

On Some Lower Triassic Ammonoids from Ankilokaza, Madagascar*

By

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Introduction

The occurrence of large number of the Lower Triassic ammonoids from Barabanja in northeastern Madagascar has been known since the publication of monograph by COLLIGNON (1933–34). But the Lower Triassic ammonoids from northwestern Madagascar have only been reported by TREAT (1933) based on some poorly preserved specimens. In 1973, Dr. K. ASAMA and his collaborators made a collection of the Lower Triassic ammonoids as well as fish-remains at Ankilokaza, south of Ambilobe. Fortunately I had a chance to study the ammonite collection.

The Lower Triassic formations in Madagascar have been included into the Sakamena Group which is composed mainly of Permian to Triassic formations. The Group was lithologically divided into three formations by BESAIRIE (1936). The lower formation consists of sandy mudstone which contains plant-, reptile-, amphibian- and fish-remains, and it is considered as Early Triassic in age. The middle formation, on the other hand, consists of sandstone, limestone and shale. The upper formation is characterized by red sandstone and correlated with the middle and lower parts of Beaufort Series of South Africa. In the northern part of Madagascar the marine Upper Permian to Lower Triassic rocks crop out for about 110 km as a narrow belt along the north-south trending coast. A large number of marine faunas occurs in the Upper Permian Beds, and many kinds of fragmentary fishes, amphibians, ammonoids and plant-remains are found in muddy concretions of Early Triassic age. The Permian-Lower Triassic Sakamena Group are overlain by the Isalo Group of the Middle Triassic to Middle Jurassic on the western coast of the Island.

On the Lower Triassic Ammonoids from Madagascar

The Lower Triassic ammonoids from Madagascar were firstly described by COLLIGNON (1933–34) from Barabanja, northeastern part of Madagascar. TREAT (1933) reported some poorly preserved ammonoid faunas from northwestern Madagascar. The ammonoid fauna from the Lower Triassic at Barabanja consists of a large number of *Koninckites*, *Flemingites* and *Pseudohedenstroemia*. This fauna is

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actually similar to the *Hedenstroemia* fauna of Spiti (KRAFFT and DIENER, 1909), the *Gyronites* and *Koninckites* faunas of Salt Range (WAAGEN, 1895) and the *Flemingites* fauna of Timor (WELTER, 1922). The *Gyronites* fauna was described by BANDO (in ISHII *et al.*, 1971) from the Lower Triassic of Kohe Safi near Kabul in Afghanistan and recently recorded from the Lower Triassic in Transcaucasia (ROSTOVTSEV and AZARYAN, 1972) and Iran (BANDO, 1977b, in press). COLLIGNON (1933–34) recognized the following species, taxonomy of which was revised by KUMMEL and STEELE (1962) and by BANDO (this paper), from Barabanja:

<i>“Ophiceras” (Gyronites) frequens</i> WAAGEN	<i>Koninckites spitiensis</i> (KRAFFT)
<i>Vishnuitesournieri</i> COLLIGNON	<i>Koninckites ensanus</i> (KRAFFT)
<i>Flemingites compressus</i> WAAGEN	<i>Koninckites wanneri</i> (COLLIGNON)
<i>Flemingites pulcher</i> WELTER	<i>Koninckites arthaberi</i> (COLLIGNON)
<i>Flemingites radiotus</i> WAAGEN	<i>Koninckites boulei</i> (COLLIGNON)
<i>Flemingites flemingi madagascariense</i>	<i>Koninckites jacobi</i> (COLLIGNON)
KUMMEL and STEELE	<i>Hedenstroemia mojsisovicsi</i> DIENER
<i>Flemingites griesbachi</i> KRAFFT	<i>Pseudosageceras multilobatum</i> NOETLING
<i>“Meekoceras” markhami</i> DIENER	<i>Paranannites cottreui</i> COLLIGNON
<i>“Meekoceras” pseudophanulatum</i> KRAFFT	<i>Proptychites douvillei</i> COLLIGNON
<i>Meekoceras khoerense</i> WAAGEN	<i>Proptychites</i> sp. ind. ex aff. <i>P. typico</i>
<i>Meekoceras</i> sp. aff. <i>M. falcatum</i> WAAGEN	KRAFFT
<i>Koninckites besairiei</i> (COLLIGNON)	<i>Proptychites roedereri</i> COLLIGNON
<i>Koninckites crassus</i> (KRAFFT)	<i>Juvenites besairiei</i> COLLIGNON
<i>Koninckites haydeni</i> (KRAFFT)	

