figs. 1-2. *Paratexanites* (*Paratexanites*) *orientalis* (YABE).....Page 253

1. GK. H5505, from loc. Ik1301b, 7 km point of the main stream of the Ikushumbets, central Hokkaido. Two lateral (a, b), frontal (c) and ventral (d) views, ×1.

2. The same specimen as above, excluding the last part. Lateral (a) and frontal (b) views, ×1.

1a 1b 2b 1c 1d 2a

T. MATSUMOTO: Collignoniceratidae [Pl. 39]

Plate 36

Explanation of Plate 36 [40]

Figs. 1-3. *Paratexanites* (*Parabevahites*) *serratomarginatus* (REDTENBACHER) ..... Page 260

1. GK. H5628, from the 8 km. point, main stream of the Ikushumbets, central Hokkaido. Lateral (a) and ventral (b) views, ×1.

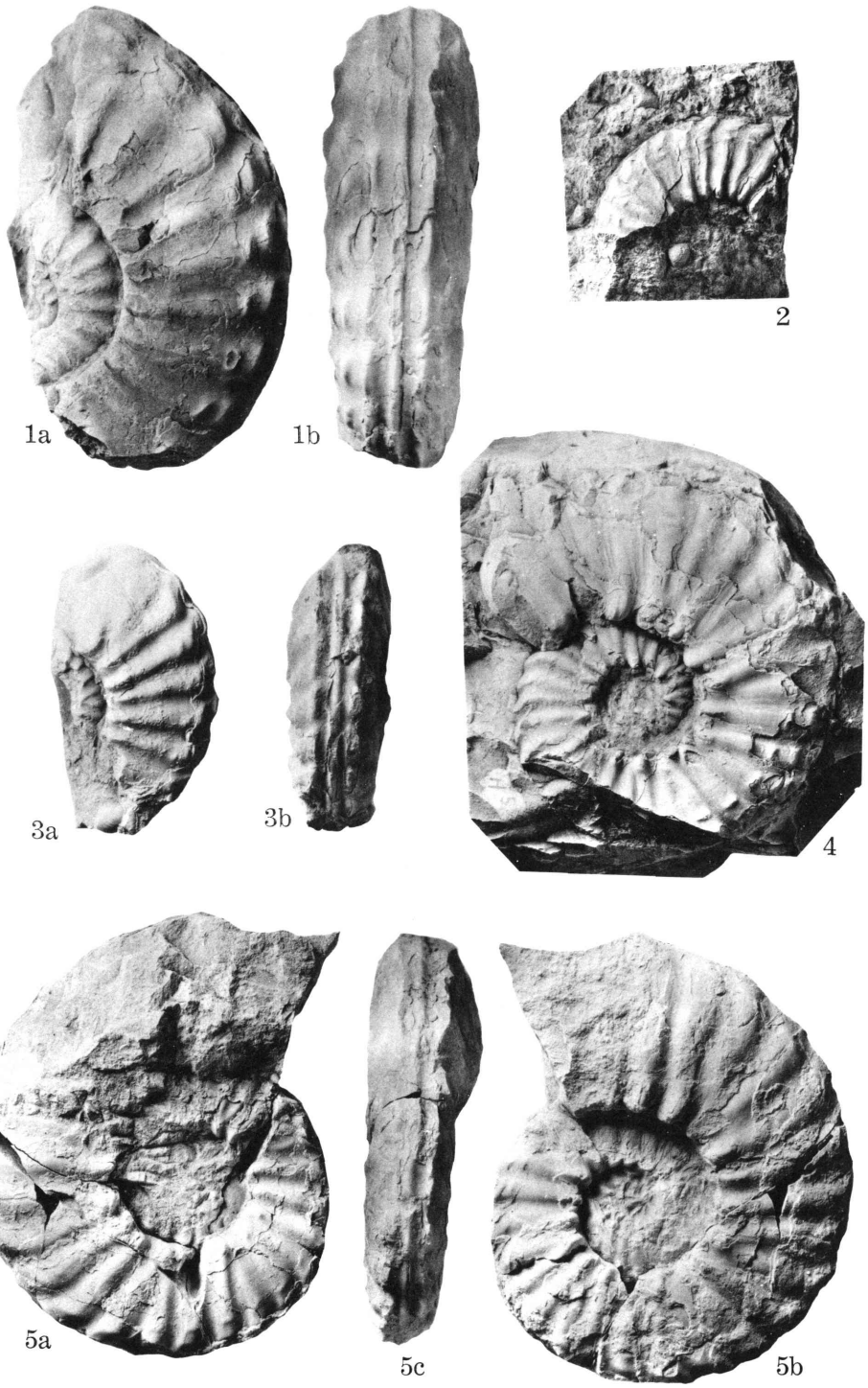
2. GK. H5558, from loc. Ik 2112, Go-no-sawa, Pombets, a tributary of the Ikushumbets, central Hokkaido (Coll. T. MURAMOTO). Lateral view, ×1.

3. GK. H5629, from loc. R 215p, Kami-no-sawa, upper reaches of the Kotanbetsu, northwestern Hokkaido. Lateral (a) and ventral (b) views, ×1.

Figs. 4-5. *Paratexanites* (*Paratexanites*) *compressus* sp. nov. ..... Page 255

4. Holotype, GK. H5511, from loc. Ik 882, Inari-zawa, a tributary of the Ikushumbets, central Hokkaido (Coll. N. KAMBE). Lateral view, ×1.

5. Paratype, GK. H5531, from loc. 12-0404, Hobetsu, Iburi Province, south central Hokkaido (Coll. W. HASHIMOTO). Two lateral (a, b) and ventral (c) views, ×1.



