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GENUS *HIMALAYITES* (AMMONOIDEA) FROM THE UPPER TITHONIAN OF THE SPITI HIMALAYA – A SYSTEMATIC REVISION OF UHLIG'S (1910) MATERIAL

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ABSTRACT

Uhlig (1910) first described the genus *Himalayites* on the basis of an array of species collected by others from the Spiti Himalaya. The species lack precise stratigraphic information. Most of the specimens of the species are archived in the Geological Survey of India, Kolkata. The subfamily Himalayatinae is now known to be strongly sexually dimorphic and exhibits great intraspecific variations. We here have revisited the Uhlig's material in the light of sexual dimorphism, ontogenetic variability and improved knowledge of geology of the Spiti area.

Keywords: Upper Tithonian, Spiti, *Himalayites*, Sexual dimorphism

INTRODUCTION

Taxonomic affinities of *Himalayites* Uhlig, 1910 and other allied genera have swung from time to time. *Himalayites* was first introduced by Böhm (1904) for the New Guinea specimen with explicit reference to Uhlig (whose monograph on The Fauna of Spiti Shale appeared later in 1910). Spath (1925) grouped *Himalayites* and other genera erected by himself and Uhlig into a new subfamily Himalayitinae within the family Berriasellidae. Later, Arkell *et al.* (1957) maintained the same rank Himalayitinae and incorporated some other genera subsequently discovered within it. Grouping of Himalayitinae within Berriasellidae was later questioned by Callomon (in Donovan *et al.*, 1981a). He believed that similarity between the two subfamilies with respect to ventral aspect (presence of mid-ventral sulcus or smooth band) is not homologous and might represent evolutionary convergence. According to him, the present classification of Berriasellidae is in a state of chaos. Moreover, intraspecific variability and sexual dimorphism are very poorly known in Berriasellidae. He, therefore, elevated subfamily Himalayitinae to the rank of family Himalayitidae.

Callomon (in Donovan *et al.*, 1981a) also suggested dimorphism in this subfamily. He even recognized dimorphic generic pair between *Micracanthoceras* Spath, 1925, macroconch (M) and *Aulacosphinctes* Uhlig, 1903, microconch (m); the present microconchs of *Himalayites* described here may resemble *Aulacosphinctes*, but closer examination reveals that they are distinct. Enay and Geyssant (1975), Enay and Cariou (1997) and later Callomon (in Donovan *et al.*, 1981a) established dimorphism between *Protacanthodiscus* Spath, 1923 (M) and *Durangites* Burckhardt, 1912 (m). The last two genera were previously considered to belong to two different subfamilies (Arkell *et al.*, 1957). Recently, Parent (2001) and Shome and Bardhan (communicated) described dimorphism within *Corongoceras* Spath, 1925. In all these genera macroconchs are larger with robust tuberculation on the body whorl, while microconchs are smaller in size with biplicate ribs and prominent ventral furrow.

Uhlig (1910) described an array of species of *Himalayites*, which display size and ornamental variations. Moreover, the species erected by Uhlig (1910) under *Himalayites* are also recently disputed. Tavera (1985) has expressed doubts regarding affinities of some of his species. Spath (1931, p. 545) mentioned that a few species of *Hoplites* Neumayr, 1875 described by Uhlig (1910), e. g. *Hoplites* (*Blanfordia*) *latidomus* or *H. middlemissi* have reminiscence of peripheral aspects of *Himalayites*. These have led us to revisit the type material of Uhlig, reposited in Geological Survey of India, Kolkata, in the light of dimorphism and intraspecific variability.

Uhlig (1910) altogether described 12 species of *Himalayites*, of which eight were archived in the Repository Unit of Geological Survey of India, Kolkata. The species have been recognized as having both macroconchiate and microconchiate affinities, but dimorphic pair could not be established due to lack of adequate stratigraphic data, poor sample size and fragmentary nature of specimens. Some of them have been clubbed into single species owing to similar morphological features.