This fauna consists of the *Koninckites*–*Flemingites*–*Proptychites* association, particularly characterized by predominance of *Koninckites* species. *Koninckites* has been included into the genus *Aspidites* by COLLIGNON (1933–34), whereas SPATH (1934, p. 158) regarded the genus *Aspidites* as a junior synonym of the genus *Clypeoceras* SMITH, 1913. KUMMEL and STEELE (1962) confirmed SPATH’s opinion and regarded that the Barabanja fauna is essentially characterized by a large number of *Clypeoceras* and *Pseudohedenstroemia* and is remarkably similar to the fauna from the *Hedenstroemia* beds of the Himalayas.

I identified the following Lower Triassic ammonoid species, some of which are new, from Ankilokaza:

- Koninckites* cf. *krafftii* SPATH
- Koninckites* cf. *evolvens* (WAAGEN)
- Koninckites* cf. *ensanus* (KRAFFT)
- Koninckites* cf. *kyokticus* (KRAFFT)
- Koninckites* sp.
- Collignonites asamai* BANDO, n. gen. et n. sp.
- Paranorites* sp.

Systematic Description

Superfamily Noritaceae KARPINSKY, 1889

Family Paranoritidae SPATH, 1930

Genus *Koninckites* WAAGEN, 1895

Type species: *Koninckites vetustus* WAAGEN, 1895, p. 216, pl. xxvii, fig. 4.

Diagnosis: Shell involute, laterally compressed, with flattened sides and narrowly rounded to subtabulated venter. Umbilical wall gently rounded. Suture with greater individualization of elements in auxiliary series.

Remarks: The type species, which was originally described by WAAGEN (1895) from the Salt Range, includes variation from involute to evolute forms. SPATH (1934, p. 150) restricted the genus *Koninckites* to the more involute forms with rounded or subtabulated venter, and especially referred “*K.*” *volutus* to *Paranorites* and “*K.*” *impressus* to *Prionolobus*, in spite of an essentially similar suture-line and similar form of tabulated venter. Essentially, *Koninckites* has a close similarity to *Aspidites*, *Kingites*, *Clypeoceras* and *Paranorites* in the forms of whorls, venter and suture-line except for some difference at umbilical area. KIPARISOVA (1961, p. 78) regarded the genus *Kingites*, *Aspidites* and *Clypeoceras* as junior synonyms of *Koninckites*. I also agree with KIPARISOVA’s opinion, but some doubt will be remained on *Paranorites*, because *Paranorites* has a wide umbilicus compared with *Koninckites*, *Aspidites* and *Clypeoceras*. Accordingly, I think that *Paranorites* should be distinguished from *Koninckites*.

Occurrence and geological horizon: Upper part of Induan Stage or Gyronitan Stage of the Lower Triassic. Salt Range, Kashmir, Spiti, Niti, Siberia, Arbania, North America, Timor and Madagascar.

Koninckites cf. krafftii SPATH

Pl. 1, fig. 6; Pl. 2, fig. 5

Compare:

Meekoceras varaha DIENER, 1909 (in KRAFFT and DIENER), p. 17, pl. ii, figs. 4a-d (lectotype), 2, 3, 5, 6; pl. xiv, figs. 7, 8; DIENER, 1915, p. 195.

Koninckites krafftii SPATH, 1930, p. 28;—SPATH, 1934, p. 155, fig. 43c.

Description: Shell rather involute, laterally compressed, discoidal, with narrowly rounded venter and gently convex sides, and with abruptly rounded umbilical shoulders. Shell surface ornamented with feeble radial folds. Suture ceratitic, composed of broadly rounded lateral saddles and broadly denticulated lateral lobes, especially first lateral lobe deepest than the other lateral lobes. Umbilical lobe rather short and shallow, but ventral lobe wider than the umbilical one. Ventral lobe shallow, denticulated and divided by siphonal narrow saddle.

Remarks: The present specimen lacks their internal shell and a half of outer volution, but the sutures, ornamentation, umbilicus and venter are well preserved. The general character of the shell resembles *Koninckites krafftii* SPATH, but the latter species has a little wider umbilicus. The sutures of the specimen at hand is similar to those of *K.*

krafftii or of *K. varaha* DIENER from the Lower Triassic in Spiti. However, the septa of *Koninckites* species are similar from one another so that the septal feature may not be critical for the specific identification of *Koninckites*.