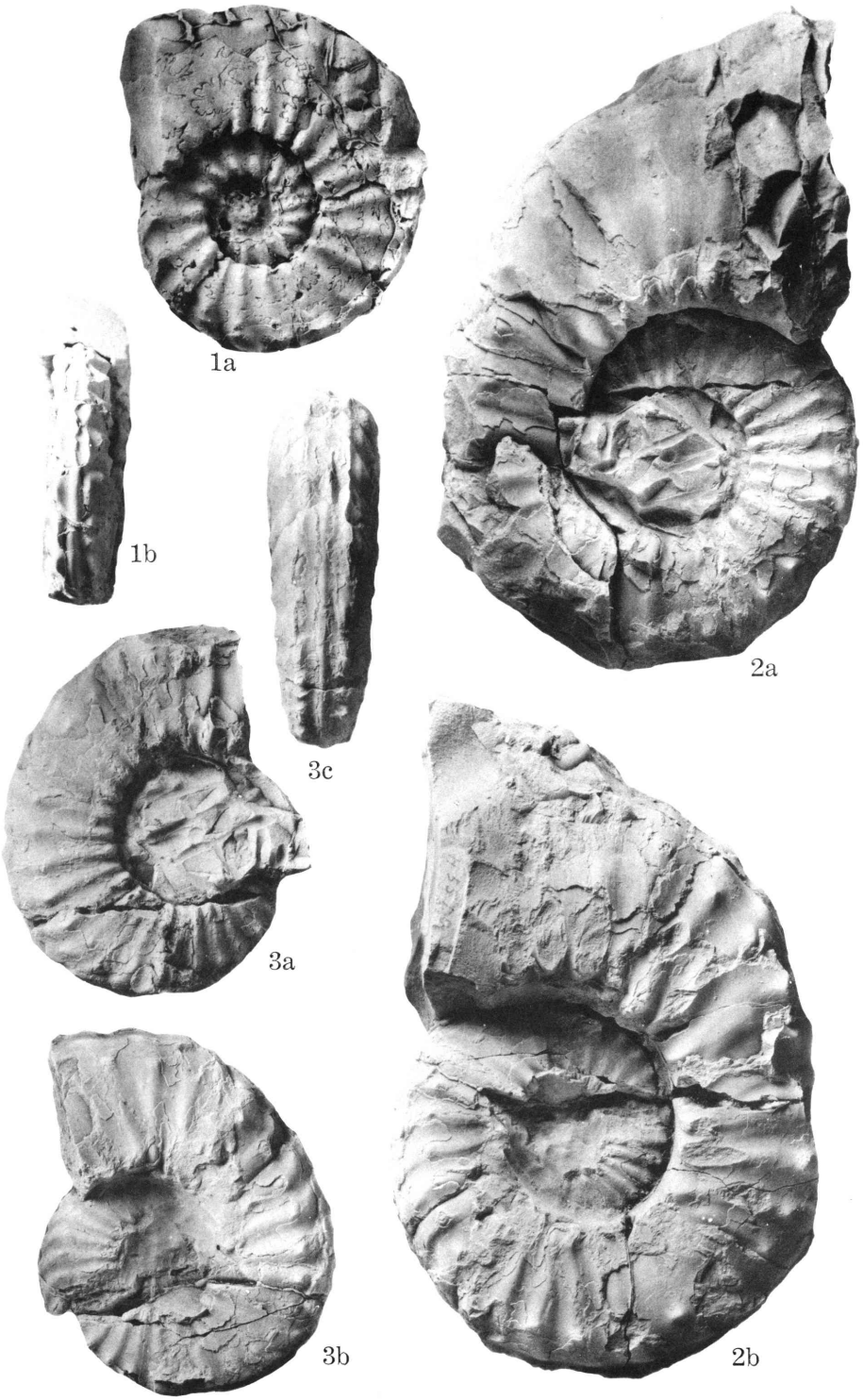
T. MATSUMOTO: Collignoniceratidae [Pl. 40]

Plate 37

Explanation of Plate 37 [41]

Fig. 1. *Paratexanites* (*Paratexanites*) *muramotoi* sp. nov.....Page 257
Holotype, GK. H5645, from loc. Y-053, Isojiro-zawa, Oyubari area, central Hokkaido. Lateral (a) and ventral (b) views, ×1.

Figs. 2-3. *Paratexanites* (*Paratexanites*) *mikasaensis* sp. nov.....Page 258
2. Holotype, GK. H5510, from approximately 17 km. point, main stream of the Ikushumbets (upper reaches), (Coll. T. MURAMOTO). Two lateral (a, b) views, ×1.
3. Inner whorl of the holotype. Two lateral (a, b) and ventral (c) views, ×1.



T. MATSUMOTO: Collignoniceratidae [Pl. 41]

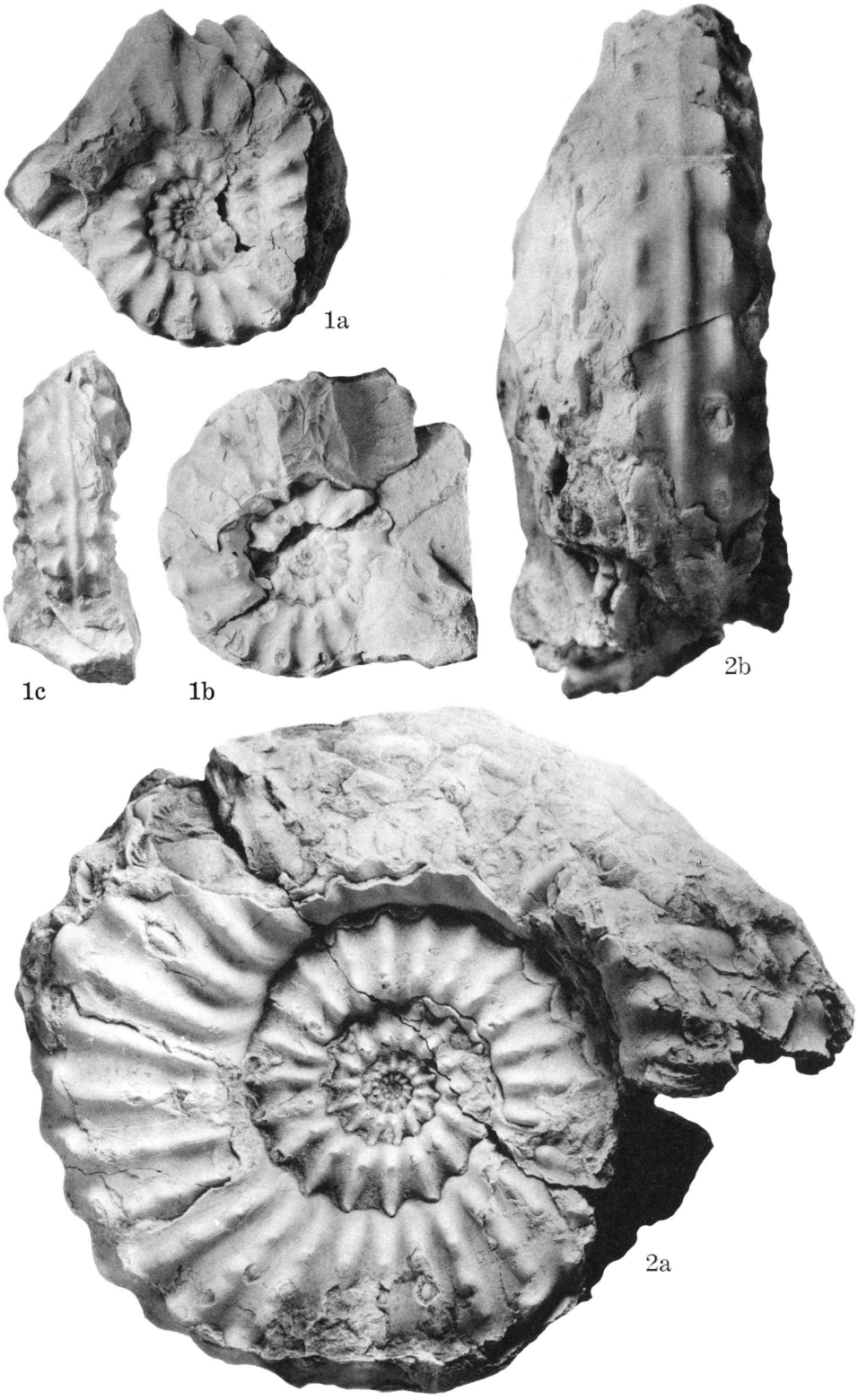
Plate 38

Explanation of Plate 38 [42]

Figs. 1-2. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA) .....Page 280

1. Holotype, GT. I-553 (=MM 7701), from the Santan-gawa, a tributary of the Naibuchi, zone Mh6, South Saghalien (Coll. M. KAWADA). Two lateral (a, b) and ventral (c) views, ×1.