Macroconchs show ontogenetic changes in ribbing pattern. An initial two to three secondary ribs with tubercles at furcation point is observed in inner whorls. Middle to late phragmocone bears four to five secondary ribs with tubercles becoming stronger. In body chamber, the number of ribs comes down again to two to three and the tubercles become robust. Examples of macroconchs are *H. seideli*, *H. hollandi* and *H. stoliczkai*.

Microconchiate forms are *H. hyphasis* and *H. ventricosus* which have bifurcating and non-tuberculate early phragmocone and bi- or trifurcating ribs with tubercles on body chamber. Ventral furrow is prominent and continue till to the end. Microconchs are smaller in size, diameter ranges between 46 mm to 53 mm. Thus, it appears that microconchiate forms retain early features of macroconch (cf. Callomon, 1981b). The initial bifurcating stage of both macroconch and microconch of *Himalayites* is a symplesiomorphic character in cladistic sense (Eldredge and Cracraft, 1980) and resembles that of other genera of Himalayitinae, e.g. *Micracanthoceras* and *Corongoceras* (Shome and Bardhan, communicated). The microconchiate forms of *Himalayites* resemble *Aulacosphinctes* which is also a microconch of

Micracanthoceras, however, has only biplicate ribbing pattern and has prominent ventral furrow with tubercles on either side.

GEOLOGIC SETTING

The Upper Jurassic-Lower Cretaceous Spiti Shale Formation is developed extensively in the Himalayan region from Zanskar in the west to southern Tibet in the east (Krishna, 1983; Olóriz and Tintori, 1990; Westermann and Wang, 1988; Enay and Cariou, 1997; Enay and Cariou, 1999; Yin and Enay, 2004). The Spiti Shale generally overlies the Ferruginous Oolitic Bed of Callovian age. Wherever this oolitic horizon is absent, the Spiti Shale disconformably overlies the Kioto Limestone Formation ranging from Upper Triassic to Bathonian. In the upper part, the Spiti Shale grades into the Giumal Sandstone Formation of Lower Cretaceous (Hauterivian) (Pascoe, 1959; Srikantia and Bhargava, 1998).

The Spiti Shale is made dominantly of argillaceous facies with occasional silty/sandy layers and calcareous concretions. There are also cases of lateral facies variation within basic motif of sediments. Throughout the sequence concretions, which yield well-preserved fossils are common. The lithofacies of this formation indicates an open marine environment of deposition (Krishna *et al.*, 1982; Pathak and Krishna, 1994; Krishna and Pathak, 1994). The faunal assemblages, particularly ammonites, show homogeneity of the biofacies with characteristic associations, the *Himalayites-Corongoceras* assemblage always occurs above *Virgatosphinctes* Uhlig, 1910 and *Aulacosphinctes* association (Krishna *et al.*, 1982). The former assemblage has been reported from other parts of the Himalaya (Krishna, 1983) as well as many other regions including Kutch and evidently indicates the Late Tithonian age (Leanza, 1980; Tavera, 1985; Cecca, 1999; Shome *et al.*, 2004).

The subdivision of the Spiti Shale was first proposed by Griesbach (1891). Diener (1895) further subdivided the Spiti Shale into the *Belemnites gerardi* Beds, the Chidamu Beds and Lochambal Beds in ascending order. As the lower part is named after a fossil and other two are based on locality names, Pathak (1993) proposed to describe them as the Lower Member, Middle Member and Upper Member in ascending order. Everywhere the Spiti Shale can be subdivided into these three basic units of which lower one is always characterized by the presence of abundant belemnites of Oxfordian age and the upper two members contain abundant and diverse ammonites of Kimmeridgian- Middle Tithonian and Upper Tithonian, respectively (Pascoe, 1959; Pathak and Krishna, 1994).

