HIMALAYAN FOSSILS.

Vol. II, Trias, Part 2.

THE CEPHALOPODA OF THE MUSCHELKALK.

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THE CEPHALOPODA OF THE MUSCHELKALK

BY

CARL DIENER, PH. D.

UNIVERSITY OF VIENNA.

WITH PLATES I—XXXI.

INTRODUCTION.

General R. Strachey[1] was the first author who mentioned the occurrence of triassic deposits in the Central Himálayas. His geological reconnaissance in the neighbourhood of the Niti Pass forms one of the most important contributions to our knowledge of the stratigraphical conditions of that part of the Himálayas. Strachey mentions the presence of triassic beds in several localities of Painkhanda and the adjoining parts of Hundés, and he was the first who noticed the resemblance of a group of rocks above the palæozoic deposits to the European Muschelkalk. At the same time he lays special stress on his not having clearly recognised the importance of those formations at the time of finding them, and he declared himself unable to determine their exact geological position. Strachey's Muschelkalk is a dark-coloured limestone alternating with shales and red sandstone beds, but he adds that most of the fossils collected by him were not found *in situ*, but in loose blocks.

In 1855 Greenough alluded to the similarity of these fossils with those of the St. Cassian fauna, and Ed. Suess, who in 1862 examined Strachey's collection, believed himself justified in identifying a number of species with forms peculiar to the Trias of the Eastern Alps. Among them he enumerates: *Ammonites floridus*, *Ammonites Aon*, *Ammonites Gaytani*, *Ammonites Ausseanus*, *Ammonites diffissus*, *Halobia Lommeli*.[2] J. W. Salter, who together with H. F. Blanford published a description of the whole palæontological material collected by General Strachey, is of the same opinion with reference to the triassic fossils.[3]

[1] *R. Strachey*,—On the geology of part of the Himálaya Mountains and Tibet. Quart. Journ. Geol. Soc. VII, 1851; pp. 292—310.

[2] *E. Suess*.—Verhandlungen der K.K., Geologischen Reichs-Anstalt, Wien XII, p. 258 (Sitzung 31 Juli 1862.

[3] *J. W. Salter* and *H. F. Blanford*,—Palæontology of Niti in the Northern Himálaya. Calcutta, 1865.

The existence of triassic beds in Spiti, Ladakh, and Hundés had meanwhile been established by the examination of fossils discovered by travellers in those districts.

In 1863 H. F. Blanford described two triassic Ammonites, *Ammonites* (*Ptychites*) *Gerardi* and *Ceratites himalayanus*, collected in Spiti by Dr. Gerard, and he proved that *Ammonites Gerardi* belongs to a genus frequently met with in the Alpine Muschelkalk.[1]

In the same year A. Oppel began his important memoir on the fossils collected by the brothers von Schlagintweit in Tibet and Spiti during the years 1854 to 1857.[2] Although the geological horizons at which the different species were found had not been recorded by the collectors, Oppel correctly inferred that these fossils had not all been found in the jurassic Spiti-shales, and later on in his "Zusætze und Folgerungen," published in 1865, he assigned a great number of species to the Trias. Among the Cephalopoda described and figured by Oppel the following are of undoubtedly triassic age: *Xenodiscus*(?) *demissus*, *Ceratites Wetsoni*, *Ceratites truncus*, *Ceratites onustus*, *Ceratites Voiti*, *Ceratites Thuillieri*, *Gymnites Lamarki*, *Gymnites Jollyanus*, *Meekoceras Khanikoffi*, *Meekoceras proximum*, *Proarcestes Balfouri*, *Ptychites Everesti*, *Ptychites cognatus*, *Ptychites cochleatus*, *Ptychites rugifer*, *Ptychites impletus*, *Japonites runcinatus*.

Among these fossils he considered some of the Ceratites, especially *Ceratites Wetsoni*, to prove the existence of a distinct triassic horizon in the Himálayas,—*i.e.*, the true Alpine Muschelkalk.

In 1864 E. Beyrich described two fragments of triassic Ammonites (*Ceratites peregrinus* and *Ammonites brachyphyllus*), which the missionary Mr. Prochnow had brought from Ladakh to Europe.[3]

In 1865 C. W. Gümbel[4] examined the brachiopods and bivalves of the Schlagintweit collection. On the strength of these researches he came to the conclusion that two different triassic horizons might be distinguished in Spiti, the lower of which was represented by the sandstones of Balamsáli with *Amoplophora fassænsis*, Wissm., *Lima costata*, Münst., *Nucula-Goldfussi* v. Alb., and the upper, by dark-grey limestones with *Meekoceras Khanikoffi*, Oppel, *Lima lineata*, v. Schloth. *Waldheimia vulgaris*, v. Schloth. This upper horizon, to which belong most of the Ceratites and Ptychites described by Oppel, is considered by Gümbel to be an equivalent of the European Muschelkalk, whilst he compares the lower one to the Werfen beds of the Alpine Trias.

