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Vol. I, Part 1.

UPPER-TRIASSIC AND LIASSIC FAUNÆ OF THE EXOTIC  
BLOCKS OF MALLA JOHAR IN THE BHOT  
MAHALS OF KUMAON.

PLATES I TO XVI.

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# HIMÁLAYAN FOSSILS.

## VOLUME I, PART I.

### UPPER-TRIASSIC AND LIASSIC FAUNÆ OF THE EXOTIC BLOCKS OF MALLA JOHAR IN THE BHOT MAHALS OF KUMAON.

(COLLECTIONS MADE BY THE GEOLOGICAL SURVEY OF INDIA IN THE YEAR 1900.)

BY

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#### INTRODUCTION.

The following descriptions of fossils are based upon the rich collections gathered by the late Dr. A. von Krafft during his survey of the frontier district between Hundes and Malla Johar in the year 1900. They represent, for the most part, completely new material.

During the expedition of 1892, in which Griesbach, Middlemiss, and myself took part, a single fossiliferous block of red limestone was discovered near Sangcha Talla encamping-ground, at the head of the Kiogarh river. It yielded some fragments of *Jovites nov. sp. ex aff. J. bosnensis*, which, according to E. v. Mojsisovics (Palæont. Ind. ser. XV, Himálayan Fossils, Vol. III, Pt. 1, p. 18), proved the block to belong to the carnic stage of the upper tria. In 1900 Dr. A. v. Krafft made an exhaustive study of the exotic blocks in the neighbourhood of the Balchdhura. He found the upper flysch and the basic igneous rocks of the district to abound with exotic blocks, some of which yielded a large number of well-preserved fossils.

The geological results of this survey have been summarized by A. v. Krafft in a very interesting paper, forming Vol. XXXII, Pt. 3, of the Memoirs of the Geological Survey of India (Calcutta, 1902). The majority of fossiliferous blocks discovered were of permian age. They have been marked on the map accompanying Dr. v. Krafft's memoir as E. B. Nos. 9, 11, 12, 13, 15, 18, 19. The rich fauna of block No. 9 has been described in my memoir on the permian fossils from the Central Himálayas (Palæont. Ind. ser. XV, Vol. I, Pt. 5, pp. 62-100).

Besides this considerable number of exotic blocks of permian age, some fossiliferous blocks containing triassic and liassic faunæ have been recorded by A. v. Krafft. Evidence has been obtained of the representation of the following stratigraphical horizons:—

1. *Lower Trias* (E. B. No. 20 on map). A large block of a dark red, earthy limestone, thin bedded, with *Danubites nivalis* Dien., *Flemingites* sp., *Meekoceras* sp., probably homotaxial with the Hedenstrœmia beds of the main region of the Himálayas.

2. *Lower Muschelkalk*, doubtful, some badly-preserved Ammonites in a loose block (*Procladiscites* cf. *Yasoda* Dien. ?) pointing to the fauna of the Middlemiss crag in the Chitichun area.

3. *Ladinic or lower carnic stage* (E. B. No. 1). A dark red, very ferruginous limestone yielded a few specimens of *Daonella indica* Bittn.

4. *Upper carnic stage* (E. B. No. 2). From a bright red marine marble like that of the Hallstatt beds, about 1 mile to the north-west of the Balchdhura pass, a very large collection of Ammonites was obtained, most of them closely related to species characteristic of the zone of *Tropites subbullatus*. The following list of fossils, based on a cursory examination of the materials from this block, is given by A. v. Krafft on p. 143 of his memoir:—

*Cladiscites subaratus* Mojs.  
*Phylloceras Ebnerei* Mojs.  
*Juvavites (Griesbachites) Medleyanus* Stol.  
*Arcestes* div. sp.  
*Jovites* sp. ex aff. *bosnensis* Mojs.  
*Placites* sp. ind.  
*Tropites* sp. aff. *subbullatus* Hauer.  
 „ sp. aff. *acutangulus* Mojs.  
 „ sp. aff. *Barthi* Mojs.  
 „ sp. aff. *spinosus* Mojs.  
*Nautilus* sp. ind.

5. *Dachsteinkalk* (E. B. No. 8). No fossils.

6. *Lower Lias* (E. B. Nos. 4, 6, 7, 16, 17). In a very earthy, brick red, thin-bedded, nodular limestone several species of *Aricitites* and *Phylloceras* have been found. In preservation they are exactly identical with the Lias of Adneth near Salzburg in the Eastern Alps.

The faunæ representing the three horizons, 3, 4, 6, have been submitted to me for examination. They are of particular interest. The Subbullatus fauna from exotic block No. 2 is the first upper-triassic fauna obtained from a facies identical with the famous Hallstatt limestone of Austria, and differing considerably from what is seen in the main region of the sedimentary belt of the Central Himálayas. The liassic fossils from exotic blocks Nos. 16 and 17 are the first as yet recorded from India.

## I.—FOSSILS FROM EXOTIC BLOCK NO. 1 (BALCHDHURA HEIGHTS).

The fossil materials from this block available for examination are extremely scanty, consisting of two fairly well-preserved casts of *Daonella indica* Bittn. and of the fragment of a *Halobia*.

## DAONELLA INDICA Bittner. Pl. VIII, fig. 1.

1899. *Daonella indica* Bittner, Himálayan Foss. Palæontologia Ind. ser. XV, Vol. III, Pt. 2, p. 39, Pl. VII, figs. 4-11.

1900. *Daonella indica* A. v. Krafft, General Report, Geol. Surv. of India, for 1899-1900, p. 203.

1902. *Daonella indica* A. v. Krafft, Mem., Geol. Surv. of India, XXXII, Pt. 3, p. 142.

1907. *Daonella indica* Dlemer, Himál. Foss. l. c. Vol. V, Pt. 3, Pl. III, figs. 6, 7, 10.

The specimen illustrated—a right valve with fairly well-preserved sculpture—agrees in all its characters with the types of this species, which have been figured by A. Bittner. It is of very large size and scarcely inferior in its dimensions to any of the examples known from the Central Himálayas of Paínkhánda and Spiti. Its exact measurements cannot be given, the outlines of the shell being but partly accessible to examination.

There is no anterior ear developed, but the radial ribbing reaches the hinge-margin on either side of the apex almost in full strength. In accordance with the large size of the specimen the majority of secondary ribs are subdivided in the vicinity of the margins, especially so in the middle of the shell.

The ribbing is very regular, being characterized by the almost uniformly bipartite structure of ribs and furrows.

## HALOBIA sp. ind. Pl. VIII, fig. 1.

Together with the illustrated specimen of *Daonella indica* a fragmentary cast has been noticed, showing an unmistakable anterior ear, which has probably been flat and narrow. The ribs are very delicate and undulating, but are curved backward in the middle of the height of the valve. They begin near the umbo, but are rather distant and exhibit a bundle-like arrangement, which is due to a very regular intercalation of new ribs of a second and third order. The wrinkles of growth are closer set and stronger than the majority of ribs.

Among European species it is probably the group of *Halobia rarestriata* Mojs. to which the present form is most nearly allied, but its preservation is not sufficiently perfect to justify a specific determination.

## CONCLUSIONS.

As has been remarked by A. v. Krafft, no definite age can be assigned to the limestone of exotic block No. 1 with *Daonella indica*. In the Himálayas th

species is not confined to a distinct stratigraphical horizon, as had been suggested by Bittner, but is of comparatively wide stratigraphical distribution, ranging throughout the ladinic into the lower carnic stage. In Painkhánda it has its main layer in the bed with *Norella Kingi* and *Norella tibetica*, immediately overlying the *Traumatocrinus* limestone of lower carnic age, but it has also been discovered by A. v. Krafft in the thin-bedded limestone series separating the *Traumatocrinus* beds from the main layer of *Ptychites rugifer*. In the Cephalopoda-bearing limestone near the Ralphu glacier (Lissar valley) it is associated with a fauna of Ammonites which is certainly older than that of the *Traumatocrinus* limestone. In Spiti it occurs both in the *Daonella* limestone and in the *Daonella* shales, where it is associated with *Daonella Lommeli*, *Protrachyceras Archelaus*, and numerous species characteristic of the ladinic stage.

Exotic block No. 1 may therefore represent either the ladinic or lower carnic stage. The presence of a true *Halobia* is rather in favour of the latter alternative.

## II.—FAUNA OF EXOTIC BLOCK NO. 2 (BALCHDHURA HEIGHTS, ABOUT 18,000 FEET).

Among all mesozoic faunæ from the exotic blocks of Malla Johar this is by far the richest and best preserved. The specimens are in preservation exactly identical with those from the Hallstatt marble of the Roethelstein near Aussee and they are often provided with their test.

### LAMELLIBRANCHIATA.

The materials collected by A. v. Krafft are so scanty and so imperfectly preserved that it is impossible to venture on a specific identification of the single valves, none of them allowing an observation of any characters of generic importance. Another reason which renders the fragmentary examples lying before me unfit for determination is the incomplete state of our knowledge of the Lamellibranchiata of the Hallstatt limestone, *Daonella*, *Halobia*, and perhaps *Monotis*, being the only genera of the class which have been treated thoroughly by previous authors. There is only one single specimen admitting of a special description, although a more minute investigation into its relationship is impracticable on account of its incomplete state of preservation.

#### CASSIANELLA sp. ind. Pl. VIII, fig. 6.

A cast of a left valve of large size deserves mentioning on account of its similarity with Alpine representatives of the genus *Cassianella*.

It is considerably inflated, of nearly equal length and height. The central inflation of the valve exhibits a saddle-like depression in the middle, which is, however, but faintly marked and extends from the umbonal region to the ventral

margin. The strongly vaulted posterior wing is separated from the central portion of the cast by a sharp incision. Otherwise there is no interruption to the regularity of the posterior slope.

The anterior wing has, unfortunately, not been preserved. But two slight keel-like ribs are recognized along the anterior slope of the umbo. These are the only radial ribs, otherwise the sculpture of the shell, which has been partly preserved, consists of numerous and delicate concentric lines of growth. The beak is strongly incurved and with its apex shifted anteriorly. It projects above a flat area of moderate width, whose lower borders are not distinctly known.

That this specimen belongs really to the genus *Cassianella*, is very probable but not certain. The shape of the beak, the presence of an area, the plug-shaped incision in the posterior margin, and the anterior radial ribs are all structures characteristic of the genus *Cassianella*. But the entire absence of an anterior wing and of any characters of the hinge leaves a shade of doubt about our determination.

#### GASTEROPODA.

Gen. : LOXONEMA Phill.

##### LOXONEMA (POLYGIKINA) cf. ELEGANS Hoernes. Pl. I, fig. 6.

1836. *Loxonema elegans* Hoernes, Gastropoden und Acephalen der Hallstaetter Schichten, Denkschr. Kais. Akad. d. Wissensch. Wien, LX, p. 36, Taf. I, fig. 2.

1897. *Loxonema (Polygirina) elegans* Koken, Gastropoden der Trias um Hallstatt, Abhandl. K. K. Geol. Reichsanst. XVII, p. 94, Taf. XV, figs. 6, 7, 18.

Only one fragmentary specimen, consisting of the last whorl and two coils of the spire, are contained in A. v. Krafft's collections. Notwithstanding the absence of its apical portion it is more complete than the majority of the Alpine examples described by Hoernes and Koken, the typical shape of this species being only known from a combination of several fragmentary specimens.

My specimen agrees entirely with equal-sized fragments of *Loxonema elegans* from the Hallstatt limestone of Aussee. It is turreted and provided with high whorls, which are slightly convex and distinctly impressed along the suture. Their greatest transverse diameter is situated considerably below the middle of their height.

The aperture has not been entirely preserved, but the presence of a small canal at the posterior border is distinctly marked.

The shell, which has been partly preserved, is covered with delicate, falciform transverse striæ of growth. Spiral wrinkles are faintly developed.

*Remarks.*—*Loxonema elegans* is of little stratigraphical value, ranging from the carnic into the noric stage.

Gen. : SAGANA Koken.

SAGANA cf. GEOMETRICA Koken. Pl. II, fig. 3.

1897. *Sagana geometrica* Koken, Gastropoden der Trias um Hallstatt, Abhandl. K. K. Geol. Reichsanst. Bd. XVII, p. 39, Taf. VI, fig. 10.

This species is represented in A. v. Krafft's collections by a single but beautifully preserved and almost complete specimen, which differs from the typical shape of *Sagana geometrica* only by such details of ornamentation as are noticed in some of the intermediate forms between *Sagana geometrica* and *S. Hoernesii* Stur (Jahrb. K. K. Geol. Reichsanst. 1869, p. 285).

The turbinate shell consists of five whorls, which are strongly convex and inflated, especially the last one, which is separated from the umbilicus by a distinct spiral edge.

The slit band corresponds to the greatest convexity of the whorls. It is flatly concave, not broader than the rest of the bands enclosed between the numerous spiral ridges. The slit of the aperture has been entirely preserved. It is short and rounded. The numerous and sharp, closely set lunulae, which cover the slit band, run nearly parallel to the outlines of the apertural slit. Two spiral keels are counted between the keel bordering the slit band and the suture, and eight between the slit band and the umbilical edge. Thus the number of spiral keels is smaller than in the typical *Sagana geometrica*, but larger than in *S. Hoernesii*. My specimen moreover recalls the intermediate shapes connecting the two species by the height of its last volution, which is smaller than in *Sagana geometrica*.

Of the shelly substance small fragments only are accessible to examination, showing the beautiful lattice-shaped ornamentation characteristic of the genus *Sagana*. The transverse striae are very close-set and sharp, but inferior in strength to the spiral keels. The meshes, which are formed by the crossing of transverse ribs and spiral edges, are considerably higher than broad. The points, where the spiral ridges are intersected by the transverse ribs, are not marked by any tubercles as is the case in the typical *S. Hoernesii*.

#### Dimensions.

The measurements of this specimen are as follows :—

Entire length of the shell . . . . .	26.5 mm.
Greatest breadth of the shell . . . . .	23 "
Height of the last volution at the aperture . . . . .	13.5 "
Apical angle . . . . .	66°

*Remarks.*—*Sagana geometrica* is not rare in the carnic Hallstatt limestone of Aussee. *S. Hoernesii* and the intermediate shapes connecting the two species are known both from the carnic and noric stages of the Salzkammergut.



## Gen. : CAPULUS Montf.

## CAPULUS (PHRYX) JOHARENSIS nov. sp. Pl. II, fig. 4.

The distinction of fossil *Patellidæ* and *Capulidæ* is attended with great difficulty, since the characters of generic importance are but exceptionally preserved. The cup-shaped shells exhibit very little variation in form, and their systematic position is nearly always doubtful in the fossil state.

A single cast of a cup-shaped shell, in its external shape, more closely recalls the subgenus *Phryx* Blaschke (Gastropodenfauna der Pachyoordientuffe der Seiseralpe in Suedtirol, Beitræge zur Geol. und Palæont. Oesterrich-Ungarns, etc., XVII, p. 174) than any genus of *Patellidæ*. Montfort (Conchyl. système 1810, II, p. 54) gives the following diagnosis of the genus *Capulus*: "Coquille libre, univalve, en bonnet phrygien; à sommet plus ou moins aigu ou roulé, bouche entière; intérieur marqué de deux musculaires." K. v. Zittel (Handbuch der Palæozoologie II, p. 216) adds to this diagnosis, that the apex is always directed backwards and that the muscular scars take the shape of a horseshoe. Such forms of *Capulus*, which are provided with a symmetrical apex, which is neither enrolled spirally nor shifted laterally, have been distinguished from *Capulus s. s.* as *Phryx* by Blaschke, and have been elevated by this author to the rank of a proper subgenus. The only species of this subgenus hitherto known was *Phryx bilateralis* Blaschke (l. c. p. 172, Taf. XIX, fig. 9). Another triassic species, *Capulus Apollinis* Boehm (Die Gastropoden des Marmolatakalkes, Palæontographica XLII, p. 261), differs from *Phryx* by its spirally enrolled apex, which has been shifted considerably to the right.

The present shell agrees in its characters of subgeneric value with *Phryx bilateralis*, not with *Capulus Apollinis*. Its aperture is regularly elliptical, rather wide. The shell recalls by its shape a low Phrygian cap with its apex greatly removed posteriorly. The apex is neither enrolled nor twisted but contracted into a sharp and slightly incurved beak of symmetrical position. Muscular scars have not been noticed.

From *Phryx bilateralis* the present species differs by the following characters: The summit of the shell is not situated centrally, but nearly coincides with the apical beak. The apex is not elevated above the posterior margin of the aperture but removed anteriorly. The distance between the apex and the posterior shell margin is considerably larger and less strongly concave.

From all the triassic representatives of *Patellidæ*, which have been described by Boehm, Kittl, S. von Woehrmann, Koken, and Blaschke, my Himálayan species is distinguished by the curved shape of its apical beak. I therefore deemed it preferable to unite it with the subgenus *Phryx* among the family of *Capulidæ*.

Gen. : NATICOPSIS McCoy.

NATICOPSIS sp. ind. ex aff. OBVALLATÆ Koken. Pl. I, fig. 5.

In making use of the generic name *Naticopsis* McCoy for a triassic species I am not in accordance with E. Kittl, who in his monograph of the Gasteropoda of the Esino limestone (Annalen des K. K. Naturhistorischen Hofmuseums XIV, 1899, p. 25) reserves this denomination for *Natica ampliata* Phill, and its allies. But my materials are so scanty, consisting of two shells only, one of them rather incomplete, that I cannot detect such characters of distinction as might enable me to establish their generic determination with any certainty. The only internal feature which I have been able to discover is the presence of a median tooth projecting from the inner lip, which is curved and flattened. This character clearly shows that our species has nothing to do with *Natica* and its allies, but is not sufficient for its grouping among the family of *Naticopsidæ*. The most important characters for a generic distinction, namely, the reabsorption of inner walls in the earlier whorls, are not accessible to examination in my examples. As it has been customary to group under the general head of *Naticopsis* such fossil shells as externally recall *Natica*, and are not specially distinguished by some other characters, I shall keep provisionally to this denomination.

Among Alpine species the present one bears a close resemblance to *Naticopsis obvallata* (Gastropoden der Trias um Hallstatt, Abhandl. K. K. Geol. Reichsanst. XVII, p. 70, Taf. XII, fig. 5), from which it differs, however, by the insignificant depression of its sutures.

Shell globose. Spire with a pointed apex, whorls increasing rapidly. Last whorl inflated, with a regular aperture whose outline is somewhat flattened along the upper portion of the outer lip. Striæ of growth describing a curve, which is turned backwards considerably.

## CEPHALOPODA.

### AMMONOIDEA.

#### ARCESTOIDEA.

Fam. : CLADISCITIDÆ.

Gen. : CLADISCITES v. Mojsisovics.

The genus *Cladiscites* is rather richly represented in the fauna of exotic block No. 2. The majority of the specimens belong to representatives of *Cladiscites s. s.*, distinguished by the serial arrangement of their sutural elements. Two species belong to the subgenus *Hypocladiscites* (group of *Cladiscites subturnati*).

Of the subgenus *Paracladiscites* no representative is known to me, although from the triassic belt of the main region of the Himálayas a species of this subgenus (*Paracladiscites indicus*) has been described by E. v. Mojsisovics.

1. *CLADISCITES CRASSESTRIATUS* v. Mojsisovics, Pl. II, figs. 5-8; Pl. IV, figs. 1, 2, 8.

1878. *Arceutes crassestriatus* E. v. Mojsisovics, Cephalopoden der Hallstätter Kalks, Abhandl. K. Geol. Reichsanst. VI-1. p. 79, Taf. XXX, fig. 4.  
 1902. *Cladiscites crassestriatus* E. v. Mojsisovics, ibidem, Supplementbd., p. 280.

This is the most common species of the genus and, indeed, one of the leading fossils of the red limestone of exotic block No. 2. It attains considerable dimensions. My largest fragment, which has been illustrated on Pl. II, fig. 7, is yet entirely chambered. As one more volution at least must be reckoned for the body-chamber, the diameter of the adult individual cannot have been less than 150 mm. Thus the Indian types of the species are scarcely inferior in size to Alpine specimens from the Roethelstein, among which some examples, consisting of air-chambers only, have a diameter of 90 mm.

I should not have ventured on a direct identification of my Himálayan examples with the Alpine species without a personal examination of large materials from the Hallstatt limestone of jolic and tuvalic age. The most prominent features of the species have not been reproduced satisfactorily in the illustration on Pl. XXX, fig. 4, of E. v. Mojsisovics' memoir, as will be seen from a comparison with the illustration of his type-specimen on Pl. IV, fig. 9, of the present monograph. It must, however, be remarked that this type-specimen is of rather small size and that some of the specific characters of *Cladiscites crassestriatus*, especially the angular shape of the cross-section and the insignificant development of striæ on the siphonal area are less prominent than in the majority of specimens from the Hallstatt limestone. An illustration of an average-sized specimen from the *Subbullatus* beds of Aussee is given on Pl. V, fig. 5, of this memoir.

The most important distinctive feature between *Cl. crassestriatus* and other congeneric forms in the carnic stage is the presence of distinctly marked angular margins, bordering the siphonal area. The siphonal area is gently arched and separated sharply from the flat lateral parts. The width of the siphonal area is but slightly inferior to the greatest transverse diameter of the cross-section. It is only in very young stages of growth (Pl. II, fig. 8) that the marginal angles are rounded off. In later stages of development the rectangular shape of the cross-section is as distinctly marked as in *Cl. morosus* v. Mojsisovics (l. c. p. 76, Pl. XXIX, fig. 3) or in *Paracladiscites diturnus* v. Mojsisovics (l. c. p. 89, Taf. XXXI, fig. 2).

The volutions are comparatively high, the width of the shell being as a rule more than three-quarters of its length, but invariably inferior to the latter.

Another feature of specific importance is the remarkable difference in the strength of ornamentation on the ventral area and lateral parts. The striation of

the lateral parts is rather coarse, especially so in specimens of large dimensions. The ventral area is either perfectly smooth or covered with very delicate longitudinal striæ only. Examples with a siphonal striation, as distinctly marked as in the type-specimen from the Roethelstein (Pl. IV, fig. 9), are quite an exception.

*Dimensions.*

	Pl. IV, fig. 1.	Pl. II, fig. 5.
Diameter of the shell . . . . .	52 mm.	67 mm.
"    "    umbilical . . . . .	0 "	0 "
Height of the last } above the umbilical suture . . . . .	31 "	42 "
"    "    "    " } "    "    preceding whorl . . . . .	21 "	27 "
Thickness of the last volution . . . . .	25 "	34 "

*Sutures.*—The sutural line of this species was not known to E. v. Mojsisovics in 1873. I have succeeded in developing the sutures of a specimen from the Hallstatt limestone of the Roethelstein, although not in its details. The illustration represented in Pl. IV, fig. 8, is taken from one of my largest Himálayan examples. The complication of the sutural line renders its preparation extremely difficult.

In the genus *Cladiscites* *s.s.* special importance is attributed by E. v. Mojsisovics to the shape of the siphonal saddle. Three external branches are developed, besides the bipartite culminating outer branch of the dimeroïdic siphonal saddle. The arrangement of the lobes is typically serial, the lateral and auxiliary lobes standing at an equal level. The number of auxiliary lobes is not exactly known to me.

*Remarks.*—Among the species of *Cladiscites* from the triassic beds of Sicily which have been described and figured by Gemmellaro (I cefalopodi del trias superiore della parte occidentale della Sicilia, Palermo, 1904), *Cl. Ferdinandi* Gemmellaro (l. c. p. 275, Tav. XXIX, figs. 43, 44) is probably identical with the present species. The species illustrated by Gemmellaro is of small size, attaining a diameter of 26 mm. only, but it is provided with a part of its body-chamber. It recalls very strongly *Cladiscites crassestriatus*. The features of distinction enumerated by Gemmellaro, namely, the more delicate striation and the compressed shape of the lateral parts, are either insignificant or due to a misinterpretation of the unsatisfactory illustration given by E. v. Mojsisovics.

2. CLADISCITES cf. GORGIA Gemmellaro. Pl. IV, fig. 5.

1904. *Cladiscites Gorgia* Gemmellaro. I cefalopodi del Trias superiore della parte occidentale della Sicilia, p. 270, Tav. III, figs. 19, 20; XXIII, figs. 3-5.

This species shows in its external characters a great resemblance to *Cladiscites Gorgia* Gemm. from the carnic limestone of Sicily. My Himálayan examples differing from the European type in some subordinate details, the species is recorded here as *Cl. cf. Gorgia*.

All my Himálayan examples are entirely chambered but do not reach the dimensions of the largest types from Sicily. They agree best in size and shape

with the specimen illustrated on Pl. III, figs. 19, 20, by Gemmellaro. The width of the shell is either equal or inferior to the height. The specimen figured is as strongly compressed as the Sicilian types, whose dimensions have been chosen for standard by Gemmellaro. The flattened siphonal area is not marked off from the gently and regularly arched flanks by sharp margins, but passes into them more gradually than in *Cl. crassestriatus*. The umbilicus is closed, as in the majority of congeneric species.

The ornamentation recalls *Cl. crassestriatus* by the faint development of spiral striæ in the siphonal region. Transverse striæ of growth have not been noticed in any of my specimens, whereas such have been mentioned in the diagnosis of the Mediterranean species by Gemmellaro.

#### Dimensions.

Diameter of the shell . . . . .	49 mm.
" " " umbilicus . . . . .	0 "
Height of the last { above the umbilical suture . . . . .	29 "
{ " " preceding whorl . . . . .	14 "
Thickness of the last volution . . . . .	26 "

*Sutures*.—I have succeeded in chiseling out the inner nucleus of a large specimen, which shows the sutural line fairly well. It agrees very closely with the sutures of *Cl. Gorgia*, as illustrated by Gemmellaro on Pl. XXIII, fig. 5.

There are from seven to eight saddles counted from the umbilical suture to the middle of the siphonal area. Their stems and branches are thinner than in the majority of congeneric species, perhaps, even a little more robust than in the Sicilian type-specimen of *Cl. Gorgia*. All saddles are distinctly dimeroidic. In the main saddle each portion of the dimeroidic top is again subdivided into two smaller secondary phylla. The arrangement of lobes and saddles is typically serial. The siphonal lobe is the deepest. The lateral lobes show a tripartite arrangement of their basal branches.

### 3. CLADISCITES cf. PUSILLUS v. Mojsisovics. Pl. IV, figs. 6, 7.

1873. *Arcestes pusillus* E. v. Mojsisovics, Cephelopöden der Hallstätter Kalk'e, Abhandl. K. K. Geo. Reichsanst. VI-1, p. 77, Taf. XXVIII, fig. 4.

1902. *Cladiscites pusillus* E. v. Mojsisovics, *ibidem*, Supplementbd., p. 281.

Having E. v. Mojsisovics' type-specimens of *Cladiscites crassestriatus*, *Cl. pusillus* and *Cl. striatissimus* at hand for comparison, I find their distinction from each other and from *Cl. Gorgia* Gemm. a difficult matter. All of them are certainly most nearly allied and differ by very subordinate details only.

The type-specimen of *Cladiscites pusillus* from the *Ellipticus* beds of the Roethelstein is a small Ammonite of 24 mm. in diameter (not 28, as has been stated by E. v. Mojsisovics). Its cross-section is of nearly equal height and width. The lateral parts are very gently arched. The demarcation between them and the flat siphonal area is not so sharp as in *Cl. crassestriatus*, but a little sharper than

in *Cl. Gorgia*. The only distinction which I can find in the ornamentation is confined to the very delicate striation of the lateral and siphonal parts. The latter is not smooth as in the majority of examples of *Cl. crassestriatus*. An equally delicate striation is found in *Cl. striatissimus* v. Mojsisovics (l. c. p. 77, Taf. XXX, fig. 1), but this species is more strongly inflated, and the ventral area is considerably less broad than the largest transverse diameter of the shell.

With the type-specimen of *Cl. pusillus* some Himálayan representatives of *Cladiscites* agree very well in their external shape and sculpture. Both the flanks and siphonal part are covered with numerous and thin concentric striæ. Their transverse section is less distinctly angular than in *Cl. crassestriatus*, but in this respect transitional shapes between the two species are known to me.

#### Dimensions.

	E. v. Mojsisovics' type-specimen (Pl. XXVIII, fig. 4).	Himálayan specimen (Pl. IV, fig. 7).
Diameter of the shell . . . . .	24 mm.	27 mm.
" " " umbilicus . . . . .	0 "	0 "
Height of the last { above the umbilical suture	. . . . . 14 "	15 "
" " " " { " " preceding whorl	. . . . . 7 "	7 "
Thickness of the last volution . . . . .	14 "	16 "

*Sutures*.—Not known in detail.

#### 4. CLADISCITES sp. ind. cf. CORACIS, Gemm. Pl. V, fig. 4.

A single, imperfectly preserved specimen of a large *Cladiscites* is mentioned here on account of its resemblance to *Cl. Coracis* Gemmellaro (I cefalopodi del Trias superiore della regione occidentale della Sicilia, p. 273, Tav. XXII, fig. 7; XXIII, figs. 1, 2) from the carnic limestone of Sicily. It is strongly compressed, high-mouthed and considerably higher than broad. The lateral parts are regularly although gently arched. Their greatest transverse diameter is situated below the middle of the height. They unite with the flattened siphonal area without forming a sharp angle. The concentric striation is coarse and not restricted to the lateral parts, as in *Cl. crassestriatus*.

The affinity with *Cl. Coracis* shows itself in the shape of the cross-section and in the strong compression of the whorls. From *Hypocladiscites subornatus* and its allies, which are also provided with strongly compressed volutions, our species is distinguished by its flat siphonal area and by its more distinctly defined lateral margins.

#### Dimensions.

Diameter of the shell . . . . .	89 mm.
" " " umbilicus . . . . .	0 "
Height of the last { above the umbilical suture	. . . . . 53 "
" " " " { " " preceding whorl	. . . . . 35 "
Thickness of the last volution . . . . .	39 "

*Remarks.*—The specimen has been referred provisionally to *Cladiscites Coracis* as *sp. ind.*, but its possible connection with the subgenus *Hypocladiscites* cannot be excluded, the sutural line being entirely unknown.

Subgen. : *HYPOCLADISCITES* v. Mojs.

5. *HYPOCLADISCITES SUBCARINATUS* Gemmellaro. Pl. IV, fig. 4.

1904. *Hypocladiscites subcarinatus* Gemmellaro, I cefalopodi del Trias superiore della regione occidentale della Sicilia, p. 279, Tav. XXII, figs. 8-11; XXV, fig. 21; XXVI, figs. 1, 2.

This species of the upper carnic limestone of Sicily is represented in A. v. Krafft's collections by numerous and well-preserved specimens which permit of an accurate determination. The largest of my Himálayan examples, which consists of air-chambers only, has been chosen for illustration.

In its general shape this species recalls *Cladiscites crassestriatus* v. Mojsisovics, especially in the rectangular outlines of its cross-section, but in the character of its siphonal area it is at a glance distinguished from all congeneric forms. The siphonal area is slightly excavated, forming a shallow depression, which is interrupted in the middle by a low and rounded keel. The two marginal elevations separating the depressed siphonal area from the lateral parts are higher than the median keel and more broadly rounded. The lateral parts are very gently arched. Their greatest transverse diameter is situated in the umbilical region.

Both the median keel and the rounded marginal elevations are developed at very early stages of growth. I have seen them clearly marked in a chambered nucleus attaining a diameter of 10 mm. only. Thus a determination of this species is even possible if inner nuclei of small size only are available for examination.

The lateral parts are covered with numerous and delicate longitudinal striæ. On the siphonal area those striæ are still more delicate and are gradually obliterated in the direction towards the median keel, which remains free from any sculpture. Transverse striæ or folds, as noticed by Gemmellaro in a minority of his Sicilian specimens, are entirely absent.

The strongly inflated variety which has been mentioned as *Hypocladiscites nov. form. ind. prox. H. subcarinato* by Gemmellaro (l. c. p. 280, Tav. XXII, figs. 12, 13) is not represented among my Himálayan materials.

*Dimensions.*

Diameter of the shell	. . . . .	37 mm.
" " " umbilicus	. . . . .	0 "
Height of the last	} above the umbilical suture	. . . . . 22.5 "
volution		
Thickness of the last volution	. . . . .	16 "

*Sutures.*—Not known in detail, but in their general arrangement agreeing with the illustration on Tav. XXV, fig. 21, of Gemmellaro's memoir. The second lateral lobe is considerably deeper than the following lobes.

6. *HYPOCLADISCITES SUBARATUS* v. Mojsisovics. Pl. IV, fig. 3.

1895. *Cladiscites* cf. *subornatus* E. v. Mojsisovics in Diener, Ergebnisse einer geologischen Expedition in den Central-Himalaya, etc., Denkschr. Kais. Akad. d. Wissensch. LXII, p. 564.  
 1896. *Cladiscites* (*Hypocladiscites*) *subaratus* E. v. Mojsisovics, Obertriadische Cephalopodenfaunen des Himalaya, Denkschr. Kais. Akad. d. Wiss. LXIII, p. 657, Taf. XX, fig. 2.  
 1899. *Cladiscites* (*Hypocladiscites*) *subaratus* E. v. Mojsisovics, Palaeont. Ind. ser. XV. Himālayan Foss., Vol. III, Pt. 1, p. 102, Pl. XX, fig. 2.

A species of *Hypocladiscites* from the carnic Daonella beds of Lauka, which in its outward shape agrees very closely with *H. subornatus*, has been separated from this Alpine form by E. v. Mojsisovics, on account of some differences in its sutural line.