The collections of ammonites made by Stoliczka (1866) and Griesbach (1891) were studied in detail and monographed by Uhlig (1903-1910). Uhlig was well aware of the subdivisions of the Spiti Shale. His specimens of *Himalayites* came from several localities where some famous sections, e. g. Lochambal-Kichak, the Giumal and the type Spiti section are exposed. In the Lochambal-Kichak area which is two miles east of 'Chitichun' (=Chichim) only the Jurassic sediments, i.e. 'Lochambal beds' are exposed and conformably overlain by the Giumal Sandstone (Pascoe, 1959). From here Uhlig reported two *Himalayites* species, i. e. *H. seideli* and *H. ventricosus*. Other *Himalayites* species described by Uhlig came from Giumal, Spiti and other localities where the stratigraphic position of *Himalayites* was unknown and uncertain. Recently, Pathak and Krishna (1994) studied the Upper Jurassic sections at Chichim and Gate (Fig. 1) which are nearby the areas mentioned above. They placed *Himalayites* along with *Corongoceras* in their 'Upper Member' (equivalent to Lochambal bed) and assigned the Upper Tithonian age. They mentioned the occurrence of two species, i.e. *H.* cf. *seideli* and *H.* sp. and photographed only the latter (Pl. III, fig. 5)

The upper unit shows some lithologic variation in the two fossiliferous sections. In Chichim, the assemblage *Himalayites* comes from the whitish gray shale, and in Gate the equivalent part is grayish black. Our inspection of the types as well as the enclosing matrix of the Uhlig's material reveals that all specimens were collected from the black shale which crops out at Gate. Pascoe (1959) mentioned that the Lochambal beds are frequently intercalated with regularly bedded black shale. It is most likely that all the *Himalayites* species described by Uhlig actually came from the Late Tithonian Lochambal bed. Besides, the ammonite association, i.e. *Corongoceras*, *Aulacosphinctes*, *Blanfordiceras Cossmann*, 190[illegible], etc. which forms the Late Tithonian assemblage elsewhere, also supports this assumption.

SYSTEMATIC PALAEONTOLOGY

All specimens are kept in the Repository Unit of Geological Survey of India, Kolkata. Dimensions are measured in millimeter where D = Whorl diameter, U = Umbilical Diameter, W = Whorl width and H Whorl height, M = Macroconch, m= Microconch, BC = Body Chamber, Eph End Phragmocone and Ph = Phragmocone.

Family **Berriasellidae** Spath, 1922
Subfamily **Himalayitinae** Spath, 1925
Genus ***Himalayites*** Uhlig in Böhm, 1904
(*Type species* : ***Himalayites treubi*** Douvillé, 1912)
Himalayites seideli (Oppel) [M]
(Pl. I, figs. 1-6; Pl. II, figs. 1-4)

Ammonites seideli Oppel, 1865, Palaeontologische M[illegible] IV, p. 238, pl.80, figs. 3 a-b.

Himalayites seideli (Oppel) Uhlig, 1910, p. 140, pls. XX[illegible]IX, figs. 2, a-b; XL, fig. 1

Himalayites depressus Uhlig, 1910, p. 148, pl. XL, fig. 2, a-d

Himalayites hoplitiformis Uhlig, 1910, p. 151, pl. XLII, figs. 2 a-e.

Himalayites cf. *seideli* Pathak and Krishna, 1994

Himalayites sp. Pathak and Krishna, 1994, p.217, pl. 3, fig. 5

Material: The species was originally described by Oppel (1865) based on three specimens which were collected from Spiti. Uhlig (1910) later commented that only two of Oppel's specimens belong to *H. seideli*. In addition, he introduced two more specimens (GSI type no. 9996 9997 and reproduced

EXPLANATION OF PLATE I

1. ***Himalayites seideli*** Oppel (GSI Type No. 9996), lateral view.
2. ***H. seideli***, same specimen, ventral view.
3. ***H. seideli***, same specimen, apertural view.
4&5. ***H. seideli*** (GSI Type No. 9997), lateral views.
6. ***H. seideli***, same specimen, apertural view.