[1] *H. F. Blanford*,—"On Dr. Gerard's collection of fossils from the Spiti valley in the Asiatic Society's Museum." Journal Asiat. Soc. of Bengal, 1863, No. 2, pp. 121—138.

[2] *A. Oppel*,—"Über ostindische Fossilreste aus den secundæren Ablagerungen von Spiti und Gnari-Khorsum in Tibet." Palæontologische Mittheilungen aus dem Museum des Königl. bayr. Staates, I, p. 267.

[3] *E. Beyrich*,—Monatsber. Kgl. preuss. Akad. d. Wiss. Berlin, 18 Januar 1864, p. 58.

[4] *C. W. Gümbel*,—"Über das Vorkommen von unteren Triasschichten in Hochasien—(Nach den von den Gebruedern Schlagintweit gesammelten Fundstuecken beurtheilt)." Sitzungsber. Kgl. bayr. Akad. d. Wiss. 1865 [11], pp. 348—366.

To a similar conclusion came E. Beyrich[1] in his valuable memoir on the Cephalopoda of the Alpine Muschelkalk. He maintains the opinion that most of the triassic Ammonites described by Oppel bear a closer relationship to species peculiar to the Muschelkalk than to forms of the upper Trias, and he thinks that a great portion at least of the triassic deposits of the Himálayas must be looked upon as an equivalent of the Alpine Muschelkalk. He objects to Salter's identification of Himálayan species with St. Cassian and Hallstatt forms as incorrect, and at the end of his memoir sums up his views in the sentence, "that the whole Himálayan cephalopod-fauna of the Trias known at present,—provided it belonged to the same stratigraphical system,—should rather be called a fauna of the European Muschelkalk than of the upper Triassic Keuper."[2]

In strict opposition to these results of palæontological examination, Stoliczka,[3] who in 1864 had visited a number of geological sections in the North-Western Himálayas of Spiti and Rupshu, denies the existence of strata of lower triassic and Muschelkalk age. He asserts that his Lilang series, representing exclusively upper triassic deposits (Hallstätter or St. Cassian-Schichten) rests immediately on the carboniferous Kuling series, and that the Permian and the equivalents of the Alpine Buntsandstein and Muschelkalk had no representative in this part of the Himálayas.

This view, although adopted by the authors of the "Manual of the Geology of India," has not been confirmed by later examinations, neither in the field nor after close examination of the fossils. The existence of lower Trias and Muschelkalk has been proved by C. L. Griesbach in Kumaon, Gurhwal, Hundés, and Spiti. My examination of the whole palæontological material of triassic Cephalopoda in the Geological Museum in Calcutta, comprising Stoliczka's type-specimens, leads to the conclusion that probably not more than two species, *Sagenites Medleyanus*, Stol., and *Cladiscites indicus* nov. sp. (*Ammonites Gaytani* Stol.) were found in upper triassic horizons. Two others, *Isculites Hauerinus*, Stol., and *Lobites Oldhamianus*, Stol., are doubtful. All the rest are typical species of the Indian Muschelkalk. Whilst Stoliczka assumed a break of continuity between the carboniferous and upper triassic strata,[4] we know now that, on the contrary, the Himálayas contain the richest development of the lower Trias hitherto discovered.

As a distinct geological horizon in the Himálayan Trias the Muschelkalk was established by C. L. Griesbach, whose surveys form by far the most important additions to our knowledge of the geology of the Central Himálayas.[5] According to

[1] *E. Beyrich*,—"Über einige Cephalopoden aus dem Muschelkalk der Alpen und über verwandte Arten. Abhandlgn. Königl. Akademie d. Wiss. Berlin, 1866, No. 2, pp. 105—179.

[2] Most of the Cephalopoda described by Salter belong indeed to the Muschelkalk. The identification of the few genuine upper triassic forms with European species is utterly erroneous.

[3] *F. Stoliczka*,—"Geological sections across the Himálaya Mountains from Wangtu bridge on the River Sutlej to Sungdo on the Indus, etc." Memoirs of the Geol. Survey of India, Vol. V, Pt. 1. Calcutta, 1865, pp. 1-154.

[4] In the results of a geological reconnaissance of Kashmir and Ladakh in 1865, published under the title "Summary of geological observations during a visit to the provinces of Rupshu, Karnag, South Ladakh, Zanskar, Suroo, and Dras of Western Tibet in 1865" (Mem. Geol. Surv. of India, V. Pt. III, 1866, pp. 337—354.) Stoliczka still maintains these views, based on his first visit to Spiti.