Koninckites kyokticus (KRAFFT) [= *Meekoceras kyokticum* KRAFFT, in KRAFFT and DIENER, 1909, p. 52, pl. ii, figs. 8a-c] is also similar to the present specimen, but the species has considerable number of radial folds on the shell surface. On the other hand, "*Meekoceras*" *hodgsoni* DIENER, which also belongs to *Koninckites* as already suggested by SPATH (1934, p. 71, 151), resembles the present specimen except for umbilical characters; umbilical width of the present specimen is intermediate between those of *K. krafftii* and *K. hodgsoni*.

Occurrence and geological horizon: Lower Scythian *Koninckites* bed at Ankilokaza, northern Madagascar. Late Induan or Gyronitan Stages of the Early Triassic. Reg. No. NSM. PM9191 and 9192, Coll. K. ASAMA, 1973.

Koninckites cf. *evolvens* (WAAGEN)

Pl. 1, figs. 1a-b, 3

Compare:

Aspidites evolvens WAAGEN, 1895, p. 223, pls. 25, figs. 1a-b.

Meekoceras (Koninckites) evolvens, DIENER, 1915, p. 197.

Clypeoceras evolvens, SPATH, 1934, p. 221.

Description: Shell rather evolute, discoidal, with narrowly tabulated venter and gently convex sides. Umbilical shoulders sharply rounded, and their wall almost vertical. Outer whorl embraced about 2/3 height of inner whorl. Shell surface ornamented by radially-projected fine striae extending from umbilical margin to ventral shoulders. Sides gently convex, maximum width slightly above umbilical margin. Faint radial folds observed, but irregularly spaced in inner whorl. Venter narrowly tabulated, with sharply edged ventral shoulder as in *Meekoceras*. Suture slightly preserved in inner whorl, consists of broad-arched-shape lateral saddle and roughly denticulated lateral lobes. Lateral lobes divided by single main and other small denticulations as is in *Clypeoceras*.

Measurements (in mm; D: Diameter, H: Height, W: Width, U: Diameter of umbilicus):

	D	H	W	U	H/D	W/H	U/D
NSM. PM9193	59.0?	23.5?	19.6?	12.4	0.39?	0.83?	0.21?
WAAGEN's type specimen	164	77	36	34	0.46	0.46	0.20

Remarks: The present specimen is an external cast missing internal one. The material resembles "*Aspidites*" *evolvens* WAAGEN (1895) in the general character of shell and form of umbilicus, leaving some slight differences in the form of venter and thickness of the whorl. These differences may be ascribed to different growth stage, because WAAGEN's specimen is larger than the present material. On the other hand, the sutures show a close relationship from each other, although they are partly preserved in the present specimen.

Occurrence and geological horizon: Lower Scythian *Koninckites* bed at Ankilokaza,

northern Madagascar. Late Induan or Gyronitan Stages of Early Triassic.
Reg. No. NSM. PM9193 and 9194, Coll. K. ASAMA, 1973.

Koninckites cf. *ensanus* (KRAFFT)

Pl. 1, figs. 5a–b

Compare:

Aspidites ensanus KRAFFT, 1909, in KRAFFT and DIENER, p. 56, pl. v, figs. 3, 4, 5, 6, 7; pl. vi, fig. 1; pl. xiv, fig. 6;—COLLIGNON, 1934, p. 46, pl. viii, figs. 2, 3.

Clypeoceras ensanus (KRAFFT), SPATH, 1934, p. 154, 155.

Remarks: The present material at hand is incomplete lacking a half of outer volution, but the shell ornamentation and the feature of venter are well preserved. Unfortunately, the suture is hardly observed on the inner whorl. Regarding shell ornamentation and whorl cross-section the material resembles *Clypeoceras ensanus* (KRAFFT), which was originally described from the horizon of "*Meekoceras*" *lilangense* and "*M.*" *varaha*, at one mile north of Lilang in Spiti. In the original description KRAFFT stated as follow: "The sculpture of the shell differed from that of the inner cast, although in general characters they are similar. The shell as a rule thickens out in the umbilical region. Here the inner cast bears thick, slightly falciform folds, becoming broader and disappearing half way up the sides. These folds grow larger and thinner towards the anterior termination, where the lowest part of the sides is entirely smooth. The shell is covered by more delicate folds, which run parallel to those of the cast. These two are stronger on and near the chambered part than towards the anterior termination, but it seems that the folds on the shell have changed into delicate striae than the folds on the cast. At any rate it can be observed that, in some places where the folds of the cast are still comparatively thick, the shell already bears thin striae."