All are in natural size, bar represents 2 cm and X marks the beginning of body chamber.

Plate I

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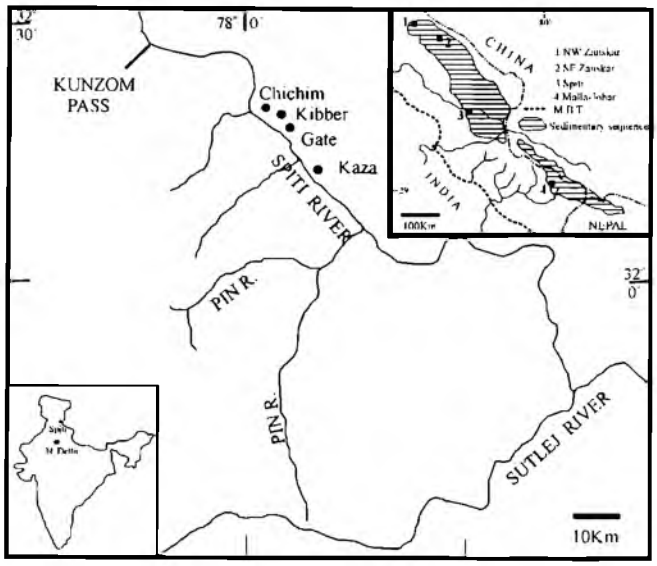

Fig.1. Locality map of the Spiti Himalaya (Modified after Pathak and Krishna, 1994).

here in Pl. I, figs. 1 -6). Neither Oppel, nor Uhlig, selected any of the studied syntype as holotype. The 4th edition of the ICZN code (1999, art. 73.1.3 and 74.6) does not encourage to designate any holotype but only lectotype. We here propose Oppel's specimen (1865, pl. 80, fig. 3) as a lectotype of the present species.

Description: Species now includes four specimens (Type No. 9996 is designated here as lectotype, refigured here in Pl. I, figs. 1-3 and others are paratypes). Specimens have composite state of preservation. It is large, highest diameter observed c.113 mm with adult body chamber (GSI type no. 9996). Shell is strongly ribbed with robust tubercles which form the base of slender spines. Strength of tubercles suddenly increases at the beginning of the body chamber. Inner whorls weakly tuberculate with bifurcating secondary ribs which may be bunched into three to four on the adult phragmocone. The number of secondary ribs drops to two to three in the body chamber. The point of furcation where tubercles sit is at the mid-lateral or slightly below. Ribs may be slightly flexuous on the body whorl. Mid-ventral sulcus weakly developed on the adult body whorl and ribs are continuous across the venter. Venter becomes progressively more flattened towards aperture. The body chamber seemed to occupy half of the last whorl as evident from the trace of the umbilical seam.

Discussion: *H. depressus* (Type No. 9998, refigured in Pl. II, figs. 1-2)) described by Uhlig (1910) is represented by a single specimen having partly preserved body whorl with two last septa. The septate part has now been detached from the body whorl and has been given another type number (9995i). But Uhlig studied them as parts of the same specimen. The two last septa do not show any sign of approximation and body chamber has three to four secondaries like that of phragmocone of the adult lectotype. Strength of tubercles also does not increase on the body chamber. These indicate that the specimen was not adult. Ribbing pattern however, strongly resembles that of *H. seideli*, only it is more inflated (W/H at the preserved end is 1.40). It is a depressed variant of the present species and is synonymised here (see pl. II, figs. 1 and 2).

H. hoplitiformis described by Uhlig (1910) is based on a broken adult body chamber with part of the phragmocone preserved (Type No. 10004). Ribs are equally strong, flexuous and number of secondaries is two. Body chamber and tubercles are robust. Thus, it strongly resembles the adult character of *H. seideli* and is also synonymised here (see Pl. II, figs 3-4).