2. An example of moderate size, GT. I-551 (=MM 7702), from the Santan-gawa, a tributary of the Naibuchi, South Saghalien (Coll. M. KAWASAKI). Lateral (a) and ventral (b) views, ×1.

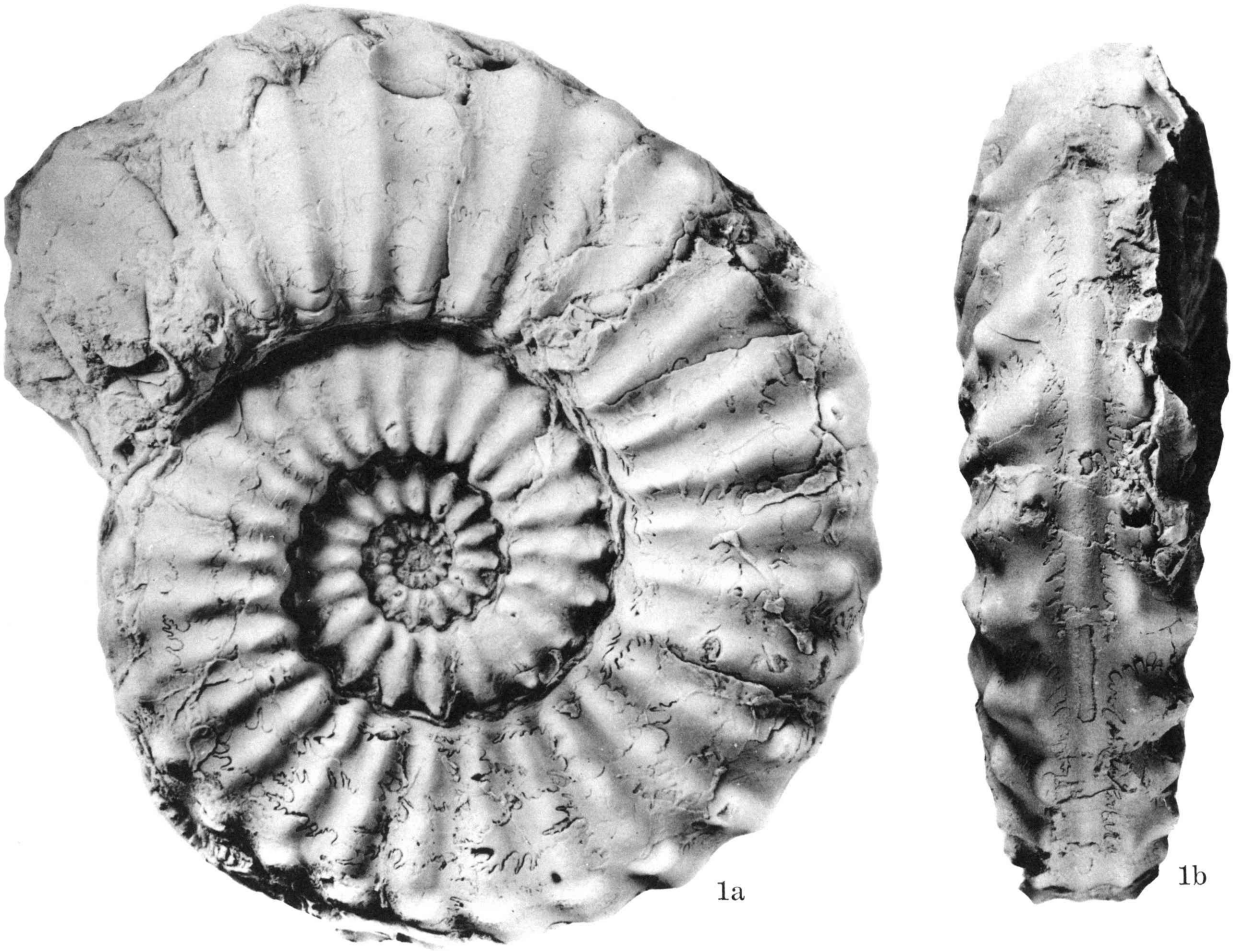


T. MATSUMOTO: Collignoniceratidae [Pl. 42]

Plate 39

Explanation of Plate 39 [43]

Fig. 1. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA) ..... Page 280
A moderately large, but wholly septate example, GK. H5507, from the Kikumezawa, a tributary of the Ikushumbets, central Hokkaido (found by K. YONEKAWA and presented to Kyushu University through T. MATSUMOTO). Lateral (a) and ventral (b) views, ×9/10.