Occurrence and geological horizon: Lower Scythian *Koninckites* bed at Ankilokaza, northern Madagascar. Late Induan or Gyronitan Stages.

Reg. No. NSM. PM 9195, Coll. K. ASAMA, 1973.

Koninckites cf. *kyokticus* (KRAFFT)

Pl. 1, fig. 4; Pl. 2, fig. 3

Compare:

Meekoceras kyokticum KRAFFT, 1909, in KRAFFT and DIENER, p. 52, pl. ii, figs. 8a–c.

Koninckites? *kyokticus*, SPATH, 1934, p. 151.

Description: Shell rather evolute, with gently convex sides and narrowly rounded venter. Umbilical shoulders sharply edged and umbilical wall almost vertical, but shallow. Shell surface ornamented by feeble radial folds forming falciradial extending from umbilical margin to near ventral sides. Each fold most prominent on half below the height but more obscure nearer to umbilical and ventral margin of shell surface. Suture unknown.

Measurements (in mm):

	D	H	W	U	H/D	W/H	U/D
NSM. PM 9196	42.2	18.9	9.0?	10.5	0.45	0.48	0.25

KRAFFT's specimen 46 22 10 8 0.48 0.45 0.17

Remarks: The hand specimen is a plaster cast and unfortunately lacks the septa. But the general characters of the specimen is similar to those of *Koninckites kyokticus* (KRAFFT) which was described from the *Otoceras* beds at 5 miles south of Ensa in Spiti (Kyokti valley) by KRAFFT (in KRAFFT and DIENER, 1909), who noted especially on the shell ornamentation and character of umbilicus. The description gave no remarks on comparison with the other species of *Koninckites* (his *Meekoceras* or *Aspidites*). *Koninckites kyokticus* seems to resemble *K. varaha* DIENER, except for slight differences of the venter form. The venter of the latter species is narrowly tabulate, whereas the former shows a narrowly rounded venter same as in *Vishnuites*.

Occurrence and geological horizon: Lower Scythian *Koninckites* bed at Ankilokaza, northern Madagascar. Late Induan or Gyronitan Stages.

Reg. No. NSM. PM 9196, Coll. K. ASAMA, 1973.

Koninckites sp. indet.

Pl. 1, fig. 2

Description: Whorl involute, discoidal, with smooth and convex sides. Venter subtabulated with round ventral shoulders. Umbilicus small, but inner whorls slightly exposed. Surface almost smooth or slightly ornamented by falciradial striations from umbilical margin to ventral shoulder. Maximum width at 1/3 height of outer whorl. Umbilical shoulders sharply rounded with steep wall in umbilicus. Suture unfortunately unknown.

Measurements (in mm):

	D	H	W	U	H/D	W/H	U/D
NSM. PM 9197	61.0	29.4	9.6?	8.9	0.48	0.33?	0.15

Remarks: The present specimen almost lacks the whorl and is represented only by its external cast so that the specific identification is difficult. However, forms of umbilicus, shell surface and venter seem to indicate genus *Koninckites* which is characterized by narrowly rounded to subtabulated venter, gently rounded umbilical wall, and slight ornamentation of the shell. The general characters may be similar to those of *Koninckites truncatus* SPATH, 1934 [= *K. davidsonianus* WAAGEN, 1895], which were originally described from the Lower Ceratite Limestone (Gyronitan) in the Salt Range. Compared with this specimen, however, *K. truncatus* possesses thicker outer whorl with higher umbilical slope and excentric umbilicus as noted by SPATH (1934, p. 153).

Occurrence and geological horizon: Lower Scythian *Koninckites* bed at Ankilokaza, northern Madagascar. Late Induan or Gyronitan Stages.

Reg. No. NSM. PM 9197, Coll. K. ASAMA, 1973.

Genus *Paranorites* WAAGEN, 1895

Type species: *Paranorites ambiensis* WAAGEN, 1895, p. 158, pl. 22, fig. 1.