Some fragments of high-mouthed and strongly compressed *Cladiscitidæ* in A. v. Kraft's collection must be united with *Hypocladiscites subaratus*. The close agreement of the sutures will be recognized by comparing the illustrations. In my specimen the principal lateral saddle is still higher and broader, and is provided with more richly serrated lateral branches than in the type illustrated by E. v. Mojsisovics. Thus the features of distinction between *H. subornatus* and *H. subaratus* are still more strongly marked in the present example than in the specimen from the Daonella beds of Lauka.

Fam. : *ARCESTIDÆ*.

Gen. : *ARCESTES*, Succs.

7. *ARCESTES* cf. *PERIOLCUS*, v. Mojs. Pl. III, fig. 1.

1873. *Arcestes periolcus* E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-1, p. 109, Taf. L, figs. 1-3; LII, figs. 4, 6; LIII, fig. 27.

My type-specimen is of large size, nearly complete, and has its peristome entirely preserved. It recalls most closely the Alpine *Arcestes periolcus*, both in its general outlines and in the development of a spiral sulcus surrounding the widely open umbilicus.

Of the penultimate whorl a small portion only is accessible to examination. It is globose, regularly rounded, smooth and without any constrictions or varices. The last whorl changes its shape in a manner agreeing with that in *A. periolcus*. The greatest width of the flattened siphonal area corresponds to the peristome, whereas it is most strongly compressed in the opposite middle portion of the whorl. The lateral parts are flattened. The umbilical wall is vertical and separated from the adjoining parts of the flanks by a raised marginal band, which is bordered externally by a shallow spiral sulcus. This sulcus is lower than in the majority of Alpine specimens, which have been united in this species by E. v. Mojsisovics.



The apertural margin is strongly contracted in the middle, and protracted into two lateral lappets in the siphonal region. This is the normal shape of the peristome in the group of *Arcestes coloni*.

The shell is nearly smooth. It is only in the vicinity of the peristome that delicate striæ of growth are developed, following in their direction the outlines of the apertural margin.

Traces of transitorial paulostomes, as have been noticed by E. v. Mojsisovics in some of his European examples, are altogether absent.

*Dimensions.*

Diameter of the shell . . . . .	.	.	.	.	80 mm.
" " " umbilicus . . . . .	.	.	.	.	6 "
Height } of the last volution	.	.	.	.	42 "
Thickness }	.	.	.	.	32 "

*Sutures.*—Not known.

2. *ARCESTES* OF *RICHTHOFFENI* V. MOJSISOVICS. Pl. III, fig. 2.

1873. *Arcestes Richthofeni* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalker, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 132, Taf. XLIX, figs. 4, 5; I. III, fig. 18.

The only specimen available for investigation is a nearly complete cast, with its peristome almost entirely preserved and with large portions of the shelly substance adhering. It recalls very strongly the European *Arcestes Richthofeni* from the julec stage of the carnic Hallstatt limestone.

The apertural margin, although partly injured, is sufficiently well preserved to indicate the absence of any emargination along the broadly flattened siphonal area as is noticed in the majority of *Arcestidae*. In this character it agrees exactly with the apertural margin of *A. Richthofeni* and *A. agnatus*. Peristome contracted laterally; umbilicus narrow, but open, not closed by any callosity. Siphonal area flattened in the vicinity of the peristome, but sharply rounded and narrow in the opposite quadrant of the last volution.

E. v. Mojsisovics noticed in one of his specimens an internal siphonal ridge, which was, however, restricted to the quadrant of the volution bordering the aperture. This internal siphonal ridge is clearly developed in my specimen, as is obvious from the illustration. Where the shelly substance has been preserved, its surface is perfectly smooth, but in the cast a deep impression of rectangular cross-section follows the median line of the siphonal part, marking the presence of an internal ridge. This ridge was probably intended to protect the siphuncle, which is situated more internally. Similar internal ridges have been described in *Phylloceras uermæsense* Herb. by Wachner (Beitraege zur Palæontologie Oesterreich-Ungarns und des Orients, Bd. XI, p. 176). Casts of this species, in which a deep impression marks the place of the original shelly ridge, have been described as *Phylloceras aulonotum* by Herbich (Das Szeklerland, Mitteil. aus dem Jahrb. der Kgl. ungar. geol. Anstalt, Bd. V, p. 115).

*Dimensions.*

Diameter of the shell . . . . .	55 mm.
" " " umbilicus . . . . .	2.6 "
Height of the last (above the umbilical suture . . . . .	2.5 "
volution { " " preceding whorl . . . . .	9 "
Thickness of the last volution . . . . .	21.6 "

*Sutures.*—Not known.

3. *ARCESTES* sp. ind. aff. *DECIPIENS* v. Mojs. Pl. VIII, fig. 3.

A single nucleus, consisting of air-chambers only, most probably is related to *Arcestes decipiens* from the tuvalic substage of the Hallstatt limestone.

It agrees with this species in the presence of a very narrow umbilicus and remarkably strong constrictions. The greatest transverse diameter coincides with the rounded-off siphonal margin, from which the lateral parts converge very gradually towards the umbilicus.

The only difference between the Alpine and Himálayan forms consists in the direction of the strong constrictions, which in my specimen are not turned backwards in crossing the siphonal area, as they are in *Arcestes decipiens* E. v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, l. c. VI-1, p. 133, Taf. LIV, figs. 2, 3).

*Dimensions.*

Diameter of the shell . . . . .	24 mm.
" " " umbilicus . . . . .	ca. 1 "
Height } of the last volution . . . . .	{ 13 "
Thickness } . . . . .	{ 12 "

*Sutures.*—Not known.

4. *ARCESTES* cf. *PLACENTA* v. Mojs. Pl. IX, fig. 1.

1873. *Arcestes placenta* E. v. Mojsisovics, Cephalopoden der Hallstaetter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-1, p. 106, Taf. LV, figs. 2-7.

A single but nearly complete specimen of *Arcestes* recalls very closely *A. placenta* v. Mojs. from the tuvalic Hallstatt limestone of Aussee. It is of larger size than full-grown European examples, but agrees with them in all characters of specific importance as far as such are accessible to examination.

The whorls are moderately compressed and provided with flatly arched lateral parts. The umbilicus is small but not closed. Siphonal part broadly rounded in the vicinity of the aperture and in the corresponding quadrant of the last volution, but the difference in width between this and the opposite quadrant is not considerable. Peristome slightly emarginated along the siphonal area but not contracted along the lateral parts.

There are also some Alpine specimens in the collection of the K. K. Geologische Reichsanstalt in Vienna, in which this lateral contraction of the peristome is almost insignificant.

*Dimensions.*

Diameter of the shell . . . . .	65 mm.
" " " umbilicus . . . . .	1.5 "
Height of the last { above the umbilical suture . . . . .	34 "
{ " " preceding whorl . . . . .	11 "
Thickness of the last volution . . . . .	31 "

*Sutures.*—Not known.

Subgen. : *PROARCESTES* v. Mojs.

1. *PROARCESTES GAYTANI*, v. Klipstein. Pl. III, figs. 3, 4, 5, 7, 8.

1845. *Ammonites Gaytani* v. Klipstein, Beiträge zur geologischen Kenntniss der oestlichen Alpen, p. 110, Taf. V, fig. 4.
1847. *Ammonites Gaytani* F. v. Hauer, Neue Cephalopoden von Aussee, Haidingers Naturwissenschaftl. Abhandl. I, p. 267.
1849. *Ammonites Gaytani* F. v. Hauer, Neue Cephalopoden von Hallstatt und Aussee, ibid, III, p. 17, Taf. IV, figs. 13, 14.
1869. *Arcestes Gaytani* Laube, Fauna der Schichten von St. Cassian, Denkschr. Kais. Akad. d. Wissensch. math. nat. Cl. XXX, Bd. p. 89, Taf. XLIII, fig. 5.
1873. *Arcestes Gaytani* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-1, p. 100, Taf. LVIII, figs. 1—3.
1902. *Proarcestes Gaytani* E. v. Mojsisovics, ibidem, Supplementbd., p. 259.
1906. *Proarcestes Gaytani* G. v. Arthaber, Die alpine Trias des Mediterrangebietes, Letzba mesozoica I, Taf. XLIV, fig. 3.
1906. *Proarcestes cf. Gaytani* Diener, Fauna of the Tropites limestone of Byans, Palæont. Ind. ser. XV, Vol. V, Pt. 1, p. 177, Pl. XII, figs. 10, 11.

It is this well-known species of the jülic substage to which a considerable number of *Arcestidæ* in A. v. Krafft's collections can be safely assigned. The character of the sutural line is that which is peculiar to the group of *Arcestes bicarinati*, and which is distinguished by the presence of a moderately high and richly serrated median prominence. From *Proarcestes bicarinatus* Münster and from *P. Ausseanus* v. Hauer our species differs remarkably by its less globose shape and by the faint development of varices. On the other hand the majority of specimens agrees very closely with *P. Gaytani*.

In some of them, it is true, the flattening of the lateral parts is less strongly marked than in typical shapes of *P. Gaytani*. This is especially the case with inner volutions, exactly as in the examples from the Tropites limestone of Byans, which have been referred to the present species as *cf.* in Himál. Foss., Vol. V, Pt. 1. The specimen illustrated in fig. 4 affords a good instance of this character. In the penultimate whorl, which consists of air-chambers only, the lateral parts are almost regularly rounded, describing a graceful and uninterrupted curve from the siphonal convexity to the rounded-off umbilical margin. In the last volution, however, which has been partly preserved, the lateral parts are high, compressed

and flattened as distinctly as in full-grown individuals from the carnic Hallstatt limestone of the Salzkammergut. This specimen is scarcely inferior in size to the largest European examples which have been noticed by E. v. Mojsisovics.

The umbilicus is widely open, both in chambered nuclei and in specimens provided with their body-chambers. Constrictions on varices are but faintly marked, confined to inner nuclei and often entirely absent. No constriction has been noticed in the example illustrated in fig. 5, whereas in the two nuclei, illustrated in figs. 7 and 8, two varices are counted within the circumference of the last whorl. Their direction is nearly straight with a convexity slightly turned forward in the siphonal area.

*Dimensions.*—The measurements of my largest specimen (fig. 4), with a portion of its body-chamber preserved, are as follows:—

Diameter of the shell . . . . .	ab. 86 mm.
" " umbilicus . . . . .	8 "
Height of the gap above the umbilical suture . . . . .	46 "
last volution } " " preceding whorl . . . . .	15 "
Thickness of the last volution . . . . .	44 "
Height } of the penultimate whorl . . . . .	32 "
Thickness } . . . . .	38 "

*Sutures.*—Agreeing entirely with those of the Alpine types of *P. Gaytani*.

## 2. PROARCESTES sp. cf. AUSSEANUS v. Hauer. Pl. III, fig. 6.

The comparatively high and serrated median prominence of the siphonal lobe proves this species to be a representative of the group of *Arcestes bicarinati*.

The only specimen available for examination is an inner nucleus with part of the last volution adhering, which is yet entirely chambered. It shows three constrictions, which are narrow and faintly developed, as in inner nuclei of *Arcestes Ausseanus* v. Hauer (Haidingers Naturwissenschaftl. Abhandl. I, p. 268, Taf. VIII, figs. 6-8). From typical shapes of *Proarcestes Ausseanus*, as illustrated by E. v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-1, Taf. LI, figs. 1, 4) my specimen differs by its less globose shape, although its height is yet considerably inferior to its thickness.

### *Dimensions* (of the nucleus).

Diameter of the shell . . . . .	39 mm.
" " umbilicus . . . . .	3 "
Height } of the last volution . . . . .	23 "
Thickness } . . . . .	29 "

*Sutures.*—Agreeing entirely with those of *Proarcestes Ausseanus*. The principal lateral lobe is situated on the convexity, by which the siphonal area passes into the lateral parts. Two auxiliary lobes outside the umbilical margin.

*Remarks.*—My scanty materials do not allow one to decide the question of specific identity or close affinity of the Himalayan shell with the European *P. Ausseanus*.

*PROARCESTES* (?) sp. ind. ex aff. *BARRANDEI* Laube. Pl. VIII. fig. 5.

The systematic position of the only specimen available for examination is somewhat doubtful. It is only on account of its external similarity with *Arcestes Barrandei* Laube (Die Fauna der Schichten von St. Cassian, Denkschr. Kais. Akad. d. Wissensch. Bd. XXX, 1869, 5. Abt. p. 90, Taf. XLIII, fig. 2) that I have united it with *Proarcestes*, not with *Arcestes s. s.* It must, however, be borne in mind, that not even the connection of *Arcestes Barrandei* itself with the group of *Arcestes extralabiati* (*Proarcestes*) has been ascertained by E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke l. c. VI-1, p. 91), although the sutures exhibit some characters peculiar to this group.

In its general shape my specimen agrees with *Proarcestes Barrandei*, especially so in the outlines of its transverse section, but it differs remarkably by the presence of a large and widely open, funnel-shaped umbilicus. The inner volutions are globose and strongly inflated, the place of greatest inflation corresponding to the rounded umbilical margin. In the last whorl, which apparently belongs to the body-chamber, the regularly rounded siphonal part becomes considerably narrower, the transverse section thus assuming a cordiform shape. No traces of furrows are noticed on the body-chamber volution preceding the aperture, but a shallow contraction is marked on the cast of the penultimate whorl.

*Dimensions.*

Diameter of the shell . . . . .		57 mm.
"    "    umbilicus . . . . .		9 "
Height } of the last volution . . . . .		39 "
Thickness }		31 "

*Sutures.*—As far as known, agreeing with those of *P. Barrandei*. Median prominence moderately high and laced at its base by converging digitations of the siphonal lobe. Siphonal saddle not perfectly symmetrical, but with larger external branches. Number of auxiliary lobes not known exactly.

*PROARCESTES* sp. ind. (GROUP OF *EXTRALABIATI*). Pl. VIII, fig. 4.

Among the *Arcestidæ* from exotic block No. 2 a species belonging to the group of *extralabiati* is rather richly represented, although by incomplete specimens only. In none of them has the body-chamber been entirely preserved, nor have I succeeded in developing the sutural line. The relation of this species is therefore based on its external features only, exactly as in the case of *P. Danai* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, l. c. VI-1, p. 93, Taf. LVII, fig. 4), to which species it appears to be most nearly allied.

In the specimen illustrated, the inner nucleus is globose with siphonal and lateral parts regularly rounded. In the last volution the lateral parts are flatly arched and marked off indistinctly from the broad and flattened siphonal area. No constrictions or varices have been noticed on the inner volutions as far as they

have been exposed, but, near the aperture, the shallow furrows and folds characteristic of the group of *Arcestes extralabiati* make their appearance. In a second specimen these furrows are even more strongly marked and deeper than in the present one, but their exact number is not known to me, the body-chamber being incomplete in all the examples available for examination.

From *Proarcestes Danai* our species is distinguished by its more slowly increasing whorls and by its narrower umbilicus.

*Dimensions.*

Diameter of the shell . . . . .			cca. 67 mm.
" " umbilicus . . . . .			" " 3 "
Height of the { above the umbilical suture			" " 29 "
last volution { " " preceding whorl			" " 7 "
Thickness of the last volution . . . . .			" " 30 "

*Sutures.*—Not known.

PINACOCERATITOIDEA.

Fam. : *LYTOCERATIDÆ.*

Gen. : *PHYLLOCERAS* Suess.

Subgen. : *DISCOPHYLLITES* Hyatt.

There is much discrepancy of opinion among different authors as to the range and interpretation of the subgenem of the genus *Phylloceras* Suess. The majority of triassic species have hitherto been grouped with the subgenus *Rhacophyllites* v. Zittel, but there are strong reasons against the correctness of this grouping, which seems to be at variance with the circumscription of *Rhacophyllites*, introduced in the memoirs on liassic cephalopod faunæ.

K. v. Zittel (Handbuch der Palæontologie II, p. 439) proposed the new subgenus (or genus) *Rhacophyllites* for the accommodation of such species of *Phylloceras* as are distinguished by wide umbilici, by a steep umbilical slope, and by a smaller number of auxiliary lobes than are noticed in typical shapes of *Phylloceras*. In this interpretation, *Rhacophyllites* comprises species of triassic, liassic and even jurassic age (*Phyll. tortiaulcatum* d'Orb.) and is not at all identical with a group of *Phylloceras* for which E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X, p. 151) had claimed a special systematic position, chiefly on account of its body-chamber differing materially from the chambered portion of the shell, and on account of a special arrangement of the auxiliary series, which is united into a sloping suspensive lobe.

Geyer in his valuable memoir on the liassic Cephalopoda of the Hierlatz near Hallstatt (Abhandl. K. K. Geol. Reichsanst. XII, p. 223) agrees with E. v. Mojsisovics in attributing a paramount importance to the character of the body-chamber

and sutural line, and not to the widely umbilicated shape of the whorls. According to his view special stress ought to be laid on the difference in the terminal phylla of the saddles, which are regularly oval in *Phylloceras*, conically elongated or club-shaped in *Rhacophyllites*, and on the position of the branches which in *Rhacophyllites* never produce an angular geniculation of the stems of the main saddles, as is commonly noticed in typical species of *Phylloceras*.

This interpretation of *Rhacophyllites* would make v. Zittel's subgenus include *Phylloceras psilomorphum* Neum. or *Ph. planispira* Reyn. but would peremptorily exclude triassic species of the groups of *Ammonites debilis* v. Hauer or *Ammonites neojurensis* Quenst.

In his memoir on the liassic Cephalopoda of the Schafberg (Abhandl. K. K. Geol. Reichsanst. XV, p. 74) Geyer does not any longer insist on differences in the shape of the phylla, but considers the presence of an abnormal body-chamber and of a suspensive lobe as the only distinctive features on which a generic separation of *Rhacophyllites* and of widely umbilicated species of *Phylloceras* s. s. ought to be based.

Wæhner in his "Beitraege zur Kenntnis der tieferen Zonen des unteren Lias in den nordoestlichen Alpen" (Beitraege zur Palæontologie Oesterreich-Ungarns, etc., XI, Bd. p. 173) is altogether averse to a generic separation of *Phylloceras* and *Rhacophyllites*. According to his observations the widely umbilicated shapes allied to *Phylloceras stella*, which might be considered as descendants from triassic *Phylloceratidæ*, are most intimately connected in the lower lias with narrowly umbilicated species agreeing with the typical forms of *Phylloceras*, no important characters of difference affording any clue for their generic distinction.

In the palæontological works of E. v. Mojsisovics three different views have been taken regarding the classification of triassic species of *Phylloceras*. In 1882 (l. c. p. 151) this learned author advocated the generic separation of *Ammonites eximius* v. Hauer and of *A. lariensis* Menegh. from *Phylloceras* on account of their abnormally shaped body-chambers. In this new genus *A. rakosensis* Herbich, *A. transsylvanicus* Herbich, and *A. mimatensis* d'Orb. should be included, with *A. eximius* as prototype, but the majority of triassic species ought to be left with *Phylloceras* s. s. In the description of the upper triassic Cephalopoda of the Himálayas (Pal. Ind. ser. XV, Himál. Foss., Vol., III, Pt. 1, p. 114) the triassic forms which are grouped round *Phylloceras neojurensis* and had been assigned to *Rhacophyllites* by Zittel and Steinmann are explicitly considered as direct ancestors of the liassic *Phylloceratidæ* and as true representatives of the genus *Phylloceras*.

"*Phylloceras neojurensis* and its contemporaries from the same group"—E. v. Mojsisovics remarks—"are distinguished from the typical representatives of the genus *Phylloceras*, as, for instance, from *Ph. heterophyllum*, only by the wider umbilicus and by the smaller number of auxiliary saddles, connected with the lesser degree of involution. Out of the evolute species of *Phylloceras* are developed on the one hand the strongly involute typical species of *Phylloceras* of

the Jura, and on the other hand the subgenus *Rhacophyllites* Zittel, which is distinguished by inclined auxiliary lobes and a variable body-chamber and is confined to the lias."

From this diagnosis it is evident that E. v. Mojsisovics has adopted the subgenus *Rhacophyllites* in a much narrower circumscription than it had been established originally by K. von Zittel and that in 1899 none of the triassic species of *Phylloceras* were by himself considered referable to this subgenus. It must, however, be remarked that one triassic species at least, *Phylloceras occultum* v. Mojs. (Abhandl. K. K. Geol. Reichsanst. VI-1, p. 38, Taf. XVI, figs. 3-6), must be included in the subgenus *Rhacophyllites*, even if the latter is taken in the narrower circumscription, as is evident from the shape of its body-chamber, differing from the chambered whorls by the development of broad transverse plications.

In 1902 E. v. Mojsisovics entirely abandoned his former view and adopted *Rhacophyllites* in the original circumscription proposed by v. Zittel. In the supplement to the Cephalopoda of the Hallstatt limestone (Abhandl. K. K. Geol. Reichsanst. VI-1, Supplem. p. 317) he states the practical advantages of retaining the name of *Rhacophyllites* for all the widely umbilicated *Phylloceratidæ* of triassic age, which K. von Zittel himself had enumerated among the leading types of his new subgenus.

It is to these triassic types of the genus *Phylloceras*, as *Ph. neojuvensis* Quenst., not to the liassic species of *Rhacophyllites*, that the Himálayan form, which I am going to describe, is most nearly allied. If we accept the subgeneric designation of *Rhacophyllites* for this species, it would mean a contradiction of the majority of authors dealing with liassic ammonites, who in their memoirs have accepted *Rhacophyllites* in the narrow interpretation proposed by Geyer. If we wish to choose a proper subgeneric name for the widely umbilicated *Phyllocerata* of triassic age, we must make use of the name *Discophyllites*, which has been proposed by Hyatt for the group of *Phylloceras patens* (Zittel's Text-book of Palæontology, Vol. II, p. 566).

No diagnosis of *Discophyllites* had been given by Hyatt, who was content with fixing the prototype of his new subgenus. E. v. Mojsisovics (Cephalopoden Hallstaetter Kalke l. c. VI-1, p. 318) restricted the name to such types as he considered to be transitional shapes between *Monophyllites* and *Phylloceras* (or *Rhacophyllites* in the wider interpretation). But in including *Phylloceras Ebneri* v. Mojsisovics (Himálayan Foss. l. c. Vol. III, Pt. 1, p. 116, Pl. XIX, fig. 6) among them, he was misled by an erroneous reconstruction of the sutures of the strongly weathered type-specimen of *Phylloceras Ebneri* from the *Daonella* beds of Lauka. As I have shown in my memoir on the fauna of the Tropites limestone of Byaus (Himál. Foss. l. c. Vol. V, Pt. 1, p. 173), the sutural line of excellently preserved examples from Kalapani and Lilinthi exhibits a distinctly diphylic development of the siphonal and a rich foliation of the principal lateral saddles. It is only in the second lateral saddle that the monophyllic plan is still clearly marked. Thus



this species is, indeed, a transitional shape connecting *Discophyllites patens* most intimately with the rest of the widely umbilicated *Phylloceratidæ* of triassic age.

We should not be in contradiction with Hyatt's views in uniting all triassic *Phyllocerata* with *Ph. patens* in the subgenus *Discophyllites*, all these forms being linked together very closely and differing among each other by features of specific value only. In this narrow interpretation both *Discophyllites* and *Rhacophyllites* would comprise well-defined groups of subgeneric rank. A third group of widely umbilicated *Phyllocerata* of liassic age corresponds to Hyatt's subgenus *Schistophylloceras*.

*DISCOPHYLLITES FLOWERI* nov. sp. Pl. VIII, fig. 2; IX, fig. 2.

An examination of extensive materials of this species has convinced me that it must be separated from the European *Discophyllites neojurensis* Quenstedt (Cephalopoden, p. 255, Taf. XIX, fig. 8) on account of some subordinate but constant features.

In its external shape one of the most remarkable characters of *Discophyllites Floweri* is the considerable height of the whorls. In *D. neojurensis* the height and width of the volutions are nearly equal. Among my materials, consisting of more than twenty individuals, there is not a single one in which the proportion of the height and thickness were not conspicuously in favour of the first dimension. This remark applies equally to smaller and larger examples. In this character our Himálayan species more strongly recalls *Discophyllites Ebneri* Mojs. than *D. neojurensis*, with which it otherwise agrees in all the rest of the external features.

Subordinate differences are also exhibited in the arrangement of the sutural line. The general structure of the sutures is the same in both species, and a close examination of their details is needed for observing the points of difference.

All the main saddles are distinctly diphyllic, exactly as in *D. neojurensis*. The illustrations of the sutural line of the latter species, as reproduced by E. v. Mojsisovics (Cephalopoden der Hallstaetter Kalke VI, Supplement. Taf. XXIII, figs. 2, 3) after Quenstedt and F. v. Hauer, show the constancy of all the characters of importance, notwithstanding a certain individual variability in some minor details. From a comparison of these illustrations with the sutures of *D. Floweri* the following differences are evident:—

In *D. neojurensis* the saddles are more richly serrated, the terminal phylla of the saddles are more slender and elongated, the stems are very narrow, especially near the base. In the main saddles of *D. Floweri* the base is broad and the terminal leaves are very large, recalling in this respect *D. Zitteli* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, l. c. VI-1, p. 318, Taf. XVII, figs. 3, 4). Of the two terminal leaves in the siphonal saddle the internal one is decidedly the lower in *D. neojurensis*, whereas it is the higher one in *D. Floweri*. There are three

auxiliary lobes present in the Himálayan species, the third one being divided by the umbilical suture. They slope obliquely towards the umbilical suture, but are not united into a suspensive lobe, as in typical species of the subgenus *Rhacophyllites* Zittel.

*Dimensions.*

	Pl. VIII, fig. 2.	Pl. IX, fig. 2.
Diameter of the shell . . . . .	76 mm.	ab. 52 mm.
"    "    "    umbilicus . . . . .	24 "	16 "
Height of the { above the umbilical suture . . . . .	36 "	23 "
last volution { "    "    preceding whorl . . . . .	ab. 29 "	18 "
Thickness of the last volution . . . . .	25 "	17 "

*Remarks.*—With the exception only of the higher and more strongly compressed whorls and of the bulky shape of the phylloid saddles in the sutural line, I could not detect any characters among the congeneric forms of the Alpine trias in which this species differs from *Discophyllites neojurensis*.

*Discophyllites Zitteli* v. Mojs. from the carnic Hallstatt limestone of Aussee is also among its nearest allies. In its external shape, especially in the proportion of height and width, it agrees even better with this species than with *D. neojurensis*. A closer comparison of the sutural lines is, however, rendered difficult by the great difference in the dimensions of the European and Indian type-specimens. The small example illustrated by E. v. Mojsisovics has also diphyllic main saddles with bulky terminal leaves and comparatively broad stems. In the siphonal saddle the internal phylum is the higher one, exactly as in *D. Floweri*. There are only two auxiliary lobes present, but this character is evidently connected with the smaller size of the Alpine type-specimen. A more important feature of difference is the larger size of the monophyllic auxiliary saddle. This saddle is united with the preceding lateral one, thus forming a kind of suspensive lobe, and is not distinctly separated from it by the first auxiliary lobe. In *D. Floweri*, as in *D. neojurensis* and in *D. debilis*, the auxiliary saddles are considerably smaller, dwindling down to rather insignificant elements of the sutural line, but they are not united into a sloping suspensive lobe.

There are no other European triassic species of the genus *Discophyllites* to which the present one might advantageously be compared. *D. pumilus* v. Mojs., *D. despectus* v. Mojs., *D. invalidus* v. Mojs. are all dwarf species. So are the three triassic species from Sicily, which have been described by Gemmellaro as *D. billimontensis*, *D. Laubei* and *D. Jacquoti* (I cefalopodi del Trias superiore, della regione occidentale della Sicilia, Palermo, 1904, pp. 294-297). *D. debilis* v. Hauer has triphyllic saddles. *D. occultus* v. Mojs. agrees with *D. Floweri* in the general arrangement of the sutures, but is provided with an abnormal body-chamber.

An Indian species to which the present one bears a remarkable similarity in its external shape is *Discophyllites Ebneri* v. Mojs. (Himálayan Foss. Palæont. Ind. ser. XV, Vol. III, Pt. 1, p. 116, Pl. XIX, fig. 6). I should, indeed, be at a loss how to distinguish them without an examination of their sutural lines, in

whose details considerable differences are noticed (*vide* Himálayan Foss. l. c. Vol. V, Pt. 1, Pl. V, fig. 5).

Fam. : PINACOCERATIDÆ.

Gen. : PINACOCERAS v. Mojsisovics.

PINACOCERAS sp. ind. aff. REX Mojs.

In the fauna from exotic block No. 2 the genus *Pinacoceras* s. s. is represented by several specimens, all of them too imperfectly preserved to permit a specific determination. They are distinguished by slowly increasing volutions, with wide umbilici, thus recalling the group of *P. rex* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-1, p. 65, Taf. XXIII, figs. 8, 9; XXIV, fig. 8) from the Alpine trias. Several forms belonging to this group have been described from the triassic rocks of Sicily by Gemmellaro, especially *P. Zitteli* Gemm. (I cefalopodi del trias superiore della parte occidentale della Sicilia, p. 283, Pl. IX, fig. 20; X, figs. 3, 4) and *P. Haueri* Gemm. (*ibidem*, p. 289, Pl. XIX, figs. 1, 2; IX, figs. 17, 18, 19).

That our Indian species does really belong to the group of *Pinacoceras rex* is evident from the character of the sutural line, which I have been able to trace in a fragment which is otherwise too poorly preserved to allow a reconstruction of the original shell. In common with *P. rex* this fragment has the circular arrangement of lobes and saddles, the apex of the curve coinciding with the innermost adventitious saddle. There are six adventitious saddles present, all of which are distinctly diphyllic, in sharp contrast to the pyramid-shaped main saddles, which occur to the number of two, exactly as in *P. rex*.

Gen. : PLACITES v. Mojsisovics.

PLACITES cf. PERAUCTUS v. Mojsisovics. Pl. IX, figs. 3, 4.

The majority of the species of *Placites*, belonging to the group of *Pl. platyphyllus* v. Mojs., are distinguished by the presence of two adventitious lobes and saddles. There is only one Alpine species, *Pl. perauctus* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-1, p. 53, Taf. XXI, figs. 7-8), in whose sutural line a larger number of adventitious lobes and saddles has been developed. The typical form of *Placites perauctus* has been collected in the noric Hallstatt limestone of the Sommeraukogel, but types closely related are already found in the jalic deposits of the Salzkammergut. They are only imperfectly known and have been described cursorily as *Pl. cf. perauctus* by E. v. Mojsisovics (l. c. p. 53).

Types very closely allied to *Pl. perauctus* have also been met with in the Himálayan trias. A chambered fragment measuring one half volution, from the

upper Daonella beds of the Bambanag section, has been mentioned by E. v. Mojsisovics (Upper triassic cephalopod faunæ of the Himálayas, Palæont. Ind. ser. XV, Himál. Foss. Vol. III, Pt. 1, p. 111, Pl. XVIII, fig. 9) as *Placites sp. ind. aff. peraucti*. A similar fragment has been discovered by myself among the materials collected by Smith in the Tropites limestone of Lilingthi (Himál. Foss. l. c. Vol. V, Pt. 1, p. 167, Pl. XXV, fig. 6). To these fragmentary examples several better preserved specimens have been added recently from the fauna of exotic block No. 2. They undoubtedly are related to *Placites perauctus*, not to *Pl. Oldhami* v. Mojsisovics, as is shown by the occurrence of three adventitious lobes and saddles. The lobes are as deeply incised and the saddles nearly as richly serrated as in the typical form of *Pl. perauctus*. The number of auxiliary lobes is not exactly known to me.

The measurements of the two specimens figured are as follows:—

	Fig. 3.	Fig. 4.
Diameter of the shell . . . . .	67 mm.	25 mm.
„ „ „ umbilicus . . . . .	0 „	0 „
Height } of the last volution . . . . .	40 „	15 „
Thickness } . . . . .	14 „	6 „

I dare not identify my specimens with the typical *Placites perauctus*. The type-specimens from the Sommeraukogel are all of large size, showing a diameter of the last volution from 100 to 124 mm. The only Himálayan example of similar dimensions is a body-chamber fragment, in which a height of 55 mm. corresponds to a thickness of 17 mm. It is, however, not the more slender and compressed shape of the whorl but rather the difference in the shape of the cross-section on which I am inclined to lay a special stress.

In the typical *Placites perauctus* the flanks run nearly parallel from the siphonal shoulder to the umbilical region, whereas in my Himálayan fragment they converge strongly towards the latter. Whether this character is sufficient for a specific distinction can only be decided after an examination of larger materials. For the moment it will be preferable to mention the Indian species as *Placites cf. perauctus*, but without insisting on an identification with the Alpine form from the carnic Hallstatt limestone of the Roethelstein.

## TROPITOIDEA.

Fam. : *TROPITIDÆ*.

Gen. : *DISCOTROPITES* Hyatt and Smith.

1905. *Discotropites* Hyatt and Smith, The triassic Cephalopod genera of America, U. S. Geol. Survey Professional Papers No. 49, p. 69.

In 1877 A. Hyatt (in Meek, U. S. Geol. Exploration 40th Parall., Vol. IV, p. 126) introduced the generic name of *Eutomoceras* for a triassic Ammonite from Nevada, which E. v. Mojsisovics considered as the nearest ally to the *Alpiæ*

*Ammonites sandlingensis* v. Hauer. Thus the generic name of *Eutomoceras* was assigned by him to the European group of *Ammonites sandlingensis* and was, on his authority, accepted unanimously in this interpretation.