1a

1b

T. MATSUMOTO: Collignoniceratidae [Pl. 43]

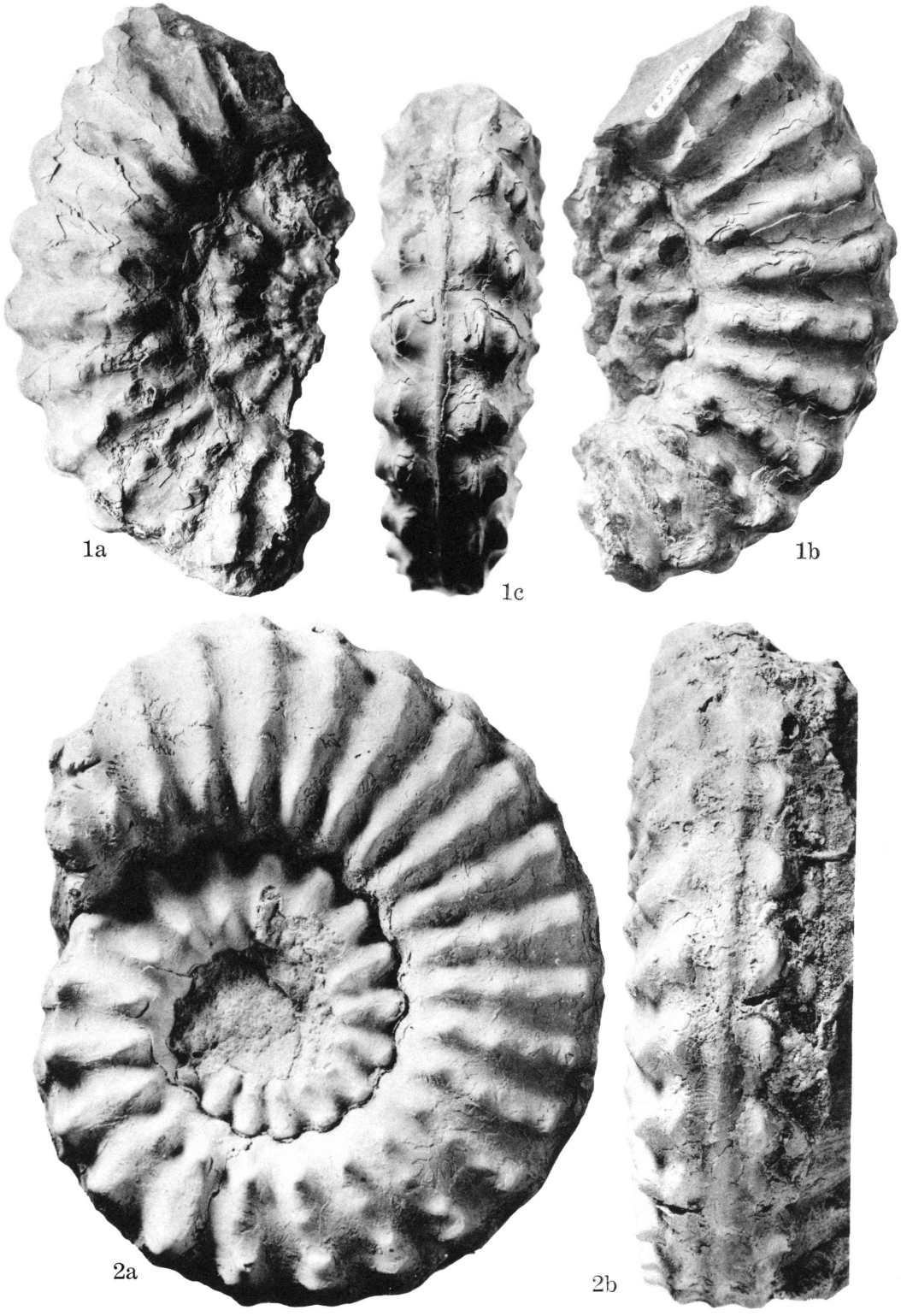
Plate 40

Explanation of Plate 40 [44]

Figs. 1–2. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA) .....Page 280

1. An example, GK. H5518, from loc. 547 of the Sankebetsu, Chikubetsu-tanko quadrangle, northwestern Hokkaido (Coll. K. MATSUNO-K. TANAKA). Two lateral (a, b) and ventral (c) views, ×1.

2. Inner whorls of a large specimen, GK. H5517, from loc. 481–12, the Sankebetsu, Chikubetsu-tanko quadrangle, northwestern Hokkaido (Coll. K. MATSUNO-K. TANAKA). Lateral (a) and ventral (b) views, ×1. See also Text-figs. 21 a, b and 22, Pl. 42, Fig. 4 and Pl. 43, Fig. 1.



T. MATSUMOTO: Collignoniceratidae [Pl. 44]

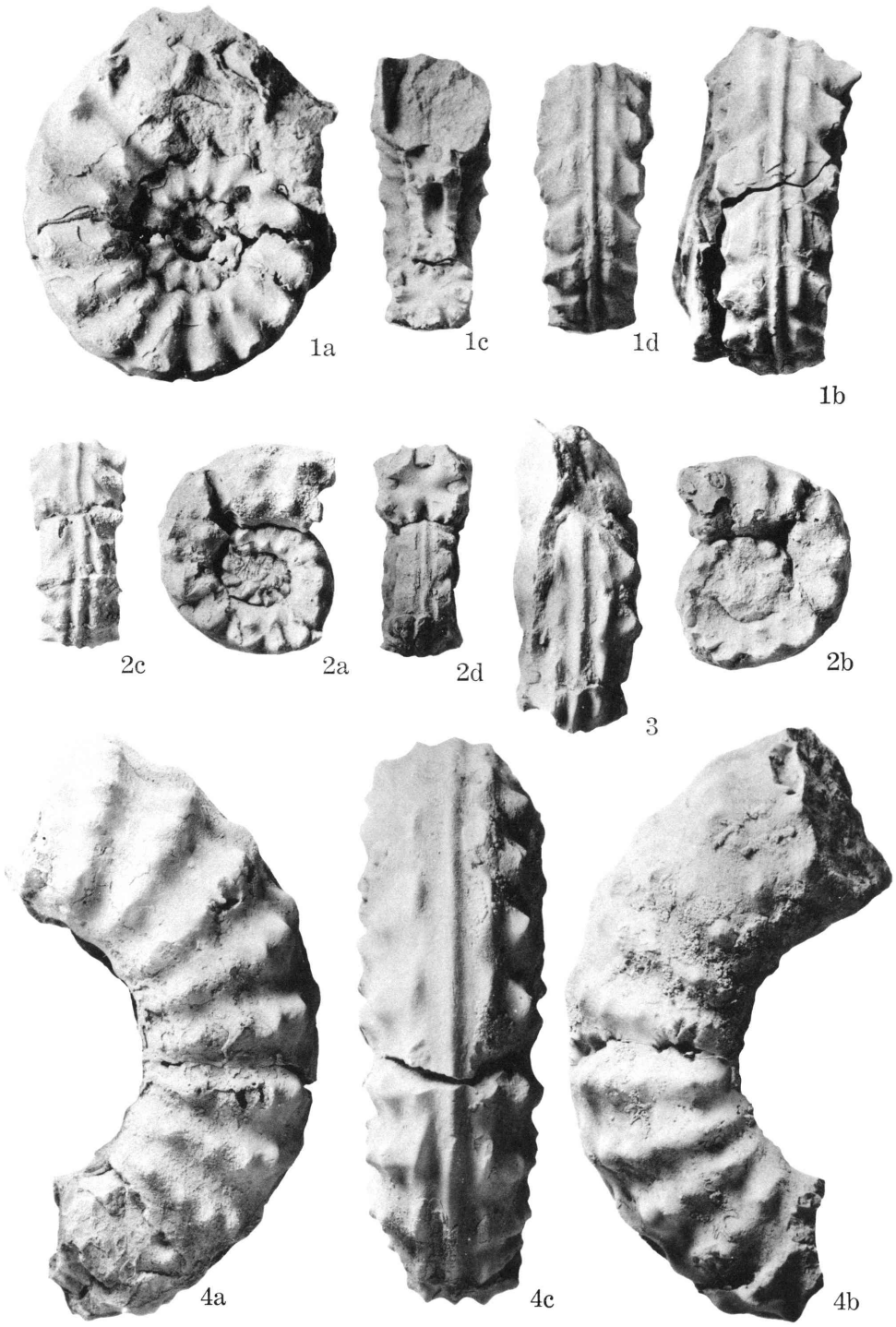
Plate 41

Explanation of Plate 41 [45]

Fig. 1. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA) ..... Page 280
An immature example, GK. H5513, from loc. CK. 80, Deto-futamata, a tributary of the Haboro, Chikubetsu-Haboro area, northwestern Hokkaido (Coll. Y. UEDA). Lateral (a) and ventral (b) views, enlarged. ×2.2. Sectional view (c) and another ventral view (d) of −90° earlier whorl, ×2.

Figs. 2–4. *Texanites* (*Plesiotexanites*) *stangeri* (BAILY) ..... Page 285
Illustrations of three different growth-stages of one and the same individual, GK. H5521, from the Chikubetsu-tanko quadrangle, northwestern Hokkaido (Coll. K. MATSUNO-K. TANAKA).

2. Inner whorl. Two lateral (a, b), ventral (c) and apertural (d) views, ×1.
3. A part of the succeeding whorl. Ventral view, ×1.
4. Outer whorl, which is still wholly septate. Two lateral (a, b) and ventral (c) views, ×1.