Remarks: The genus *Paranorites* was established by WAAGEN in 1895 (p. 157) for a single species, *P. ambiensis* WAAGEN, that was found from the Ceratite Formation of

the Salt Range. *Paranorites* was regarded as a junior synonym of *Meekoceras* by DIENER (1915), but later SPATH (1934, p. 140) stressed that the Meekoceratidae are distinguished from the Paranoritidae by different proportions of the sutural elements and by different stages of development, without becoming involute nor sharpening periphery. Depending on the features of suture, I consider that the genus *Paranorites* is a representative form of the evolutionary stage of *Ophiceras*–*Gyronites*–*Prionolobus* to *Proptychites* and *Koninckites*. SPATH (1934) also described some species of *Paranorites*, e.g. *P. hydaspis* SPATH, *P. praestans* SPATH, *P. aequilis* SPATH and *P. inflatus* SPATH, based upon the collection from the Ceratite Formation of the Salt Range. KIPARISOVA (1961) placed *Meekoceras tuberculatum* SMITH (1932, p. 62, pl. 50, figs. 1–4) in the genus *Paranorites* and described a new species, *P. subhydaspis* KIPARISOVA, from the Lower Triassic in the Ussuri region. In addition, POPOV (1961) also described *Paranorites* from the Induan bed (*Paranorites* Zone) in northeast Siberia, where *P. vercheri* WAAGEN, *P. tzeregradskii* POPOV, *P. kolymensis* POPOV, *P. kolymensis costata* POPOV, *P. cf. inflatus* SPATH, *P. olenekensis* (KIPARISOVA) and *P. cf. gigas* WAAGEN are recognized. Recently I reported a new species, *P. kummeli* BANDO (1977a, in press), from a bed with *Paranorites-Vishnuites* (Bed 75–76) of the Guryul Ravine in Kashmir.

Occurrence and geological horizon: Lower Scythian, Gyronitan or Late Induan Stages. Salt Range, Kashmir, Ussuri, northeast Siberia and North America.

Paranorites sp. indet.

Pl. 2, figs. 4a–b

Description: Shell rather evolute, laterally compressed, with slightly and narrowly tabulated venter and shallow umbilicus. Sides ornamented with indistinct radial folds in inner whorls, but almost smooth in outer whorl. Umbilical shoulder sharply rounded and three inner volutions observed in umbilicus. Suture ceratitic, consisting of entirely rounded lateral saddles and denticulated lateral lobes. First lateral lobe deepest and umbilical series considerably long and denticulated. Ventral lobe unfortunately absent.

Measurements (in mm):

	D	H	W	U	H/D	W/H	U/D
NSM. PM 9198	17.8	8.0	4.0?	6.0	0.45	0.5?	0.34
NSM. PM 9201	17.4	7.0	—	6.5?	0.40	—	0.37?

Remarks: The present specimens lack half of their outer volution and almost all parts of the inner whorls. Judging from the inner whorls of the plaster cast, ornamentation of surface and shape of their venters, the present materials should be included into *Paranorites*. Since specimens are poorly preserved, their specific determination is impossible. The general characters of shells are similar to those of "*Koninckites*" *volutus* WAAGEN (WAAGEN, 1895, p. 268, pl. 28, figs. 1, 2a–b), but the present specimens have more compressed whorls than those of "*Koninckites*" *volutus*. Thus, it may be included into *Paranorites* as already mentioned by SPATH

(1934, p. 146, 149).

Occurrence and geological horizon: Lower Scythian *Koninckites* bed at Ankilokaza, northern Madagascar.

Reg. No. NSM. PM 9198, Coll. K. ASAMA, 1973.

Genus *Collignonites* BANDO, n. gen.

Type species: *Collignonites asamai* BANDO, n. gen. et n. sp.

Diagnosis: Shell rather involute, discoidal, with compressed whorl and small umbilicus. Venter tabulated with sharp external edge. Umbilical wall vertical and rather high. Surface ornamented by distinctly falciform ribs, which are especially remarkable on sides at 2/3 height from umbilical margin.

Remarks: The present type specimen consists of an external mould and unfortunately lacks suture. The general character of shell is similar with that of *Prionolobus undatus* WAAGEN (1895, p. 319, pl. 36, figs. 5a–b) from the Ceratite Formation of the Lower Triassic at Virgal in the Salt Range, although WAAGEN's specimen is more incomplete and fragmentary. WAAGEN noted on his *Prionolobus undatus* as follows: "This species has been founded on a single fragmentary specimen, which, however, is of considerable interest, as it is the only form of *Prionolobus* occurring in the Ceratite Marls, and it is the more interesting, in that it shows no relationship whatever to any of the other species, . . ."