A re-examination by Hyatt and Smith of the type-specimen of *Eutomoceras Laubei* Meek, the American prototype of the genus, led to the surprising result that the American Ammonite was a member of the section of *Ceratitoides*, showing close affinities to *Hungarites* v. Mojs., but differing widely from *Ammonites sandlingensis*, which is a typical representative of the longidome section of *Tropitoides*. Thus the grouping of the latter species with *Eutomoceras* Hyatt having been based on a misinterpretation of the true affinities of the American genus by E. v. Mojsisovics, a new generic designation, *Discotropites*, was proposed for *Ammonites sandlingensis* by Hyatt and Smith.

It must be conceded that from Meek's memoir, in which the name *Eutomoceras* is used for the first time, a satisfactory decision on the distinguishing characters of the new genus is not at all easy. E. v. Mojsisovics therefore did not meet with any opposition in applying the name to the European group of *Ammonites sandlingensis*, which ever since has been considered as the true prototype of the genus *Eutomoceras* in substitution of the almost forgotten American species.

The rules of priority being decidedly and indubitably in favour of the first species described under the generic designation of *Eutomoceras*, the inconvenience of changing the generic name, usurped hitherto by *Ammonites sandlingensis*, cannot be avoided. I feel consequently obliged to follow P. Smith in adopting the generic name *Discotropites* for the European form from the Hallstatt limestone, notwithstanding the confusion in the nomenclature of triassic Ammonites which will undoubtedly result from the misinterpretation of Hyatt's genus.

DISCOTROPITES cf. SANDLINGENSIS v. Hauer. Pl. VI, fig. 4.

1840. *Ammonites sandlingensis* F. v. Hauer, Ueber neue Cephalopoden aus den Marmorschichten von Hallstatt und Aussee, Haidingers Naturwiss. Abhandl. III, p. 10, Taf. III, figs. 10-12.
1866. *Ammonites sandlingensis* A. v. Ditmar, Zur Fauna der Hallstätter Kalke, Geognost. Palmont. Beitr. von Benecke, etc., I, p. 370.
1898. *Eutomoceras sandlingense* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-2, p. 286, Pl. CXXX, figs. 11-13; CXXXI, figs. 1-11.
1896. *Eutomoceras cf. sandlingense* E. v. Mojsisovics, Himál. Foss. Pal. Ind. ser. XV, Vol. III, Pt. 1, p. 49.
1904. *E. sandlingense* Gemmellaro, I cefalopodi del Trias superiore della parte occidentale della Sicilia, p. 77, Tav. VIII, figs. 8-10.
1904. *E. sandlingense* I. P. Smith, The comparative stratigraphy of the marine trias of Western America. Proceed. Californian Acad. of sciences 3rd ser. Vol. I, p. 397, Pl. XLVI, fig. 10; XLVIII, figs. 5, 6.
1905. *Discotropites sandlingensis* Hyatt and Smith, Triassic cephalopod genera of America, U. S. Geol. Surv. Ser. C. Profess. Papers No. 40, p. 63, Pl. XXXV, figs. 1-12.
1906. *Eutomoceras cf. sandlingense* Disner, Fauna of the Tropites limestone of Bryan, Himál. Foss. Vol. V, Pt. 1, p. 138.

It is a rather astonishing fact that this wide-spread species of carnic age is numerously represented in the upper trias of the Himálayas, but in fragments only, and that no complete specimen has as yet been noticed.

The only specimen known to me from exotic block No. 2 is less fragmentary and in a better state of preservation than any of the examples from the *Tropites* limestone of Byans. Its identification with F. v. Hauer's species is, indeed, pretty certain. It is only my aversion against an unrestricted determination of incomplete specimens which has induced me to add the designation *cf.* to the specific name.

My specimen is of moderate size. One half volution and a large part of the umbilicus have been preserved. The siphonal edge is surmounted by a low and distinct keel. The steep umbilical wall is separated from the flattened lateral parts by a sharply rounded edge.

The ornamentation agrees almost perfectly with the delicate sculpture of the American example illustrated by Hyatt and Smith on Pl. XXXV, fig. 3, and of the Alpine specimen illustrated by E. v. Mojsisovics on Pl. CXXXI, fig. 8. The majority of the sickle-shaped ribs are dichotomous. There is no angular geniculation in their gentle backward curve along the middle of the flanks. Of umbilical tubercles faint traces only have been noticed. The spiral striation is very delicate.

*Dimensions.*

Height	}	of the last whorl	. . .	27 mm.
Thickness			. . .	11 "
Diameter of the umbilicus			. . .	7.5 "

*Sutures.*—Not known in detail.

*Remarks.*—*Discotropites sandlingensis* is one of the leading fossils of the zone of *Tropites subbullatus* in the Eastern Alps and in California, but it has also been met with, although very rarely, in the geologically older (juristic) *Ellipticus* beds of Aussee.

Gen. : TROPITES v. Mojsisovics.

TROPITES cf. SUBBULLATUS v. Hauer. Pl. VI, fig. 9.

1840. *Ammonites subbullatus* F. v. Hauer, Ueber neue Cephalopoden aus den Marmorabichten von Hallstatt und Aussee, Haidingers Naturwiss. Abhandl. III, p. 19, Taf. IV, figs. 1-4 (*non* 5-7).
1893. *Tropites subbullatus* E. v. Mojsisovics, Die Cephalopoden der Halltatter Kalke, Abhandl. K. K., Geol. Reichsanst. VI-2, p. 187, Taf. CVI, figs. 1-3, 5, 7; CVII, figs. 1-8; CVIII, figs. 1-6; CX, fig. 6.
1905. *Tropites subbullatus*, Hyatt and Smith, Triassic cephalopod genera of America, U. S. Geol. Surv. ser. C, Prof. Pap. No. 40, p. 67, Pl. XXXIII, figs. 1-7; XXXIV, figs. 1-14; LXXIX, figs. 1-10.
1906. *Tropites subbullatus* Diener, Fauna of the *Tropites* limestone of Byans, Himäl. Foss., Vol. V, Pt. 1, p. 145, Pl. IV, figs. 6-7.
1907. *Tropites cf. subbullatus* Diener, Ladinic, carnic and nolic faunas of Spiti, *ibid.*, Vol. V, Pt. 3, Pl. XIV, figs. 2, 3.

There are only three fragmentary casts of inner nuclei available for examination. Although more or less deformed and damaged they show a remarkable resemblance in shape and sculpture to *Tropites subbullatus*. The whorls are considerably thicker than high. In one of my casts the siphonal part has been

preserved satisfactorily enough for illustration. It exhibits the low median keel towards which numerous straight ribs converge at steep angles.

Although it is not possible to establish the identity of the Indian fossil with the European species, the presence of the group of *T. subbullatus* in the fauna of exotic block No. 2 has been ascertained.

*TROPITES* sp. ind. aff. *ACUTANGULO* v. Mojs. Pl. X, fig. 3.

1902. *Tropites* aff. *acutangulus* A. v. Krafft, Mem. Geol. Surv. of India, XXXII, Pt. 3, p. 143.

The figured specimen belongs to all appearance to a species nearly allied to *Tropites acutangulus* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, l. c. VI-2, p. 203, Taf. CXII, figs. 1, 2). It is not sufficient for an exact determination, the outer whorls only having been preserved.

The cast, which has been partly injured by weathering, agrees in its size and shape with the type-specimen from the Subbullatus beds of the Salzkammergut and belongs probably to an adult specimen, in which a small part of the body-chamber only is wanting. It differs from *Tropites acutangulus* by the regularity of its involution, the umbilical suture not leaving the normal spiral. Height and thickness of the last volution increase slowly, but quite regularly, from the beginning of the whorl to the very aperture. The cross-section agrees exactly with that in *T. acutangulus*, being only a little wider than high.

In its sculpture our specimen shows a remarkable resemblance to *T. acutangulus*. The ribs are numerous and sharp and exhibit an angular geniculation outside the umbilical margin. In the anterior half of the last volution all the ribs are simple and undivided. In the posterior half of this whorl the sculpture has, unfortunately, suffered considerably from weathering along the umbilical margin. It cannot be decided, therefore, whether or not sharply edged umbilical tubercles have been present, but from the direction of the ribs it is obvious that the majority of them dichotomised in the umbilical region. No secondary bifurcations have been noticed in the marginal region.

Although the siphonal part has been severely damaged, I have been able to state the presence of a keel, accompanied by a distinctly marked keel-furrow.

*Dimensions.*

Diameter of the shell	. . . . .	. . . . .	69 mm.
" " " umbilicus	. . . . .	. . . . .	27 "
Height of the last { above the umbilical suture			ab. 28 "
{ " " preceding whorl			ab. 21 "
Thickness of the last volution	. . . . .	. . . . .	82 "

*Sutures.*—Not known.

*Remarks.*—Species very closely allied to *Tropites acutangulus* have been mentioned from the Tropites limestone of Byans by E. v. Mojsisovics (Himalayan Foss., Vol. III, Pt. 1, p. 46, Pl. XI, fig. 4) and by myself (*ibid.*, Vol. V, Pt. 1, p. 51). As they are represented by specimens still more fragmentary than the

present one, their specific identity with the form here described cannot be ascertained.

*TROPITES* sp. ind. aff. *WODANI* v. Mojs. Pl. VI, fig. 11.

A fragmentary cast of a small species of *Tropites* recalls in its external characters *T. Wodani* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-2, p. 221, Taf. CXVI, fig. 6). It agrees with the Alpine type-specimen in size and in the shape of the transverse section. The volutions are of equal height and thickness, the flattened lateral parts being separated from the high and perpendicular umbilical wall by a sharp edge and passing gradually into the rounded external part in a very regular curve.

The delicate ribs originate in pairs from faintly developed umbilical nodes. They are nearly straight and turned forward very strongly on the siphonal area, thus meeting the median keel at acute angles.

The presence of *Tropites Wodani* in the Tropites limestone of Byans (Himál. Foss., Vol. V, Pt. 1, p. 152, Pl. V, fig. 6) is in favour of a closer comparison of this undeterminable cast with the Alpine species from Aussee.

Subgen.: *ANATROPITES* v. Mojsisovics.

*ANATROPITES* cf. *SPINOSUS* v. Mojsisovics. Pl. VI, fig. 10.

1893. *Tropites (Anatropites) spinosus* E. v. Mojsisovics, Cephalopoden der Hallstaetter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-2, p. 225, Taf. CX, fig. 2.

1902. *Tropites aff. spinosus* A. v. Kraft, Mem. Geol. Surv. of India, Vol. XXIII, Pt. 3, p. 143.

The figured specimen, tolerably well preserved, is a typical representative of the group of *Tropites spinosus* (*Anatropites*), as is shown by the large thorns adorning the umbilical edge of its inner volutions. In the last volution, which forms part of the body-chamber, the umbilical thorns are replaced by tubercles, from which faint radial ribs arise, which become obsolete before reaching the siphonal part. The median keel is comparatively high and sharp, but not accompanied by lateral furrows.

My specimen agrees so closely with the Alpine type of *Anatropites spinosus* that I should have ventured on a direct identification, if the inner whorls of the Himálayan example had been preserved more completely. Although the latter is slightly inferior in size, its proportions and sculpture agree almost exactly. The thickness of the last volution is considerably greater than the height, but is equal to the width of the umbilicus.

Seventeen umbilical thorns or nodes are counted within the circumference of the last volution.

From *Tropites (Anatropites) Adalgi* v. Mojsisovics (*ibid.*, p. 225, Taf. CX, fig. 3) our specimen is distinguished by the greater height of its whorls and by its less strongly depressed external shoulders.



*Dimensions.*

Diameter of the shell . . . . .	23.5 mm.
" " " umbilicus . . . . .	10 "
Height } of the last volution . . . . .	7.5 "
Thickness } . . . . .	10 "

*Sutures.*—Not known.

*Remarks.*—*Anatropites spinosus* is a very rare species in the julic stage of the Salzkammergut. One single specimen only has been quoted by E. v. Mojsisovics from the *Ellipticus* beds of the Roethelstein.

## ANATROPITES PILGRIMI nov. sp. Pl. VI, figs. 6, 7; IX, fig. 5.

That this species belongs to the genus *Tropites*, not to *Tropicellites*, is proved by the character of its sutural line, which, although not entirely known, is decidedly dolichophyllic, not clydonitic. It is, however, less easy to fix its systematic position among the five groups which have been distinguished among the genus *Tropites* by E. v. Mojsisovics, and to which even a subgeneric rank has been attributed by that learned author.

The inner volutions are not adorned with proper thorns along their umbilical edges, but rather with very broad and stout ribs. A similar type, *Tropites Geyeri*, has been grouped with the subgenus *Anatropites* by E. v. Mojsisovics. Our species, indeed, agrees with typical representatives of this subgenus in the majority of its leading features, especially in the external shape, which recalls *Tropicellites*, and in the gradual weakening of the ornamentation in the outer whorls.

Three fairly well-preserved examples, consisting both of inner nuclei and body-chambers, are available to me for examination. They are provided with numerous, slowly increasing whorls, which leave a wide umbilicus open. The transverse section is more strongly compressed than in *A. Geyeri* and higher than thick.

In the inner volutions the sculpture consists of strong umbilical ribs, which are but exceptionally elevated into obtuse tubercles near the umbilical edge and die out gradually towards the external shoulders. Some of them, although thinning out into delicate folds, reach across the siphonal area to the median keel, which is high and sharp. The body-chamber whorl is distinguished by its more delicate ornamentation. The umbilical ribs are reduced to obtuse nodes, and the delicate folds are arranged in crescents with their convexity turned backward.

*Dimensions.*

Diameter of the shell . . . . .	27 mm.
" " " umbilicus . . . . .	11 "
Height } of the last volution . . . . .	10 "
Thickness } . . . . .	8.5 "

*Sutures.*—Not known in detail. Siphonal lobe narrow, with two diverging

points at its base, which are separated by a low median prominence. Siphonal saddle large and dolichophyllic, as in typical species of *Tropites*.

*Remarks.*—Among Alpine species of *Anatropites* *A. Geyeri* v. Mojs. is certainly most nearly allied to the present one. It is less strongly compressed, provided with more slowly increasing whorls, and exhibits a large umbilicus. But otherwise the two species agree pretty well in their general shape and ornamentation, especially in the reduction of umbilical thorns, which are replaced by stout ribs.

From the triassic rocks of Sicily two species with a similar ornamentation have been described by Gemmellaro, namely, *Anatropites Mojsisovicsi* Gemmellaro (I cefalopodi del trias superiore della regione occidentale della Sicilia, p. 123, Tav. VII, figs. 40-42) and *A. Frechi* Gemm. (*ibid.*, p. 120, Tav. XXV, figs. 13-15). But both of them are easily distinguished from the Himalayan form by their compressed and slender shape, especially *A. Mojsisovicsi*, which has a very large umbilicus and numerous radiating costæ.

Gen. : MARGARITES v. Mojsisovics.

MARGARITES IRREGULARICOSTATUS nov. sp. Pl. VI, fig. 8.

This species represents a type of the group of *Margarites unispinosi*, which is distinguished from the most closely related forms of the Alpine trias by the irregular character of its sculpture.

My type-specimen, which is fairly well preserved and provided with a part of its body-chamber, shows slowly increasing and low whorls of a nearly quadrangular section, thus recalling *Marg. subauctus* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, l. c. VI-2, p. 305, Taf. CXCIV, fig. 17). The external keel is low and not crenulated.

The ornamentation of the inner whorls is distinguished by the lack of umbilical tubercles, and by the alternation of stout primary and delicate secondary ribs. The stouter ribs are disposed at considerable distances and elevated into marginal spines. Their direction is not exactly radial but slightly turned backward. The delicate secondary ribs, which are of irregular strength and number, are directed backward more strongly, thus including an acute angle with the primary costæ. On the last volution the disposition of primary and secondary ribs is much more irregular. The development of marginal spines or tubercles is no longer confined to the primary ribs, some of which occasionally bifurcate. This tendency towards bifurcation is also exhibited in some of the secondary ribs, which are of very different strength and number and occasionally of an undulating direction.

There is no species of *Margarites* known to me, either in the carnic Hallstatt limestone of the Salzkammergut, or among the triassic faunas of Sicily, which for irregularity of ornamentation can be compared with the present one.

*Dimensions.*

Diameter of the shell	. . . . .	23.5 mm.
" " umbilicus	. . . . .	10 "
Height } of the last volution	. . . . .	7 "
Thickness	. . . . .	8.5 "

*Sutures*.—Not known.

## Fam.: HALORITIDÆ.

Gen.: JOVITES v. Mojsisovics.

## JOVITES cf. SPECTABILIS Dien. Pl. V, fig. 1.

1906. *Jovites spectabilis*, Diener, Fauna of the Tropites limestone of Byans, Himál. Foss. Palmont. Ind. ser. XV, Vol. V, Pt. 1, p. 123, Pl. XVI, fig. 1; Pl. IX, fig. 10.

1907. *Jovites spectabilis*, Diener, Ladinic, carnic, and urtic faunæ of Spiti, *ibid.*, Vol. V, Pt. 3, Pl. XV, fig. 3.

The specimen figured is a mature example of a species of *Jovites* with a very distinct umbilical opening of the body-chamber whorl. It is partly crushed and no exact idea of its transverse section can be formed from its outlines. It could, however, be ascertained that the greatest inflation corresponds to the commencement of the last volution, and that in the vicinity of the aperture a second, although moderate, inflation and widening of the external part follows the compression of the body-chamber.

The siphonal part has not been preserved well enough to state whether or not a keel-like median projection has been developed. The opening of the umbilicus is very considerable. Indeed, it expands so considerably that the height of the transverse section does not increase throughout one half of the entire length of the last volution.

In its general character and ornamentation this specimen agrees very closely with the type from the Tropites limestone of Byans, to which the name *Jovites spectabilis* has been assigned by myself. The sculpture consists of stronger ribs than in *J. dacus* v. Mojs. or *J. daciformis* Diener. Dichotomising ribs are noticed in the posterior half of the last whorl, although rather exceptionally, but are entirely absent in the anterior portion, where they are arranged at larger distances and become sharpened.

*Dimensions.*

Diameter of the shell	. . . . .	21 mm.
" " umbilicus	. . . . .	23 "
Height of the last volution	. . . . .	29 "
Thickness at the commencement of the last whorl	. . . . .	31 "

*Sutures*.—Not known.

As a specific distinction between *Jovites spectabilis* and *J. bosnensis* can only be based on essential differences in the sutural line, I have not ventured on a direct identification of the present specimen, although there are some strong reasons in favour of its identity with the Himálayan species from the Tropites limestone of Byans and Spiti.

JOVITES DACIFORMIS Diener. Pl. V, fig. 2; VII, fig. 8.

1906. *Jovites daciformis*, Diener, Fauna of the Tropites limestone of Byans, Pal. Ind. ser. XV, Himál. Foss. Vol. V, Pt. 1, p. 119, Pl. XV, figs. 5-10. XVI, fig. 2.

Two inner nuclei in a satisfactory state of preservation, and two internal casts with fragments of the body-chamber adhering, agree so closely with *Jovites daciformis* from the Tropites limestone of Byans that I do not hesitate in identifying them.

The two figured casts are strongly globose and broader than high, with closed umbilici. The numerous bifurcating ribs cross the keel-like median projection of the siphonal part.

The sutures agree with those of *Jovites daciformis*, not with those of *J. dacus* v. Mojs. The lateral leaves accompanying the stems of the high and slender saddle are arranged obliquely to the axis of the latter.

The presence of *Jovites daciformis* in the fauna of the exotic blocks of Malla Johar having been established, there is some probability of the two fragments collected by myself in the Kiogarh range, south of Sangolia Talla, in 1892, and described as *Jovites nov. sp. ex aff. bosnensis* by E. v. Mojsisovics (upper triassic cephalopod faunæ of the Himálayas, Pal. Ind. ser. XV, Himálayan Foss. Vol. III, Pt. 1, p. 18, Pl. IX, figs. 4, 5), belonging also to this species. Their only difference consists in the smaller number and somewhat greater strength of the ribs, but the range of variation with reference to this feature is so large in *J. daciformis*, as well as in its European representative, *J. dacus*, that it can barely be considered sufficient for justifying a specific separation.

JOVITES nov. sp. ind. Pl. IX, fig. 6.

The figured fragmentary cast belongs to all appearance to a species of *Jovites* which is distinguished from all congeneric forms by the absence of any external ornamentation. It was provided with low and moderately inflated whorls. The egression of the umbilicus, which is not as widely expanded as in the group of *Jovites dacus* Mojs., corresponds to the beginning of the last volution.

In the transverse section the presence of obtusely rounded siphonal shoulders is a remarkable feature. The siphonal area is broad and flattened. The faint, keel-like projection in the middle of the siphonal part extends to the end of the last whorl.

The surface of the cast is entirely smooth and devoid of any kind of sculpture.

*Dimensions.*

Diameter of the shell . . . . .	44 mm.
" " " umbilicus . . . . .	6 "
Height } of the last volution . . . . .	19 "
Thickness } . . . . .	ab. 26 "

*Sutures.*—Not known.

*Remarks.*—There is no European species of *Jovites* known to me to which the present specimen might be compared. Its incomplete state of preservation prevents me from introducing a new specific designation.

Gen. : JUVAVITES v. Mojsisovics.

JUVAVITES KRAFFTII nov. sp. Pl. VII, fig. 3.

This species belongs to a group of *Juvavites interrupti*, which is distinguished by a gradual obliteration of the sculpture in the body-chamber of adult individuals. Its nearest allies in the Alpine trias are *Juvavites nepotis* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, l. c. VI-2, p. 92, Taf. LXXI, fig. 12) and *J. Ellæ* v. Mojsisovics (l. c. p. 93, Taf. CXXIX, fig. 20). There is also a great external resemblance between the figured specimen and *Juvavites (Anatomites) Halavatai* v. Mojsisovics (l. c. p. 93, Taf. CXXIX, fig. 22), but the absence of any paucostome furrows or ribs in the Himalayan type peremptorily forbids its identification with representative of the subgenus *Anatomites*.

At the beginning of the last volution the whorls are semiglobose, being considerably broader than high. In the anterior half the height of the volution increases more rapidly than its width. Thus the transverse section of the aperture appears to be compressed and provided with a very narrow external part, whereas it is broadly rounded in the chambered portions of the shell.

The sculpture on the two halves of the shell corresponds exactly, but is interrupted along the median line of the external part by a narrow, smooth zone, which is reached by the lateral ribs with very steep angles. This interruption of the sculpture does not result from an obliteration of the ribs, but from a gradual elevation of the intercostal furrows. The median zone of the external part is therefore elevated above the general level of the shell. Where the elevation of the intercostal furrows is not sufficiently high to obscure the ribs, the latter are seen to cross the external part, meeting from both sides at very obtuse angles.

The posterior part of the last volution is covered with numerous high and narrow ribs, which are slightly curved and separated by deep and broad intercostal valleys. Their arrangement is rather irregular. Two stem-ribs are simple but accompanied on either side by intercalated ribs. The rest are forked ribs. They are either dichotomous or united into fasciculi with a tripartite arrangement.

The change in the transverse section of the last whorl coincides with a complete change of the sculpture. The numerous and strong ribs become obliterated rather rapidly. The ornamentation of the anterior half of the shell, which probably belongs to the body-chamber, is reduced to a small number of broad and indistinct folds. Otherwise this portion of the shell is entirely smooth. No traces of tubercles have been noticed, either in the umbilical or in the marginal region.

*Dimensions.*

Diameter of the shell . . . . .		80 mm.
"    "    "    umbilicus . . . . .		6.6 "
Height of the { above the umbilical suture . . . . .	{	41 "
last volution { "    "    preceeding whorl . . . . .		20 "
Thickness of this last volution . . . . .		.36 "
Height } at the beginning of the last volution . . . . .	}	21 "
Thickness }		28 "

*Sutures.*—Not known.

JUVAVITES DOGRANUS nov. sp. Pl. V, fig. 3.

This species, which is represented in the Himálayan collection by the figured, incomplete specimen only, is very nearly allied to the preceding one, from which it differs by its smaller size, more strongly compressed shape, and more closely set ribs.

The transverse section of the last volution changes considerably, being elliptical at the beginning, whereas it is of nearly triangular shape at the aperture, faint rounded angles forming the boundary of the gently curved external part. The umbilicus is deep, but very narrow.

The ribs are more numerous and developed less strongly than in *Juvavites Krafti*. The smooth band, which interrupts the sculpture along the median zone of the external part, is comparatively broad. Its elevation does not reach the height of the lateral ribs.

The ribs are arranged almost symmetrically on both sides of the shell. Some of them cross the external part in uninterrupted curves, which are slightly turned forward. The ornamentation is rather irregular. At the beginning of the last volution simple ribs alternate with bipartite, tripartite, and quadripartite ones; but in the anterior portion of this whorl the majority of the ribs are dichotomous, and a simple rib, which is restricted to the marginal region, is often interrelated between two stem-ribs.

As in *Juvavites Krafti*, the sculpture becomes obliterated completely in the vicinity of the aperture. But this obliteration does not coincide exactly with the beginning of the body-chamber, the last two septa being situated within the smooth region of the shell.

*Dimensions.*

Diameter of the shell . . . . .	62	mm.
" " umbilicus . . . . .	4	"
Height of the f above the umbilical suture . . . . .	34.5	"
last volution { " " preceding whorl . . . . .	20.5	"
Thickness of the last volution . . . . .	24.5	"
Height } at the beginning of the last whorl . . . . .	16	"
Thickness }	17	"

*Sutures.*—The sutures, as far as known, agree well with those in typical species of *Juvavites*. Saddles elongated and dolichophyllic. Siphonal saddle terminating in rounded phylla, imparting to the apex a rounded aspect, whereas in the principal lateral saddle the median phylum is considerably longer than the adjoining lateral leaves.

Principal lateral lobe bipartite, its two short diverging points being divided by a mesial indentation. Auxiliary series not accessible to observation.

*Remarks.*—A species, which is probably very nearly allied to the present one, is *Juvavites tonkinensis* Diener (Note sur deux espèces d'Ammonites triasiques du Tonkin, Bull. Soc. géol. de France, 3e. sér. XXIV, 1896, p. 883), from the upper basin of the Black River in Tonkin. There is a very close agreement in the sculpture, with the only exception that the ribs are curved forward more strongly on the external part of the Indo-Chinese form. Near the aperture of *Juvavites tonkinensis* the ornamentation is also obliterated, but the transverse section of the last volution is not subject to any change throughout the entire length of the last volution, the anterior half of which belongs to the body-chamber.

A species nearly allied to *Juvavites tonkinensis* as well as to the present form has also been noticed from the upper Daonella beds of the Central Himálayas, but its unsatisfactory state of preservation does not allow a closer comparison.

JUVAVITES sp. ind. ex aff. SUBINTERRUPTO v. Mojs. Pl. VII, figs. 4, 6.

Two fragmentary casts belong to a globose form from the group of *Juvavites interrupti*, and, chiefly by the character of their sculpture, they recall *J. subinterruptus* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, l. c. VI-2, p. 90, Taf. LXXXIX, fig. 13; XC, figs. 2, 3; CXXVI, fig. 16) from the carnic stage of the Hallstatt limestone.

No traces of septa having been preserved, I cannot decide whether or not the two specimens were provided with their body-chambers, although from the character of their ornamentation I am inclined to consider them as nuclei rather than as adult individuals. They are robust and strongly globose, much more so indeed than any of the Alpine or Sicilian species of this group. There is no change in the shape of the transverse section from the beginning of the last volution to the aperture.

The direction of the ribs is nearly radial on the lateral parts, but faintly curved or flexuous. The majority of the ribs are dichotomous, bifurcating at a point situated about one-third of the height of the whorl, but in a small number of ribs a second

bifurcation is noticed in the marginal region. In the middle part of the last volution of the specimen illustrated in fig. 6 a bundle of ribs is formed by the coalescence of two forked stem-ribs near the umbilical margin, but this bundle is not accompanied by any paulostome furrow. Some intercostal valleys appear, indeed, to be a little larger than the adjoining ones, but they are not true paulostome furrows. The difference between the broader and narrower intercostal furrows is certainly smaller than in *Juvavites anatomitoides* Gemmellaro (I cefalopodi del trias superiore della parte occidentale della Sicilia, p. 185, Tav. XVIII, fig. 50), which is, nevertheless, a typical species of *Juvavites s. s.*

The ribs are not arranged symmetrically on both sides of the shell and are interrupted along the middle line of the external part by a comparatively broad, smooth band. They terminate very abruptly, the smooth zone not corresponding to a gradual elevation of the intercostal valleys.

*Dimensions.*

	Fig. 6.
Diameter of the shell . . . . .	. 42 mm.
"    "    "    umbilicus . . . . .	. 6 "
Height of the { above the umbilical suture . . . . .	. 22.5 "
last volution { " " preceding whorl . . . . .	. 16 "
Thickness of the last volution . . . . .	. 20 "

*Sutures.*—Not known.

JUVAVITES nov. sp. ind. (GROUP OF CONTINUI). Pl. IX, fig. 8.

The spheroidal shell represents the chambered nucleus of a small species of *Juvavites*. The last septum corresponds to the aperture; little fragments adhering to the external part at the beginning of the last volution form a part of the body-chamber.

The whorls are considerably wider than high and are covered with numerous forked ribs. The majority of the ribs are dichotomous. One bundle formed by the coalescence of two forked stem-ribs immediately outside the umbilical margin and two simple, undivided ribs have also been noticed. The dichotomous ribs bifurcate at a point about one-third of the height of the whorl.

The ribs are arranged symmetrically on both sides of the shell, and are united in the middle of the broad siphonal part without any interruption. In crossing the siphonal part they describe a flat curve, with its convexity turned forward, but there is no geniculation at the place where they meet from both sides, as in *Juvavites gastrogonius* v. Mojsisovics, or in the unnamed species from the carnic Hallstatt limestone which has been illustrated by E. v. Mojsisovics on Pl. LXXXIX, fig. 9, of the "Cephalopoden der Hallstaetter Kalke" (Abhandl. K. K. Geol. Reichsanst. VI-2).

Although the ribs are not interrupted along the median zone of the external part, they appear to be considerably lower than in the flanks, on account of a gradual flattening of the intercostal valleys.



*Dimensions.*

Diameter of the shell . . . . .	. . . . .	23 mm.
" " " umbilical suture . . . . .	. . . . .	3 "
Height of the ( above the umbilicus	. . . . .	11 "
last volution { " " preceding whorl	. . . . .	7 "
Thickness of the last volution . . . . .	. . . . .	20.5 "

*Sutures.*—Not known.

*Remarks.*—There is no European species to which the present fragment could be more closely compared. I have mentioned it here especially in order to prove the presence of a form of the group of *Juvavites continui* in the fauna of exotic block No. 2. But no stratigraphical evidence can be gathered from its presence, typical species of this group having been distributed both in carnic and noric beds of the Alpine trias.

Subgen. : *GRIESBACHITES* v. Mojsisovics.

1896. *Griesbachites* v. Mojsisovics, Denkschr. Kais. Akad. d. Wiss. math. nat. Kl. Bd. LXIII, p. 603.

1899. *Griesbachites* v. Mojsisovics, Himälaysan Foss. Pal. Ind. ser. XV, Vol. III, Pt. 1, p. 35.

The subgeneric denomination of *Griesbachites* has been proposed by E. v. Mojsisovics for a small number of species of *Juvavites*, in which marginal tubercles are developed both on the body-chamber and in the inner whorls of the shell. There were only three typical species of this subgenus known to him, *Griesbachites Medleyanus* Stoliczka (Memoirs Geol. Survey of India, Vol. V, p. 54, Pl. IV, fig. 5) from Spiti, of unknown age, *G. Hami* v. Mojsisovics, from the upper Daonella bed of the Bambanag and Lauka sections, and *G. Kastneri* v. Mojs., from the carnic Ellipticus beds of the Salzkammergut. The first of these three species is considered as the prototype of the subgenus.

In his preliminary notes on the cephalopod faunæ of the Himälaysan trias (Sitzungsber. Kais. Akad. d. Wiss., 1892, Bd. CI, p. 65) E. v. Mojsisovics united *Juvavites Medleyanus* with the genus *Sagenites* v. Mojs., considering the development of stout marginal tubercles as a feature of generic importance. In his memoir on the Cephalopoda of the Hallstatt limestone (Abhandl. K. K. Geol. Reichsanst. VI-2, p. 157) he compares the Indian species to *Sagenites Schaubachi* v. Mojs. of the group of *reticulati* and even notices traces of a longitudinal striation on the siphonal part of the cast.

From his later description in the *Palæontologia Indica* it is, however, evident that he had been misled by an external similarity between *Griesbachites Medleyanus* and *Sagenites*. That there is, indeed, no real affinity between this species and *Sagenites* is obvious from my recent examination of A. v. Krafft's materials. In his collections from exotic block No. 2 six specimens of *Griesbachites* are represented, which are so nearly allied to the prototype of the subgenus, *G. Medleyanus*, that they had been identified with the latter by A. v. Krafft. In several specimens large fragments of the shell have been beautifully preserved. In none of them

does the test show any trace of reticulation or longitudinal striæ. Thus the morphological agreement with *Sagenites* is not connected with any closer affinity.