Type No.		D	U	W	H
9996		?113	54		
	EPh	100	51		
9997	Ph	90	41	35	28
	Ph	72	30	28	20
9998	BC	-	-	35	c.26
10004	BC	-			

Himalayites hollandi Uhlig [M]
(Pl. II, figs. 5-7)

Himalayites hollandi Uhlig, 1910, p. 144, pl. XXXIX, figs. 1 a-d.

Material: The only specimen (GSI type no. 9995) described by Uhlig (1910) is designated here as lectotype.

Remarks: The species is vividly described by Uhlig (1910). We have made a few additional observation The species is largest and most evolute (U/D= 0.52) among the species of *Himalayites*. The species (Type No. 9995) is still septate at 120 mm diameter. Septal sutures are all through closely approximated, but shallowing of the ventral sulcus towards the late phragmocone stage perhaps indicates adult nature. Ribs are still prominent on internal mould with secondaries being two to three. Tubercles are blunt and rounded and whorl is depressed (W/H varies from 1.15 to 1.17). The continuation of tubercles and presence of two to three secondaries up to the preserved end suggest its adult macroconchiate affinity.

	D	U	W	H
Ph	120	63	36	[illegible]

Himalayites stoliczkai Uhlig [M]
(Pl. III, figs. 1-3)

Himalayites stoliczkai, Uhlig, 1910, p. 146, pl.XXXVII , fig. 1 a-d.

Material: The only specimen (GSI type no. 9988) described by Uhlig (1910).

Remarks: Shell is small, fully septate. Tubercles appear from the third whorl. Strength of tubercles also increases during ontogeny. Secondary ribs are dominantly bifurcating in the inner whorls, but become polyfurcate (four to five) in the preserved outer whorl (Type No. 9988). Shell appears to be a young macroconch but can not be matched with present larger species that have in most of the cases inner whorls missing.

EXPLANATION OF PLATE II

1. ***Himalayites seideli*** Oppel (GSI Type No. 9998), lateral view.
2. ***H. seideli***, same specimen, apertural view.
3. ***H. seideli*** (GSI Type No. 10004), lateral view.
4. ***H. seideli***, same specimen, ventral view.
5. ***H. hollandi*** Uhlig (GSI Type No. 9995), lateral view.
6. ***H. hollandi***, same specimen, apertural view.
7. ***H. hollandi***, same specimenventral view.

All are in natural size, bar represents 2 cm and X marks the beginning of body chamber.

Plate II

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	D	U	W	H
Ph	48	20	21	17
Ph	38	18	17	12

Himalayites ventricosus Uhlig [m]
(Pl. III, figs. 4-6)

Himalayites ventricosus, Uhlig, 1910, p. 145, pl.XXXVIII, figs. 4 a-d.

Material: The only specimen (GSI type no. 9991) described by Uhlig (1910).

Remarks: The shell with partially preserved body chamber is mostly internal mould. Sudden strengthening of ribs and rapid increase of the whorl width mark the beginning of body chamber. The inner whorls are less depressed (W/H= 1.1 at c. 35 mm diameter) with fine, slightly flexuous, dense ribbing and the secondary ribs are at best bifurcated. Body chamber is more depressed (W/H= 1.5 at diameter 51 mm) with strongly developed bi- or trifurcated secondary ribs with haphazardly placed intercalatories. Inner whorls are non-tuberculate or weakly tuberculate near the end-phragmocone, but robust tubercles suddenly develop at the beginning of the body chamber at 43 mm diameter. It appears that the timing of appearance of tubercles has been delayed in comparison to other species. Number of primary ribs and secondary ribs remain more or less similar at different ontogeny. Ventral furrow continues up to the preserved end. The shell is small with body chamber present. The sudden strengthening of ribs and tubercles in body chamber suggests its adulthood. Besides ribs are biplicate or triplicate. These features indicate that the present species is an adult microconch.