T. MATSUMOTO: Collignoniceratidae [Pl. 45]

Plate 42

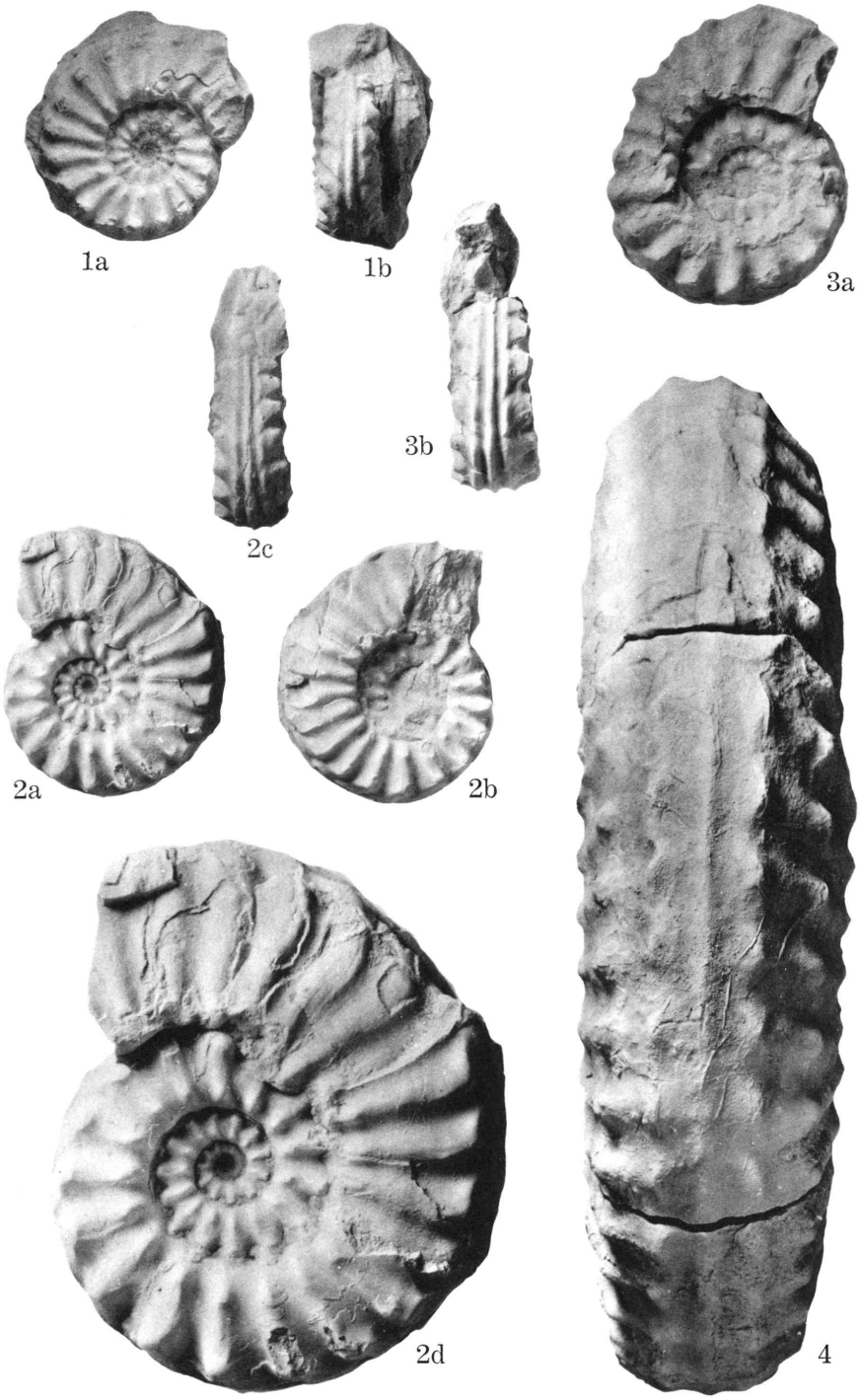
Explanation of Plate 42 [46]

Fig. 1. *Paratexanites* (*Parabevahites*) sp. cf. *P.* (*P.*) *sellardsi* YOUNG ..... Page 264
A probably immature example, GK. H5630, from the 16 km. point, upper reaches of the Ikushumbets, central Hokkaido. Lateral (a) and ventral (b) views, ×1.

Fig. 2. *Texanites* (*Plesiotexanites*) *pacificus* sp. nov. ..... Page 289
An immature shell, GK. H5640, from the 10 km. point of the Ikushumbets, central Hokkaido. Two lateral (a, b) and frontal (c) views, ×1.; enlarged lateral view (d), showing earlier inner whorls, ×2.

Fig. 3. *Texanites* (*Texanites*) sp. aff. *T.* (*T.*) *quinquenodosus* (REDTENBACHER) ..... Page 273
An immature example, GK. H5642, from Kumaoi-zawa, a tributary of the Ikushumbets, central Hokkaido (Coll. T. TAKAHASHI). Lateral (a) and frontal (b) views, ×1.

Fig. 4. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA) ..... Page 280
GK. H5517, from loc. 481-12, Sankebetsu, Chikubetsu-tanko quadrangle (Coll. K. MATSUNO-K. TANAKA), northwestern Hokkaido. Ventral view of a large shell, approximately ×2/3. See Pl. 43, Fig. 1 for the lateral view.



T. MATSUMOTO: Collignoniceratidae [Pl. 46]

Plate 43

Explanation of Plate 43 [47]

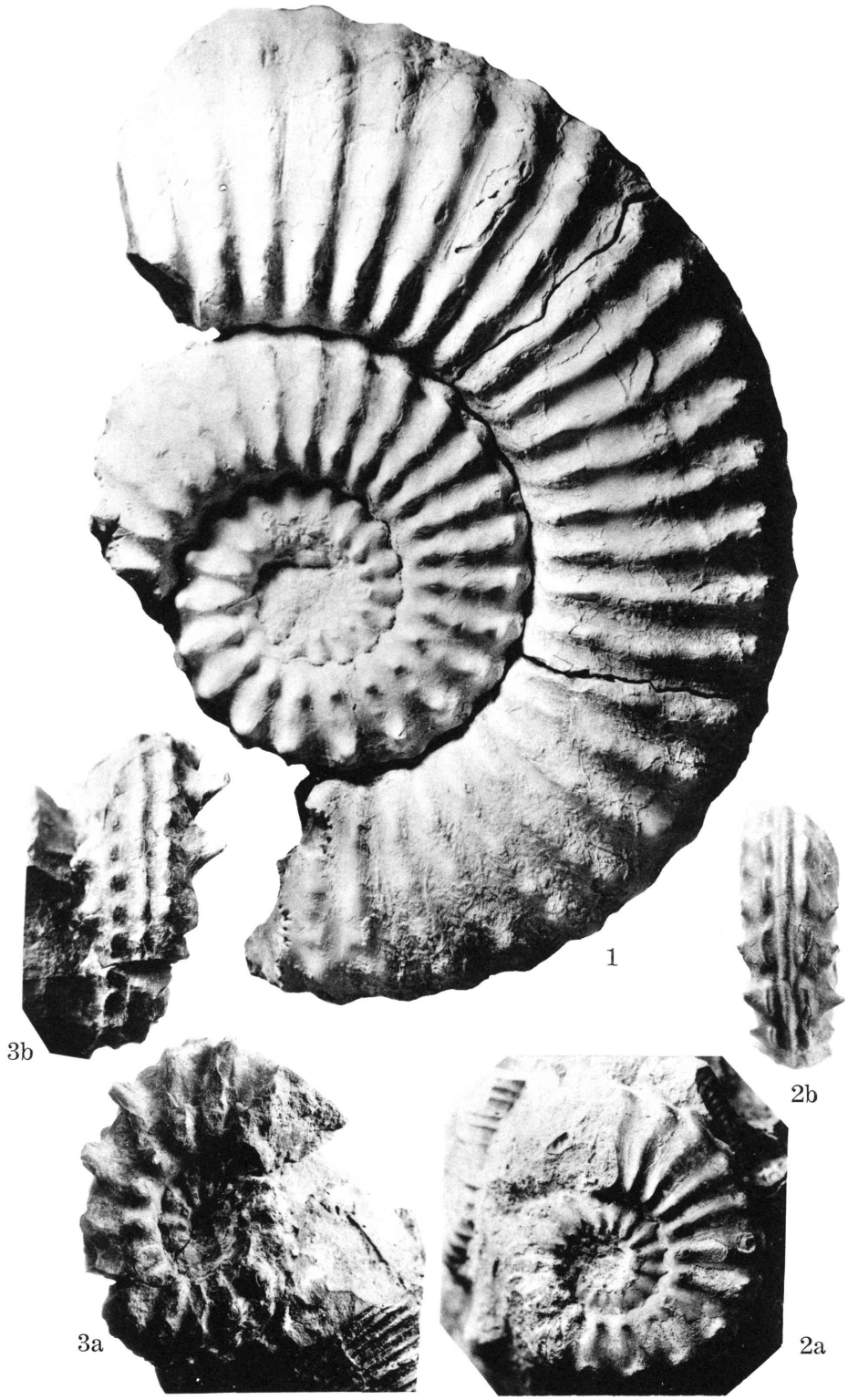
Figs. 1–2. *Texanites* (*Plesiotexanites*) *kawasakii* (KAWADA) .....Page 280