All characters of importance lead to the suggestion of a very close affinity of *Griesbachites* with *Juvavites*. Among knob-bearing forms with distinct marginal ears *Juvavites Chamissoi* v. Mojsisovics (l. c. p. 94, Taf. LXXXVII, fig. 2) has been left with this genus by E. v. Mojsisovics, whereas a second one, *Juvavites fulminaris* v. Dittmar (E. v. Mojsisovics, l. c. p. 136, Taf. LXXXVII, fig. 1), has been grouped with the subgenus *Anatomites*, on account of some differences in the strength of the lateral ribs.

To me both species seem to be related most intimately to the prototype of the subgenus *Griesbachites*. The only feature of distinction, which has been pointed out by E. v. Mojsisovics, is the confinement of marginal tubercles to the body-chamber of adult individuals in the two last-mentioned species, whereas in *Griesbachites Medleyanus* such marginal tubercles already make their appearance on the chambered whorls. But this feature of distinction I cannot consider to be a very safe one. In *Juvavites fulminaris* the inner whorls are not known. According to the description, the commencement of the last volution corresponds exactly with the last septum. The entire periphery of this volution being adorned with marginal tubercles, E. v. Mojsisovics himself declares it to be an open question whether or not such tubercles may be developed on the inner nucleus. On the other hand it is barely possible to ascertain the position of the last septum in the type-specimen of *Juvavites Kastneri*. As marginal ears make their appearance in the anterior half of the last volution only, a very small part of the chambered portion of the shell only can be distinguished by their presence. A similar difficulty of ascertaining the boundary between air-chambers and body-chamber is met with in the three Himalayan specimens, which I have united provisionally with *Juvavites Kastneri*. Nor have any sutures been noticed by E. v. Mojsisovics in his fragments of *Griesbachites Hanni*, and his suggestion that they were completely chambered still lacks proof.

Although I am at variance with the views of E. v. Mojsisovics on the systematic value of the relative position of marginal tubercles on the body-chamber or on the last air-chambers, I fully concur in his opinion that the forms grouped around *Griesbachites Medleyanus* are distinguished by characters sufficiently important to justify a proper subgeneric designation. But I prefer to propose a slight change in the circumscription of this subgenus, and to include in it all forms of *Juvavites* which are distinguished by the development of strong marginal tubercles or ears.

Whether all forms distinguished by the presence of marginal tubercles are also connected genetically is a question which cannot be answered at present. Some knob-bearing species of *Juvavites* from the triassic rocks of Sicily have been grouped with the subgenus *Anatomites* v. Mojs. by Gemmellaro. Such species are *Anatomites elegans* Gemmellaro (I cefalopodi del trias superiore della parte occidentale della Sicilia, p. 241, Tav. XX, figs. 14-16; XXIII, fig. 9), *A. Bukowskii* Gemm. (l. c.

p. 24, Tav. XI, figs. 7, 8; XXIII, fig. 8), *A. Timaei* Gemm. (l. c. p. 226, Tav. XVII, figs. 10, 11; XXIII, fig. 7). All of them are provided with deep paulostome furrows and have the marginal tubercles restricted to the body-chamber. In *A. Timaei* they are even confined to the posterior portion of the body-chamber only, whereas in the vicinity of the aperture the ornamentation becomes altogether obsolete.

But paulostome ribs, the characteristic feature of the subgenus *Anatomites*, have also been noticed in one of the most typical species of *Griesbachites*, in *G. Hanni*, by E. von Mojsisovics. They are not known either in *G. Medleyanus* or in *G. Kastneri*, but it must be remarked that in neither species have inner nuclei as yet been available for examination.

If the examination of new materials should prove the inner nuclei of these two species to be devoid of paulostomes, we should be obliged to suggest that marginal tubercles have been acquired by different lines of *Juvavites*. In this case it would become necessary to restrict the name *Griesbachites* to the descendants of *Juvavites s. s.* and to introduce a new subgeneric designation for the knob-bearing types of *Anatomites*. But then *G. Hanni* could no longer be left within the subgenus *Griesbachites*, even if the latter were taken in the narrow original interpretation which has been proposed by E. v. Mojsisovics.

In the fauna of exotic block No. 2 the subgenus *Griesbachites* is represented by two typical species, one of them with Alpine and the second with Indian affinities. Together with *Cladiscites* they are the most remarkable and characteristic elements in the fauna of exotic block No. 2.

#### GRIESBACHITES cf. *KASTNERI* v. Mojsisovics. Pl. VI, figs. 1, 2, 3.

1893. *Juvavites Kastneri* E. v. Mojsisovics, Cephalopoden der Hallstätter Kalken, Abhandl. K. K. Geol. Reichsanst. VI-2, p. 45, Taf. CLXXXVI, fig. 3.

Three specimens, in which all characters have been excellently preserved with only the exception of the sutural line, are related so closely to the Alpine *Juvavites Kastneri* v. Mojs., from the carnic Ellipticus beds of the Salzkammergut, that I cannot find any distinctive feature which might justify a specific separation.

It is especially the smallest specimen (fig. 1) which in its shape and proportions exactly agrees with the type specimen of *J. Kastneri*. Its whorls are moderately inflated, their width being slightly inferior to the height, and they overlap one another as far as the umbilical margin, which is steeply rounded and separates a low but vertical umbilical wall from the gently curved flanks. Siphonal part rounded, and marked off from the lateral parts by an indistinct marginal shoulder.

The two other specimens differ from the smallest one by their more compressed shape. The whorls are considerably higher than broad. The lateral parts are flattened and they converge less strongly towards the external part; the marginal shoulder is more distinctly marked. In the specimen illustrated in fig. 3 the cross-section of the aperture is almost rectangular in its outlines, the siphonal part widening into a flattened area.

As the specimen illustrated in fig. 2 is a truly transitional shape between the two other types, I cannot consider these differences as characters of specific importance, but only as marks of individual variability.

There are also some individual variations of minor importance shown in the sculpture of the three figured specimens. The specimen illustrated in fig. 2 in its ornamentation agrees most nearly with the Alpine type. It consists of broad and low folds or ribs, which are directed radially in the lower half of the lateral parts, but show a sigmoidal curve in the vicinity of the marginal shoulder. Their number is increased towards the external part, either by bifurcation of the stem-ribs or by intercalation of secondary ribs. Some of the primary ribs are more strongly marked than the rest, but the difference in strength is only insignificant.

Along the median line of the siphonal area the ribs are interrupted by a narrow, smooth band. Their arrangement on both sides of this median zone is rather irregular, alternation and correspondence of opposite ribs occurring indiscriminately. In the anterior half of the last volution the development of marginal tubercles sets in. Six marginal tubercles are counted in the last half volution. In the majority of tubercles a bifurcation of ribs is noticed. As a rule every fourth or fifth rib is adorned by a tubercle. The majority of tubercles are arranged symmetrically with the median line of the shell, but there are some exceptions from this rule. The ribbing weakens gradually towards the aperture, whereas the tubercles become stronger.

The specimen illustrated in fig. 1 possesses broader ribs separated by wide intercostal furrows, but a large number of marginal tubercles, eight of which are counted in the circumference of the last half volution. Thus only one or two simple ribs are intercalated between such ribs as bear marginal tubercles. The smooth zone of the siphonal part is very narrow. Some of the ribs, which are arranged almost symmetrically on both halves of the shell, even close together on the external area in the vicinity of the aperture.

In the specimen fig. 3 there are very numerous, chiefly forked ribs. Tubercles are developed in a rather advanced stage of growth, and in small numbers only. The ribs continue increasing in strength, although becoming less numerous, to the very aperture of the shell. Coming alternately from both halves of the last volution, they are interrupted by a narrow, smooth zone along the external part, with the exception of the last three ribs, which close together.

All the specimens differing somewhat from each other in their external shape and ornamentation, but being linked together by the agreement of all characters of importance, they are to be regarded as varieties of one species.

#### *Dimensions.*

	Fig. 1.	Fig. 2.	Fig. 3.
Diameter of the shell . . . . .	48.5 mm.	60 mm.	62 mm.
" " umbilical . . . . .	5 "	6 "	6 "
Height of the { above the umbilical suture	25 "	31.5 "	30 "
last volution { " " preceding whorl	14 "	20 "	20 "
Thickness of the last volution . . . . .	23 "	20 "	23.5 "

*Sutures*.—Not known. I have entirely failed in discovering any trace of septa. It is consequently impossible for me to decide whether my specimens are yet entirely chambered or provided with parts of their body-chambers. E. v. Mojsisovics declared his type-specimen of *J. Kastneri* to be a chambered nucleus, but was obliged to state that its sutural line was not known to him in detail.

*Remarks*.—Although the establishment and limitation of the present species offer considerable difficulties on account of its individual variability, I consider the specific identity of the three figured examples as sufficiently well established by their agreement in all characters of importance. The species is so closely allied to the European *Juvavites* (*Griesbachites*) *Kastneri*, that I have not thought it appropriate to introduce a new specific denomination, although the question of identity cannot be decided without a thorough knowledge of their sutural lines.

Among Himálayan species *Griesbachites Hanni* v. Mojsisovics (Himálayan Foss., Vol. III, Pt. 1, p. 39, Pl. X, figs. 3-5) from the upper Daonella beds of the Bambanag cliffs and of Lauka might be taken into consideration for a closer comparison. Of this interesting species specimens more or less fragmentary only are, unfortunately, known to us. But, as we may judge from the beautiful illustrations given by E. v. Mojsisovics, the large size of the umbilicus seems to be a remarkable feature of distinction. In the ornamentation the two species resemble each other very closely, although marginal tubercles seem to be developed more numerously in *G. Hanni*. On the outer volution an alternation of the marginal tubercles occurs by the swelling of each second rib along the marginal shoulder. In some fragments even marginal tubercles occurring regularly on each rib have been noticed.

The Tibetan species from exotic block No. 2 cannot, therefore, be united with *G. Hanni* from the triassic belt of the main region of the Himálayas.

GRIESBACHITES PSEUDOMEDLEYANUS nov. sp. Pl. VII, figs. 1, 2; IX, fig. 7.

1902. *Juvavites* (*Griesbachites*) *Medleyanus* (Stoliczka) A. v. Krafft, Mem. Geol. Surv. of India, Vol. XXXII, Pt. 3, p. 143.

There seems to exist a similar relationship between this species and *Griesbachites Medleyanus* Stol. from the upper trias of Spiti as between *G. cf. Kastneri* and *G. Hanni* v. Mojs. They are, indeed, very closely allied, and their identification was only a slight mistake of A. v. Krafft's, which is easily understood if we consider that the sutural line of his Tibetan specimens was not known to him.

Two well-preserved examples of large size are before me. In the smaller one (fig. 2) one quarter of the last volution belongs to the body-chamber. In the larger specimen (fig. 1) I have not been able to discover any trace of septa, but from its size and sculpture we may assume that at least one half of the last volution forms part of the body-chamber.

In their external shape both specimens agree exactly with the type-specimen of *Griesbachites Medleyanus* Stoliczka (Mem. Geol. Surv. of India, Vol. V, p. 54,

Pl. IV, fig. 5) as figured anew and redescribed by E. v. Mojsisovics (Himálayan Foss., Vol. III, Pt. 1, p. 38, Pl. X, fig. 2). The whorls overlap one another up to the rounded umbilical margin, and are higher than wide. The lateral parts are gently curved and pass into the regularly rounded siphonal part without the intervention of any marginal shoulder. The umbilicus is deep, but very narrow.

In contrast to the faintly marked lateral ornamentation of *G. Medleyanus* the sculpture is strongly developed in the present species, and not restricted to the chambered portions of the shell. In my smaller specimen it is continued as far as the aperture, although with diminishing strength, whereas in the larger example (fig. 1) the lateral parts in the anterior half of the last volution are nearly smooth.

The sculpture consists of numerous broad and low folds, which are of an approximately radial direction, not sigmoidal as in *G. Kastneri* or in *G. Hanni*. The majority of ribs are dichotomous. In the smaller specimen they are interrupted along the middle of the external part, alternating distinctly on the two halves of the shell. In the larger specimen, where the ornamentation on both sides of the last whorl corresponds pretty well, a large number of the ribs are not interrupted, but closing together on the siphonal area.

Fourteen marginal tubercles are counted within the circumference of the last volution in my smaller specimen. They are already developed at the beginning of the last whorl and, consequently, are not confined to the body-chamber. Whether or not this has also been the case in the larger specimens cannot be decided, but there is no doubt that in the latter the development of marginal tubercles sets in at later stages of growth only, the posterior quarter of the last volution being still free from any marginal sculpture. In this specimen the marginal tubercles attain very considerable dimensions, swelling out into high and elongated "ears" in the vicinity of the aperture. In my smaller specimen the tubercles in the anterior portion of the shell are also distinguished by their remarkable size.

#### Dimensions.

	Fig. 1.	Fig. 2.
Diameter of the shell . . . . .	122 mm.	113 mm.
" " " umbilicus . . . . .	9 "	7 "
Height of the $\zeta$ above the umbilical suture . . . . .	67 "	61 "
last volution $\zeta$ " " preceding whorl . . . . .	40 "	32 "
Thickness of the last volution . . . . .	54 "	55 "

*Sutures.*—The sutural line, as far as known, differs remarkably from that in *G. Medleyanus* and bears a greater similarity to the sutures of *Anatomites* than to the group of *Juvavites interrupti*. The main saddles are not as narrow and slender as in *G. Medleyanus*, but rather broad and of nearly equal height. The second lateral saddle is provided with three large lateral lappets on its umbilical slope. The third lappet is separated from the preceding one by a deep incision, which might be considered eventually as a rudimentary auxiliary lobe. The actual auxiliary lobe terminates in two sharp points and is followed by a large

auxiliary saddle. Thus the second lateral saddle and the auxiliary series are united into a sort of suspensive lobe.

A similar intimate connection of the second lateral and auxiliary saddles is noticed in several species of *Anatomites*, especially in *A. Bacchus* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-2, p. 143, Taf. LXXXVII, fig. 20) or in *A. Philippii* v. Mojsisovics (l. c. p. 128, Taf. LXLIII, fig. 3).

This difference in the character of the sutural line justifies a specific separation of the present form from *Griesbachites Medleyanus*.

GRIESBACHITES nov. sp. ind. Pl. VII, fig. 7.

The generic position of the only specimen available for examination cannot be fixed with full certainty. This specimen, which is incomplete, badly preserved, and somewhat distorted by pressure in the rocks, belongs to an undeterminable species, which seems to be related to the group of *Juvavites continui*. All lateral ribs cross the external part without any interruption. On the other hand they are not forked three or four times, as in the Alpine representatives of the group of *Juvavites continui*, but are only dichotomous. Simple, intercalated, and forked ribs occur in almost equal numbers. This is a kind of sculpture which reminds us more strongly of the group of *Griesbachites Hanni* than of *Juvavites s. s.* In the vicinity of the aperture traces of marginal tubercles are noticed, but so indistinctly that their presence could not be ascertained.

I have provisionally referred this specimen to the subgenus *Griesbachites*. Provided this determination were correct, it should certainly be considered as a new species, although, on account of its incompleteness, it is preferable to refrain from the imposition of a new specific name.

*Dimensions*.—Not measurable.

*Sutures*.—Not known.

Subgen. : *ANATOMITES* v. Mojsisovics.

*ANATOMITES* sp. ind. aff. *CAMILLI* v. Mojs. Pl. VII, fig. 5.

A single specimen consisting of air-chambers only agrees pretty well in its outlines and sculpture with *Anatomites Camilli* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, VI-2, p. 103, Taf. XCI, fig. 3) from the caraic Hallstatt limestone of Aussee.

The shell is of very globose shape, more strongly inflated than in *A. Camilli*, and is provided with a robust sculpture. In the vicinity of the umbilicus the number of broad and coarse stem-ribs is comparatively small, but towards the marginal shoulders their number increases considerably by bifurcation, which is

repeated in such ribs as precede the deep paulostome furrows. These paulostome-furrows are turned forward more strongly than the normal intercostal valleys, which are directed radially.

Three paulostome-furrows are counted within the circumference of the last volution. This is probably also the normal number of paulostomes in *A. Camilli*, the posterior part of the last volution having been so considerably injured in the Alpine type-specimen that the presence of a third paulostome could not be ascertained by E. v. Mojsisovics.

The ribs are not arranged symmetrically to the median plane of the shell, although an exact correspondence in all details does not exist. They cross the siphonal part without any distinct interruption, but some of them are turned very low at the place where they meet from both sides of the shell.

*Dimensions.*

Diameter of the shell . . . . .	29 mm.
"    "    "    umbilicus . . . . .	3 "
Height of the { above the umbilical suture . . . . .	16.5 "
last volution { "    "    preceding whorl . . . . .	8.5 "
Thickness of the last volution . . . . .	24 "

*Sutures.*—Not known.

*Remarks.*—Although this specimen agrees very remarkably with *Anatomites Camilli* in its sculpture, especially in the division of ribs and in their arrangement in reference to the paulostome-furrows, I dare not venture on an identification on account of its more strongly inflated shape. Among the numerous species of *Anatomites* from the upper-triassic rocks of Sicily, as described and figured by Gemmellaro, there is none which might put in a claim for a closer comparison.

ANATOMITES sp. ind. ex aff. HENRICI v. Mojs. Pl. VII, fig. 9.

This species may be looked upon as a Himālayan representative of the Alpine group of *Anatomites Bacchus* v. Mojsisovics (Cephalopoden der Hallstätter Kalke l. c. VI-2, p. 143, Taf. LXXXVI, fig. 73 LXXXVII, figs. 14-21). It is closely allied to this form or perhaps still more so to *A. Henrici* v. Mojsisovics (l. c. p. 146, Taf. LXXXVIII, figs. 11, 12), agreeing with the latter not only in the absence of any distinct sculpture, but also in the compressed shape of its transverse section.

From *Anatomites Bacchus*, and from its Indian representatives in the Tropites beds of Spiti which have been illustrated on Pl. XIV, figs. 6, 7, of the third part of Vol. V of this series, it differs by its narrow whorls, which are but slightly thicker than high, and by the absence of any keel-like elevation in the middle of the regularly rounded siphonal part. An identification with either *Jovites* or *Isculites* is at once excluded on account of the absence of an expanding umbilicus. Although the general shape might at first suggest an affinity of our species with *Arcestes* rather than with *Anatomites*, the arrangement of the sutural line proves it to be a representative of the family of *Juracitinae*.



The cast of the nucleus being strongly weathered, no traces of ornamentation have been noticed.

*Dimensions.*

Diameter of the shell	.	.	.	.	.	35 mm.
" " umbilicus	.	.	.	.	ab.	"
Height of the	{	above the umbilical suture	.	.	.	19 "
last volution		" " preceding whorl	.	.	.	8 "
Thickness of the last volution	.	.	.	.	.	21.5 "

*Sutures.*—As far as known, exhibiting the general characters of the sutural line in the genus *Juvavites*. Details not accessible to examination.

## ANATOMITES sp. ind. ex aff. CRASSEPLICATO v. Mojs.

A fragmentary cast, unworthy of illustration, belongs to a large species of the subgenus *Anatomites*, which reminds us of *A. crasseplicatus* v. Mojsisovics (Cephalopoden der Hallstaetter Kalko l. c. VI-2, p. 139, Taf. XCIV, figs. 6-10) from the carnic Subbullatus beds of the Salzkammergut, on account of its globose shape and of its broad folds which are restricted to the outer half of the shell and are separated by narrow intercostal furrows. Two low paulostome-furrows are noticed in the vicinity of the aperture, exactly as in the Alpine specimen of *A. crasseplicatus* illustrated by E. v. Mojsisovics in fig. 10 on Pl. XCIV of his memoir.

With this specimen our fragment agrees in its size, but it does not possess an expanding umbilicus.

## Gen.: GONIONOTITES. Gemmellaro.

GONIONOTITES cf. ITALICUS Gemmellaro. Pl. IX, fig. 9; V, figs. 6, 7.

1904. *Gonionotites italicus* Gemmellaro, I cefalopoli del trias superiore della regione occidentale della Sicilia, p. 158, Tav. V, Figs. 6, 7; IX, figs. 6, 7; XXI, figs. 4-6; XXX, fig. 8.

This species is represented by two inner nuclei (Pl. V, figs. 6, 7) and a larger fragment in which the last septum is situated close to the aperture. That the two nuclei and the larger specimen do really belong to the same species is obvious from a comparison of the inner whorls of the latter, which agree in every respect with the figured nuclei.

The inner volutiones are strongly compressed, discoidal, with a high and narrow cordiform transverse section. The small umbilicus is surrounded by a steep wall and separated from the lateral parts by a rounded-off margin. The greatest transverse diameter coincides with the umbilical margin. From this place the flattened sides converge very gradually towards the siphonal part, which is regularly rounded.

The sculpture consists of numerous sigmoidal folds, which are developed more strongly in the vicinity of the marginal shoulders than in the umbilical region. They are either simple or dichotomous. Exceptionally a first bifurcation is noticed

at a point about one-third of the height of the whorl, and a second one near the marginal shoulders. The ribs are interrupted along the middle of the external part.

In the two nuclei the ornamentation becomes gradually obsolete in the vicinity of the aperture. Constrictions or paulostome ribs have not been noticed.

In the larger fragment, which consists of an inner nucleus and the six last air-chambers preceding the body-chamber, the ornamentation of the test has been completely obliterated. At the same time the transverse section becomes high and very strongly compressed. The external part is sharpened into a steeply rounded and narrow ridge. The inflation of the shell in the vicinity of the peristome, as it has been described in the type-specimen of *Gonionotites italicus* by Gemmellaro, could not be noticed in this fragment, whose aperture is situated immediately in front of the last septum.

#### Dimensions.

	Larger fragment. Pl. IX, fig. 9.	Inner nucleus. Pl. V, fig. 6.
Diameter of the shell . . . . .	?	30 mm.
" " umbilicus . . . . .	?	2.5 "
Height of the { above the umbilical suture . . . . .	46 mm.	17 "
last volution { " " preceding whorl . . . . .	32 "	10 "
Thickness of the last volution . . . . .	23.5 "	12 "

*Sutures.*—There are five saddles outside the umbilical suture, but the two auxiliary saddles could not be examined in detail.

Siphonal lobe broad and nearly as deep as the principal lateral lobe. It is divided by a broad and pyramid-shaped median prominence, whose apex is flatly rounded and accompanied by a small indentation on each side. The median prominence does not reach half as high as the siphonal saddle.

Principal lateral lobe deeply serrated, terminating in two sharp points which are separated by a median indentation. Second lateral lobe considerably shorter, ending with an elongated terminal point, with lateral digitations arranged symmetrically on each side. Saddles provided with distinctly individualized, foliaceous branches, especially the siphonal saddle, which is bipartite at its top, the two apical branches being subdivided by secondary incisions. The two lateral saddles, which are also richly ornamented, have their apices divided asymmetrically, the external phylum exceeding the internal one in size and height.

The sutures do not agree in all their details throughout the chambered outer volution of the fragment illustrated, but show some variations, which may, however, be attributed to an accidental difference in the weathering of the surface of the cast.

*Remarks.*—This Himálayan species agrees so closely with *Gonionotites italicus* Gemm., that in a better and more complete state of preservation of the larger specimen at hand I should not have hesitated in venturing on a direct identification. The difference in the details of the complicated sutures is so slight that they can scarcely be considered as distinctive features of specific importance.

## CERATITOIDEA.

Fam. : *DINARITIDÆ* v. Mojs.Gen. : *TIBETITES* v. Mojsisovics.*TIBETITES BHOTENSIS* nov. sp. Pl. VI, fig. 5.

The figured specimen, tolerably completely preserved, is an adult individual, more than one-third of its last volution belonging to the body-chamber. The shape and sculpture of the body-chamber agree exactly with those of the chambered parts of the shell. Thus the reference to *Tibetites s. s.* is justified. The complete absence of any notchings in the external ears distinguishes our species from the genus *Cyrtopleurites*, to an Alpine representative of which it is otherwise nearly allied.

Among the hitherto described Himálayan species of *Tibetites* the nearest allies to the present one are *T. Ryalli* v. Mojsisovics (Upper-triassic faunæ of the Himálayas, Palæont. Ind. ser. XV, Himál. Foss., Vol. III, Pt. 1, p. 77, Pl. XV, figs. 3, 4) from the Halorites limestone of the Bamanag cliff, and a second unnamed species from the upper Daonella beds of the same locality, which differs from the preceding one by being more delicately ribbed and therefore ornamented more richly.

The chief difference from *T. Ryalli* consists in the entire absence of any lateral tubercles. The stem-ribs are broad and bifurcate at a point situated below the middle of the height of the volution, but the point of bifurcation is not marked by any swelling of the ribs. There are only two rows of tubercles, one of them corresponding to the marginal shoulders, and the second consisting of large external ears. The marginal tubercles are small, of circular outlines, not elongated spirally. The number of intercalated ribs in the upper half of the sides is very small. Two marginal tubercles correspond, as a rule, to one primary stem-rib.

In its general shape this species agrees very nearly with *Tibetites Ryalli* v. Mojs. and with *Cyrtopleurites Herodoti* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, l. c. VI-2, p. 518, Taf. CLVIII, fig. 10). The whorls overlap one another almost completely and are strongly compressed, the transverse section being considerably higher than broad. The umbilicus is comparatively wide. The narrow and slightly depressed mesial band, which is enclosed within the external ears, undergoes no change from the beginning up to the aperture of the last volution.

*Dimensions.*

Diameter of the shell	. . . . .	39	mm.
" " " umbilicus	. . . . .	4.5	"
Height of the	} above the umbilical suture	22.5	"
last volution		17	"
Thickness of the last volution	. . . . .	14	"

*Sutures*.—Not known in detail. A more exact characterisation is not possible on account of the defective preservation of the sutural line.

## NAUTILOIDEA.

Fam. : *ORTHO CERATIDÆ*.Gen. : *ORTHO CERAS* Breyn.*ORTHO CERAS* div. sp. ind.

A few fragments of *Orthoceras*, unworthy of illustration, are only sufficient to determine the genus. There are at least two species present. The fragment of a large body-chamber, with parts of the striated shell adhering to the cast, belongs to the group of *Orthocerata striata*. The majority of isolated air-chambers belongs to a species of the group of *O. lævia*. Their dimensions and the small angle of divergency remind one of *Orthoceras triadicum* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, l. c. VI-1, p. 4, Taf. I, figs. 2, 3), but their incomplete state of preservation renders them unfit for specific determination.

Fam. : *CLYDONAUTILIDÆ* v. Mojs.Gen. : *PROCLYDONAUTILUS* v. Mojs.*PROCLYDONAUTILUS TRIADICUS*. v. Mojsisovics. Pl. I, fig. 1.

1873. *Nautilus triadicus* E. v. Mojsisovics, Cephalopoden der Hallstaetter Kalke, l. c. VI-1, p. 27, Taf. XIV, figs. 1-4.  
 1902. *Proclydonautilus triadicus* v. Mojsisovics, *ibidem*, Supplementbd. p. 209.  
 1904. *Clydonautilus triadicus* Gemmellaro, I cefalopodi del trias sup. della regione occid. della Sicilia, p. 7, Pl. I, figs. 14, 16.  
 1904. *Proclydonautilus triadicus* P. Smith, Comparative stratigraphy of the marine trias of Western America, Proceed. California Acad. of Sciences, 3d ser. Vol. 1, p. 401, Pl. XLVII, fig. 2.  
 1905. *Proclydonautilus triadicus* Hyatt et Smith, Triassic cephalopod genera of America, U. S. Geol. Surv. Profess. Papers No. 40, p. 206, Pl. XLIX, figs. 1-3; L, figs. 1-17.

The only specimen available for examination agrees so closely with the type-specimen of *Proclydonautilus triadicus* from the Carnic Hallstatt limestone of the Salzkammergut, that a direct identification cannot be avoided.

My specimen is of moderate size, and provided with the beginning of the body-chamber. It has slowly increasing whorls, which overlap one another completely, and a closed umbilicus. The transverse section is ovoid, the flatly curved lateral parts passing into the steeply rounded external part without intervention of any marginal shoulder. The aperture is of equal height and width.

The shell, which has been preserved entirely on one side of the last volution, is smooth, without any trace of a longitudinal or transverse sculpture. Not even striæ of growth have been noticed.

*Dimensions.*

Diameter of the shell . . . . .	42 mm.
"    "    umbilicus . . . . .	0 "
Height of the { above the umbilical suture . . . . .	27 "
{ "    "    preceding whorl . . . . .	19 "
Thickness of the last volution . . . . .	27 "

*Sutures.*—The septa are situated very close to each other, especially those preceding the last septum, the lateral walls of the saddles even touching one another occasionally.

Siphonal lobe small and narrow, not divided by a median prominence. Lateral lobe broad, deep, and tongue-shaped. A small umbilical lobe follows outside the large and regularly rounded lateral saddle.

*Siphuncle.*—Not known.

*Remarks.*—The specimen of *Proclydonautilus* from the carnic stage of Castromuovo in Sicily, which has been identified with *P. triadicus* by Gemmellaro, differs slightly from the Alpine and Himálayan examples of this species by its whorls increasing still more slowly. But as it agrees with them in the remaining characters, especially in the arrangement of the sutural line, there is no sufficient reason for a specific separation.

The specimens from the Subbullatus beds of California, as described and illustrated by J. Perrin Smith, seem to agree with the Alpine type as closely as my Himálayan example.

*Proclydonautilus triadicus* must be counted among the most wide-spread cephalopoda of the carnic stage, being almost universally distributed throughout the triassic seas.

PROCLYDONAUTILUS BUDDHAICUS nov. sp. Pl. I, figs. 2, 3, 7.

This species is very nearly allied to *Proclydonautilus Griesbachi* v. Mojsisovics (Upper-triassic faunæ of the Himálayas, Pal. Ind. ser. XV, Himál. Foss. Vol. III, Pt. 1, p. 123, Pl. XXII, fig. 1) and to *P. Griesbachiiformis* Diener (Fauna of the Tropites limestone *ibid.*, Vol. V, Pt. 1, p. 15, Pl. XVII, fig. 2).

My type-specimen, which is provided with its body-chamber, attains large dimensions. It is strongly involute, provided with a very small umbilicus and with high, laterally compressed whorls. The inflated siphonal part is separated from the converging lateral parts by distinct marginal shoulders. In the inner volutions these shoulders form sharp angles, which are slightly elevated above the general convexity of the shell. These acute rims, which recall the blunt keels in *Norites*, make their appearance at an early stage of development. At the beginning of the last volution the elevated sharp rim is reduced to an acute edge,

which passes gradually into a rounded angle. Near the aperture this broadly rounded angle forms the boundary of the external part, which is inflated still more strongly than in the adolescent stage.

This mode of development is just the contrary of what is seen in *P. Griesbachi* v. Mojs. In *P. Griesbachi* the inner volutions possess a regularly cordiform transverse section, their inflated external part merging into the sides with a continuous swelling, without even the indication of an angle. It is only in later stages of growth that angles are developed, which are most conspicuous in the vicinity of the aperture. In its developmental features our species agrees better with *P. Griesbachiformis* from the Tropites limestone of Byans, which is also distinguished by the presence of sharp marginal angles at very early stages of growth. But in this species the elevated keel-shaped rims persist also in the gerontic stage.

Another feature of distinction between *Proclydonautilus buddhaicus* and *P. Griesbachiformis* is the shape of the transverse section in the siphonal region. In *P. buddhaicus* the siphonal area is strongly inflated, whereas it is depressed and even deeply excavated between the marginal keels in *P. Griesbachiformis*. Otherwise the transverse section is very similar in both species. The lateral parts regularly converge from the place where the shell reaches its greatest transverse diameter, *i. e.*, from the vicinity of the umbilical margin. There is no umbilical edge present, but the flank descends in a strongly bent curve from the region of the greatest inflation to the umbilical suture.

The sculpture of the test consists of delicate transverse striæ which are approximately parallel to the septa.

#### Dimensions.

Diameter of the shell	110 mm.
" " " umbilicus	6 "
Height of the } above the umbilical suture	75 "
last volution } " " preceding whorl	52 "
Thickness of the last volution	67 "

*Siphuncle*.—In the last air-chambers the orifice of the siphuncle is situated above the middle of the distance between the external parts.

*Sutures*.—Agreeing with those of *P. Griesbachi*. Siphonal lobe not divided by a median prominence.

*Remarks*.—There seems to exist a very near affinity between *Proclydonautilus buddhaicus* and the American genus *Cosmonautilus* Hyatt et Smith (Triassic cephalopod genera of America, U. S. Geol. Surv. Prof. Pap. No. 40, p. 207). The typical species, *Cosmonautilus Dilleri* (l. c. p. 207, Pl. LI, fig. 1; LII, fig. 1; LIII figs. 1, 2; LIV, figs. 1-4; LV, figs. 1-11) develops marginal edges at a very early stage of growth, but these edges become adorned with tubercles, until the shape and sculpture are very like those in *Melacoceras* Hyatt. At the diameter of 35 mm. the tubercles become obsolete and the marginal shoulders lose their angularity.

Having succeeded in chiseling out the inner nucleus of a second specimen of *P. buddhaicus* with a diameter of 25 mm., I could ascertain the entire absence of

any marginal tubercles. This species does not, therefore, go through a *Metaco-ceras* stage, as does *Cosmonautilus*. The absence of *Metaco-ceras*-characters in the young stage, and the persistence of marginal edges into more advanced stages of growth—they do not become obsolete, before a diameter of 55 mm. has been reached—distinguishes our Indian shell from *Cosmonautilus*, which, according to the present stage of our knowledge, is confined to the American trias.