I consider that *P. undatus* should be included into the present new genus, *Collignonites*, judging from the shell ornamentation and the form of umbilicus.

Occurrence and geological horizon: Late Induan or Gyronitan Stages of the Lower Triassic. Madagascar and Salt Range?

Collignonites asamai BANDO, n.gen. et n. sp.

Pl. 2, figs. 1a–c

Description: Shell rather involute, discoidal, with compressed whorls and small umbilicus. Venter narrowly tabulated with sharp external edge. Umbilical wall vertical and rather high. Shell surface ornamented by distinct radial folds extending from umbilical margin to 2/3 height of shell, about 12–13 ribs observed on shell surface in outer whorl. Each ribs prominent on 1/3 height, though diminishing on ventral and umbilical margin. Suture unknown.

Measurements (in mm):

	D	H	W	U	H/D	W/H	U/D
NSM. PM 9199	36.5	16.6	8.0?	10.4	0.45	0.48?	0.28

Remarks: General characters of shell are well preserved, except for sutural characters. The present specimen resembles *Prionolobus undatus* WAAGEN described from the Ceratite Formation in the Salt Range as mentioned above, but it is difficult to compare with that of WAAGEN's specimen, because the WAAGEN's specimen is more incomplete and fragmentary. WAAGEN stated himself that "I am not quite sure

whether I am right in including this species [*P. undatus*] in the genus *Prionolobus*, as its configuration is not quite typical of the genus . . .” and he included this species into the genus *Prionolobus* only on the basis of similarity of sutures. In this paper, I would like to propose that *P. undatus* should be moved from the genus *Prionolobus* and included into *Collignonites* because the shell surface of *Prionolobus* is smooth without any ribs or radial ridges. I also could not find any other species comparable with the present species, and therefore I proposed *C. asamai*, n. sp. in honor of Dr. Kazuo ASAMA of the National Science Museum in Tokyo.

Occurrence and geological horizon: Lower Scythian *Koninckites* bed at Ankilokaza, northern Madagascar.

Reg. No. NSM. PM 9199, Coll. K. ASAMA, 1973.

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Explanation of Plates

All the specimens illustrated here from the *Koninckites* bed at Ankilokaza, northern Madagascar. Upper Induan Stage of the Lower Triassic.

(All $\times 1$ except for Pl. 1, fig. 6 $\times 1.5$)

Plate 1

Figs. 1, 3. *Koninckites* cf. *evolvens* (WAAGEN). NSM. PM 9193 and 9194.

Fig. 2. *Koninckites* sp. NSM. PM 9197.

Fig. 4. *Koninckites* cf. *kyokticus* (KRAFFT). NSM. PM 9196.

Figs. 5a, b. *Koninckites* cf. *ensanus* (KRAFFT). NSM. PM 9195.

Fig. 6. *Koninckites* cf. *krafftii* SPATH. NSM. PM 9191.