1. A large example, GK. H5517, from loc. 481–12, Sankebetsu, Chikubetsu-tanko quadrangle (Coll. K. MATSUNO-K. TANAKA), northwestern Hokkaido. Lateral view, approximately ×2/3. See Pl. 42, Fig, 4 for the ventral view and Pl. 40, Fig. 2 for the inner whorls.

2. A probably immature shell, GK. H5520, from loc. Sk 30, upper reaches of the Kami-no-sawa, a tributary of the Kotanbetsu, uppermost part of Unit U3, Sankei quadrangle, northwestern Hokkaido (Coll. K. TANAKA). Lateral (a) and ventral (b) views, ×1.

Fig. 3. *Australiella* sp. aff. *A. pattoni* YOUNG.....Page 300

GK. H5439, from the upper reaches of the Ikushumbets (near the 17 km. point), central Hokkaido (Coll. T. MURAMOTO). Lateral (a) and ventral (b) views, ×1.



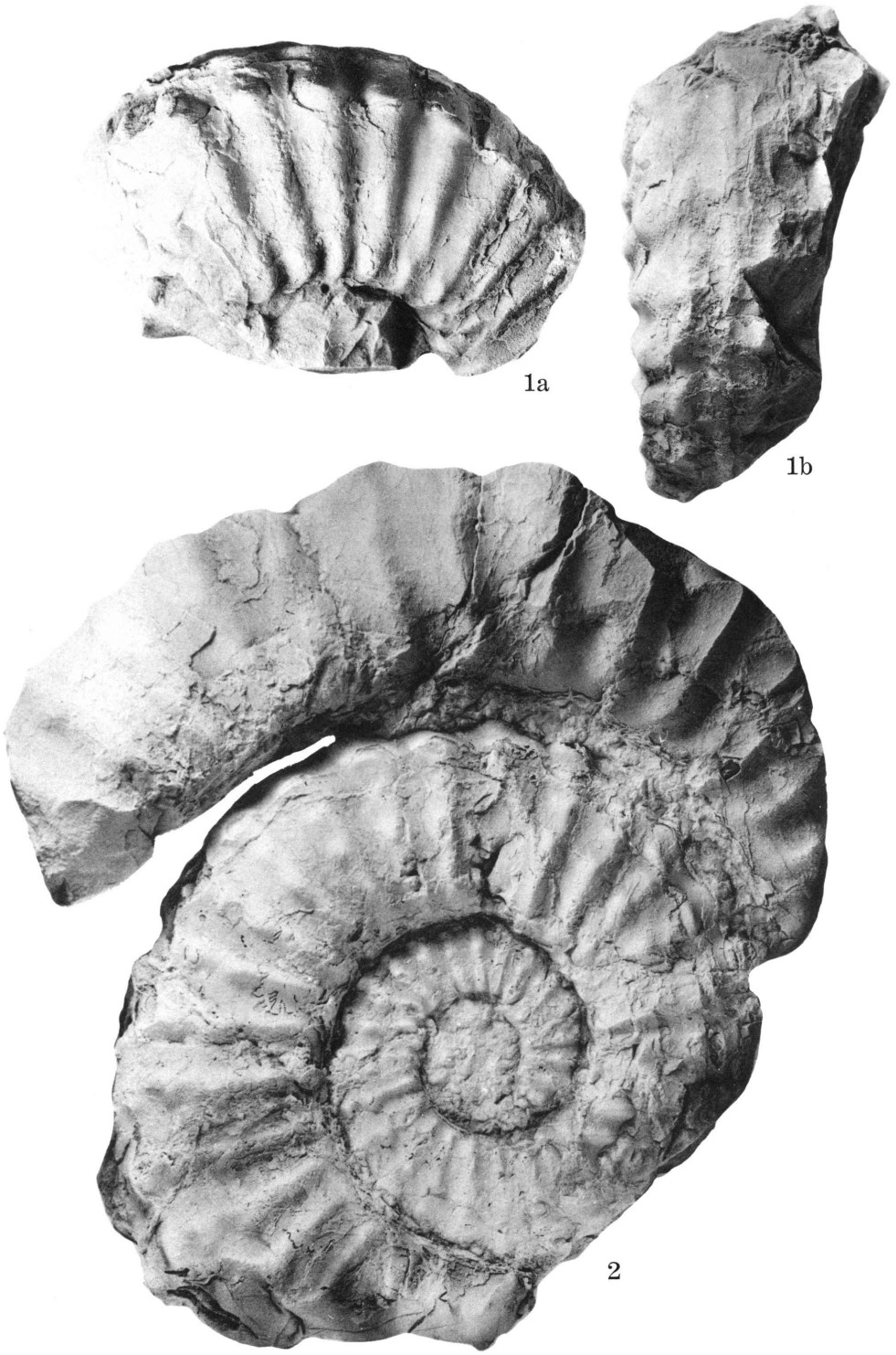
T. MATSUMOTO: Collignoniceratidae [Pl. 47]

Plate 44

Explanation of Plate 44 [48]

Fig. 1. *Protexanites* (*Anatexanites*) sp. cf. *P.* (*A.*) *fukazawai* (YABE and SHIMIZU).....Page 241
A fragmentary whorl, TKU. 30722, from the upper reaches of the Haboro, Unit Uy4 of the Soeushinai quadrangle, northwestern Hokkaido (Coll. K. NAGASE-W. HASHIMOTO). Lateral (a) and ventral (b) views, ×1.