P. Smith has suggested that *Clydonautilus biangularis* v. Mojsisovics (Himálayan Foss., l. c. Vol. III, Pt. 1, p. 124, Pl. XXII, figs. 2, 3) from the Halorites limestone of the Bambanag section might belong to his genus *Cosmonautilus*, "as may also some of the European species assigned by E. v. Mojsisovics to *Clydonautilus*." But with this view I cannot agree, because the two forms differ widely by their mode of development. Young specimens of *Clydonautilus biangularis* have a rounded siphonal part. The two marginal angles, which are not combined with any tubercles, make their appearance simultaneously with the flattening and individualisation of the external area only at a diameter of about 16 mm. Even in old age the external part remains flattened and is not inflated.

Gen.: *STYRIONAUTILUS* v. Mojsisovics.

*STYRIONAUTILUS* nov. sp. ind. Pl. II, fig. 1.

Of this interesting species only a single, fragmentarily preserved cast of the body-chamber has been found, with the last air-chamber and a small part of the inner nucleus adhering. The reference to the genus *Styrionautilus* v. Mojsisovics has been established with full certainty, the siphonal saddle having been observed crossing the external area without any indication of a siphonal lobe.

There is no species to which the present one appears to be nearly allied. From the Alpine representatives of the genus *Styrionautilus* it is distinguished by the biangular shape of its cross-section and by its very high and strongly compressed whorls. In the inner volutions the sides converge from the place of the greatest inflation outside the deep umbilicus towards the narrow external part in a very flat curve. The siphonal area is truncated and bordered by sharp marginal angles. In the body-chamber these marginal angles become obsolete, and the flanks pass gradually into the external part which is no longer truncated but steeply rounded. The deep umbilicus is surrounded by a perpendicular wall which unites with the lateral parts in a sharply rounded edge.

*Dimensions*.—Not measurable, on account of the defective state of the figured specimen. In the body-chamber a height of the last volution of 49 mm. corresponds to a transverse diameter of 29 mm.

*Siphuncle*.—Elongated elliptically in the direction of the radius. Its position is approximately central in the last air-chamber.

*Sutures*.—The siphonal saddle crosses the external area in a straight line which is not interrupted by any mesial depression. The present species is therefore

a typical representative of the genus *Styrionautilus*, in the sutures of which no transitional stage is marked to *Proclydonautilus* or *Clydonautilus*. The deep lateral lobe is tongue-shaped, as in *Styrionautilus styriacus* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, Abhandl. K. K. Geol. Reichsanst. VI-1, p. 27, Taf. XIV, fig. 7) or in *St. Sauperi* v. Hauer. It is followed by a large lateral saddle and by a rounded umbilical lobe. An internal or annular lobe has not been observed.

Fam.: GRYPONAUTILIDÆ.

Gen.: GRYPOCERAS HYATT.

GRYPOCERAS SUESSIIFORME nov. sp. Pl. X, fig. 1.

This is a very interesting species, recalling *Gryponautilus Suessii* v. Mojsisovics (Cephalopoden der Hallstaetter Kalke l. c. VI-1, p. 26, Taf. VI, fig. 11, Taf. XIII, fig. 2), but distinguished by its wider siphonal area and by the persistence of an open umbilicus in advanced stages of growth.

There is only one specimen available for examination. It is a cast, with some fragments of the shell adhering to the siphonal and lateral parts. More than three-quarters of the last volution consist of air-chambers. As the beginning of the body-chamber has been preserved, the complete example must have been considerably inferior in size to full-grown specimens of *G. Suessii*.

In its shape, sculpture and sutures the figured specimen is very similar to *G. Suessii*. The whorls are very thick, their transverse section being twice as broad as high. The greatest transverse diameter is situated in the lower third of the lateral parts. From this place the strongly inflated flanks converge both towards the abdominal and umbilical margins. The external area is broad, gently arched and separated from the lateral parts by sharp edges, which are accompanied by a row of small, spirally elongated, very low and blunt tubercles along their external slopes. About 25 tubercles are counted within the circumference of the last volution.

The width of the external area is considerably larger than in *G. Suessii*. In my type-specimen an external area of 18 mm. in width corresponds to a transverse diameter of 37 mm., whereas in the Alpine species the respective proportions are as 12.5 to 34 or as 21 to 67 mm. Another feature of difference is the flattened shape of the external area in *Gryponautilus Suessii*, whereas it is slightly convex in the Himalayan species.

The umbilical margin is steeply rounded and is bordered by a perpendicular umbilical wall. The umbilicus is comparatively wide, wider than in the smaller of the two Alpine type-specimens of *G. Suessii*, illustrated by E. v. Mojsisovics, which consists of air-chambers only. As the beginning of the body-chamber has been preserved in my Himalayan example, the umbilicus cannot have been closed, as



in full-grown specimens of *G. Suessii*. The present species must consequently be grouped with the genus *Grypoceras s. s.*, not with the subgenus *Gryponautilus* v. Mojs.

The lateral parts of this species exhibit the delicate transverse sculpture which has been described in *Gryponautilus Suessii* by E. v. Mojsisovics. It consists of sharp, crescentic ledges with their convexities turned forward, which originate in the blunt tubercles of the marginal edges.

*Dimensions.*

Diameter of the shell . . . . .	.	46 mm.
" umbilicus . . . . .	.	65 "
Height of the (above the umbilical suture . . . . .	.	24 "
last volution { " " preceding whorl . . . . .	.	17.6 "
Thickness of the last volution . . . . .	.	37 "

*Sutures.*—Agreeing with those of *G. Suessii*. External saddle divided by a very flat lobe. Lateral lobe gently curved and followed by an equally flat lateral saddle.

*Siphuncle.*—Not known.

Fam. : *TEMNOCHELIDÆ.*

Gen. : *MOJSVAROCERAS* Hyatt.

*MOJSVAROCERAS* sp. ind. ex aff. *TURNERI* Hyatt et Smith. Pl. I, fig. 4.

This is a single fragment of the outer volution of a *Nautilus* consisting of four air-chambers and of the beginning of the body-chamber. It was strongly evolute and provided with little embracing whorls and with a wide umbilicus. The transverse section is subquadrangular and considerably wider than high. The lateral parts are flattened and separated from the steep umbilical wall by a sharply rounded margin and from the gently curved siphonal area by acute abdominal edges.

Surface nearly smooth, but ornamented with two rows of faint tubercles outside the umbilical margin and on the abdominal edge.

*Dimensions.*—Not measurable.

*Siphuncle.*—Below the centre of the whorl.

*Sutures.*—Septa very simple, slightly sinuous, with very shallow siphonal and lateral lobes and with a broadly curved external saddle. The presence of an internal annular lobe could not be ascertained.

*Remarks.*—This species is more nearly allied to *Mojisvaroceras Turneri* Hyatt et Smith (Triassic cephalopod genera of America, U. S. Geol. Surv. Prof. Pap. No. 40, p. 209, Pl. XLVIII, figs. 6-11) from the *Tropites* beds of California, than to any of the Alpine forms. A more detailed comparison is, however, difficult, on account of the incomplete state of preservation of both the American and Himalayan types.

## DIBRANCHIATA.

Fam.: *BELEMNITIDÆ*.Gen.: *ATRACTITES* Guembel.*ATRACTITES* sp. ind.

A slab of rock contains numerous fragments of rostra, which are perfectly smooth, without any ribs or furrows. They are elongated, with a circular transverse section. The lumen of the funnel does not change throughout the entire length of the rostrum, as far as known.

Among my materials there is no example fit for illustration nor for a specific determination.

Gen.: *DICTYOCONITES* v. Mojsisovics.*DICTYOCONITES* sp. ind. ex aff. *HAUERI* v. Mojs. Pl. II, fig. 2.

The genus *Dictyoconites*, as introduced by E. v. Mojsisovics, comprises such forms of *Aulacoeratinae*, in which the conotheca of the phragmacone is ornamented externally with numerous raised longitudinal lines and with delicate asymptotic ribs, which in the guard or rostrum correspond with deep dorso-lateral grooves.

Among the materials available from the triassic limestone of exotic block No. 2 there is a fragment of the phragmacone of *Dictyoconites*, with a short part of the surrounding guard. It cannot serve for the establishment of the species, although it seems to indicate a form of the group of *D. striati*, nearly allied to *D. Haneri* v. Mojsisovics (Cephalopoden der Hallstætter Kalke, l. c. VI-1, Supplementbd. p. 187, Taf. XIV, figs. 15, 16) from the carnic Hallstatt limestone of Aussee.

The divergent angle of the phragmacone is very small. The conotheca, which has been partly preserved, is ornamented with numerous and delicate longitudinal striæ, among which the asymptotic striæ are not remarkable in any way, either by their strength or by their position. They can only be recognized near the beginning of the calcareous sheet of the rostrum, where deep dorso-lateral furrows are noticed.

The transverse section of the phragmacone is elliptical. A section through the apical region of the phragmacone together with the surrounding guard shows the deep dorso-lateral furrows shifted towards the flattened antisiphonal side. In the conotheca of the phragmacone no transverse ornamentation has been noticed. Both in this absence of a reticulate sculpture and in the slender shape of the

phragmacone the illustrated fragment agrees better with *Dictyoconites Haueri* v. Mojs. than with *D. reticulatus* v. Hauer.

Notwithstanding its unsatisfactory state of preservation this fragment deserves to be mentioned, as it is the first representative of the genus *Dictyoconites* hitherto known in the Indian triassic province.

## CONCLUSIONS.

By far the richest among the mesozoic faunæ collected by A. v. Krafft in the district of the exotic blocks in Malla Johar is that from exotic block No. 2. It consists of the following species :—

(a) *Lamellibranchiata.*

1. *Cassianella* sp. ind.

(b) *Gasteropoda.*

2. *Loxonema* (*Polygyrina*) cf. *elegans* Hoernes.
3. *Sagana* cf. *geometrica* Koken.
4. *Capulus* (*Phryx*) *joharensis* nov. sp.
5. *Naticopsis* sp. ind. ex aff. *obvallata* Koken.

(c) *Ammonoidea.*

6. *Cladiscites crassestriatus* v. Mojs.
7. " cf. *Gorgia* Gemm.
8. " cf. *pusillus* v. Mojs.
9. " sp. ind. cf. *coracis* Gemm.
10. *Hypocladiscites subcarinatus* Gemm.
11. " *subaratus* v. Mojs.
12. *Arcestes* cf. *periolcus* v. Mojs.
13. " cf. *Richthofeni* v. Mojs.
14. " sp. ind. aff. *decepiens* v. Mojs.
15. " cf. *placenta* v. Mojs.
16. *Proarcestes Gaytani* v. Klipst.
17. " sp. cf. *Ausseanus* v. Hauer.
18. " (?) sp. ind. ex aff. *Barrandei* Lbe.
19. " sp. ind. (group of *extralabiate*).
20. *Discophyllites Floweri* nov. sp.
21. *Pinacoceras* sp. ind. aff. *rex* v. Mojs.
22. *Placites* cf. *peractus* v. Mojs.
23. *Discotropites* cf. *sandlingensis* v. Hauer.
24. *Tropites* cf. *subbullatus* v. Hauer.
25. " sp. ind. aff. *acutangulo* v. Mojs.
26. " sp. ind. aff. *Wodani* v. Mojs.
27. *Anatropites* cf. *spinosus* v. Mojs.
28. " *Pilgrimi* nov. sp.
29. *Margarites irregularicostatus* nov. sp.
30. *Jovites* cf. *spectabilis* Dien.
31. " *daciiformis* Dien.
32. " nov. sp. ind.

33. *Juvavites Krafti* nov. sp.  
 34. " *Dogranus* nov. sp.  
 35. " nov. sp. ind. ex aff. *subinterrupto* v. Mojs.  
 36. " nov. sp. ind. (group of *continui*).  
 37. *Griesbachites* cf. *Kastneri* v. Mojs.  
 38. " *Pseudomedleyanus* nov. sp.  
 39. " nov. sp. ind.  
 40. *Anatomites* sp. ind. aff. *Camilli* v. Mojs.  
 41. " " " ex aff. *Henrici* v. Mojs.  
 42. " " " ex aff. *craspedicato* v. Mojs.  
 43. *Gomionotites* cf. *italicus* Gemm.  
 44. *Tibetites bhotensis* nov. sp.
- (d) *Nautiloidea.*
45. *Orthoceras* sp. ind. (group of *O. lavia*).  
 46. " sp. ind. (group of *O. striata*).  
 47. *Procydonautilus triadicus* v. Mojs.  
 48. " *buddhaicus* nov. sp.  
 49. *Styrionautilus* nov. sp. ind.  
 50. *Grypoceras suessiiforme* nov. sp.  
 51. *Mojsvaroceras* nov. sp. ind. ex aff. *Turneri* Hyatt et Smith.
- (e) *Dibranchiata.*
52. *Atractites* sp. ind.  
 53. *Dictyoconites* nov. sp. ind. aff. *Haneri* v. Mojs.

Altogether 53 species—among which the Cephalopoda, numbering 48 species, by far predominate, both in species and in individuals. The red limestone of exotic block No. 2 may consequently be termed a cephalopod-bearing facies with equal reason with the Halorites limestone of the Bambanag range or the Tropites limestone of Byans. In the richness of species it is but little inferior to the Halorites limestone, from which 69 species (62 ammonites) have been described hitherto by E. v. Mojsisovics and by myself.

Leaving out of discussion those forms which do not admit of specific determination or of a closer comparison with any species hitherto described, there remain 45 species.

The most important fact appearing on a first glance at the preceding list is the very large percentage of species nearly allied to European forms. The number of faunistic elements peculiar to the Indian triassic province is comparatively small. There is only one single genus of exclusively Indian habit (*Tibetites*) represented in this fauna. A special stress must be laid on the very close affinity with the carnic faunæ of the Alpine Hallstatt limestone, because in none of the faunæ from the triassic belt of the main region of the Himālayas are such affinities indicated as clearly and strongly. In all triassic horizons of the main region of the Himālayas which are rich in Cephalopoda species representing types which differ widely from Alpine forms occur in considerable numbers, whereas in this fauna they are of very rare occurrence.

This close affinity of the fauna of exotic block No. 2 with the faunæ of homotaxial beds in Europe is so much the more important, as the determination of its geological age must be based on palæontological evidence only, the exotic block itself exhibiting no stratigraphical connection with the surrounding beds.

With regard to its general character, the fauna of exotic block No. 2 bears the stamp of the *carnic* age so indubitably that it seems to me superfluous to discuss its correlation with the *carnic* Hallstatt limestone of the Alps. There is not a single form among the Cephalopoda which might point to either *ladinic* or *noric* (juvavic) affinities, not even *Tibetites bhotensis*, which belongs to a genus appearing already in *carnic* beds although it reaches its chief development in the lower *noric* stage only.

It is more difficult to establish a more exact determination of the geological age. An analysis of the fauna shows that it has relations both with the *julic* and *tuvalic* faunæ. It remains therefore for me to decide whether it should be correlated with the zone of *Trachyceras Aonoides* (*julic* substage) or with that of *Tropites subbullatus* (*tuvalic* substage). A. v. Krafft, from a cursory examination of his fossil materials, has decided in favour of a correlation with the zone of *Tropites subbullatus*, but from a detailed analysis we shall learn an almost equal distribution of the elements of the two Alpine zones in our *Himálayan* fauna.

It will be found convenient to treat the affinities of our fauna with each *carnic* fauna of extra-*Himálayan* districts separately, although the palæontological evidence must rely chiefly on a comparison with the *julic* and *tuvalic* faunæ of the Alpine Hallstatt limestone.

The assemblage of genera being almost the same in both zones, we are obliged to investigate the specific affinities of the Cephalopoda, which by far predominate over all the rest of the organic remains. All forms, which have not been determined specifically but designated only according to their relationship with Alpine types, are of very little service for an identification of the exact geological horizon. For this purpose such species only can be taken into consideration as are either directly identical with, or so closely allied to, Alpine types that they could be referred to such as *cf.*

The following species are identical or probably identical with those from the Hallstatt limestone which in Europe connect the faunæ of the *julic* and *tuvalic* substages:—

- Loronema cf. elegans* Hoern.
- Saguna cf. geometrica* Koken.
- Cladiscites crassestriatus* v. Mojs.
- Placites cf. peractus* v. Mojs.
- Discotropites cf. sandlingensis* Hau.
- Proclydonautilus triadicus* v. Mojs.

The following species are identical or probably identical with species which in the Alpine Trias are restricted to the *julic* substage:—

- Cladiscites cf. pusillus* v. Mojs.
- Arcestes cf. periolens* v. Mojs.

*Arcestes cf. Riechthofeni* v. Mojs.  
*Proarcestes Gaytani* v. Klipst.  
 „ *cf. Ausseanus* v. Hau.  
*Anatropites cf. spinosus* v. Mojs.  
*Griesbachites cf. Kastneri* v. Mojs.

As elements pointing to a close affinity with the fauna of the tuvalic substage of the Salzkammergut, the following two species only can be quoted:—

*Arcestes cf. placenta* v. Mojs.  
*Tropites cf. subbullatus* v. Hau.

Among fifteen species identical or probably identical with Alpine forms, seven belong to the julic, two to the tuvalic substage, six are common to both substages. It is evident from this proportion that the greater number of relationships are in favour of a correlation with the julic substage. The circumstance that a species referable to *Tropites subbullatus*, the leading fossil of the tuvalic substage of the Hallstatt limestone, is represented in this fauna, loses much of its importance, as this species is exceedingly rare in the red limestone of exotic block No. 2, and as types allied very closely to *T. subbullatus* make their first appearance in the julic substage (*T. Quenstedti* v. Mojs.). On the other hand those carnian elements which are most conspicuous for their fecundity in species and individuals, especially *Cladiscites*, *Placites*, and *Discophyllites*, are of a rather indifferent habit and do not indicate exclusively either julic or tuvalic affinities.

With the upper-triassic rocks of Sicily the fauna of exotic block No. 2 has six species in common. These are the following:—

*Cladiscites cf. Gorgia* Gemm.  
 „ *cf. coracis* Gemm.  
*Hypocladiscites subcarinatus* Gemm.  
*Gonionotites cf. italicus* Gemm.  
*Discotropites cf. sandlingensis* v. Hau.  
*Proclydonantulus triadicus* v. Mojs.

All these species have been found in the carnian limestone of Modanesi (Castro-nuovo) or Votano (San Stefano Quisquina). *Cladiscites cf. Gorgia* occurs also at Madonna del Balzo, where carnian and noric elements have been mixed together.

The carnian age of the fauna of Votano and Modanesi is obvious from Gemmellaro's lists, but an exact correlation with carnian faunæ of the Eastern Alps has not yet been attempted. G. Di Stefano, it is true, considers the limestone of Votano and Modanesi as a homotaxial equivalent of the Alpine *Subbullatus* beds, but G. v. Arthaber (Die Alpine Trias des Mediterrangebietes, *Lethæa geognostica*, 2 Theil, Bd. I, p. 461) believes with equal reason that both the *Aonoides* and *Subbullatus* zones are represented in the faunæ of those two Sicilian localities.

The region which is geographically least distant from the exotic blocks of Malla Johar is the main region of the mesozoic belt of the Central Himalayas. There are three districts in this region with fossiliferous triassic beds, the faunæ of

which show relations to that of exotic block No. 2. But those relations are less close than the affinities between the present fauna and the carnic faunæ of the Alpine Hallstatt limestone.

With the Daonella beds of Lauka in Kumaon the present fauna has only one species in common, *Hypocladiscites subaratus* v. Mojs., an Indian representative of the group of *Cladiscites subornati*, which differs from the European *Hypocladiscites subornatus* by some very subordinate details.

The number of species probably identical in the faunæ of exotic block No. 2 and of the Tropites limestone of Byaus is five. These species are the following :—

- Proarcestes* cf. *Gaytani* v. Klipst.  
*Jovites* cf. *spectabilis* Dien.  
 „ *daciformis* Dien.  
*Tropites* cf. *subbullatus* v. Hauer.  
*Discotropites* cf. *sandlingensis* v. Hauer.

With the Tropites shales of Spiti the present fauna has the following species in common :—

- Jovites* cf. *spectabilis* Dien.  
*Tropites* cf. *subbullatus* v. Hau.  
*Proarcestes* cf. *Gaytani* v. Klipst.

As species indicating very close affinities the four following might be mentioned :—*Anatomites* sp. ind. ex aff. *Henrici* v. Mojs., which is certainly very nearly allied to *Anatomites* sp. ind. cf. *Bacchus* v. Mojs. from the Tropites shales of Lilang, *Tropites* sp. ind. aff. *acutangulo* v. Mojs., *Juvavites* (*Griesbachites*) *Pseudomedleyanus*, which belongs to the same group of *Juvavitinæ*, as *Griesbachites Medleyanus* of unknown geological age, and *Discophyllites Floweri* Dien., which agrees with *D. Ebneri* from the Daonella beds of Lauka in all characters, except some differences in the arrangement of the sutural line.

The presence of *Tropites* aff. *acutangulo*, *Jovites spectabilis* and *Jovites daciformis* increases the number of species with decidedly tivalic affinities in the present fauna, and consequently reduces the preponderance of julic elements. To the species connecting the faunæ of the julic and tivalic substages in the Indian triassic province *Proarcestes Gaytani* has to be added. Thus the majority of species (7), which are referable to forms previously described, are distributed through both the julic and tivalic substages. Six species point to a closer relation with julic and four with tivalic faunæ.

This analysis seems to show that in the fauna of exotic block No. 2 there is an assemblage of species indicating nearly equal affinities with the zones of *Trachyceras Anoides* and of *Tropites subbullatus*. It cannot therefore be correlated with either of them directly or exclusively, but must be considered as a homotaxial equivalent of both substages.

## III.—FOSSILS FROM EXOTIC BLOCK NO. 5 (MALLA KIOGARH E.G.)

Four exotic blocks of very small size were discovered by A. v. Krafft in the igneous rocks and black shales of the upper Flysch near Malla Kiogarh encamping ground and marked on the map accompanying A. v. Krafft's memoir (Mem. Geol. Surv. of India, Vol. XXXII, Pt. 3) as E. B. 4, 5, 6, 7. Blocks 6 and 7 yielded some fossils of liassic age. In the concretionary limestones of block 4 no fossils were found. Block 5 is described by A. v. Krafft as a massive, much altered red limestone. Among the small number of fossils collected, one Ammonite has been noticed, strongly resembling *Sageceras* (l. c. p. 162). A. v. Krafft consequently considered this block to be of middle or upper triassic age.

The number of fossils suitable for a determination is exceedingly small. The following two species are represented among my scanty materials :—

## CARNITES sp. ind. Pl. XVI, fig. 1.

The fragments, which have been compared to *Sageceras* by A. v. Krafft, belong to a chambered whorl with a narrow and deeply excavated siphonal furrow, which is bordered by sharp, marginal keels. In its external characters this fragment agrees equally well with representatives of the genera *Sageceras* v. Mojs. and *Carnites* v. Mojs., but the character of its sutural line does not admit of any doubt that we have to deal with a species belonging to the latter genus.

Of the sutural line two lobes and saddles only are accessible to examination. The saddles have reached a stage of development transitional between the brachyphyllic and dolichophyllic stages. The outer saddle corresponds with the adventitious saddle, the inner one with the principal lateral saddle in *Carnites floridus* Wulf. The resemblance of the sutures to those of *Carnites floridus* is very striking, but a specific identification of my fragment is, nevertheless, impossible, on account of its too incomplete state of preservation.

## PROARCESTES sp. ind. ex aff. AUSSEANO v. Hauer. Pl. XVI, fig. 2.

A large specimen of *Arcestes* is lying before me, showing a diameter of nearly 100 mm. Notwithstanding its remarkable dimensions it is entirely chambered. The breadth of the whorls surpasses the height considerably. The well-rounded external part passes gradually into the similarly rounded lateral parts. The umbilicus is comparatively broad and surrounded by a high and steep wall. The umbilical margin is obtusely rounded.

In the circumference of the last volution three varices are faintly developed which are directed radially, and cross the external part without being turned forward. This character distinguishes our species from the group of *Arcestes intuslabiati*, which it recalls otherwise by the shape of its umbilicus. The varices are flat and low and disposed at regular distances.



*Dimensions.*

Diameter of the shell . . . . .	97	mm.
" " umbilicus . . . . .	12.5	"
Height of the { above the umbilical suture . . . . .	45	"
last volution { " " preceding whorl . . . . .	21	"
Thickness of the last volution . . . . .	60	"

*Sutures.*—The external part of my specimen having been injured by weathering, it is not possible to examine the details of the siphonal prominence, the most characteristic element in the sutures of *Arcestes*. Otherwise the sutures do not differ from those in the group of *Arcestes bicarinati*. The principal lateral saddle stands on the convexity, by which the external part merges into the sides. There are altogether five saddles outside the umbilical margin.

*Remarks.*—The determination of chambered nuclei of *Arcestidæ* is, as a rule, uncertain, the chief features of distinction having been made on differences of nuclei and body-chambers by E. v. Mojsisovics. Although the present specimen shows in its general characters a great resemblance to *Proarcestes Ausseanus* v. Hauer (Cephalopoden von Aussee, Haidinger's Naturwiss. Abhandl. I, 1877, p. 268, Taf. VIII, figs. 6-8), it can be included in the group of *Arcestes bicarinati* with some reserve only.

## CONCLUSIONS.

The carnio type of the fauna of exotic block No. 5 is obvious from the few remains quoted above, in spite of the great deficiency of the materials. Both *Carnites* and the group of *Arcestes bicarinati* (*Proarcestes*) are restricted to the carnio stage in the Mediterranean region, of which they are characteristic.

## IV.—FOSSILS FROM EXOTIC BLOCKS NOS. 16 AND 17 (KIOGARH HIGH PLATEAU).

South of the Kiogarh high plateau two exotic blocks containing fossils of lower liassic age have been discovered by A. v. Krafft and marked as Nos. 16 and 17 on the map accompanying his memoir. In one place only the limestone was found *in situ*. A. v. Krafft (l. c. p. 166) describes the rock as bedded, concretionary, chiefly of red colour, but with a few grey layers, thicker than the red beds. "It is impossible to say how many liassic blocks were originally present, as they have all been more or less decomposed into large patches of débris. We can distinguish two main occurrences, one (E. B. 17) situated near E. B. 18, a large number of permocarboniferous crags, and the other (E. B. 16) somewhat higher up near the crest of a ridge running from south to north."

The fossils, which were collected by A. v. Krafft in the accumulation of débris at both localities, have not been kept separate, the labels attached to the slabs of rock being marked "E. B. 16 and 17." I have consequently treated the fauna of the two blocks as a single one. Although not rich in well-preserved specimens, it is very interesting on account of its affinity with European faunæ of lower liassic age.

## DIBRANCHIATA.

ATRACTITES sp. ind. Pl. XIV, fig. 1.

In two Himálayan materials a species of *Atractites* is represented by two fragments of phragmacones. They are casts without any trace of the test. The transverse section is circular. Angle of emergency very small. Distance of septa considerable, equal to three-quarters of the diameter of the anterior septum.

The scarcity of my materials excludes any attempt at a specific determination. Phragmacones similar to the present ones have been described from the Margaritatus-beds (middle Lias) of the Schafberg by Geyer (Die mittelliasische Cephalopodenfauna des Hinter Schafberges, Abhandl. K. K. Geol. Reichsanst. XV, Bd. p. 65, Taf. IX, fig. 3). In the lower lias this group of *Atractites* is represented by *A. liasicus* Guembel, and by an unnamed species of Valesaoca (Bukowina), which has been mentioned by Uhlig (Über eine unterliasische Fauna aus der Bukowina, Abhandl. des deutsch. naturwiss. med. Ver. Lotos, Prag, 1900, Bd. II, p. 31). *Atractites italicus* Mich. (= *orthoceroopsis* Savi et Menegh.) is distinguished from our species by its elliptical cross-section.

## AMMONOIDEA.

Fam.: PHYLLOCERATIDÆ, v. Zittel.

Gen.: PHYLLOCERAS, Suess.

PHYLLOCERAS MONTGOMERYI nov. sp. Pl. XIII, fig. 1; XI, figs. 3, 4.

This beautiful species is represented in A. v. Krafft's collection by a large, fairly well-preserved cast, consisting entirely of air-chambers, and by several examples of smaller size. In its shape and sutures it shows a very great resemblance to *Phylloceras persanense* Herb., from which it differs only by some characters of minor importance.

The shell consists of very stout, rather rapidly increasing whorls, which overlap one another to more than one half of their height, and leave a comparatively wide umbilicus open. The cross-section is rectangular with rounded-off margins. The broad siphonal area is flatly arched. The greatest transverse diameter is situated in the middle of the height. The lateral parts are almost flat and pass into the vertical umbilical wall by an obtusely rounded edge. The surface of the cast has been slightly injured by weathering. It cannot be decided therefore whether or not a delicate ornamentation was present. But the absence of constrictions has been ascertained indubitably.

That this species is a Himálayan representative of the European group of *Phylloceras persanense*, is obvious from a comparison of the illustrations given by Uhlig and Fucini. Among the genus *Phylloceras* this group forms a very characteristic section, distinguished by its stout shape and rectangular cross-section and by the remarkable development of the principal lateral lobe among its sutural elements. Among the species from the lower lias belonging to this group there is unfortunately only a single one, *Phylloceras persanense* Herbich (Szeklerland, Mitteil. aus dem Jahrb. der Kgl. Ungarischen Geologischen Anstalt, V, p. 111, Taf. XX, B. fig. 3; XX, F. fig. 1), of which satisfactory information is given by the memoirs of Uhlig (Ueber eine unterliassische Fauna aus der Bukowina, Abhandl. Deutsch. naturwiss. med. Ver. Lotos, Prag, 1900, Bd. II, p. 15, Taf. I, fig. 1) and Fucini (Cefalopodi liasici del Monte di Cetona I, Palæontographia Ital. VII, 1901, p. 22, Tav. IV, figs. 1, 2). To this species our Himálayan type is certainly very nearly allied, although it is specifically different. Both species agree in the shape of the cross-section, which is almost identical, but *Phylloceras Montgomeryi* has more rapidly increasing whorls, which overlap one another less strongly, a wider umbilicus, and no constrictions. The absence of constrictions distinguishes our species likewise from *Ph. Calais* Meneghini (Fossiles du Medolo, Paléont. Lombarde 4e sér. p. 24, Tav. III, figs. 1, 2), *Ph. dubium* Fucini (l. c. Palæont. Ital. VII, p. 27, Tav. V, figs. 5, 6) and *Ph. microgonium* Gemmellaro (Sui fossili degli strati à Ter. *Aspasia* etc., p. 10, Tav. I, figs. 4-6). In the relative size of the umbilicus our Himálayan form agrees better with the latter species than with *Ph. persanense*.

European species of this group, which are conspicuous by the absence of paucostomatic constrictions, are *Phylloceras leptophyllum* v. Hauer, *Ph. subcylindricum* Neumayr, and perhaps *Ph. Hebertinum* Reynès.\*

*Phylloceras leptophyllum* v. Hauer is only known to us by the unsatisfactory description and illustration given by Herbich (l. c. p. 112, Taf. XX, H. fig. 1). It differs from *Ph. persanense* by its whorls increasing more rapidly. In this character it approaches our Himálayan specimens very closely. No front view of F. v. Hauer's type having been figured by Herbich, a closer comparison is, unfortunately, not possible. Provided a complete agreement in their external characters should be proved, no specific identity of *P. leptophyllum* and *P. Montgomeryi* could be established, regarding the difference in the arrangement of their sutures.

*Phylloceras subcylindricum* Neumayr (Zur Kenntnis der Fauna des untersten Lias in den Nordalpen, Abhandl. K. K. Geol. Reichsanst. VII, p. 22, Taf. I, fig. 15) is distinguished by higher, more strongly compressed and more slowly increasing volutions but agrees with *Ph. Montgomeryi* in the width of the umbilicus.

\* *Phylloceras alontinum* Gemmellaro (Sui fossili degli strati à *Terebratula Aspasia*, etc., Palermo, 1887, p. 9, Tav. I, fig. 7; II, figs. 18-20) cannot be counted among those species, as might be suggested from a cursory examination of Gemmellaro's illustration on Pl. I, fig. 7. The smaller example is provided with four or five constrictions, as is obvious from Gemmellaro's description. Pompekj has discovered a species either identical with or very closely allied to *Ph. alontinum* in the liassic strata of Kessik tsch, Asia Minor. This species shows deep constrictions with their direction turned very strongly forward (Palæontologische und stratigraphische Notizen aus Anatolien, Zeitsch. Deutsch. Geol. Ges. 49, Bd. 1897, p. 733, Taf. XXIX, figs. 5-8).

*Phylloceras Hebertinum* Reynès (Essai de géol. et paléont. Aveyronnaises, p. 94, Pl. II, fig. 3) is a dwarf species, with its lateral parts more strongly arched than in *Ph. persanense*. In general its cross-section seems to be less distinctly rectangular, especially in the types from the Medolo, which have been illustrated by Meneghini (Fossiles du Medolo, l. c. p. 30, Pl. III, fig. 6), which is provided with whorls of nearly elliptical outlines. The species from the Kessik tash (Asia Minor), which has been referred to *Ph. Hebertinum* by Pompeckj (Zeitschr. Deutsch. Geol. Ges. XLIX, p. 730, Taf. XXIX, fig. 10), shows a closer affinity to *Ph. persanense* than the types from the Medolo. The greatest transverse diameter is situated in the upper portion of the height, the lateral parts and siphonal area are flattened less distinctly and the umbilicus is narrower than in *Ph. Montgomeryi*.