[5] *C. L. Griesbach*,—Records, Geol. Survey of India, XIII., 1880, p. 83-93 (Section of the Shalshal cliff), and "Geology of the Central Himálayas." Memoirs of the Geol. Survey of India, XXIII., 1891, pp. 71, 72.

this author two divisions of this stage may be distinguished. The lower division consists of a dark, sometimes earthy limestone, with a poor Brachiopod fauna of Muschelkalk type. This zone, which in the Shalshal cliff-section is only 3 feet in thickness, is closely connected with the beds above, which are grey, concretionary, generally very hard limestones, containing a typical Muschelkalk fauna.

From personal inquiry I can only confirm the full correctness of Griesbach's statement.

In Kashmir the existence of the Muschelkalk, characterised by fossil remains of the genus *Ptychites*, has been proved by R. Lydekker.[1]

In 1882 E. v. Mojsisovics published his valuable memoir on the Cephalopoda of the Mediterranean Trias.[2] In this memoir the learned author shortly discusses the triassic Ammonites described by Oppel and their relationship to Alpine forms. His conclusions fully agree with the views of Oppel and Beyrich concerning the age of the deposits from which the fossils were derived. He remarks that most of the triassic Cephalopoda described by Oppel are closely allied to species of the Alpine Muschelkalk, but that in the meantime affinities to forms of the Spitzbergen Muschelkalk seemed probable. This relationship to Spitzbergen Ammonites has been more completely worked out in the same a uthor's memoir on the faunas of the Arctic Trias.[3]

In his preliminary notes on the triassic fauna of the Himálayas, E. von Mojsisovics[4] considers the Himálayan Muschelkalk to be a clearly-defined geological horizon of the Indian province, which he looks upon as a connecting link between the triassic Mediterranean and Arctic-Pacific provinces.

A monograph on the Cephalopoda of this horizon is contained in the following pages. The materials for this work consist of the Schlagintweit collection in Munich, Griesbach's collection in the Geological Museum in Calcutta with Blanford's and Stoliczka's type-specimens, and last, but not least, in the large number of fossils collected in 1892 by the expedition to Johár, Painkhanda, and Hundés, in which C. L. Griesbach, C. S. Middlemiss, and myself took part.

My gratitude is due to Geheimrath Professor Dr. K. A. von Zittel in Munich, who kindly furnished me with Oppel's type-specimens from the Schlagintweit collection. I am also most indebted to Dr. Edmund von Mojsisovics, Vice-Director of the K. K. Geologische Reichs-Anstalt in Vienna, whose valuable advice has aided me in many ways.

[1] *R. Lydekker*,—" The Geology of the Kashmir and Chamba territories and the British district of Khágán. Memoirs, Geol. Survey of India, XXII., 1883, p. 146.

[2] *E. von Mojsisovics*,—" Die Cephalopoden der Mediterranen Triasprovinz." Abhandlgn. K. K., Geol. Reichs Anstalt i. Wien X., Bd. 1882.

[3] *E. v. Mojsisovics*, *F. Teller* und *A. Bittner*,—"Arktische Triasfaunen." Mem. de l'académie impér. de sciences de St. Pétersbourg, XXIII. Bd., 6. Lieferung, 1886.

[4] *E. v. Mojsisovics*,—"Vorläufige Bemerkungen ueber die Cephalopodenfaunen der Himalaya-Trias." Sitzgs ber Kais. Akad. d. Wiss ; i. Wien ; Math. Nat. Cl. GI. 1. Abth. Mai 1892.

CHAPTER I.

THE MUSCHELKALK OF THE MAIN-REGION.

DESCRIPTION OF FOSSILS.

I. AMMONEA.

A. AMMONEA TRACHYOSTRACA.

Family: *CERATITIDÆ.*

Sub-family: DINARITINÆ.

Genus: CERATITES, de Haan.

For the general character and classification of the genus *Ceratites* I refer to *E. v. Mojsisovics*, "Die Cephalopoden der Mediterranen Triasprovinz" (Abhandlungen der K. K. Geologischen Reichs-Anstalt Vienna X., 1882), p. 18; "Arktische Triasfaunen," (Memoires de l'acadèmie impériale de sciences de St. Pétersbourg VII. ser. T. XXXIII., No. 6, 1886), p. 19; "Die Cephalopoden der Hallstætter Kalke," Vol. II. (Abhandlungen der K. K. Geologischen Reichs-Anstalt, Vol. VI, pt. 2, 1893, p. 397).

In the Muschelkalk of the Himálayas this genus is represented by 26 species. Among them 17 belong to the group of the *Circumplicati*, 4 to the group of the *Nodosi*, 3 to the group of the *Subrobusti*, 2 probably to the group of the *Geminati*.