Fig. 2. *Texanites* (*Plesiotexanites*) *yezoensis* sp. nov.....Page 294
Holotype, GK. H5646, from loc. Ik M1550, upper reaches of the Ikushumbets, central Hokkaido (Coll. T. MURAMOTO). Lateral view, ×2/3.



T. MATSUMOTO: Collignoniceratidae [Pl. 48]

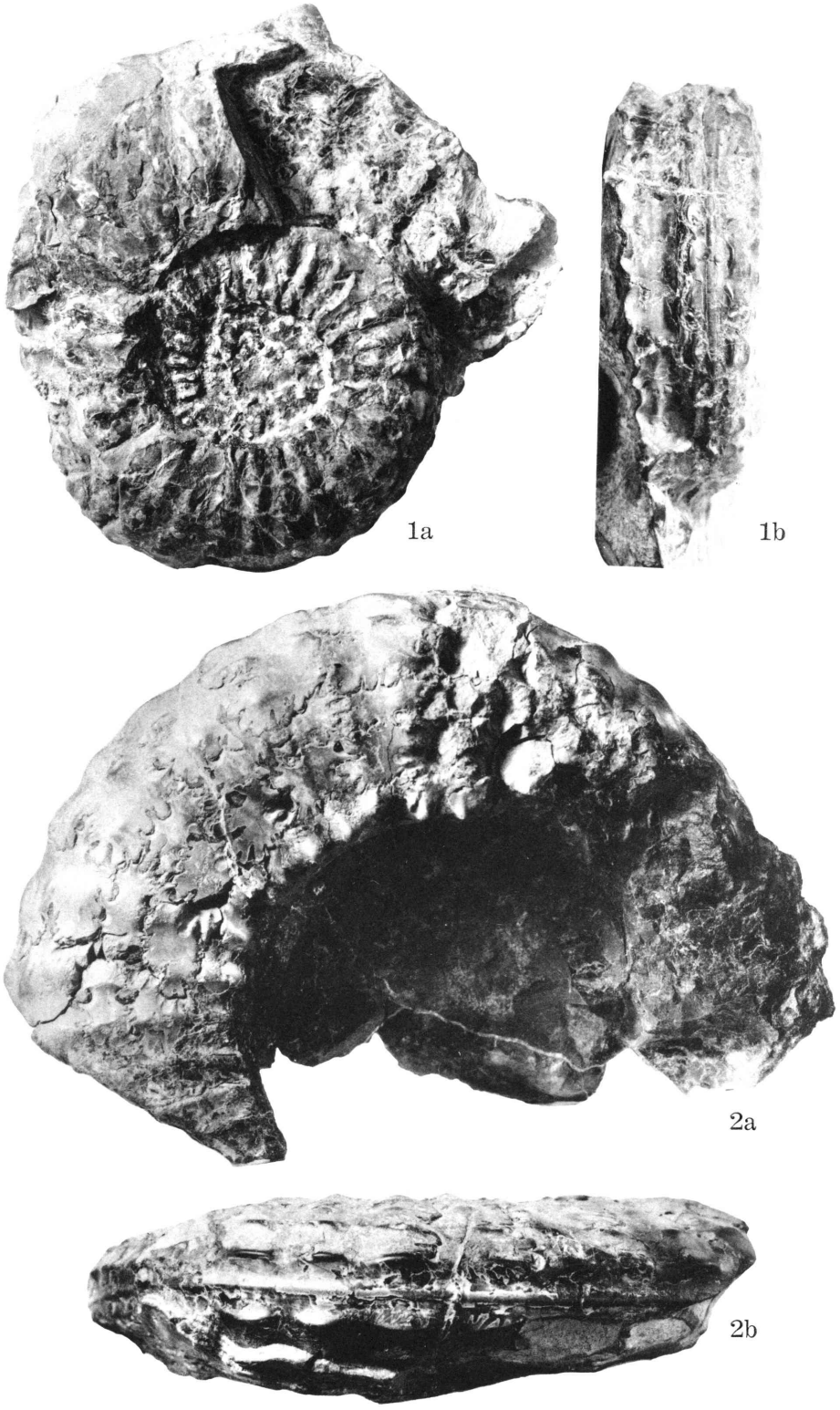
Plate 45

Explanation of Plate 45 [49]

Figs. 1-2. *Texanites* (*Plesiotexanites*) *pacificus* sp. nov. ..... Page 289
Illustrations of one and the same specimen at different growth-stages, paratype, GK. H5644, from the 13.5 km. point, upper reaches of the Ikushumbets, central Hokkaido.

1. Lateral (a) and ventral (b) views of the inner whorls, ×1.
2. Lateral (a) and ventral (b) views of the outer whorl, which is still septate, ×4/5.

Photos at Kyushu University, without whitening.



T. MATSUMOTO: Collignoniceratidae [Pl. 49]

Plate 46

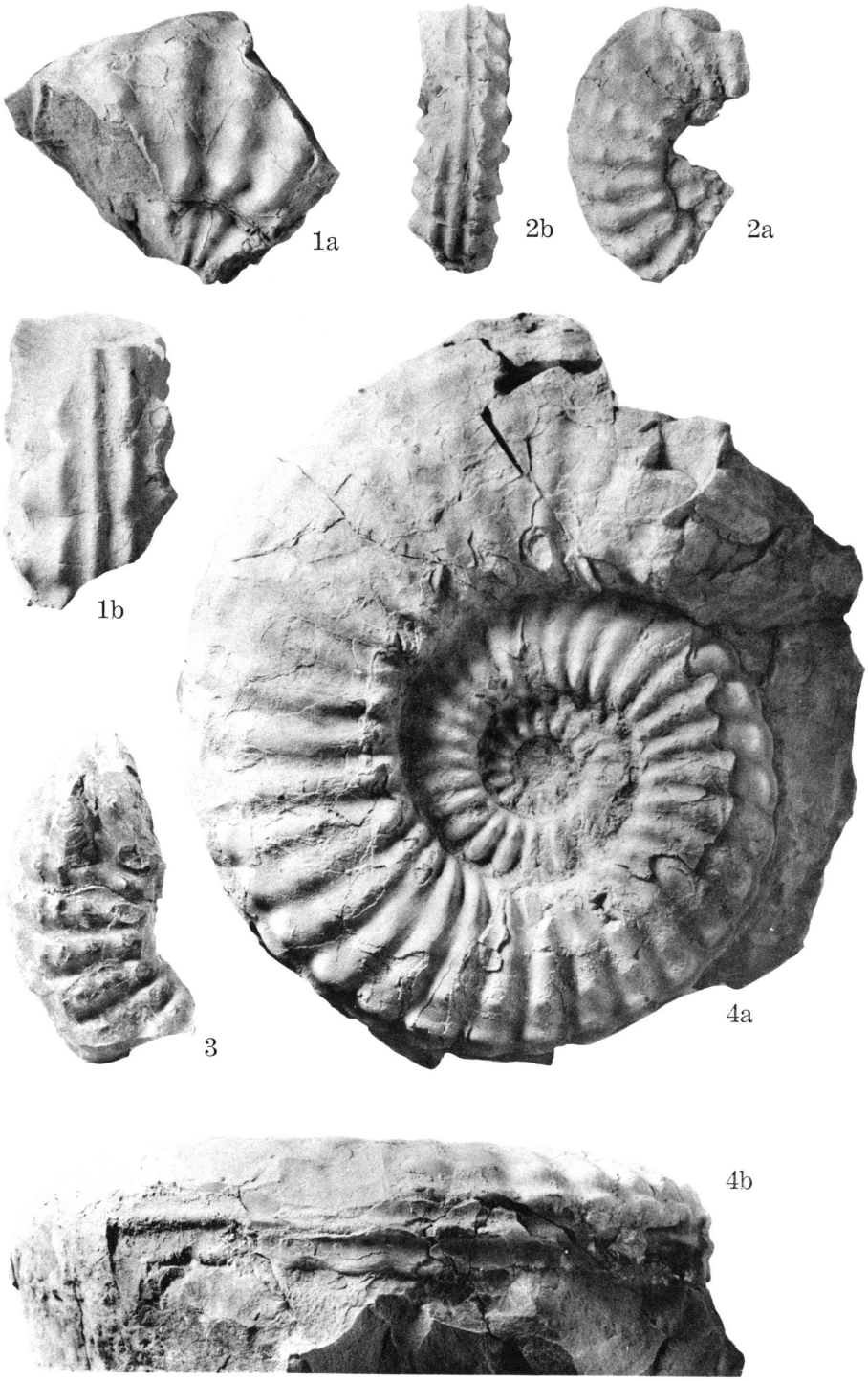
Explanation of Plate 46 [50]