#### Dimensions.

Diameter of the shell . . . . .		82 mm.
"    "    umbilicus . . . . .		12 "
Height of the { above the umbilical suture . . . . .	}	43.5 "
last volution { " " preceding whorl . . . . .		cca. 35 "
Thickness of the last volution . . . . .		36 "

*Sutures*.—The sutural line is not entirely known to me. As far as accessible to examination it agrees pretty well with the sutures of *Phylloceras persanense*. The less rich ramification of the branches and the more massive shape of the saddles may be partly due to a stronger weathering of the casts in my Himálayan specimens. In the chief characters of the sutural line, namely, in the high position of the siphonal lobe and in the width of the lateral lobes, especially of the principal lateral lobe, there is a complete agreement between the two species.

The principal lateral lobe is nearly twice as deep as the siphonal lobe and is tripartite at its base. The following lobes diminish gradually in depth. The siphonal lobe is narrow, bifid and divided by a median prominence with entire borders. The siphonal saddle is diphyllic. Of its two lateral branches the inner one projects strongly beyond the inner terminal leaf. The lateral saddles are also diphyllic. The principal lateral and siphonal saddles are of nearly equal height.

The sutural line can only be traced as far as the outer wall of the first auxiliary saddle, but from its position we are allowed to suggest that the number of auxiliary elements must have been comparatively small, smaller probably than in the types of *Ph. persanense* illustrated by Uhlig and Fucini.

The sutural line of *Phylloceras leptophyllum* v. Hauer, although imperfectly known to us by Herbig's illustration, differs certainly from the sutures of *Ph. persanense* and *P. Montgomeryi* by the shape of the siphonal saddle. Whether or not Fucini is right in uniting *P. leptophyllum* with *P. conoexum* de Stefani (*Lias inferiore ad Arieti dell' Appennino settentrionale*, Atti Soc. Toscana di scienze nat. in Pisa, Memorie, VIII, 1887, p. 49, Taf. I, fig. 14; II, fig. 16), cannot be decided until larger materials of both species are available for examination.

*Remarks.*—The propriety of uniting the group of *Phylloceras persanense* with the subgenus *Geyeroeras* Hyatt, which has been proposed for the accommodation of *Ph. cylindricum* Sow. and its allies, is questionable. The two groups agree in the rectangular shape of their transverse sections and in the generality of their external characters, but the sutural line of *Ph. cylindricum* is distinguished from the sutures of *Ph. persanense* and its allies by the triphyllic arrangement of the siphonal saddle and by the deep position of the siphonal lobe. To me both characters appear to be of sufficient importance for separating the present species from Hyatt's subgenus *Geyeroeras*.

PHYLLOCERAS SCLATERI nov. sp. Pl. XII, fig. 2; XIII, fig. 3.

This species, which is represented by two nearly complete and well-preserved casts and by some fragmentary examples, is closely allied to *Phylloceras Lipoldi* v. Hauer, from the lower lias of the Mediterranean province. The Mediterranean species, which is well known to us from the memoirs of F. v. Hauer (Beitragæ zur Kenntnis der Heterophyllen in den österr. Alpen, Sitzgsber. Kais. Akad. d. Wiss. XII, 1854, p. 834, Taf. III, figs. 8-10), Reynès (Monographie des Ammonites du Lias inférieur, Atlas Pl. XLIV, figs. 27-31), Geyer (Ueber die liasischen Cephalopoden des Hierlatz bei Hallstatt, Abhandl. K. K. Geol. Reichsanst. XII, p. 220, Taf. I, figs. 13, 14) and Fucini (Cefalopodi liasici del Monte di Cetona, Palæont. Ital. VII, 1901, p. 24, Tav. IV, fig. 9) is distinguished by its comparatively wide umbilicus and ovoid cross-section. In both characters my Himálayan species agrees with the European type, from which it differs, however, by its higher, more strongly compressed whorls, which increase more slowly. But in general the two species approach each other so closely in their external features, that with transitional shapes at hand, the Himálayan form might be termed a large and compressed variety of *Ph. Lipoldi*.

In my larger type-specimen exactly one-half of the last volution belongs to the body-chamber. The umbilical wall is very steep and separated from the flanks by an obtusely rounded edge.

Fucini considers *Phylloceras Hebertinum* Reynès to be the nearest ally to *Ph. Lipoldi*. This near affinity is, however, restricted to the type from Medolo, as illustrated by Meneghini (Fossiles du Medolo, Palæontologie Lomb. IV, Appendice, Pl. III, fig. 6) and not extended to the types from Aveyron as described by Reynès, or from Asia Minor, which have been discovered by Pompeckj. From the present species Meneghini's examples of *Ph. Hebertinum* differ remarkably by their whorls increasing more rapidly, by the absence of a distinctly defined umbilical margin, by their inflated and regularly elliptical—not ovoid—cross-sections, and by their smaller umbilicus.

In *Phylloceras Waehneri* Gemmellaro (Sui fossili degli strati à Ter. Aspasia, p. 11, Tav. I, figs. 1-3) the whorls increase still more rapidly, the umbilicus

is considerably smaller, and the greatest transverse diameter is situated above the middle of the height.

*Phylloceras ancylonotos* de Stefani (Lias inferiore ad Arieti del Appennino settentrionale, Atti Soc. Toscana scienze nat. Pisa, Mem., Vol. VIII, 1887, p. 50, Tav. II, fig. 15), which is considered as identical with *Ph. Lipoldi* by Facini, has been based on a fragment too incomplete to warrant a certain identification. It shows no closer affinity with our Himálayan species, having more elliptical outlines and a narrow umbilicus. What is seen of the sutural line of *Ph. ancylonotos* in de Stefani's illustration does not agree with the sutures of *Ph. Lipoldi*, the siphonal saddle appearing to be considerably larger than the principal lateral one.

*Dimensions.*

Diameter of the shell . . . . .	76 mm.
" " " umbilicus . . . . .	12 "
Height of the (above the umbilical suture . . . . .	38.5 "
last volution ( " " preceding whorl . . . . .	26 "
Thickness of the last volution . . . . .	a. 26.6 "

*Sutures.*—The illustrations of the sutural lines of *Phyll. Lipoldi* in the memoirs of F. v. Hauer, Geyer, and Fucini do not agree in a satisfactory manner. The differences are too remarkable to be explained by the different state of preservation of the examples examined. The sutures illustrated by F. v. Hauer and Geyer show massive saddles with broad stems, whereas the lobe line figured by Fucini is conspicuous by very slender saddles with elongated branches and small terminal phylla. I have had the opportunity of examining Geyer's type-specimen from the Hierlatz and of convincing myself of the absolute correctness of his drawings.

The sutures of *Phyll. Sclateri* take an intermediate position between those in Geyer's type from the Hierlatz and in Fucini's examples from the lower lias of Monte di Cetona, exhibiting saddles which are deeply incised, but provided with large terminal leaves. All saddles are diphyllid, as in *Ph. Lipoldi*. The siphonal lobe is as deep as the second lateral one, not remarkably inferior in length to the principal lateral lobe, and very narrow. All the lateral lobes are tripartite at their base, the median point being the longest.

There are four auxiliary lobes and three corresponding saddles developed in the last septum preceding the body-chamber.

The siphonal saddle has four branches, including the two terminal phylla. It is considerably shorter than the principal lateral saddle.

PHYLLOCERAS sp. ind. aff. SCLATERI, Dien. Pl. XIII, fig. 2.

This species, which is represented by a single, imperfectly preserved cast, recalls still more strongly *Phylloceras Lipoldi* than the typical *Ph. Sclateri*. It has the lateral parts not flattened, but regularly although moderately arched, and a comparatively high and steep umbilical wall, which is separated from the flanks

by an obtusely rounded edge. The umbilicus is wider than in *Phylloceras Lipoldi* and in *Ph. Sclateri*. The whorls envelop one another for two-third parts of their entire height.

*Dimensions.*

Diameter of the shell . . . . .	56 mm.
"    "    umbilicus . . . . .	12 "
Height of the ( above the umbilical suture . . . . .	26 "
last volution l " " preceding whorl . . . . .	20 "
Thickness of the last volution . . . . .	21 "

*Sutures.*—The sutures are distinguished from those of *Phylloceras Sclateri* by a smaller number of auxiliary lobes, corresponding to the larger diameter of the umbilicus. There are only three auxiliary lobes and two saddles developed. The umbilical margin divides the second auxiliary saddle, whereas in *Ph. Sclateri* three auxiliary saddles are exposed within the distance between the second lateral saddle and the umbilical edge.

PHYLLOCERAS HORSEFIELDII NOV. SP. Pl. XII, fig. 3.

The specimen illustrated, a cast consisting of air-chambers only, agrees in its external features with *Phylloceras oenotrium* Fucini (Cefalopodi liasici del Monte di Cetona, Palæont. Ital. VII, 1901, p. 34, Tav. V, figs. 8, 9; VI, fig. 1) in such a remarkable way, that I should not have hesitated to identify it with this characteristic species from the lower lias of Italy but for the fact that the less complicated structure of its sutural line required a specific separation of the Himálayan form.

It is provided with rapidly increasing, very high and strongly compressed whorls, which include a comparatively wide umbilicus. The lateral parts are very flatly curved, reaching their greatest transverse diameter below the middle of their height. The umbilical margin is narrowly rounded.

From the typical shape of *Phylloceras Zetes* d' Orb. (= *Anmonites heterophyllus amalthei* Quenstedt, Cephalopoden, p. 100, Taf. VI, fig. 1) our specimen differs chiefly by its wider umbilicus. It is distinguished both from the species from Enzesfeld, which has been united with *Ph. Zetes* by F. v. Hauer (Cephalopoden aus dem Lias der nordöstlichen Alpen, Denkschr. Kais. Akad. d. Wissensch. XI, 1855, p. 56, Taf. XVIII) and from *Ph. psilomorphum* Neumayr (Zur Kenntnis der Fauna des untersten Lias in den Nordalpen, Abhandl. K. K. Geol. Reichsanst. VII, p. 21, Taf. II, fig. 4) by a more regularly oval shape of its cross-section. In those two species the lateral parts converge as flat planes from the place corresponding to the greatest transverse diameter, towards the rounded external part, whereas they are curved very distinctly in the direction of the umbilicus. This imparts to their cross-sections a sagittal or subsagittal shape, whereas in my Himálayan species the lateral parts are distinctly and regularly, although discretely, arched.

*Phylloceras globerrimum* Neumayr (l. c. p. 20, Taf. II, figs. 2, 3) is too imperfectly known to permit of a closer comparison with the present species.

*Dimensions.*

Diameter of the shell	. . . . .	. 67	mm.
" " " umbilicus	. . . . .	. 65	"
Height of the { above the umbilical suture	. . . . .	. 39	"
last volution { " " preceding whorl	. . . . .	. 28	"
Thickness of the last volution	. . . . .	. 20	"

*Sutures.*—The sutures of this species are very much like those in *Phylloceras dubium* Fucini (l. c. p. 27, Tav. V, figs. 5, 6) and in the Italian types of *Phylloceras Lipoldi* described by that author.

The siphonal lobe is shorter than in *Ph. dubium*, as it does not reach the length of the second lateral lobe. The principal lateral lobe is very broad, nearly as broad as in the group of *Ph. persanense* Herb. All the lobes as far as known are tripartite at their base, but with the lateral branches arranged asymmetrically to the median indentation. The saddles are diphyllic, with large terminal leaves. The lateral branches are especially well developed in the siphonal saddle, which is provided with a narrower stem than the rest of the saddles.

There are two auxiliary saddles present within the distance from the second lateral saddle to the umbilical margin.

Among the sutures of *Phylloceras oenotrium* the sutural line of this species differs so remarkably by its more simple structure, that a close affinity of the two forms is rather doubtful, notwithstanding their great external similarity. For its nearest relationship we will perhaps have to look among the group of *Ph. Lipoldi*. From *Ph. Sclateri* the present species is distinguished not only by its external features, but also by considerable differences in its sutural line, especially by the large size of its siphonal saddle, which is ramified more richly.

PHYLLOCERAS CALDWELLII nov. sp. Pl. XIII, fig. 4.

This species, which is represented by a single, almost entirely chambered cast in A. v. Krafft's collection, belongs to the relationship of *Phylloceras Horsefieldii*, as is obvious from the similar structure of its sutural line.

In its external shape and involution it is distinguished from *Ph. Horsefieldii* by its whorls being more strongly convex and arched less regularly. The greatest transverse diameter is situated in the umbilical region. In the posterior half of the last volution it coincides with the umbilical margin, which is rounded off sharply. Near the aperture it is shifted somewhat towards the lower part of the flanks, which pass into the high and steep umbilical wall in a more regularly rounded curve. Thus the transverse section is of a decidedly subsagittal shape, much more so than in *Phylloceras oenotrium* Fucini.

This character of the cross-section distinguishes our species from the group of *Ph. frondosum* Reynès (Essai de géol. et paléontol. Aveyronnaises, Paris, 1868, p. 98, Pl. V, fig. 1). In the typical shapes of *Ph. frondosum* the cross-section is, according to Pompeckj (Zeitschr. Deutsch. Geol. Ges. 49, Bd. 1897, p. 729) of



regularly elliptical outlines, whereas it is slightly oval in some forms described by Fucini (Cefalopodi liassici del Monte di Cetona Pte. I, Pal. Ital. VII, 1901, p. 43) as transitional shapes connecting the typical *Ph. frondosum* and *Ph. Wachneri* Gemm. But in some of them the greatest transverse diameter is situated as close to the umbilical region as in our Himälavian species.

The siphonal part is narrowly rounded at the beginning of the last volution, but becomes curved more flatly in the vicinity of the aperture.

The umbilicus is as wide and deep as in specimens of *Ph. oenotrium* of equal size.

*Dimensions.*

Diameter of the shell . . . . .	. 82 mm.
"    "    "    umbilicus . . . . .	. 9.5 "
Height of the } above the umbilical suture . . . . .	. 48 "
last volution } "    "    preceding whorl . . . . .	. 35 "
Thickness of the last volution . . . . .	. 32 "

*Sutures.*—Agreeing in general with those of *Phylloceras Horsefieldii*. All main saddles diphyllic. Three auxiliary lobes and saddles outside the umbilical suture. The second auxiliary lobe coincides with the umbilical margin. The two inner auxiliary saddles are monophyllic.

The most characteristic feature in the sutural line is the shape of the principal lateral lobe, which is very large at its base and very narrow in its upper portion, where the branches of the bordering saddles approach one another considerably. A strong divergence of the basal branches of this lobe has also been noticed in *Phylloceras Horsefieldii* and in the group of *Ph. frondosum*, but in none of the species belonging to the latter group is it developed as strongly as in *Ph. Caldaeellii*, in which the distance of the extreme basal points of this lobe is equal to two-fifths of the entire radius.

This remarkable enlargement of the basal region is restricted to the principal lateral lobe. The second lateral lobe is of normal shape. Its median terminal point reaches considerably deeper than the two lateral points, whereas in the principal lateral lobe the difference in depth between the three basal points is almost insignificant.

The terminal branches of the two lateral lobes approaching one another very closely, the stem of the principal lateral saddle is laced at its base more strongly than in *Phylloceras Horsefieldii*.

*Remarks.*—Among the undescribed species of *Phylloceras* from the lower Lias of Adneth there is one, which, from its external similarity, might be supposed to be nearly allied to the present form.

PHYLLOCERAS sp. ind. ex aff. DIENERI Rosenbg. Pl. XII, fig. 5.

This is a very remarkable species of *Phylloceras*, which deserves mentioning notwithstanding the very incomplete and unsatisfactory state of preservation of the only specimen available for description.

It is a widely umbilicated *Phylloceras* with flatly arched lateral parts and with a nearly elliptical cross-section. The greatest transverse diameter corresponds to the middle of the height. The siphonal part has not been preserved nor am I able to give any exact measurements of the cross-section.

The most remarkable feature of this species is the development of distinct narrow paulostomatic folds, which are directed radially and show an inverse imbrication. The two folds, which are clearly exposed in the figured fragment, are disposed at right angles. Traces of a third radial fold have been noticed exactly opposite the anterior one. The folds were probably connected with faintly marked paulostomatic constrictions, but the poor state of preservation of my only type-specimen is not sufficient for a positive conclusion.

In the lower lias of the Kratzalpe (Salzburg) there is an undescribed species, for which the name *Phylloceras Dieneri* will be proposed by Rosenberg, who is studying the fauna of this locality, which recalls the present cast in its external features. It is also provided with radial folds, which are disposed at right angles, each quadrant of the last volution being separated from the neighbouring one by a radial fold, which is accompanied by a low constriction.

*Dimensions*.—Not measurable.

*Sutures*.—Not known.

Subgen.: *SCHISTOPHYLLOCERAS* Hyatt (Group of *Phylloceras Uermæsense* Herb.)

PHYLLOCERAS (SCHISTOPHYLLOCERAS) MONGOLICUM nov. sp.  
Pl. XI, fig. 2; XII, fig. 1.

This species is a representative of a very remarkable group of *Phylloceratidæ* which is distinguished by wide umbilici and by a triphylic termination of the principal lateral saddle. Two Alpine species of this group have been studied most carefully, namely, *Phylloceras Uermæsense* Herb. and *Ph. planispira* Reynès. To both of them our Himálayan form is very closely allied, without, however, being actually identical with either of them.

The new name *Phylloceras mongolicum* is proposed for two specimens. One of them is well preserved and nearly complete, one half of its last volution belonging to the body-chamber. The second one is a fragment of the last volution, comprising the last air-chambers and a portion of the body-chamber. In this specimen the sutural line has been excellently preserved.

The nearly complete specimen illustrated on Pl. XI, fig. 2, agrees in its shape and dimensions very closely with the type-specimen of *Phylloceras Uermæsense*, Herbieh (Szeklerland, Mitteilungen aus dem Jahrb. d. ungar. Geol. Anst. V, p. 113, Taf. XX, K. fig. 1). The slowly increasing whorls leave a wide umbilicus open. The shape of the shell is disciform, with strongly compressed volutions.

The transverse section is irregularly ovoid, with the largest transverse diameter situated in the lower part of the height.

In their involution the two specimens do not agree exactly. In my Himálayan type the whorls overlap one another to more than one half their height. In Herbieh's type-specimen the rate of involution is less considerable, but among the Alpine representatives of *Phylloceras Uermæsense*, illustrated and described by Waehner (Beitraege zur Kenntnis der tieferen Zonen des Lias in den nordoestlichen Alpen, Beitræge zur Palæont. und Geol. Oesterr.-Ungarns, etc., Bd. XI, p. 173, Taf. XXIII, figs. 3-5, Taf. XXIV, figs. 1-8), there are some examples in which the overlap of the two last volutions is scarcely inferior to that in *Ph. mongolicum*.

The siphonal part is sharply rounded, more sharply even than in any of the Alpine examples of *Phylloceras Uermæsense* illustrated by Waehner, but never acute. The lateral parts are marked off from a steeply inclined umbilical wall by an umbilical edge, which is obtusely rounded. But the umbilical wall is neither as steep nor separated from the lateral parts as sharply as in the majority of the Alpine types of *Ph. Uermæsense*. It is especially in the inner volutions that the low umbilical wall passes into the lateral parts more gradually. In this character my specimen might be compared with the European type illustrated by Waehner on Pl. XXIII, fig. 3.

The peristome has not been preserved, but a deep contraction preceding the aperture of my type-specimen might perhaps indicate the vicinity of the actual peristome, provided it were not accidental.

As has been demonstrated by Waehner, in *Phylloceras Uermæsense* an internal shelly ridge is occasionally developed along the median line of the siphonal part. In casts the presence of this internal ridge is marked by a deep, angular depression or furrow. Specimens showing this external furrow have been described as *Ph. aulonotum* by Herbieh (Szeklerland, l. c., p. 115, Taf. XX, G. fig. 2). It is worth mentioning that among the materials collected by A. v. Krafft there is also a fragment with the trace of a siphonal furrow, recalling somewhat casts of *Ph. aulonotum*. It is too fragmentary to permit of a specific identification.

Waehner's amalgamation of *Phylloceras Uermæsense* and *Ph. aulonotum* has been doubted by Prinz (Centralblatt f. Mineral. etc., 1906, p. 238), who considers the latter species as the prototype of a new subgenus *Kochites* (= *Schistophylloceras* Hyatt), but I am not inclined to follow his view, agreeing entirely with Uhlig (Centralblatt, l. c., 1906, p. 421), that no valid arguments have as yet been raised against the correctness of the results of Waehner's careful studies.

It is not impossible that a broad and low keel occurs in the vicinity of the aperture of my Himálayan type-specimen, as has been described in large examples of *Phylloceras Uermæsense* by Waehner, but its presence cannot be ascertained, this region of the external part having suffered from weathering.

Paulostomatic constrictions or folds are entirely absent in all my specimens.

Fragments of the shelly substance, as far as preserved, are nearly smooth. Of

the radial stripes and striæ, which have been described and illustrated in *Phylloceras Uermæsense* by Wachner, no traces have been discovered, but this fact may be partly due to the imperfect condition of the test.

*Phylloceras Uermæsense* is certainly more nearly allied to *Ph. mongolicum* than any congeneric species of this group. There exists also a close similarity with *Ph. planispira* Reynès. The chief character of distinction between the two species is the difference in size, *Ph. planispira* being a small form which never exceeds 50 mm. in diameter. As has been remarked by Uhlig (Ueber eine unterliassische Fauna aus der Bukowina, Lotos, Prag., l. c., p. 17), the umbilical wall of *Phylloceras planispira* always slopes at flat angles, and has a broadly rounded margin. In these two features our species agrees more closely with *Ph. Uermæsense*.

#### Dimensions.

Diameter of the shell . . . . .	62 mm.
" " " umbilicus . . . . .	30 "
Height of the { above the umbilical suture . . . . .	35 "
last volution { " " preceding whorl . . . . .	22 "
Thickness of the last volution . . . . .	22 "

*Sutures*.—The sutural line shows a remarkable similarity with the sutures of *Phylloceras Uermæsense*, from which it differs, however, by the more robust shape of the saddles, the phylla being considerably smaller in comparison to the stems, and by the smaller number of auxiliary elements. In both characters it seems to agree, perhaps, somewhat more nearly with the sutures of *Ph. planispira*, although a closer comparison is rendered difficult by the incorrect illustration in Reynès' memoir and by the very small size of the sutural lines which have been illustrated by Uhlig and Geyer.

The siphonal lobe is very short, reaching less deeply than the external branch of the principal lateral lobe. The second lateral lobe is shorter than the principal one, but longer than the first auxiliary lobe—which should, perhaps, be designed more exactly as third lateral lobe. From the first auxiliary lobe the line connecting the basal points of the following two lobes runs in a radial direction toward the umbilical suture. A third lobe is situated on the umbilical wall.

An equal number of auxiliary elements has been counted in small examples of *Phylloceras Uermæsense* by Wachner, whereas full-grown types reaching the dimensions of our specimen (Pl. XII, fig. 1) are provided with six auxiliary lobes.

The siphonal saddle is diphyllic, the inner terminal leaf being the higher one. The second inner leaf following underneath the terminal phyllum projects rather strongly, making the principal phylla of this saddle approach a tripartite arrangement. The principal lateral saddle is distinctly triphyllio, the middle leaf being the highest, the external phyllum standing a little deeper than the internal one, and at a nearly equal level with the inner terminal phyllum of the siphonal saddle. It is considerably larger than its neighbours. The two following saddles

exhibit a diphyllic arrangement. The second auxiliary saddle has one single terminal leaf.

It is obvious from a comparison of the sutural lines in *Phylloceras Uermæsense* and *Ph. mongolicum* that there is an almost complete agreement in the arrangement of the phylla of the saddles, even in the minor details. Nevertheless there exists a decided difference in the general shape of the saddles, the lobes being comparatively broad, the stems massive, the phylla small and slender in my Himál-ayan species.

Should the differentiation of the present species not be considered justified by its external features of distinction—which in this as in so many other cases is only a matter of individual conception or personal judgment—the structure of its sutural line would, according to my opinion, require its separation from *Phylloceras Uermæsense*.

*Remarks.*—There is some difference of opinion among palæontologists regarding the systematic position of *Phylloceras Uermæsense*.

If all *Phylloceratidæ* with a wide umbilicus are included in the genus (or subgenus) *Rhacophyllites*, as interpreted originally by K. v. Zittel (*Handbuch der Palæontologie*, II, p. 439), *Ph. Uermæsense* must certainly be grouped with this genus. The interpretation of *Rhacophyllites* proposed by E. v. Mojsisovics in 1902 would not give us any clue for a decision, because, of the two characters of subgeneric importance, namely, presence of a short siphonal lobe and diphyllic or triphyllic arrangement of the main saddles but monophyllic auxiliary saddles, the first character is developed in *Ph. Uermæsense*, whereas the second is not.

If the subgeneric designation of *Rhacophyllites* is restricted to those forms of *Phylloceras* in which the body-chamber differs from the chambered parts of the shell in shape and sculpture, or in which the auxiliary series is united into a suspensive lobe, as has been proposed by E. v. Mojsisovics in 1882 and by Geyer in 1886, it is equally difficult to decide whether or not *Ph. Uermæsense* should be grouped with *Rhacophyllites*. Shape and sculpture of the body-chamber do not agree exactly with those of the chambered parts of the shell, because occasionally a shelly internal ridge and a low keel are developed in the body-chamber. The auxiliary elements are not united into a sloping suspensive lobe, but show a serial arrangement, decreasing in size quite regularly from the second lateral lobe to the umbilical suture.

Hyatt (*Zittel's Text-book of Palæontology*, English edition, Cephalopoda, p. 568) has elevated *Phylloceras aulonotum* Herb., which, according to Wæbner, is identical with *Ph. Uermæsense*, to the rank of a proper subgenus, *Schistophylloceras*. To the same group of *Phyllocerata* Prinz has applied the subgeneric designation of *Kochites*, which, regarding the law of priority in palæontological nomenclature, cannot be accepted.

The subgeneric value of a character, which is rather faintly marked and not even developed in all specimens of *Ph. Uermæsense*, might be questioned. It might also be taken into consideration, as it has been remarked by Uhlig, that the

development of a keel in *Phylloceras* is a very subordinate feature in the history of its evolution, the carinate forms disappearing without having given rise to any progeny. If a subgeneric rank should, notwithstanding those objections, be attributed to the group of *Phylloceras Uermæsense-aulonotum*, the present species from the exotic blocks of Malla Johar ought, probably, to be grouped with *Schistophylloceras*, although the presence of a keel has not been ascertained.

Subgen. : *RHACOPHYLLITES* v. Zittel.

*RHACOPHYLLITES* cf. *GIGAS* Fucini. Pl. XI, fig. 1.

1901. *Rhacophyllites gigas* Fucini, *Cefalopodi liasici del Monte di Cetona*, Pte. 1, Palæont. Ital. VII, p. 56, Tav. IX, figs. 2-5.

This species is represented in A. v. Krafft's collection by a well-preserved cast without any trace of its shelly substance. It consists both of air-chambers and the body-chamber, to which exactly one half of the last volution belongs. It is an Indian representative of a group of *Rhacophyllites* which is widely distributed in the lower and middle lias of Europe, and is very nearly allied to *Rhacophyllites gigas* Fucini, *Rh. transsylvanicus* Hauer and *Rh. diopsis* Gemm. I have referred it to the first of these three species as *cf.*, although it is perhaps not exactly identical with it.

With the type of *Rh. gigas* illustrated by Fucini on Pl. IX, fig. 4, of his above-quoted memoir, my Himálayan specimen agrees in all its characters of specific importance. The whorls are strongly compressed and include a wide umbilicus. The lateral parts are very gently arched and separated from the high, steeply inclined umbilical wall by a distinct, obtuse edge, which becomes gradually rounded in the body-chamber only. The largest transverse diameter is perhaps situated a little higher than in *Rh. gigas*, but the difference can be insignificant only. The external part is regularly rounded, neither inflated nor truncated.

The surface of the chambered parts of the shell is smooth. Near the beginning of the body-chamber an indistinct sulcus or constriction has been noticed crossing the sculpture in front at oblique angles. The sculpture, which is restricted to the body-chamber, consists of strong and moderately sharp ribs, which are separated by broad intercostal valleys. Fifteen ribs are counted altogether within the circumference of the body-chamber. The ribs are slightly falciform and describe a crescent-shaped curve, with its convexity turned forward in crossing the siphonal area. This is the place where they reach their maximum strength, whereas they are obliterated gradually in the lower part of the flanks. None of them reaches the umbilical region.

From the Italian type of *Rhacophyllites gigas* our specimen differs in some subordinate details of its shape and sculpture. Its whorls increase more

rapidly, as is obvious from a comparison of the dimensions in the two following examples :—

	Himálayan type-specimen.	Fucini's type-specimen (Pl. IX, fig. 4).
Diameter of the shell . . . . .	89 mm.	78 mm.
„ „ „ umbilicus . . . . .	22 „	17.5 „
Height } of the last volution . . . . .	37.5 „	35 „
	Thickness } 23.5 „	17.5 „

The difference in the width of the umbilicus is larger than in the height of the last volution. Nor do the proportions of height and thickness in the transverse section agree exactly, our Himálayan form being comparatively thicker than the Italian type-specimen illustrated by Fucini on Pl. IX, fig. 4. But there are some other European examples of *Rh. gigas* which seem to agree better with our specimen in this respect. Fucini did not succeed in ascertaining the presence or absence of a constriction in the body-chamber of his specimens, although their absence in the chambered parts of the shell was made certain.

If Fucini's suggestion, that the ribs originate in the vicinity of the umbilical margin, could be proved to be correct, this character might be counted among the subordinate features of distinction, as in our specimen none of the lateral ribs comes near the umbilical margin.

Among Fucini's illustrations of *Rhacophyllites gigas* no view, unfortunately, has been given of the external part. Thus it is impossible to say whether or not there exists a complete agreement in the direction of ribs in that region between the Himálayan and Italian species.

A second species, to which the present one appears to be very closely allied, is the group of forms from the lower lias of Monte di Cetona, which have been united with *Rhacophyllites transsylvanicus* v. Hauer by Fucini (l. c. p. 52, Tav. VIII, figs. 1-7).

As has been demonstrated by Uhlig (Ueber eine unterliassische Fauna aus der Bukowina, Abhandl. d. deutsch. naturwiss. Med. Ver. Lotos, Prag, 1900, II, Bd. p. 20), the name *Rhacophyllites transsylvanicus* must be assigned to the specimen illustrated by Herbich on Pl. XXI of his memoir "Das Szeklerland" (Mitt. aus d. Jahrb. d. Ungar. Geol. Aust. V, 1878). From this type of the species our Himálayan specimen differs considerably by the smaller number of its ribs, which are curved more strongly along the siphonal area. But among Fucini's materials numerous forms have been assigned to the Hungarian species, which might be considered as shapes intermediate between *Rh. transsylvanicus* and *Rh. diopsis* Gemm., some of them bearing a greater affinity to our species than the typical *Rh. transsylvanicus*. It is especially the var. *dorsocavata* Fucini (Pl. VIII, fig. 7) which approaches our specimen in the shape of its cross-section and in the direction of the lateral ribs crossing the siphonal area in crescent-shaped curves. But the number of ribs is considerably larger in all the Italian types illustrated by Fucini. To this distinctive feature the presence of faintly marked paulostomatic constrictions in the chambered parts of the Italian

shells must be added, whereas such are certainly absent in my Himálayan specimen.

A third species which might put in a claim for closer comparison with the present one is *Rhacophyllites diopsis* Gemmellaro (Sugli fossili degli strati à *Terebratula Aspasia* della contrada Rooce rosse presso Galati, Giorn. di sci. nat. ed econ. Palermo, 1881, p. 6, Tav. II, figs. 6-8; VI, figs. 1, 2).

The specific independence of *Rhacophyllites diopsis* has been questioned by C. de Stefani, Greco, Fucini and Uhlig, who advocated its amalgamation with *Rh. Nardii* Menegh. But in his above-quoted memoir (p. 50) Fucini, disagreeing with his former view, insists again on a separation of the two species, restricting the name of *Rh. Nardii* to Meneghini's type-specimen from Campiglia (l. c. Pl. VII, fig. 1).

A comparison between Gemmellaro's type-specimen of *Rh. diopsis* (figs. 6, 7) and my Himálayan example is rendered difficult by the fact that the first is provided with the test, whereas the latter is a cast. The number and strength of ribs are somewhat larger in *Rh. diopsis*, and the ribs are turned forward more strongly. The entire absence of constrictions has been remarked expressly by Gemmellaro. From our species *Rh. diopsis* is, moreover, distinguished by the opening of the umbilicus near the aperture of its body-chamber whorl, where its umbilical suture leaves the normal spiral.

Two body-chamber fragments from the Hierlatz, which have been described as *Rhacophyllites cf. diopsis* by Geyer (Ueber die liasischen Cephalopoden des Hierlatz bei Hallstatt, Abhandl. K. K. Geol. Reichsanst. XII, p. 225, Taf. I, fig. 20), approach our species in the strength and direction of the ribs more closely than Gemmellaro's type, but are distinguished by the smaller height and greater width of their transverse sections.

From other congeneric species with ribbed body-chambers our specimen is easily distinguished. *Rhacophyllites Nardii* Meneghini—in the narrow circumscription proposed by Fucini (l. c. p. 48, Tav. VII, figs. 1-7)—and *Rh. libertus* Gemmellaro (l. c. p. 4, Tav. II, figs. 1-5) have wider umbilici and deep constrictions. *Rh. lunensis* de Stefani (Lias infer. ad Arieti, l. c. p. 57, Tav. III, figs. 1, 2) and *Rh. Quadrii* Menegh. are provided with a more delicate ornamentation and with paulostomatic constrictions affecting both the chambered parts of the shell and the body-chamber.