In the Indian Muschelkalk, as in the Arctic-Pacific province of the Trias, the Ceratites of the *Circumplicati* group predominate. As to their family affinities, they seem to fall naturally into three sections. One of them contains the descendants of *Ceratites polaris*, Mojs., one of the most remarkable forms of the Arctic-Pacific province, whilst the two other sections are closely related to species of the Mediterranean Trias. One of these two sections is represented by *Certatites Wetsoni*, Oppel, and a second species of the *Wetsoni* type, both closely allied to *Ceratites Erasmi*, Mojs., of the Alpine Muschelkalk. The other subdivision comprises the groups of *Ceratites onustus*, Oppel, and *Ceratites Vyasa*. Both seem to possess a close relationship to the European *Ceratites Zezianus*, Mojs., of which species unfortunately we have a rather imperfect knowledge only. In the Alpine Muschelkalk *Ceratites Erasmi* and *Ceratites Zezianus* appear as isolated forms.

The most important forms among the Ceratites of the *Circumplicati* group are those which may rightly be considered to be descendants from *Ceratites polaris*, Mojs., from the Posidonomya Limestone of Spitzbergen. In his valuable memoir on the

triassic fauna of the Arctic-Pacific province E. v. Mojsisovics has justly laid some stress on the relationship of the Indian *Ceratites Voiti*, Oppel, to the group of *Ceratites polaris*. My examination of the rich material collected by Griesbach and myself has proved the existence of a considerable number of species representing this type in the Indian Trias. Among them *Ceratites Hidimba* of the Himálayan Muschelkalk is the nearest allied form to *Ceratites Lindstrœmi*, Mojs., and *Ceratites Oebergi*, Mojs., from Spitzbergen. In *Ceratites Hidimba* one or two ribs rise from faintly-marked umbilical tubercles on the inner whorls, whilst on the outer whorl the umbilical tubercles gradually disappear and the ribs do not separate into branches. On the shell radial growth-lines peculiar to the *Ceratites* of the *Polaris* group are well defined in *Ceratites Hidimba*. *Ceratites Dungara* differs, inasmuch as its ribs become stouter near the middle of the sides and also near the siphonal edge. Forms closely allied to *Ceratites Hidimba* are *Ceratites Arjuna* and *Ceratites Visvakarma*, with single radial ribs. A further stage of development is marked by *Ceratites Ravana* and its allies. The sculpture of their shell differs considerably from *Ceratites Hidimba*. In them, the umbilical tubercles persist in the adult stage and the ribs are, as a rule, divided on the outer whorl. To *Ceratites Ravana*, *Ceratites Airavata* stands in a relationship similar to that existing between *C. Dungara* and *C. Hidimba*. *Ceratites Voiti*, Oppel, may be considered as the most developed form of this group. In this species the ribs are not only divided on the sides of the body-chamber, but they develop into protracted, flat, lateral and marginal tubercles.

Both with reference to their sculpture and to the nature of the sutural line, the Indian representatives of the group of *Ceratites polaris*, mark a higher stage of development than the geologically older forms from the Spitzbergen Posidonomya-limestone. Even *Ceratites Hidimba*, which species shows the greatest resemblance to the Arctic forms, characterised by a small number of single ribs, shows deep, finger-like denticulations on the base of the lobes. The borders of the saddles are denticulated and their upper extremities faintly indented. Among other forms belonging to this group a small number only possess saddles, which are serrated at their upper extremities. In most of them, as in *Ceratites Voiti*, *Ceratites Ravana*, *Ceratites Airavata*, the saddles are brachyphyllic.[1]

Types of such ancient character as are represented by the group of *Ceratites decipiens*, Mojs., in the Arctic-Pacific Trias are not met with in the Indian Muschelkalk.

Within the group of the *Ceratites nodosi*, a near relationship may be observed between *Ceratites Thuillieri*, Oppel, and *Ceratites Himálayanus*, Blanf., to *Ceratites trinodosus*, Mojs., the well-known leading species of the upper portion of the Alpine Muschelkalk. *Ceratites Kamadeva* and *Ceratites Kuvera* bear sufficiently distinct characters to afford a wider separation from Mediterranean types.

The group of the *Ceratites subrobusti* is represented by three species in the Muschelkalk of the Himálayas. One of them, rather imperfectly preserved, may

[1] I make use of this term in the sense given to it by E. v. Mojsisovics in "Arktische Triasfaunen" l. c., p. 63.

be compared with *Ceratites Middendorfi*, Keys. The second is allied to *Ceratites subrobustus*, Mojs., from the Olenek-beds of Siberia, but differs by more extensive denticulation of the sutures. Sharply-pointed fingers reach almost to the upper extremities of the saddles, whereas in the true *Ceratites subrobustus*, occurring also in the rock-group between the Muschelkalk and the Otoceras-beds of the Himálayas, the borders of the saddles are not serrated. A similar remark applies to the third species, *Ceratites truncus*, Oppel. Its sutures are more highly developed than in the geologically older forms of this group from the Trias of the Arctic-Pacific region.

Of the two species, which I have placed into the group of the *Ceratites Geminati*, only one can be referred to this group with full certainty. Even this form is only represented by a single, rather imperfect specimen. Nevertheless the fact alone is of sufficient interest, that forms belonging to the *Geminati* group, hitherto unknown from the Indian Trias, do occur in this formation. It forms a new connecting link between the faunas of the Arctic-Pacific province and the Himálayan region.

a. Group of the CERATITES CIRCUMPLICATI.