Figs. 1–3. *Texanites* (*Texanites*) sp. aff. *T.* (*T*) *quinquenodosus* (REDTENBACHER) ..... Page 273

1. A fragmentary specimen, GK. H5514, from loc. CK 76, Deto-futamata, a tributary of the Haboro, Haboro-Chikubetsu area, northwestern Hokkaido (Coll. Y. UEDA). Lateral (a) and ventral (b) views, ×1.
2. A small specimen, GK. H5637, from loc. R378, Sakasagawa, a tributary of the Haboro, Haboro-Chikubetsu area, northwestern Hokkaido. Lateral (a) and ventral (b) views, ×1.
3. A fragmentary whorl, GK. H5635 from the 9–10 km. point, main stream of the Ikushumbets, central Hokkaido. Lateral view, ×1.

Fig. 4. *Texanites* (*Plesiotexanites*) *pacificus* sp. nov. ..... Page 289

Holotype, GK. H5506, from loc. CK 52, Sankebetsu, Haboro-Chikubetsu area, northwestern Hokkaido (Coll. Y. UEDA). Lateral (a) and ventral (b) views, ×1.



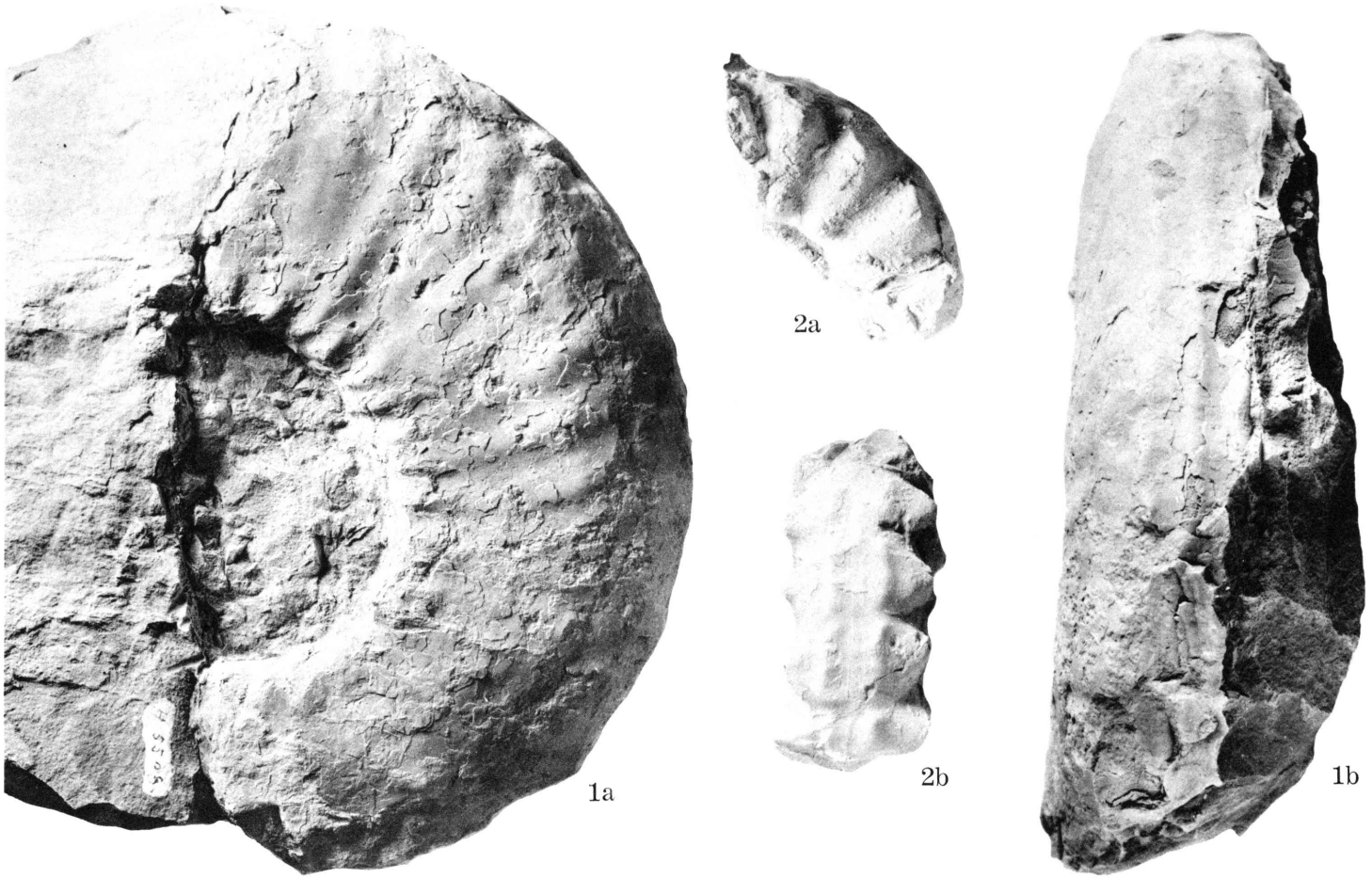
T. MATSUMOTO: Collignoniceratidae [Pl. 50]

Plate 47

Explanation of Plate 47 [51]

Fig. 1. *Texanites* sp. cf. *Texanites* (*Plesiotexanites*) *shiloensis* YOUNG ..... Page 296
GK. H5508, from Inari-zawa (loc. 37558p), a branch in the upper reaches of the Ikushumbets, central Hokkaido (Coll. T. MURAMOTO). Lateral (a) and ventral (b) views, ×1.

Fig. 2. *Defordiceras* (?) *japonicum* sp. nov. ..... Page 301
Holotype, GK. H5638, probably immature specimen from loc. R 371, Sakasagawa, a branch in the upper reaches of the Haboro, northwestern Hokkaido. Lateral (a) and ventral (b) views, ×2.



T. MATSUMOTO: Collignoniceratidae [Pl. 51]