Plate 2

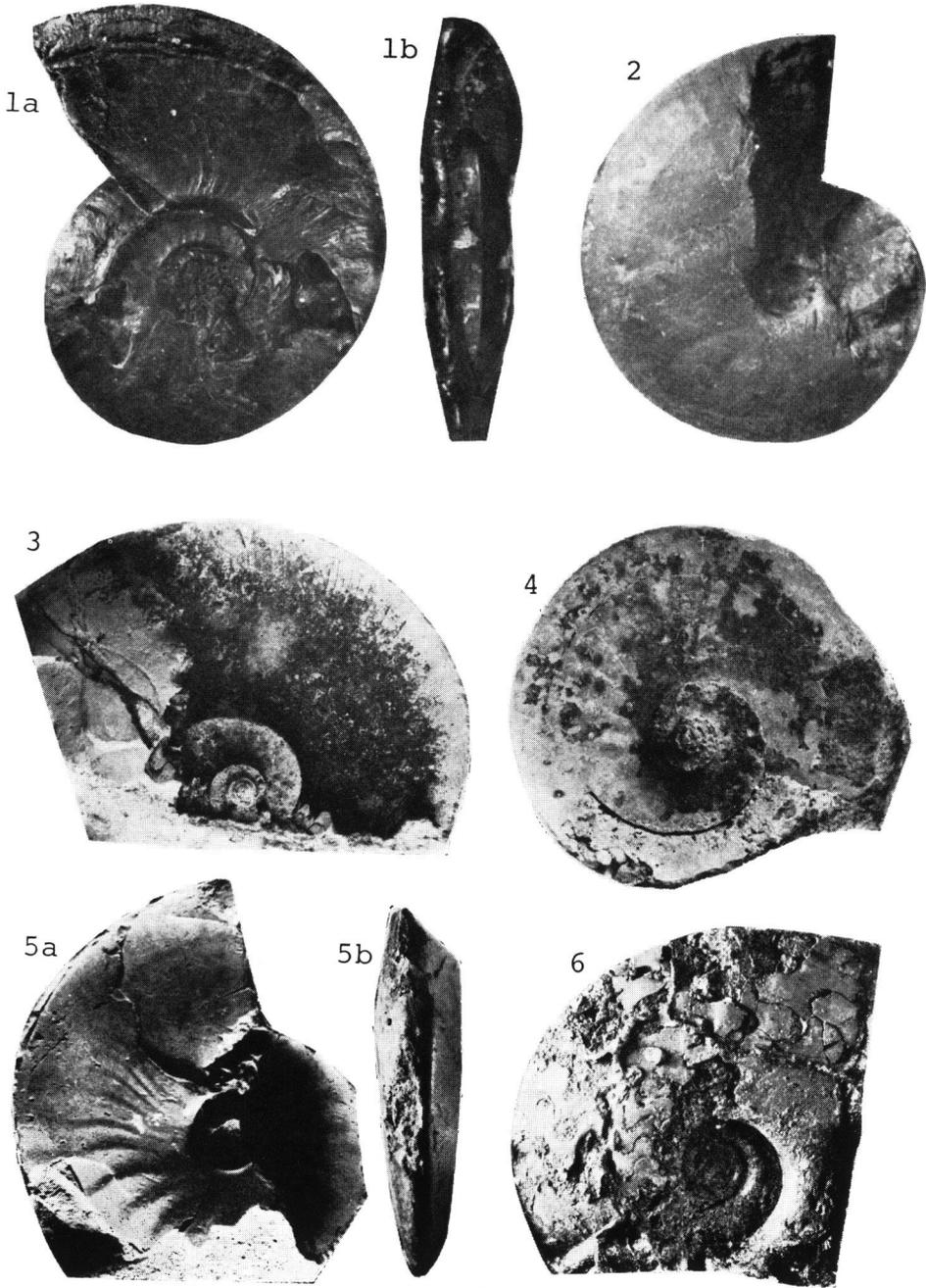
Figs. 1a-c. *Collignonites asamai* BANDO, n. gen. et n. sp. NSM. PM 9199.

Fig. 2. *Koninckites* cf. *ensanus* (KRAFFT). NSM. PM 9200.

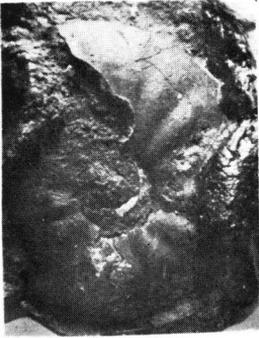
Fig. 3. *Koninckites* cf. *kyokticus* (KRAFFT). Plaster cast of NSM. PM 9196.

Figs. 4a, b. *Paranorites* sp. NSM. PM 9198, b: suture line, NSM. PM 9201.

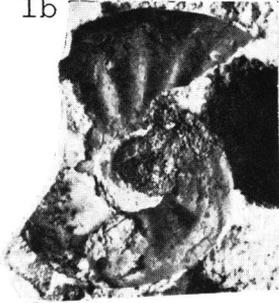
Fig. 5. *Koninckites* cf. *krafftii* SPATH. Suture line, NSM. PM 9192.



1a



1b



1c



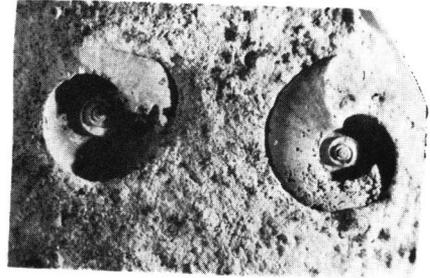
2



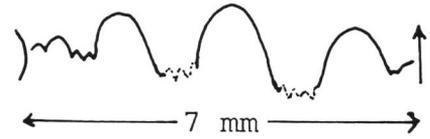
3



4a



4b



5