1. Ceratites Wetsoni, Oppel, Pl. I., fig. 6.

1865. *Ammonites Wetsoni*, Oppel, Paläontologische Mittheilungen aus dem Museum des Königl. bayr. Staates I, Taf. 86, fig. 2, p. 291.

1882. *Ceratites Wetsoni*, E. von Mojsisovics, Die Cephalopoden der Mediterr anen Triasprovinz, Abhandlungen der K. K. Geologischen Reichs-Anstalt, in Wien, X., 1882), p. 43.

A. Oppel has founded this species on a very imperfect fragment of a chambered outer whorl. In the shape of the shell, involution and sculpture, it shows a close affinity with *Ceratites Erasmi*, as has been shown by E. v. Mojsisovics.

The whorls are much higher than broad, with slightly convex sides, which converge obliquely towards the ventral area. The greatest thickness of the whorl coincides with the lower third of its height. From the line of their greatest thickness the sides of the whorls bend down to the umbilical suture in a more convex curve. The ventral area is sharpened and forms with the sides of the whorl an obtuse edge.

Near the umbilical suture rise simple, broad folds, which gradually disappear towards the siphonal margin. They are most prominent near the lower third of the sides. The rather imperfect preservation of the specimen under description makes it impossible to give the accurate number of folds on one volution. Oppel's figure[1] is unsatisfactory in this respect and does not give a clear representation of this sculpture.

Sutures.—As has been shown by E. v. Mojsisovics, the lobe-line differs considerably from *Ceratites Erasmi*, E. v. Mojs. The upper extremities of the saddles are much broader and not serrated. The serration rises on the sides of the saddles

[1] l, c., Pl. 86, fig. 2.

only to the middle of their height. The inferior lateral lobe is much higher situated than the principal. From the first auxiliary lobe follows a broad saddle without any trace of denticulation and a second, considerably protracted auxiliary lobe.

In this respect *Ceratites nodosus*, de Haan, and *Ceratites semipartitus*, Montf., from the German Muschelkalk, show a similar arrangement of the lobe-line.

Locality, number of examined specimens.—Spiti (no particular locality known) 1, Oppel's type-specimen from the Schlagintweit collection in the Palæontological Museum in Munich.

2. Ceratites sp. ind. ex. aff. C. Wetsoni, Pl. I., fig. 3.

In my collection from the Muschelkalk of the Shalshal cliff near Rimkin Paiar Encamping Ground (Painkhanda), I have a specimen of this species, which consists of a very imperfect fragment of the outer whorl. This form seems to be closely allied to *Ceratites Wetsoni*, Oppel. The transverse section differs slightly by its greater thickness. The sides of the whorls are more convex and gradually bend towards the round siphonal area without defined borders. The lower part of the lateral area bears simple, strongly developed folds, which disappear near the ventral margin. The total number of folds on the last volution seems to be slightly greater than in *Ceratites Wetsoni*. With reference to its shape this species is still more closely allied to the Mediterranean *Ceratites Erasmi*, especially when considering its flatly rounded siphonal area, although the latter is less sharply defined from the lateral parts of the whorl than in *Ceratites Erasmi*.

The sutures, so far as preserved, are entirely identical with those of *Ceratites Wetsoni*. In this form also, the principal lateral lobe is characterised by its remarkably deep position. The upper extremities of the saddles are broad and not serrated. As the umbilical margin is wanting in our fragment, the lobe-line can only be examined as far as to the first auxiliary saddle.

3. Ceratites Voiti, Oppel, Pl. II., fig. 1, 2.

1863. *Ammonites Voiti*, Oppel: Palaeontologische Mittheilungen I. p. 276, Taf. 77, fig. 1.
1865. *Ammonites Thuillieri*, Stoliczka: ex parte Memoirs, Geological Survey of India, V., Pt. I., p. 57.
1866. *Ammonites Voiti*, Beyrich: "Über einige Cephalopoden aus dem Muschelkalk der Alpen und über verwandte Arten. Abhandlgn. Kön. Akademie der Wissensch. in Berlin, 1866, p. 115.
1882. *Ceratites Voiti*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, p. 27.
1886. *Ceratites Voiti*, E. v. Mojsisovics: "Arktische Triasfaunen:" Mém. de l'académie impér. des sciences de St. Pétersbourg, sér. VII., T. XXXIII., No. 6, 1886, p. 21.