*Sutures*.—The sutural line of the present specimen differs from the sutures of *Rhacophyllites gigas* or *Rh. transsylvanicus* by some insignificant details only.

The siphonal lobe is bifid, very narrow and short, not reaching deeper than the middle of the length of the principal lateral lobe. The lateral lobes are tripartite. As in *Rh. gigas*, the arrangement of basal branches is different in the two lobes, the denticulations adjoining the stem of the principal lateral saddle being less deep than the opposite ones. From the first auxiliary lobe the sutural line descends towards the umbilicus, thus exhibiting the arrangement of sutures characteristic in typical representatives of *Rhacophyllites*. The number of



auxiliary lobes could not be ascertained, but I do not think that more than three could be developed in the last septum preceding the body-chamber.

The siphonal saddle is lower than the principal lateral one. It is diphyllic. The inner terminal branch is higher and larger than the outer one. Fucini describes this saddle as triphyllic, counting the large lateral inner branch among the terminal leaves. With this view I am, however, obliged to disagree, the two real terminal phylla being distinctly laced at their base and thus separated from the next lower phylla, which must consequently be considered as lateral, not as terminal ones.

The lateral saddles are diphyllic. The second lateral saddle differs from the corresponding element in *Rh. gigas* by the larger size of the outer lateral branch. Another subordinate difference consists in the shape of the main saddles, which are laced at their bases more strongly in the present example.

RHACOPHYLLITES SCHOFARIFORMIS nov. sp. Pl. XII, fig. 4.

This species of *Rhacophyllites* represents a very peculiar type, which is distinguished by the trumpet-shaped enlargement of its body-chamber in the apertural region.

My type-specimen is a somewhat fragmentary cast, but sufficiently well preserved for allowing a satisfactory reconstruction, which is enough to render conspicuous all its external features. In its involution it agrees almost equally well with some widely umbilicated species of *Phylloceras* (*Ph. Sclateri* Dien., *Ph. persanense* Herb.), as with some types of *Rhacophyllites stella* Sow., possessing comparatively narrow umbilici. It has been grouped with *Rhacophyllites* in this memoir on account of its abnormal body-chamber. The remarkable change in the cross-section of the last whorl is obvious from the following measurements:—

Diameter of the shell . . . . .	96 mm.
" " umbilicus . . . . .	15 "
Height } at the beginning of the last volution . . . . .	30 "
Thickness } . . . . .	11.5 "
Height } corresponding to a diameter of 62 mm. . . . .	32 "
Thickness } . . . . .	21.5 "
Height } near the aperture . . . . .	38 "
Thickness } . . . . .	42 "

The last volution begins with a high and strongly compressed cross-section of a subsagittal shape, the lateral parts converging from the umbilical region, which corresponds to the greatest transverse diameter, as very flatly arched planes towards the narrowly rounded siphonal part. The whorl increases rather rapidly as far as the middle of the last volution, changing its transverse section very slowly, which turns gradually from a subsagittal into a more regularly oval shape. In the vicinity of the aperture the width of the cross-section increases far more considerably than its height, and the greatest transverse diameter is shifted towards the middle of the volution. Thus a trumpet-shaped inflation of the

apertural region is produced, recalling a similar trumpet-shaped opening of the aperture in some species of *Lytoceras* (Neumayr).

The actual peristome has not been preserved, but cannot have been situated considerably in front of the aperture in my cast.

The surface is entirely smooth, without any traces of folds or paulostomation constrictions.

*Sutures*.—Not known.

Fam. : *PLEURACANTHIDÆ* Hyatt.

The careful researches of Wæhner have acquainted us with a very interesting stock of Ammonites, which seem to mark transitional stages connecting *Phylloceras*, *Lytoceras* and *Psiloceras*, thus proving the common origin of all the widely different families of liasic Ammonoidea, the roots of which must probably be looked for in the triassic genus *Monophyllites* (*Mojsvárites*).

To the groups of transitional forms, combining characters of *Phylloceras*, *Lytoceras* and *Psiloceras*, a special systematic position should be attributed. By uniting one of them (*Euphyllites* Wæhner) with the *Phylloceratidæ*, a second one (*Ectocentrites* Wæhner) with the *Lytoceratidæ* and a third one, consisting of two more genera (*Pleuracanthites* Can. and *Analytoceras* Hyatt) in the new family of *Pleuracanthidæ* Hyatt has not taken sufficient care of their natural connection. I should prefer to accept the new family of *Pleuracanthidæ*, which has been proposed by Hyatt, as a descriptive term for all groups of forms by which the gaps between *Phylloceras*, *Lytoceras* and *Psiloceras* are bridged over in the lower liassic age.

It is very interesting to find representatives of this remarkable family in the lower lias of the Himálayas. The presence of two genera at least, *Pleuracanthites* and *Analytoceras*, has been ascertained. The presence of *Euphyllites* and *Ectocentrites* is as yet doubtful, although very probable.

Gen. : *ANALYTOCERAS* Hyatt.

1900. *Analytoceras* Hyatt in K. v. Zittel, Text-book of Palæontology, Vol. I, Cephalopoda, p. 568.

*ANALYTOCERAS* sp. ind. aff. *ARTICULATO* Sow. Pl. X, fig. 4.

Hyatt has been fully justified in elevating *Lytoceras articulatum* Sow. (A. d'Orbigny, Paléont. franç. Terrains jurass. I, p. 312, Pl. 97, figs. 10-13) to the rank of a proper genus. Although this species approaches a typical *Lytoceras* in its external characters, its sutural line differs so remarkably by the tripartite arrangement of its lateral lobes that it cannot be left in that genus.

In the Himálayan collection a single specimen has been found, which exhibits so close a relationship to *Analytoceras articulatum* that in a better state of preservation it might, perhaps, have led to an identification with the European fossil. Only the last volution has been preserved, and even this has been seriously

injured by weathering. It has the external shape of a typical *Lytoceras*, with whorls increasing as rapidly as in the specimen illustrated by Waehner on Pl. VIII, fig. 2, of his monograph of lower liassic Ammonites of the eastern Alps (VII, Teil, Beitrage zur Palæont. u. Geol. Oesterr. Ungarns, etc., Bd. IX, 1895). Although the surface of the whorl is badly corroded, traces of the original ornamentation are visible in the umbilical region of the apertural portion of the body-chamber. The sculpture consists of numerous, thin, radiating lines which are occasionally interrupted by stronger folds. These folds are smooth, as in *Analytoceras articulatum*, never fimbriate, as in the group of *Lytoceras fimbriatum*.

*Dimensions.*—Not measurable.

*Sutures.*—The sutural line agrees very closely with that in full-grown specimens of *Analytoceras articulatum*. The siphonal lobe is very short, bifid and divided by a low median prominence. The most characteristic element is the principal lateral lobe, which shows a tripartite arrangement of its branches, two lateral branches being disposed symmetrically to a median one. This arrangement of the lateral lobes differs widely from what is seen in a typical *Lytoceras*, where the lobes are divided into two branches by a median secondary saddle rising from the base.

In this character *Analytoceras* very closely approaches *Pleuranthites* and *Ectocentrites*, and thus enters into the series of forms connecting the two families of *Lytoceratidæ* and *Psiloceratidæ*.

The siphonal and principal lateral saddles are diphylic. Their details have been partly destroyed by weathering, but what remains is yet sufficient to show that they were arranged on the same plan as the corresponding sutural elements in *A. articulatum*.

I have not been able to trace the sutural line beyond the first auxiliary lobe, which is united with the second lateral saddle into a suspensive lobe.

One half of the last volution belongs to the body-chamber. The sutural line illustrated in the figure corresponds to the last septum.

#### Gen.: PLEURANTHITES Canavari.

PLEURANTHITES sp. ind. aff. BIFORMIS Sow. Pl. XV, fig. 3.

*Lytoceras biforme* Sow. has been elevated to the rank of the prototype of a proper genus by Canavari (Atti. Soc. Toscana sci. nat. Proc. verb. III, 1883, p. 279). The distinctive characters of this new genus, for which the name *Pleuranthites* was proposed by its author, have been studied in detail by Waehner (Beitrage zur Kenntnis der tieferen Zonen des unteren Lias, etc., VII, Teil, Beitr. Palæont. u. Geol. Oesterr. Ung., etc., IX, 1895, p. 27). According to his diagnosis this genus is distinguished from *Lytoceras*, with which it agrees in its general shape and involution, by the presence of a long body-chamber com-

prising more than one entire volution, deep lateral sinuses or crescentic tubercles, and indistinctly developed siphonal crests.

A species agreeing in all these characters of generic importance with the European prototype of *Pleuracanthites* is represented in A. v. Krafft's collection by a single specimen, which, although incomplete, is sufficiently well preserved to permit a safe determination.

In its involution the present example agrees best with the Alpine type, distinguished by whorls increasing rather rapidly in height and thickness. The cross-section of the inner whorls recalls very strongly that in Wæhner's specimen from Schreinbach illustrated in Pl. IV, fig. 1, of his memoir. It is nearly elliptical, with an obtusely rounded siphonal edge, but is considerably thicker than high. In the last volution the height increases more rapidly than the width. At the same time the siphonal crest becomes obsolete and the greatest transverse diameter is shifted gradually from the middle of the flanks towards the umbilical region. This change in the shape of the body-chamber is restricted to the vicinity of the aperture, and is a feature of specific distinction between our form and *Pleuracanthites biformis* (Sow.) Canavari (Beitr. z. Fauna d. unteren Lias von Spezia, Palæontographica, XXIX, p. 156, Taf. XVII, figs. 8-11), in which the shape of the cross-section is not subject to any variation throughout its entire length.

The actual peristome cannot have been situated far from the aperture of my specimen, the last traces of septa being visible in the third quarter of the penultimate whorl. My specimen was certainly provided with a long body-chamber, exceeding the last volution in length considerably.

The ornamentation is not very strongly marked in my specimen, but this character may be due to its state of preservation, the surface of the cast having been injured by weathering. Sinuses corresponding to paulostomes are, however, noticed at several places in the penultimate and last volutions. They agree exactly with the corresponding sculptural elements in *Pleuracanthites biformis*. In the penultimate whorl they are even combined with broadly elevated, crescent-shaped knobs or folds, exactly like those in the inner volutions of Wæhner's type-specimen from Schreinbach illustrated on Pl. III, fig. 2.

In the body-chamber a gradual obliteration of the sculpture is marked by the absence of concentric folds. In the vicinity of the aperture, where the surface of the cast has been preserved satisfactorily, two delicate paulostomatic stripes are exhibited, forming deep sinuses with their convexities turned backwards.

#### Dimensions.

Diameter of the shell	. . . . .	70 mm.
" " " umbilicus	. . . . .	30 "
Height	} of the last volution . . . . .	20 "
Thickness		24 "
Height	} at the beginning of the last volution . . . . .	16 "
Thickness		22 "

*Sutures*.—Of the sutural line the siphonal and principal lateral lobes and the siphonal saddle only are known to me. They seem to agree very closely with the corresponding elements in *Pl. biformis*.

The siphonal lobe is short, very narrow and provided with a high median prominence. The siphonal saddle is richly ramified and its terminal phylla are comparatively small.

Gen. : EUPHYLLITES Waehner.

EUPHYLLITES sp. ind. (?) Pl. XV, fig. 5.

The materials of the genus *Euphyllites* in A. v. Krafft's collections are very scanty indeed, and I have as much hesitation in placing them in this genus as in venturing on their generic determination at all. Nevertheless I think it advisable to mention them here as by them the presence of an Ammonite in the liassic crags of Malla Johar is indicated, which in its external characters seems to show a close affinity to the smooth variety of *Euphyllites Struckmanni* Neumayr (Zur Kenntnis der Fauna des untersten Lias in den Nordalpen, Abhandl. K. K. Geol. Reichsanst. VII, p. 36, Taf. VI, fig. 5).

My specimen is a cast of the body-chamber comprising exactly one half volution, with fragments of the penultimate whorl adhering to it. In its involuution it takes a position intermediate between some triassic species of *Discophyllites* (*D. neojuvensis* Quenst.) and *Euphyllites Struckmanni*. A reconstruction of its outlines makes me suppose that the width of its umbilicus was 32 mm., corresponding to a diameter of 85 mm. But in the shape of the cross-section there is a complete agreement with the type-specimens of *E. Struckmanni*, as illustrated by Waehner (Beiträge zur Kenntnis der tieferen Zonen des unteren Lias in den nordöstl. Alpen, Beitr. Palæont. u. Geol. Oesterr. Ungarns, etc., XI, p. 170, Taf. XXII, figs. 1-8; XXIII, fig. 1). The lateral parts are perfectly flat, running parallel and passing gradually into the rounded siphonal part, whereas they are separated from the steep umbilical wall by an obtusely rounded edge. The proportion of height and thickness is 34 : 24 mm.

The surface of the cast, which has been partly injured by weathering, is entirely smooth.

The present cast has been broken off, unfortunately, in front of the last septum. Thus the terminal leaves of the two lateral saddles only have been preserved. They are large and rounded elliptically as in *Psiloceras* or in *Schistophylloceras Uermæsense* Herb.

Gen. : ECTOCENTRITES Waehner.

ECTOCENTRITES sp. ind. (aff. ALTIFORMIS Bon.?).

A body-chamber fragment of large dimensions reminds me of the equally-sized example of *Ectocentriles altiformis* Bonarelli (Cefalopodi sinemuriani del

Appennino centrale, Palæont. Ital., 1899, V, p. 73, Tav. IX, figs. 4-6) from the lower lias of Monte di Cetona, which has been illustrated by Fucini (Palæont. Ital., VII, 1901, Tav. XIV, fig. 1). The cast is strongly weathered and not worthy of illustration. The cross-section is suboval and compressed, a height of 55 mm. corresponding to a width of 39 mm. The external part is regularly rounded and passes into the flattened lateral parts without any intervention of a distinct umbilical shoulder. The umbilical wall is high and steep and unites with the flanks in a sharply rounded margin.

The sculpture consists of numerous ribs, which are disposed rather irregularly. The presence of marginal tubercles could not be ascertained. The siphonal part was undoubtedly smooth.

A more minute description of the present cast is precluded on account of its insufficient state of preservation. But it is nevertheless interesting to establish the fact, that the genus *Ectocentrites* is probably also represented in the Himalayan lias.

Fam.: *AMALTHEIDÆ* Fisch.

Gen.: *OXYNOTICERAS* Hyatt.

*OXYNOTICERAS* sp. ind. ex aff. *GREENOUGHII* Sow. Pl. X, fig. 5.

The fragment of a body-chamber is comparable by its shape and sculpture with *Oxynticeras Guibalianum* D'Orbigny (Palæont. française, Terrains jurass, I, p. 259, Pl. 73) or with *O. Greenoughi* Sow. (Wright, Lias Ammonites, Palæont. Soc., p. 387, Pl. XLIV, XLV). It belongs to a moderately compressed and sharply carinated ammonite, whose surface was covered with numerous undivided ribs. The transverse section agrees best with that of the species from Adneth, identified with *O. Greenoughi* by F. v. Hauer (Cephalopoden aus dem Lias der nordöstlichen Alpen, Denkschr. Kais. Akad. d. Wiss. XI, 1856, Taf. XII, fig. 1). It is lanceolate and compressed less strongly than in *O. oxyntum* Quenst., from which it differs also in its ornamentation. The flanks, which are moderately convex, meet at an angle of 60 degrees. The keel is acute.

The umbilical region having been completely destroyed in my fragment, nothing can be said about its involution. Notwithstanding its defective condition it is sufficient for certifying the presence of the genus *Oxynticeras* in the liassic fauna of the exotic blocks of Malla Johar. A specific determination is impossible, because the fragment represents a stage of growth in which nearly all species of *Oxynticeras*, as distinguished by Hyatt (Genesis of Arietidæ, Smithsonian. Instit., 1885, p. 214), are still provided with acute keels.

Fam.: *ÆGOCEERATIDÆ* Neum.Gen.: *SCHLOTHEIMIA* Bayle.*SCHLOTHEIMIA* sp. ind. ex aff. *TRAPEZOIDALIS* (Sow.) Can. Pl. XV, fig. 2.

This is a typical species of the genus *Schlotheimia*, with slowly increasing whorls, a wide umbilicus and with radial ribs, which on the siphonal part are interrupted along a median furrow where they terminate from either side in stout, knob-shaped elevations. The ribs are not turned forward in the vicinity of the siphonal margin, as in the majority of species belonging to the group of *Schl. angulata*, but meet one another from either side of the external furrow in a straight line. This character is known in *Schl. Charmassei* d'Orb. of extra-Alpine, in *Schl. trapezoidalis*, *Schl. ventricosa* Sow. and *Schl. posttaurina* Wachn. of Alpine species.

Among those species *Schlotheimia Charmassei* shows a less near affinity to the present form than the Alpine types, especially *Schl. trapezoidalis* (Sow.) Canavari (Unt. Lias von Spezia, Palæontographica, XXIX, p. 165, Taf. XVII, figs. 8, 9). Although the only Himalayan specimen available for examination is, unfortunately, fragmentary, it permits a satisfactory reconstruction of its shape and sculpture, sufficient for a closer comparison with *Schl. trapezoidalis*, which is well known to us from the careful studies of Waehner (Beitraege zur Kenntnis der tieferen Zonen des unteren Lias, etc., Beitr. z. Palæont. Oesterr. Ungarns, etc., IV, p. 185, Taf. XXIII, figs. 1-4; XXI, fig. 6).

In its general shape and involution my Himalayan specimen differs from *Schl. trapezoidalis* by its more slowly increasing whorls and by its wider umbilicus. In these external features it reminds us rather of *Schl. Donar* Waehner (l. c. p. 172, Taf. XIX, figs. 4; XXI, figs. 1, 2) or of *Schl. extranodosa* Waehner (l. c. p. 168, Taf. XX, figs. 7-11), than of *Schl. trapezoidalis*, but from both species it differs essentially in its sculpture. The lateral and siphonal parts are nearly flat, imparting to the cross-section a rectangular outline, with rounded-off angles.

The sculpture consists of single ribs. As far as the defective state of preservation renders the ornamentation visible, no dichotomous ribs have been noticed. The ribs are of moderate strength, almost perfectly radial, with a very small forward-turned geniculation near the siphonal margin. They originate at the umbilical margin as delicate folds, but increase in strength considerably, while crossing the lateral parts, till on the siphonal area they swell into stout, knob-shaped elevations, which stand opposite each other on both sides of the external furrow. It is this character of ornamentation which imparts to the Himalayan species a similarity with *Schl. trapezoidalis*.

*Dimensions.*

Diameter of the shell . . . . .	. 61 mm.
" " " umbilicus . . . . .	24 "
Height } of the last volution . . . . .	205 "
Thickness }	15 "

*Sutures.*—The last septum separating the body-chamber from the preceding air-chamber is exposed in rough outlines. Only the siphonal lobe and saddle are known in detail. Siphonal lobe narrow and divided by a high median prominence, each wing terminating in a single sharp point, very similar to the corresponding sutural element in *Schlotheimia Donar*, as illustrated on Taf. XIX, fig. 4d. of Waehner's memoir. Principal lateral saddle united with the following elements into a suspensive lobe.

One-third of the last volution belongs to the body-chamber.

SCHLOTHEIMIA nov. sp. ind. Pl. XI, figs. 5, 6; XV, fig. 4.

This species is nearly allied to the preceding one, from which it differs chiefly by its strongly inflated whorls and by its coarser sculpture. The ribs are high, acute and rarely dichotomising. As in the preceding species, they are turned forward very little in the vicinity of the marginal shoulder.

The cross-section is oval, the lateral parts being gently curved, not flattened. The whorls increase slowly and surround a wide, open umbilicus. A more minute description of this species is precluded, on account of the fragmentary state of the casts available for examination.

*Dimensions.*—Not measurable.

*Sutures.*—Not known.

SCHLOTHEIMIA sp. ind. aff. *MARMOREA* Opp. Pl. XIV, fig. 5.

A fragment of a chambered cast of a large *Schlotheimia* shows its affinity to the Alpine group of *Schl. marmorea* Oppel (Palaeontologische Mitteil. aus dem Museum des bayr. Staates, 1862, p. 130) by its sutural line, which is extremely complicated, much more so than in any of the extra-Alpine representatives of this genus. It only needs a comparison of the sutural line of my specimen with the illustration given by Waehner on Pl. XXII, fig. 1c, of his "Beitraege zur Kenntnis der tieferen Zonen des unteren Lias in den nordoestlichen Alpen" (Beitr. Palaeont. Oesterr. Ungarns, etc., IV, 1886), to see that we have to deal here with a species which is very nearly allied to *Schl. marmorea*. That the lobes are less broad in proportion to the saddles, cannot be considered as a distinctive feature of importance, as this character is subject to a remarkable variability in *Schl. marmorea*. As has been stated by Waehner, individuals with low whorls are, as a rule, provided with more slender and deeper lobes than types with strongly compressed and high volutions.



The median prominence is high, broad and strongly serrated. The siphonal lobe is deeper than in *Schl. marmorea*, taking an intermediate position between the median and lateral indentations of the principal lateral lobe. The two wings of the siphonal lobe diverge very strongly. From the base of the siphonal saddle an accessorial branch is cut off by a very deep indentation. This branch is conspicuous by being less deeply serrated than the rest of the branches and by the rounded off lines of its secondary indentations. It corresponds exactly to the massive branch at the base of the outer margin in the siphonal saddle of *Schl. marmorea*, but it is provided with larger denticulations.

The siphonal saddle is very richly ramified and reclines towards the principal lateral saddle, which is the higher one. In both saddles the branches of the outer margin are considerably larger and developed more richly than those of the inner one.

The second lateral lobe is very short and united with the following sutural elements into a suspensive lobe. The sutural line, as illustrated in fig. 5, is not accessible beyond the second lateral lobe, but on the other side of my cast two auxiliary lobes are exposed, although the sutural line has there been strongly injured by weathering.

In its external features this fragment does not differ considerably from equal-sized specimens of *Schlotheimia marmorea*. But it must be borne in mind that a closer comparison is, unfortunately, excluded by its fragmentary condition. Neither the rate of involution nor the cross-section of the whorls are known to me. The lateral parts are flatly curved and covered with numerous ribs of moderate strength, which are provided with acute edges. In the marginal region they are directed forward more strongly than in *Schl. Charmassei* d'Orb., but a little less strongly than in the typical *Schl. marmorea*. There is no distinct siphonal furrow developed in the middle of the external part, but only a smooth zone, along which the ribs are interrupted. They do not correspond exactly along both sides of this zone.

Among the specimens of *Schlotheimia marmorea* illustrated by Waehner it is the middle-sized type from the Kammerkaralpe (l. c. Taf. XXII, fig. 2), which agrees best with our example in the shape of the siphonal part.

The fragmentary condition of this specimen does not allow of any measurements of its parts.

Gen.: *ÆGOCERAS* Waagon.

*ÆGOCERAS* sp. ind. (ex aff. *BIFER* Quenst. ?) Pl. XIV, fig. 6.

I have mentioned this poorly preserved fragment of the side of an outer whorl as the only representative of the genus *Ægoceras* Waag. in the fauna of exotic blocks Nos. 16 and 17. It is, however, not sufficient to enable me to come to a tolerably certain conclusion about its specific position, although it might

perhaps be placed near *Æg. bifer* Quenstedt (Cephalopoden, p. 83, Taf. IV, fig. 14, Der Jura, p. 103, Taf. XIII, figs. 11-13, Ammoniten des schwäbischen Jura, I, Lias, p. 160, Taf. XXII, figs. 7-27).

The whorl is subquadrangular, with the external part well rounded. Number of ribs small, about fifteen in the circumference of an entire volution. Ribs short, straight and stout, elevated into obtuse knobs near the siphonal margin. Knobs connected by low bridges, which cross the siphonal area, but not by distinctly developed external rhombi. The fragment cannot be attributed therefore to the group of *Æg. planicosta* Sow.

The regular character of ribs in our fragment seems to distinguish it from full-sized specimens of *Æg. bifer* as illustrated by Wright (Monograph on the Lias Ammonites, Palæontograph. Soc. London XXXIV, Pl. XXVI, figs. 1-4) in a very remarkable way. But these characteristic features of the European species are only developed in later stages of growth. Young examples possess straight, radially directed ribs, which are connected by low, forward-curved bridges across the siphonal part.

A specimen reminding us of the present fragment in its external features and sculpture has been described from the lower lias of the Hierlatz as *Æg. bifer* by Geyer (Ueber die liasischen Cephalopoden des Hierlatz bei Hallstatt, Abhandl. K. K. Geol. Reichsanst. XII, p. 260, Taf. III, figs. 18, 19). From this and from the equal-sized specimen of *Ægoceras bifer annulosus* Quenstedt (Ammoniten, etc., Taf. XXII, fig. 20) our specimen seems to differ only by its external ridges being lower and by its ribs being stouter and broader.

If we take into consideration that this habit represents a mode of variation, which is likely to be developed still more strongly in later stages of growth, the independent position of the present form cannot well be doubted.

Fam.: *ARIETIDÆ* v. Zittel.

Gen.: *ARIETITES* Waagen.

I am in accordance with the views of Wachner, K. v. Zittel, Boese and Uhlig in rejecting the subgeneric divisions of the genus *Arietites*, which have been proposed by Hyatt (Genesis of Arietidæ, Smithsonian. Instit., 1889) and in retaining the name *Arietites* for all groups of liassic forms, which are provided with strong radial ribs and keel furrows accompanying a distinctly developed median keel.

This genus is rather richly represented in the Himalayan lias. In the following descriptions four species have been enumerated, but their actual number is probably larger, the defective state of preservation not permitting of specific determination of several examples.

All species are closely allied to types from the lower lias of the Eastern Alps, which are well known to us from the careful researches of Wachner.

## ARIETITES cf. COREGONENSIS (Sow.) Can. Pl. XIV, fig. 2; XV, fig. 1.

1882. *Ægoceras Coregonense* Canavari, Beitrage zur Fauna des unt. Lias von Spezia, Paleontographica XXIX, p. 173, Taf. XIX, figs. 12-15.

1888. *Arietites Coregonensis* Wæhner, Beiträge zur Kenntnis der tieferen Zonen des unt. Lias in den nordöstl. Alpen, V, Theil, Beiträge zur Paläont. Oesterr.-Ungarns, etc., VI, p. 311, Taf. XXI, figs. 1-3; XXII, figs. 1-4, XXIII, figs. 1-4; XXIV, figs. 1-6.

This remarkable species is represented by two fairly complete specimens. The smaller example is able to make up for the deficiency of the inner volutions in the larger one. For their comparison with the Alpine form numerous examples from the lower lias of Adneth, Breitenberg and Enzesfeld have been available to me, among them some of Wachner's type-specimens.

In the larger specimen the whorls overlap one another but very little. The last and penultimate whorls differ considerably in the shape of their cross-sections. At the beginning of the last volution the transverse section is broader than high and provided with rounded sides. In the last volution the lateral parts become flattened gradually, and the height increases more rapidly than the width. In the penultimate whorl the greatest transverse diameter is situated in the middle of the flanks, whereas in the last volution it is shifted gradually towards the umbilical margin. At the same time the siphonal area is reduced in width and its marginal shoulders are formed by the lateral keels, accompanying the two deep external channels, whereas at the beginning of the last whorl the median keel and the accompanying channels occupy only the middle zone of the siphonal area.

In all these characters my specimen agrees exactly with equal-sized examples of *Arietites Coregonensis*.

Throughout the entire last volution the median keel and the external furrows or obannels are well defined. The latter are bordered on the marginal side by distinctly developed ridges, which become acute in the vicinity of the aperture.

The lateral parts of the last and penultimate whorls—of the inner volutions nothing has been preserved in this specimen (Pl. XIV, fig. 2)—are covered with very numerous, radiating ribs, which are narrower than the intercostal furrows, strongly elevated and sharp. Only in the vicinity of the aperture they are somewhat flattened. Their direction is radial or slightly turned backward. Before reaching the marginal shoulder they describe a flat curve, with its concavity turned forward. There are about seventy ribs counted within the circumference of the last volution, corresponding to a diameter of 125 mm. The same number is given by Wachner for the last volution of an Alpine specimen of equal size (Pl. XXII, fig. 1, p. 317).

A satisfactory idea of the shape and sculpture of the inner volutions of the Himalayan form may be gathered from my smaller specimen (Pl. XV, fig. 1), which is probably entirely chambered.

In its transverse section this specimen recalls very strongly the variety illustrated by Wachner on Pl. XXIV, fig. 6. It is comparatively high-mouthed,

and provided with a strongly compressed, nearly rectangular cross-section. Both the lateral parts and external area are remarkably flattened. Considering its small dimensions, the keel and the lateral channels are developed very strongly. Secondary keels bordering the marginal sides of the channels are distinctly defined.

The number of ribs is very large. Not less than 64 ribs are counted within the circumference of the last volution, corresponding to a diameter of 67 mm. In the penultimate whorl of the specimen illustrated by Wæhner on Pl. XXII, fig. 1, 59 ribs have been counted within a circumference corresponding to the same diameter. The ribs are straight, exactly radial, very slender, and slightly elevated near the marginal shoulder where they become obliterated very rapidly. The external area having been partly injured by weathering in my specimen, I cannot say whether or not they do meet the marginal ridges in a forward-bent curve.

#### Dimensions.

	Pl. XIV, fig. 2.	Pl. XV, fig. 1.
Diameter of the shell	. 115 mm.	. 63 mm.
" " " umbilicus	. 77 "	. 36.5 "
Height } at the aperture	. 21 "	. 15.5 "
Thickness } at the aperture	. 21 "	. 15 "
Height } at the beginning of the last volution	. 17.5 "	. ?
Thickness } at the beginning of the last volution	. 21.5 "	. ?

*Sutures*.—Not known in detail.

*Remarks*.—My specimens agree so closely with *Arietites Coregonensis* from the zone of *Schlotheimia marmorea* in the Alpine lower lias, as illustrated by Wæhner, that I do not hesitate to unite them with that characteristic species as *cf.*

As this identification is of special importance for a correlation of the Himalayan lias with the deeper stage of the lower lias in Europe, I shall pass in review such species of *Arietites* characteristic of the higher stage of the Alpine lower lias as might put in a claim for a closer comparison. In this respect our examination can be restricted to the group of forms which have been included in the genus *Verniceras* by Hyatt, and in the subdivision C, by A. v. Sutner in his systematic table of *Arietidae* as published by Boese (*Zeitschr. Deutsch. Geol. Ges.* XLVI, 1894, p. 721). In this subdivision the groups of *A. tardecrescens* v. Hauer and of *A. Conybeari* d'Orb. must be taken into consideration, but all species belonging to these groups and characteristic of the higher stage of the lower lias are provided with ribs which are turned forward, even in the inner volution. This character distinguishes our specimens at once from *A. bavaricus* Boese (l. c. p. 723, Taf. LVI, figs. 1, 2) or from *A. Rothpletzi* Boese (l. c. p. 730, Taf. LVI, figs. 5, 6), which otherwise show a considerable resemblance in the external shape and in the number of ribs.

ARIETITES nov. sp. ind. ex aff. COREGONENSIS Sow. Pl. X, fig. 6.

This fragment of an outer whorl must be separated from *Arietites Coregonensis* on account of its very low and broad cross-section. A height of 20 mm. corre-

sponds to a transverse diameter of 28 mm. In its outlines the transverse section resembles that of the last volution in large examples of *Arietites Coregonensis*. The greatest transverse diameter coincides with the umbilical margin, which is distinctly defined. From this place the lateral parts converge in flat curves towards the external part, which is remarkably narrow and occupied entirely by the very strongly developed keels and channels. The median keel and the two secondary marginal ridges are of equal height and rounded above, not acute.

The sculpture agrees with the ornamentation in *A. Coregonensis*. The ribs become obliterated very rapidly in the vicinity of the marginal ridges, where they are curved forward very slightly.

The deficient state of this fragment renders an exact determination impossible, but the character of ribs and the shape of the cross-section point to a species closely related to *A. Coregonensis*. The great thickness of the whorls and the strong development of keels and channels might perhaps suggest a comparison with the group of *A. Bucklandi* Sow., but an affinity with that group is excluded by the different shape of the cross-section and by the absence of marginal swelling of the ribs.

ARIETITES HIMALAYANUS NOV. SP. Pl. XIV, fig. 4.

This fragment of the outer whorl and of a small part of the preceding volution belongs to a species which, in the general shape of its disc, is related to *Arietites Boesei* Ublig, whereas in its sculpture it exhibits a close affinity to *A. Conybeari* Sow. and to *A. Cordieri* Can.

As has been stated by Wachner in his excellent description of *Arietites Cordieri* (Beitraege zur Kenntniss der tieferen Zonen des unteren Lias in den nordöstl. Alpen VI, Theil, Beitr. z. Palæont. Oesterr. Ung. etc., VIII, p. 250, Taf. XVII, figs. 1-4; XVIII, figs. 1-6), our knowledge of the British species *A. Conybeari* is restricted to Wright's description and illustration of a single specimen of very large size (Monograph of the Lias Ammonites 1 Pt. Palæontogr. Soc., London, XXXII, 1878, Pl. II, figs. 1-3), rendering a comparison with moderately sized types very difficult. Nevertheless it is obvious from Wright's illustration that our Himalayan specimen agrees with *A. Conybeari*, exactly in such features as are characters of distinction between the British species and its Alpine representative *A. Cordieri*. The ribs, which originate in the umbilical suture, run across the umbilical wall and the lower portion of the flanks, obliquely backward, and turn gradually into a radial direction in the marginal region of the lateral parts. Here they swell into knob-shaped elevations, which are not, however, actual tubercles, and terminate abruptly in front of the marginal ridges. The extremities only of these stout ribs are turned forward slightly in uniting with the marginal ridge.