D		U	W	H
BC	53	20	21	19
EPh	43	19	18	16
Ph	c.35	10	12	11

Himalayites hyphasis (Blanford) [m]
(Pl. III, figs. 7-10)

Ammonites hyphasis, Blanford, 1863, p. 132, pl. IV, figs. 2, 2 a-b.
Himalayites hyphasis (Blanford), Uhlig, 1910, p. 149, pl. XXXVIII, 2 a-b, 3 a-d.

Material: The species was described by Uhlig (1903-1910) on the basis of two adult specimens. Blanford's original specimen which was described by Uhlig (1910, p. 149) designated here as lectotype (GSI type no. 9990, refigured in pl. III, figs. 9-10)

Remarks: The lectotype lacks characteristic tubercles which is a diagnostic character of *Himalayites*. It is strongly evolute (U/D = 0.46) with sharply crested primaries and bifurcating secondaries. The last quarter of the body chamber have only solitary ribs indicating its undoubted adult stage. Because of these features Uhlig himself was hesitant to include his additional specimen (Type no. 9989, see pl. III, figs. 7-8) in the present species. He wrote "It is represented by only two specimens which do not completely agree with each other".

Strong bifurcating ribbing, lack of flank tuberculation in Blandford's specimen may rather point its affinity with *Aulacosphinctes*, which is very diverse in the contemporary horizons in the Spiti area and described by Uhlig himself in the same monograph. *Aulacosphinctes* has now been considered to be the microconch of *Micracanthoceras* (Callomon, 1981).

Uhlig's additional specimen (Type no. 9989) whose original shell is preserved undoubtedly belongs to *Himalayites*, because of the fact that there is a "greater tendency to the formation of tubercles" (Uhlig, 1910, p. 149) from the inner whorls; two to three secondary ribs are present in early whorls. Beginning of the body chamber is marked by the appearance of relatively strong tubercles. It is an adult microconchiate shell with diameter is about 46mm.

H. ventricosus is also characterized by the delayed appearance of tubercles. Entire adult phragmocone is devoid of tubercles in *H. ventricosus*. In *H. hyphasis* the tubercles are very minute and Uhlig's specimen contains most of the original shell preserved. On the other hand, the Blandford's specimen is mostly internal mould and small tubercles, if present, may not be preserved. Moreover, the specimen is depressed (W/H = 1.2) in adult stage like all species of *Himalayites* and has a very shallow sulcus along the mid-venter. In *Aulacosphinctes*, species are always compressed with well-developed sulcus (see Arkell *et al.*, 1957) and it differs from *Himalayites* (m) in other features (see introduction).

We, therefore, retain these two specimens within the well distinct present species.

Type No.		D	U	W	H
9989	BC	47	22	16	15
	EPh	42	17	15	14
9990	BC	47	20	18	15
	EPh	41	19	15	13