Dimensions.	Fig. 1.	Fig. 2.
Diameter of the shell	100 mm.	83 mm.
Height of the last whorl	45 „	37 „
Thickness of the „	28 „	21 „
Diameter of the umbilicus	22 „	18 „

Ceratites Voiti is characterised by slowly increasing, very involute, compressed whorls. It is rather unfortunate that in none of my specimens the inner volutions

are satisfactorily preserved. Nevertheless the existence of a deep, scale-like umbilicus is probable, as may be concluded from the steep umbilical wall, visible in the outer whorl of Oppel's type-specimen (fig. 2). It is only well defined in the innermost extremity of this whorl. Later on, the sharp umbilical margin disappears and the lateral parts of the whorl bend with gradually increasing convexity towards the umbilical suture. Quite close to the latter, their inclination becomes perpendicular.

The ventral area is narrow, not carinate and sharply rounded. In the specimen figured in fig. 1, it becomes broadly rounded near the end of the outer whorl.

All the specimens examined are completely chambered.

The sides are slightly curved and covered with numerous broad ribs, rising near the umbilical suture. The lower portion of the ribs, as far as the umbilical margin, is directed backwards. In the middle portion of the lateral parts the direction of the ribs is perfectly radial. The ribs develop into faint tubercles in the umbilical margin and into strong elongated swellings or "bumps" near the middle of the sides. In the specimen fig. 1, these "bumps" take the shape of genuine tubercles in the last portion of the outer whorl. In the upper portion of the lateral parts the ribs become less prominent. They get broader and flatter and are strongly turned towards the aperture. A considerable number of them almost reach the middle of the siphonal side. In the specimen before mentioned, the two last ribs seem to extend into marginal tubercles. The ribs are partly simple, partly divided by the lateral swellings near the middle of their height. Besides the principal ribs, intermediate ones occur, which do not reach the umbilical margin. The proportion of simple and bifurcated ribs differs widely in different specimens. In Oppel's type-specimen, for instance, the bifurcation of ribs is the rule, whilst in the specimen figured in fig. 1, the greater number of ribs remain undivided.

Sutures.—The sutures are brachyphyllic. The saddles are denticulate, even in their upper portion. The siphonal lobe is broad and short. Three auxiliary lobes and two auxiliary saddles stand between the umbilical margin and the umbilical suture. E. v. Mojsisovics asserts, on the strength of his examination of the lobe-line in Oppel's type-specimen, the existence of a "remarkable tripartite auxiliary saddle outside the umbilical margin." In Oppel's type-specimen the last whorl, at a height of 34 mm., shows indeed only a series of single indentations near the first auxiliary lobe. But in the specimen fig. 1 the deep intersections of this are clearly visible at a height of the whorl of 40 mm. As these intersections are as deep as the first auxiliary lobe, we are, I think, no longer able to speak of one tripartite auxiliary saddle, but must admit the existence of *two* different auxiliary saddles with *three* intervening auxiliary lobes.

Locality, number of specimens examined.—Kunzum Pass (Spiti), 1, Coll. Schlagintweit, Oppel's type-specimen; Kuling (Spiti), 1, Coll. Geological Museum, Calcutta; Rimkin Paiar, 1, Coll. Griesbach.

E. v. Mojsisovics remarks the affinity of *Ceratites Voiti* to *Ceratites Petersi*, Mojs., from the red marble of the Schreyer Alpe (Salzkammergut). Both species

[1] L. c. Pl. XI., fig. 10, Pl. XL, fig. 14, p. 27.

offer indeed a good many analogies in spite of differences in the details of involution and sculpture and in the arrangement of the sutures. *Ceratites Voiti* possesses a wider umbilicus and narrower whorls in consequence of its lesser involution. In *Ceratites Petersi*, the ribs are most prominent in the lower portion of the lateral parts. The upper portion of the saddles is not denticulated.

4. CERATITES RAVANA, nov. sp., Pl. II., fig. 5, var. Pl. II., fig. 3.

Dimensions.	
Diameter of the shell	86 mm.
Height of the last whorl	37 „
Thickness of the „ „	24 „
Diameter of the umbilicus	23 „

This species is most closely allied to *Ceratites Voiti*, Oppel. *Ceratites Voiti*, with which it agrees in general shape, is a little more involute, has higher whorls and a narrower transverse section. The siphonal area in *Ceratites Ravana* is less sharply rounded. Even in the last whorl, of which almost two-thirds belong to the body-chamber, the umbilical wall is perpendicular, occasionally even slightly overhanging and separated from the lateral parts by a well-marked umbilical edge, as in *Ceratites Petersi*, E. v. Mojs. (Die Cephalopoden der Mediterranen Triasprovinz· Pl. XL., fig. 14, p. 27).

Essential differences are presented by the shape of the sculpture. In *Ceratites Ravana*, tolerably flat, broad ribs rise near the umbilical margin, with tuberculate elevations. The ribs run almost straight, or with a very slight forward curve across the lower portion of the lateral area. Below the middle of the sides, they form a small prominence and become falciform. Near the siphonal margin they are strongly bent forward, in the meantime becoming broader. Near the end of the outer whorl they reach across the siphonal margin to the middle of the ventral area, where they meet at an angle of 70°, swelling out gradually. A few ribs only are single. Most of them are already bifurcate when rising near the umbilical margin. Between the principal ones, secondary ribs are intercalated in the upper portion of the lateral parts. In some of the principal ribs, a second bifurcation may be noticed.