A specimen of *Arietites longidomus* Quenstedt (Ammoniten des schwäbischen

Jura I, Lias, Taf. VI, fig. 1) in the collections of our University's Palæontological Museum shows exactly the same type of sculpture as my Himálayan example. In both of them the ribs terminate stiffly opposite the marginal ridges, and their extremities are not protruded along the latter for any considerable distance.

The external sculpture is very strongly marked. The marginal ridges are well defined, the channels deeply excavated. The median keel is high and elevated considerably above the marginal ridges.

My specimen differs both from *Arietites Conybeari* and *A. Cordieri* in the shape of its transverse section, which is slender and strongly compressed. In the last volution a width of 19 mm. corresponds to a height of 22 mm. But a character still more remarkable is the compressed shape of the penultimate volution, in which the corresponding measurements are 9 and 12 mm. In order to find similar proportions, we are obliged to look to the group of *Arietites romanicus* Uhlig. In this group it is especially *A. Boesei* Uhlig (Ueber eine unterliasische Fauna aus der Bukowina, Abhandl. d. med. naturw. Vereins Lotos, II, p. 29, Taf. I, fig. 6) which resembles our species in the shape of the high and oval cross-section. But any closer affinity with the group of *A. romanicus* is excluded by the difference in their sculpture. In *A. Boesei* the ribs are directed forward from their very origin at the umbilical suture, whereas they are turned backward strongly in the umbilical region of my Himálayan form.

Taking into consideration the remarkable cross-section of the present species, which is combined with a sculpture characteristic of the group of *A. Conybeari*, its independent position cannot well be doubted. On the strength of this fact I have ventured to introduce a new specific name for a fragment, which otherwise should not have been chosen for a type-specimen.

Several fragments of inner volutions are referable with some probability to this new species.

*Dimensions.*—Not measurable.

*Sutures.*—Not known.

ARIETITES nov. sp. ind. ex aff. ROTIFORMIS Sow. Pl. XIV, fig. 3.

A small fragment of an outer whorl, consisting of four air-chambers, shows a great resemblance in its shape and sculpture to the group of *Arietites rotiformis* Sow., which, according to Waehner, is represented very richly in the lower lias of the north-eastern Alps.

As there is only a single, small fragment available for examination, nothing definite can be said about the involution of the complete shell. But, to judge by the proportions of the cross-section and by the curvature of the outlines, it seems to have been a type with very low, slowly increasing volutions and with a wide umbilicus, comparable, perhaps, to Waehner's type-specimen of *A. rotiformis* var.

*rotator* Reynés, illustrated in Pl. II, fig. 1, of his beautiful monograph of the Alpine Ammonites of the deeper zones of the lower lias (Part VII, Beitr. zur Palæont. u. Geol. Oesterr. Ungarns, etc., IX, 1895).

The transverse section is of trapezoidal shape, with flattened lateral and external parts. The greatest transverse diameter corresponds to the siphonal margin. The whorl is thicker than high, if the measurement is taken along the stout marginal tubercles. In my specimen a height of 19 mm. corresponds to a width of 21 mm. taking the distance between two opposite marginal tubercles as transverse diameter.

Keels and channels are well defined. The median keel surpasses the marginal ridges in height.

Six stout transverse ribs are counted in my fragment. Their direction is radial, with the exception of the umbilical wall where they are slightly turned backward. They are elevated into strong tubercles along the external margin. A second elevation on a considerably smaller scale is noticed in the lower third of the lateral parts. The marginal elevations protrude more strongly than in any of the equal-sized specimens of *A. rotiformis*, as illustrated by Waehner. They are even more stout and massive than in the example illustrated by F. v. Hauer (Cephalopoden aus dem Lias der nordöstlichen Alpen, Denkschr. Kais. Akad. d. Wiss. XI, 1856, Taf. I, fig. 1). The stout tubercles terminate abruptly in front of the marginal ridges.

*Sutures*.—The sutural line has been excellently preserved. It differs from the sutural line of the typical *Arietites rotiformis* by its short siphonal lobe, by the dimeroidic character of the siphonal saddle and by the general height of the saddles.

In all the typical shapes of *A. rotiformis* the siphonal lobe extends beyond the principal lateral by about one-third, whereas in my specimen the two lobes are of equal depth. In this character as well as in the dimeroidic division of the siphonal saddle my Himalayan form appears to be nearly allied to *A. Deffneri* Oppel (Palæont. Mittheil. aus dem Museum d. bayr. Staates, I, p. 131, Taf. X, fig. 1). Their sutural lines agree, indeed, very closely and differ only in some subordinate details, especially in the more equal dimensions of the two secondary saddles, into which the siphonal saddle of the Himalayan species is divided by the secondary median lobe.

Taking into consideration the close agreement of the sutural lines, I should not hesitate in referring our Himalayan form to *A. Deffneri* as *cf.*, had not the differences in the sculpture and shape of the cross-section peremptorily required its isolation. *A. Deffneri* is a high-mouthed species with a rectangular cross-section and more numerous ribs, and is therefore in this respect allied to our species less closely than *A. rotiformis*.

The Himalayan species described here seems to represent a very interesting type of *Arietites*, combining the external characters of *A. rotiformis* with the sutural line of *A. Deffneri*.

## CONCLUSIONS.

The fauna of exotic blocks 16 and 17 consists of the following forms—all of them Cephalopoda :—

*Dibranchiata.*

1. *Atractites* sp. ind.

*Ammonoidea.*

2. *Phylloceras* *Montgomeryi* nov. sp.
3. " *Sclateri* nov. sp.
4. " nov. sp. aff. *Sclateri*.
5. " *Horsefeldii* nov. sp.
6. " *Caldwellii* nov. sp.
7. " sp. ind. aff. *Dieneri* Rosenbg.
8. " (*Schistophylloceras*) *mongolicum* nov. sp.
9. *Rhacophyllites* cf. *gigas* Fucini.
10. " *schofariiformis* nov. sp.
11. *Euphyllites* sp. ind. (?)
12. *Analytoceras* sp. ind. aff. *articulato* Sow.
13. *Ectocentrites* sp. ind. (aff. *altiformis* Bon.?)
14. *Pleuracanthites* sp. ind. aff. *biformis* Sow.
15. *Oxyntoceras* sp. ind. aff. *Greenoughi* Sow.
16. *Schlotheimia* sp. ind. ex aff. *trapezoidalis* Can.
17. " sp. ind.
18. " sp. ind. aff. *marmorea* Opp.
19. *Aegoceras* sp. ind. (ex aff. *bifer* Quenst.?)
20. *Arietites* cf. *Coregonensis* (Sow.) Can.
21. " nov. sp. ex aff. *Coregonensis* Sow.
22. " *himalayanus* nov. sp.
23. " nov. sp. ind. ex aff. *rotiformis* Sow.

Among the ammonites the genus *Phylloceras* predominates both in the number of species and individuals. It is interesting to compare the distribution of genera among the number of fossils which have been actually collected by A. v. Krafft. His collections from exotic blocks 16 and 17 contain altogether 87 specimens of ammonites which permit of a generic determination. Among them *Phylloceras* is represented by 51, *Rhacophyllites* by 2, *Arietites* by 20, *Schlotheimia* by 8, and the rest of the genera each by one single individual only. This enormous predominance of *Phylloceras* imparts to our Himālayan fauna a decidedly Alpine aspect, and distinguishes it at a single glance from all liassic faunæ of middle-European habit.

The Alpine type of this liassic fauna shows itself immediately and indubitably, not only in the preponderance of *Phylloceras*, but also in the close affinities of the majority of Himālayan species with Alpine forms. There is not one single species in this fauna which bears a distinct local character. Of the striking



peculiarities which distinguish the triassic cephalopod faunæ of the main region of the Himalayas from the homotaxial faunæ of the Mediterranean region, nothing is seen in the present fauna. No palæontologist would be astonished if it had been found in Sicily or in Greece instead of on the Tibetan frontier.

Among species indicating very close specific relationships with European forms the following may be mentioned :—

- Phylloceras Montgomeryi*—*Ph. persanense* Herb.  
*Phylloceras Scateri*—*Ph. Lipoldi* Hau.  
*Phylloceras Mongolicum*—*Ph. Uermæsense* Herb.  
*Rhacophyllites cf. gigas* Fucini.  
*Analytoceras sp. ind. aff. articulato* Sow.  
*Pleuracanthites sp. ind. aff. biformis* Sow.  
*Schlothemia sp. ind. aff. marmorea* Opp.  
*Arietites cf. Coregonensis* (Sow.) Can.  
*Arietites himalayanus*— $\left\{ \begin{array}{l} A. Boesi \text{ Uhl.} \\ A. Conybeari \text{ Sow.} \end{array} \right.$   
*Arietites nov. sp. aff. rotiformis*— $\left\{ \begin{array}{l} A. rotiformis \text{ Sow.} \\ A. Deffneri \text{ Opp.} \end{array} \right.$

This list would probably have been still larger, if the *Phylloceratidæ* of the deeper zones of the Alpine lower lias had been submitted to an examination as detailed and careful as the representatives of other families of Ammonoidea. But, unfortunately, a large number of Alpine types of *Phylloceras* of lower liassic age are as yet but very imperfectly known.

Particularly striking is the fact that the genera *Analytoceras*, *Pleuracanthites* and probably even *Euphyllites* and *Eotocentrites*, which are remarkable as connecting links between the families of *Lytoceralidæ*, *Phylloceratidæ* and *Psiloceratidæ*, are also represented in this fauna, although they are of very rare occurrence.

That the fauna of exotic blocks 16 and 17 bears the stamp of lower liassic age, as has been noticed by A. v. Kraft, is shown by the association of genera as well as by the affinities of its species to European ones. But the faunal guides are yet sufficient for a more exact determination of the age.

The specific similarities of the majority of species point to a correlation with the lower stage of the lower lias. I need only emphasize the presence of *Arietites cf. Coregonensis* Sow., of a second species of *Arietites*, combining characters of *A. rotiformis* and *A. Deffneri*, of a species of *Phylloceras* belonging to the group of *Ph. (Schistophylloceras) Uermæsense* Herb., of the genera *Analytoceras* and *Pleuracanthites*, and the rich occurrence of *Schlothemia*, which is represented by at least three species, one of them nearly allied to *Schl. marmorea* Opp.

The relationship to the faunæ of the deeper zones of the lower lias is, as can be easily seen, most clearly marked. On the other hand we cannot exclude peremptorily the possibility of the presence of faunistic elements, which might belong to the higher stage of the lower lias. As such elements, indicating perhaps a relationship with the fauna of the upper division of the lower lias, *Oxyntoceras sp. ind. ex. aff. Greenoughi* Sow. and *Arietites himalayanus* might be taken into

consideration. The latter, although recalling *A. Conybeari* in its sculpture, approaches in its general shape very closely to *Ar. Boesei* Uhl., which belongs to a group of this genus characteristic of the higher stage of the lower lias.

No great importance should be attributed to the representatives of the genus *Phylloceras*, which do not keep narrow stratigraphical horizons as strictly as might be wished for a more exact correlation. It is, however, noteworthy, that the group of *Phylloceras Partschii* Stur, which in the higher stage of the Alpine lias is invariably the most conspicuous for its frequency, is not represented in the Himálayan lias.

The limited occurrence and small thickness of the liassic strata in the region of exotic blocks in Malla Johar is no argument against the possibility of finding both the deeper and higher stages of the lower lias represented within them. I need only refer the reader to the liassic deposits of Transsylvania, as described by Herbich, which, although being only 3 m. in thickness and very little extended, have yielded numerous ammonites of the deeper and higher stages of the lower lias.

If we summarize the above observations, we come to the conclusion that the fauna of exotic blocks 16 and 17 is to be regarded as homotaxial with the lower stage of the lower lias, whereas the presence of equivalents of the higher stage has as yet not been ascertained.

#### V. FOSSILS FROM EXOTIC BLOCKS NOS. 6 AND 7 (MALLA KIOGARH).

Among four small exotic blocks occurring within the upper flysch of Malla Johar near Malla Kiogarh encamping-ground,—marked E.B. 4, 5, 6, 7, on the map accompanying A. v. Kraft's memoir—blocks 6 and 7 yielded a small number of ill-preserved specimens of *Phylloceras*, *Egoceras*, *Arietites* and *Belemnites*. None of them is sufficiently complete to permit a specific determination.

##### PHYLLOCERAS sp. ind. cf. SCLATERI Dien. Pl. XVI, fig. 4.

This chambered fragment belongs to all appearance to a species very closely allied to or identical with *Phylloceras Sclateri*, with which it agrees in its shape and involution. In consequence of the injuries which the surface of the cast has suffered from weathering, the sutures appear somewhat deformed.

Several fragments are also referable with some probability to this species, but their bad state of preservation does not permit of a safe identification.

##### PHYLLOCERAS sp. ind. aff. MONTGOMERYI Dien.

An imperfectly preserved cast, measuring 58 mm. in diameter, possessing already the commencement of the body-chamber, is comparable by its shape to

*Phylloceras Montgomeryi* Dien. The sutures are but imperfectly known to me. The specimen is not suitable for illustration.

*EGOCERAS* sp. ind. Pl. XVI, fig. 5.

This is a form (unfortunately only a small fragment of a chambered whorl) which is comparable to *Ægoceras bifer* Quenst. in reference to its general shape. But the marginal swellings of the stout, transverse ribs are but faintly developed, and no external bridges connecting them have been noticed. The sutural line, which has been partly preserved, agrees in general with that of *A. bifer*, as illustrated by Quenstedt in Pl. 22, fig. 11 of his "Ammoniten des schwäbischen Jura" I, Th. (Lias). The arrangement of the sutural line is asymmetrical, the siphonal lobe with its short median prominence being shifted to the right of the median plane of the shell.

*ARIETITES* sp. ind. ex aff. *A. GRUNOWI* v. Hauer. Pl. XVI, fig. 3.

The present specimen, which seems to possess the body-chamber, consists of a fairly well-preserved outer volution. The inner whorls have been completely destroyed. It shows a close resemblance to *Arietites Grunowii* v. Hauer (Cephalopoden aus dem Lias der nordöstlichen Alpen, Denkschr. Kais. Akad. d. Wissensch, XI, p. 27, Taf. VIII, figs. 4-6), being distinguished by a very broad transversely elliptical cross-section, and by a low keel, accompanied by shallow and ill-defined channels. The lateral parts are strongly curved and covered with numerous and stout transverse ribs, which are bent forward distinctly in the marginal region and in the external part. Their direction is not exactly radial but slightly turned backward, especially so in the umbilical region. Secondary ridges accompanying the siphonal channels are entirely absent.

The specimen is provided with a very broad umbilicus.

*Dimensions.*

Diameter of the shell . . . . .	76 mm.
" " umbilicus . . . . .	44 "
Height } of the last volution . . . . .	16 "
Thickness } . . . . .	22 "

*Sutures.*—Not known.

*Remarks.*—The new description and illustrations of F. v. Hauer's species, which have been given by Waehner (Beitraege zur Kenntnis den tieferen Zonen des unteren Lias, etc., Beitr. zur Palæont. Oesterr. Ungarns, etc., VI, p. 320, Taf. XXV, figs. 2, 3), enable me to draw a closer comparison between *Arietites Grunowii* and the present specimen. The latter is distinguished from *A. Grunowii*, to which it is certainly closely related, by comparatively lower whorls, by a wider umbilicus and by the more distinct concavity in the direction of the transverse ribs along the siphonal margin. The strength and direction of the ribs on the lateral parts is the

same in both species, but on the external part the ribs run much further towards the anterior margin than is the case in *A. Grunowi*.

#### BELEMNITES sp. ind.

Several fragments of *Belemnites* are only sufficient to determine the genus.

The rostra are very slender, of an elongated conical shape, recalling the liassic *Belemnites acuarius* Schloth. In one of the rostra a deep apical furrow has been noticed.

Ventral or dorso-lateral furrows are not known in any of my specimens.

#### CONCLUSIONS.

There can be no doubt that the small fauna of exotic blocks Nos. 6 and 7 is of lower liassic age. It is probably homotaxial with the fauna of blocks 16 and 17, although this homotaxis cannot be proved by the presence of identical species, on account of the fragmentary condition of my materials.

#### SUMMARY.

The discovery of the exotic blocks in Malla Johar by the Himálayan expedition in 1892, in which C. L. Griesbach, C. S. Middlemiss and myself took part, has acquainted us with a region, in which permian and triassic strata show a development differing from that of the corresponding beds observed in the normal sections of the Himálayas. A. v. Krafft's exploration of the Kiogarh range has not only corroborated the facts stated by the Diener expedition, but has filled up two important gaps in the series of the exotic region by the discovery of blocks of lower triassic and liassic age.

His careful examination of the entire territory of Malla Johar enabled A. v. Krafft to draw a closer comparison between the Tibetan series of beds as exposed in the exotic blocks and the normal Himálayan series. This comparison leads to the conclusion that each single subdivision of the Tibetan series known so far from the permian up to the lias differs from the corresponding Himálayan division.

In the mesozoic rocks the lithological difference is most strongly marked in the triassic horizons from the beds with *Flemingites Rohilla* to the top of the carnic stage and in the lias.

In the main region of the Central Himálayas the triassic beds underlying the great mass of the Dachsteinkalk are represented by grey or black limestones and shales, whereas in the Tibetan series they consist of red limestones exhibiting a striking resemblance to the Hallstatt limestones of the Eastern Alps. A. v. Krafft is fully justified in correlating the triassic facies of the Tibetan series, only excepting the noric (juvavic) stage, with the Hallstatt facies. The

lithological resemblance of block No. 2 with the carnic Halstatt limestone of the Roethelstein near Aussee is, indeed, so great, that it is no easy matter to distinguish fossils from these two localities without a closer inspection.

In the noric (juvavic) and rhætic stages the difference between the Tibetan and Himálayan series becomes less remarkable. During these stages great masses of grey, dolomitic limestones, very poor in fossils, have been deposited in both areas. "Nevertheless there is no complete lithological identity between the two, the Tibetan grey limestone being massive throughout, while the Himálayan Dachsteinkalk is well bedded."

The sharpest contrast between the two series shows itself in the liassic periods. In the main region of the Himálayas (Spiti) the rhætic, liassic and oolitic beds are of uniform lithological character, consisting of dolomitic, thin-bedded, black or grey limestones. The red liassic limestones of blocks 6, 7, 16, 17 are developed in the facies of Adneth, and agree lithologically most closely with rocks composing the liassic crags of the Eastern Carpathians in Transsylvania and at Valesacca (Bukowina).

The faunæ of the exotic blocks of lower triassic and of Muschelkalk age have very small affinities to Alpine faunæ, but are connected very intimately with those of the corresponding divisions in the main region of the Himálayas, although the lithological differences are important. But the carnic fauna of the Tibetan series exhibits remarkable peculiarities pointing in another direction.

As has been remarked by E. v. Mojsisovics, the preponderance of *Ammonoidea trachyostraca* (*Ceratitoidea* and *Tropitoidea*) with the simultaneous diminution of *leiostraca* (especially *Arcestoidea*) is one of the most striking peculiarities of the upper-triassic cephalopod faunæ of the Indian province. This proportion of the two divisions of triassic *Ammonoidea* is reversed in the carnic fauna of exotic block No. 2. In the Tibetan series the genera *Arcestes* and *Cladiscites*, which are of comparatively rare occurrence in the Himálayan series, appear suddenly in large numbers, imparting to this exotic fauna its special type. With this preponderance of *Arcestoidea*, especially of *Cladiscitidæ*, is united another feature of distinction from the Himálayan series, and this is the very large percentage of species allied to European forms. Referring the reader to the results of my examination of the faunæ of exotic blocks 2 and 5, I need not explain further that those faunæ bear a peculiar character which distinguishes them from the homotaxial fauna of the main region of the Himálayas, but points to a very close affinity with the faunæ of the zones of *Trachyceras Aonoides* and *Tropites subbullatus* in the Eastern Alps.

The agreement of the fauna of blocks 16 and 17 with that of the deeper stage of the Alpine lower lias is perhaps still more striking. If no other mesozoic faunæ in the Himálayas were known, our knowledge of this liassic fauna would not justify the establishment of an Indian zoogeographical province. The contrast between the Mediterranean and Indian triassic faunæ in the Himálayan region is nearly obliterated in the Tibetan region of exotic blocks during the liassic period. The

difference between the liassic faunæ of Wurtemberg or England and the Alps is, indeed, more conspicuous than that between the Mediterranean and Tibetan faunæ of the lower lias. The affinities of the latter are extraordinarily close, not a single species in the fauna of blocks 16 and 17 bearing a distinct local character.

There can hardly be a doubt that to the north of the main region of the Himálayas there extended from the Eastern basin of the Tethys to the Mediterranean area a zone, in which sediments of a nearly uniform lithological character were deposited during carnic and liassic times, and where the area was inhabited by a fauna with insignificant local peculiarities and barely influenced by the independent development which is noticed in the mesozoic faunæ of the Indian triassic province.

A. v. Krafft and Suess agree in assuming that the Tibetan facies could not be *in situ* below the region of exotic blocks in Malla Johar, but must have been carried there from a territory lying much further to the north. This hypothesis is able to explain the rapid change of facies between the Tibetan and Himálayan series, but it does not explain the striking lithological and faunistic agreement which exists between the carnic and liassic sediments of the Tibetan series, on the one hand, and of the homotaxial beds in the Mediterranean region, on the other. It is the establishment of this agreement which I consider to be the most important result of my examination of A. v. Krafft's Himálayan collections.

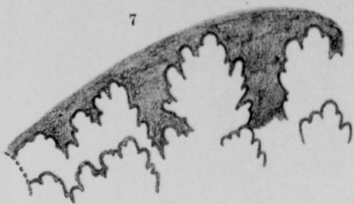
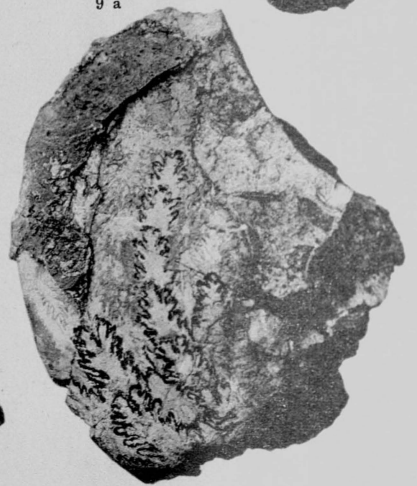


PLATE X.

- Fig. 1a, b, c      GRYPOCERAS SUESSEI FORME. Dien.  
„ 2a, b, c      CLADISCITES cf. GORGIE Dien.  
                                Inner nucleus of a large specimen.  
„ 3a, b      TROPITES sp. ind. aff. ACUTANGULO v. Mojs.  
                                These three specimens from the exotic block No. 2.  
„ 4a, b      ANALYTOCERAS sp. ind. aff. ARTICULATO Sow.  
„ 5a, b      OXYNOTOCERAS sp. ind. ex. aff. GREENOUGHII Sow.  
„ 6a, b, c      ARIETITES sp. ind. ex. aff. COREGONENSIS Sow.

These three specimens from the exotic blocks 16 and 17.



Exotic blocks of Malla Johar.

Geol. Surv. of India.

Pl. X.

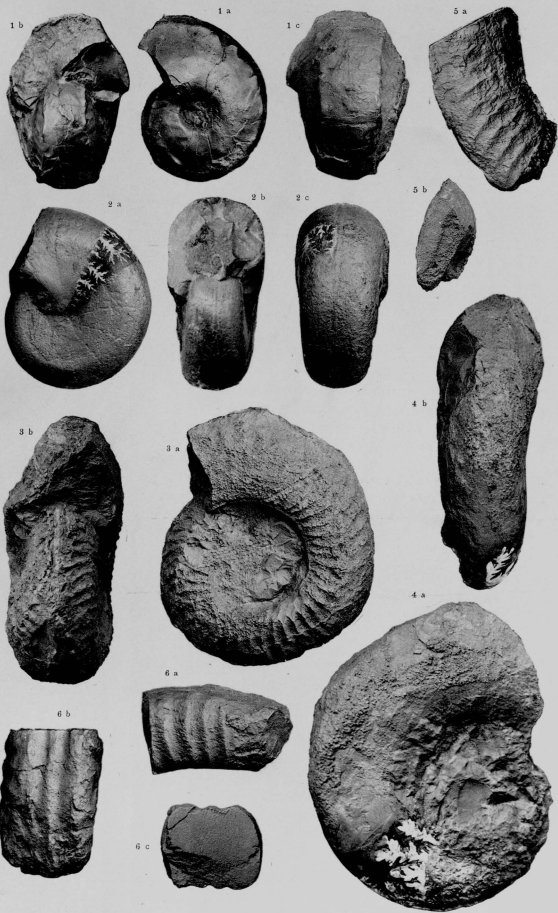


PLATE XI.

- Fig. 1a, b, c      RHACOPHYLLITES cf. GIGAS Fucini.  
" 2a, b, c      PHYLLOCERAS (SCHISTOPHYLLOCERAS) MONGOLICUM Dien.  
" 3      } PHYLLOCERAS MONTGOMERYI Dien.  
" 4      } Siphonal lobe and saddle of the large specimen illustrated on Pl. XIII,  
              fig. 1.  
" 5      } SCHLOPHEIMIA sp. ind.  
" 6a, b      }

All specimens from the exotic blocks 16 and 17.

Exotic blocks of Malla Johar.

Geol. Surv. of India.

Pl. XI.



PLATE XII.

Fig. 1	PHYLLOCERAS (SCHISTOPHYLLOCERAS) MONGOLICUM Dien.
„ 2a, b	PHYLLOCERAS SCIATERI Dien.
„ 3a, b	PHYLLOCERAS HORSEFIELDII Dien.
„ 4a, b, c	RHACOPHYLLITES SCHOFARIFORMIS Dien.
„ 5	PHYLLOCERAS sp. ind. ex aff. DIENERI Rosenbg.

All specimens from the exotic blocks 16 and 17.

Exotic blocks of Malla Johar.

Geol. Surv. of India.

Pl. XII.

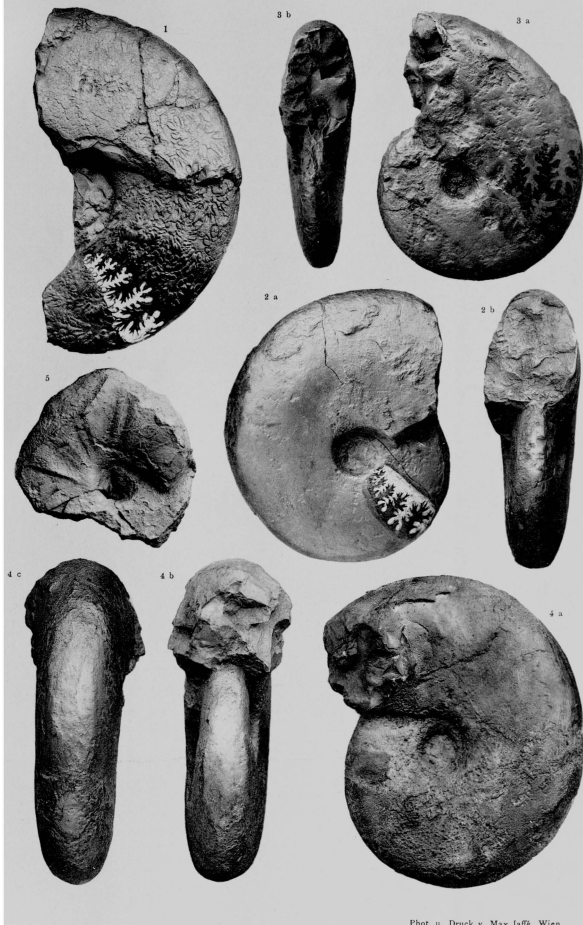


PLATE XIII.

- |                  |  |
|------------------|--|
| Fig. 1a, b, c, d | PHYLLOCERAS MONTGOMERYI Dien.            |
| „ 2a, b          | PHYLLOCERAS sp. ind. aff. SCLATERI Dien. |
| „ 3              | PHYLLOCERAS SCLATERI Dien.               |
| „ 4a, b          | PHYLLOCERAS CALDWELLII Dien.             |

All specimens from the exotic blocks 16 and 17.

Exotic blocks of Malla Johar.

Geol. Surv. of India.

Pl. XIII.

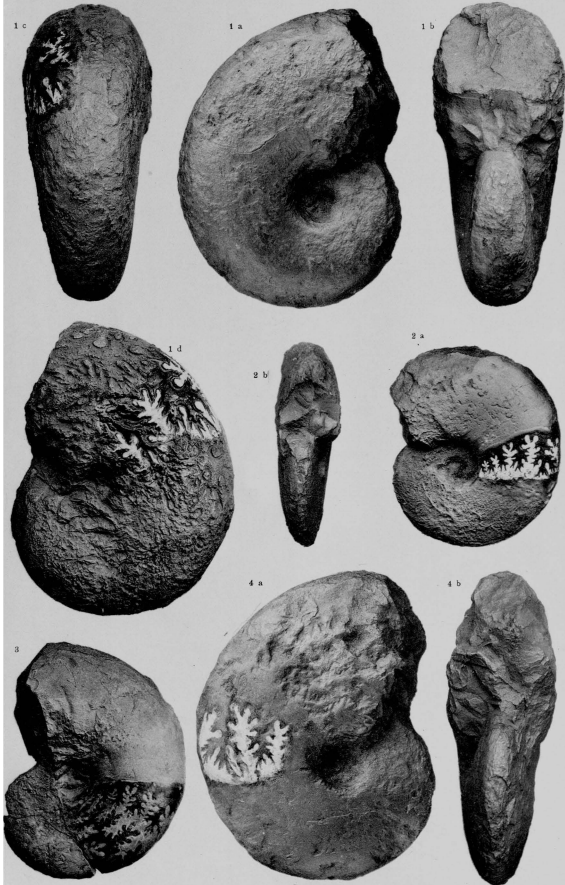


PLATE XIV.

Fig. 1 <i>a, b</i>	ATRACTITES sp. ind.
„ 2 <i>a, b</i>	ARIETITES cf. COREGONENSIS (Sow.) Cav.
„ 3 <i>a, b</i>	ARIETITES nov sp. ex. aff. ROTIFORMIS Sow.
„ 4 <i>a, b</i>	ARIETITES HIMALAYANUS Dien.
„ 5 <i>a, b</i>	SCHLOTHBIMIA sp. ind. aff. MARMOREA Opp.
„ 6 <i>a, b</i>	ÆGOCERAS sp. ind. (ex. aff. BIFER Quenst).

All specimens from the exotic blocks 16 and 17.



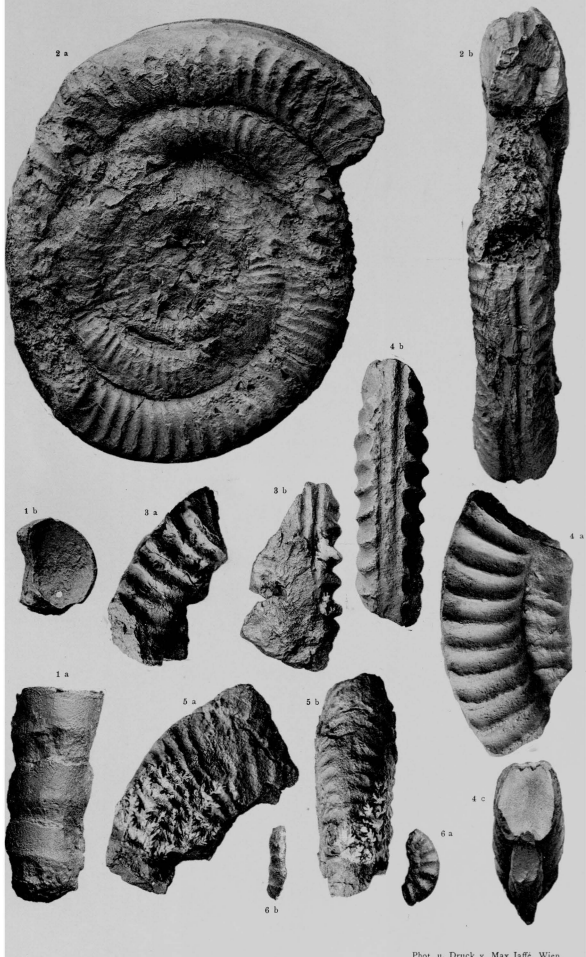


PLATE XV.

Fig. 1a, b, c	ARIETITES cf. COREGONENSIS (Sow.) Can.
" 2a, b	SCHLOTHEIMIA sp. ind. ex aff. TRAPEZOIDALIS (Sow.) Can.
" 3a, b	PLEURACANTHITES sp. ind. aff. BIFORMIS Sow.
" 4a, b	SCHLOTHEIMIA sp. ind.
" 5a, b	EUPHYLLITES sp. ind. (?)

All specimens from the exotic blocks 16 and 17.

Exotic blocks of Malla Johar.

Geol. Surv. of India.

Pl. XV.