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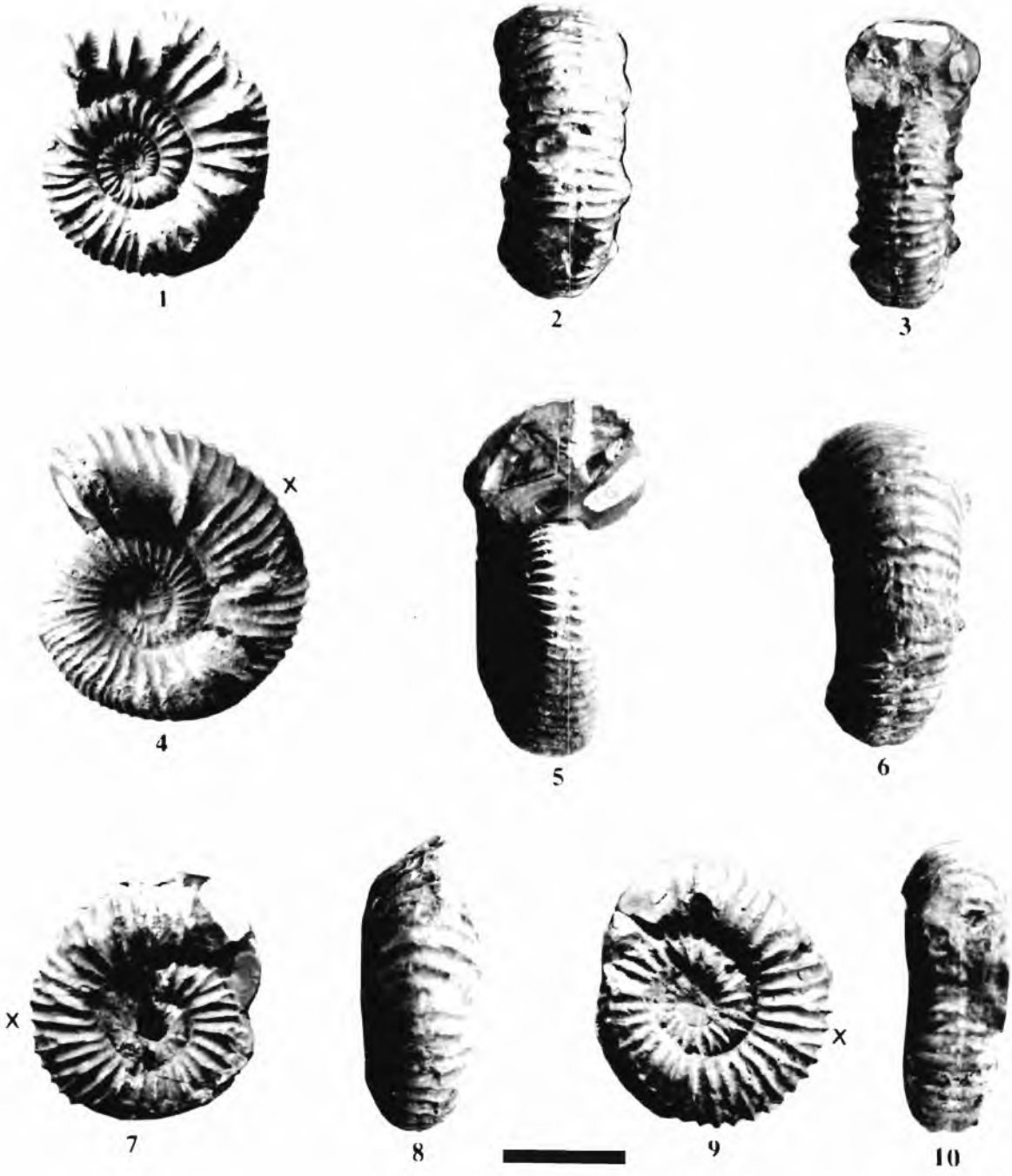
EXPLANATION OF PLATE III

1. ***Himalayites stoliczkai*** Uhlig (GSI Type No. 9988), lateral view.
2. ***H. stoliczkai***, same specimen, ventral view.
3. ***H. stoliczkai***, same specimen, apertural view.
4. ***H. ventricosus*** Uhlig (GSI Type No. 9991), lateral view.
5. ***H. ventricosus***, same specimen, apertural view.
6. ***H. ventricosus***, same specimen, ventral view.
7. ***H. hyphasis*** (Blanford) (GSI Type No. 9989), lateral view.
8. ***H. hyphasis***, same specimen, ventral view.
9. ***H. hyphasis*** (GSI Type No. 9990), lateral view.
10. ***H. hyphasis***, same specimen, ventral view.

All are in natural size, bar represents 2 cm and X marks the beginning of body chamber.

Plate III



1: Die Sudküste der Sula Inseln Taliabu und Mangoli; part 1, Grenzschichten-zwischen Jura und Kreide; part 2, Der undpunkt am oberen Lagoi auf Tailabu; part 3, Oxford des Wai Galo. *Palaeontographica*, Stuttgart, **4**(1): 1-46, pl.1-7.

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