Sutures.—There is a great resemblance with the lobe-line of *Ceratites Voiti*. The sutures are brachyphyllic, the indentation affecting even the upper extremities of the saddles. The principal lateral saddle is higher than the siphonal saddle, as in *Ceratites Voiti*. The first auxiliary lobe terminates in three sharp points and descends nearly as low as the inferior lateral lobe. One bipartite auxiliary saddle follows. The second auxiliary lobe is divided by the umbilical suture.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar E. g., 3, Coll. Diener; 1, Coll. Griesbach; Bambanag cliffs (Girthi valley), 1, Coll. Diener.

Ceratites Ravana var.—I have met with a form which differs from the last described species in possessing a more discoidal outline, higher outer whorl and more rounded ventral area, but I have considered it best to look upon this form as only a

variety of *C. Ravana*. The dimensions of a specimen from Rimkin Paiar (Pl. II., fig. 3), belonging to this variety, are as follows:—

Diameter of the shell	49 mm.
Height of the last whorl	24 „
Thickness of the „ „	13 „
Diameter of the umbilicus	11 „

The whorls overlap each other to such an extent that nearly two-thirds of the height of the last whorl are filled up by the preceding one. The umbilical margin is well marked. The umbilical walls are perpendicular but lower than in the genuine *Ceratites Ravana*, which is characterised by a deeper umbilicus.

Sculpture and sutures entirely agree with those of *Ceratites Ravana*.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar, 1, Coll. Diener; Lissar Valley, south of Dharma Nr. XI., 1, Coll. Griesbach.

5. Ceratites, nov. sp. ind. ex aff., C. Ravana. Pl. II., fig. 4.

Another species is allied to *Ceratites Ravana*, which is represented in my collection only by unsatisfactory fragments derived from the topmost strata of the Muschelkalk on the southern slope of the Utadura (Johár).

The more complete fragment comprises a little more than the half of the outer whorl and belongs almost entirely to the body-chamber. The shell is flat, discoidal with a very high and narrow cross-section. Its involution is greater and its whorls increase more rapidly than in *Ceratites Ravana*. The siphonal area is rounded. The well-marked umbilical margin is surrounded by a perpendicular wall.

The shape of the transverse section is very characteristic. As far as to the lower third of the lateral parts the sides are entirely flat, but from there, bend down in a slight curve towards each other. In the section, therefore, a very obtuse edge marks this place.

Near the extremity of the outer whorl the proportion of the height to the width of the cross-section is as 27 : 14. As my specimen does not permit exact measurements of the other dimensions, I must refer to the figure.

As in *Ceratites Ravana*, the sculpture consists of falciform ribs, the extremities of which are strongly bent forward near the siphonal margin. Single ribs have not been observed; there are only bifurcate and intermediate ribs. The bifurcation takes place either near the umbilical margin or near the lower third of the lateral parts, where it is combined with a slight swelling of the ribs. No similar swelling is visible near the umbilical margin. Towards the siphonal margin the ribs enlarge considerably, but without flattening.

Sutures.—The sutures differ but slightly from those of *Ceratites Ravana* in shape and arrangement. The saddles are equally brachyphyllic and rather high, especially the siphonal saddle. The principal lateral lobe shows unusually deep fingers along its base. The first auxiliary lobe is bipartite. The only auxiliary saddle is a simple undivided arch.

6. Ceratites, nov. sp. ind. ex aff., C. Ravana. Pl. II., fig. 6.

To another species, closely allied to *Ceratites Ravana*, belong two fragments of outer whorls. One of them, bearing the label "Spiti," is in the Schlagintweit collection and marked by Oppel as *Ceratites Voiti*. The other fragment was collected by myself in the Muschelkalk of the Shalshal cliff near Rimkin Paiar Encamping Ground (Painkhánda).

Oppel's specimen shows a portion of the body-chamber and a few traces of the preceding inner whorl. This is one of the two specimens mentioned by E. v. Mojsisovics in his notice on *Ceratites Voiti* (Cephalopoden der Mediterranen Triasprovinz, p. 27). The transverse section is narrower and higher than in *Ceratites Ravana* (height 39. mm., thickness 22. mm.). The lateral parts of the preserved whorl are covered with more numerous ribs, but the shape and the direction of the ribs are almost identical in both species. Besides the strong umbilical tubercles, faint tubercle-shaped elevations rise in the lower portion of the lateral area. In the fragment from Rimkin Paiar, these lateral tubercles are still more clearly marked. It is in these lateral tubercles that the ribs usually bifurcate.

7. Ceratites Airavata, nov. sp. Pl. IV., fig. 3.

Dimensions.

Diameter of the shell	55 mm.
Height of the last whorl	27 „
Thickness of the „ „	17 „
Diameter of the umbilicus	9 „

To *Ceratites Ravana*, *Ceratites Airavata* stands in much the same relationship as *Ceratites Dungara* (Pl. III., fig. 2) to *Ceratites Hidimba* (Pl. III., fig. 1). There are many affinities between the two species in general shape as well as in involution and sculpture. *Ceratites Airavata* has a narrower umbilicus, a lower aperture, and its flatly rounded ventral area encloses an obtuse angle with the flattened lateral parts. The last whorl overlaps two thirds of the preceding one. The umbilicus is very narrow and deep, so that only thin strips of the inner whorls are visible. The umbilical margin is sharply marked and separated from the umbilical suture by a perpendicular wall.

In the present specimen one third of the last whorl belongs to the body-chamber.

The sculpture of the inner whorls consists of flat radial ribs, whilst in the outer whorl it approaches somewhat the sculpture of *Ceratites Ravana*. As a rule two, sometimes even three, ribs rise from strong, tubercle-shaped elevations near the umbilical margin, and run in a falciform direction across the lateral parts towards the siphonal margin. In the middle of the sides some of the ribs become bifurcate. A point of difference between *Ceratites Ravana* and the present species is marked by the existence in *Ceratites Airavata*, of well-defined tubercles near the siphonal

margin, which correspond with the termination of the ribs, whilst in *Ceratites Ravana* the ribs gradually flatten towards the siphonal area.

Sutures.—The differences in the sutures of *Ceratites Airavata*, *Ceratites Voiti*, and *Ceratites Ravana* are only insignificant. In all these forms the saddles are brachyphyllic and serrated up to their topmost extremities. In the present species the first auxiliary lobe is more strongly indented than in *Ceratites Voiti*. Between this lobe and the umbilical suture appear to follow two auxiliary lobes and as many saddles. But the preservation of my specimen does not permit a very precise description.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

8. Ceratites, nov. sp. ind. Pl. IV., fig. 4.

Dimensions.

Diameter of the shell	51 mm.
Height of the last whorl	26 „
Thickness of the „ „	13 „
Diameter of the umbilicus	?

The only specimen of this species is in my collection, but is unfortunately in a rather unsatisfactory state of preservation. The lower portion of the last whorl especially is but partially preserved. Neither the shape of the inclusion of the inner whorls nor the sutures have been completely studied.

This remarkable species has a very high last whorl, and a rounded, highly curved ventral area. The inner whorls show a broad, elliptical transverse section, and increase but slowly. Their lateral parts are covered with broad, strong, straight ribs, either radial or directed obliquely forward. The height of the cross-section of the outer whorl rapidly increases and the ribs gradually disappear,—so much so, that their place is taken by flat folds which consist of numerous thin radial striae, which do not reach the siphonal margin.

Sutures.—Of these only the siphonal lobe, the siphonal saddle and the principal lateral lobe are preserved. The lobes are broad and deeply indented along their base. The upper extremity of the siphonal saddle is not serrated.

I have not considered it advisable to assign a specific name to this remarkable form, as in consequence of the imperfect state of preservation its diagnosis is rather incomplete.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

9. Ceratites Hidimba, nov. sp., Pl. III., fig. 1.

Dimensions.

Diameter of the shell	121 mm.
Height of the last whorl	45 „
Thickness of the „ „	34 „
Diameter of the umbilicus	40 „

Shell with flat, slowly increasing whorls, overlapping one-third of the preceding whorl. A slight *egression* is perceptible in the external whorl.[1] The flattened, but very slightly curved lateral parts pass into the strongly rounded siphonal area without any marked border. Nor is the umbilical margin sharply marked in the outer whorl but bends gradually down in a flat curve towards the umbilical suture. Only the inner whorls are separated from each other by a steep wall, which surrounds the umbilical margin. Transverse section high, rectangular, with rounded edges.

The sculpture consists of numerous ribs, directed slightly forward towards the mouth and considerably narrower than the intervals between them. They terminate near the siphonal margin, by forming faint prominences, from which they turn sharply forward flattening out rapidly. In the middle portion of the lateral area, the ribs show a slight wavy curve, interrupting their straight direction. Here a second maximum of height is attained by the ribs, but these elevations are not sufficiently defined to give them the character of tubercles. The transverse section of the ribs is of a triangular, sharp and roof-like shape, the intervals describe regular arches in their section. The ribs disappear near the rounded umbilical margin.

It is only the outer whorl, which is characterised by this kind of sculpture. In the inner whorls the ribs rapidly and considerably decrease in strength, whilst they seem to reach their greatest intensity near the middle portion of the body-chamber. Consequently the lateral parts of the inner whorls are only covered with flat, wavy folds, which show the same direction and arrangement, as the ribs on the outer whorl. Most of these folds are dichotomous. They bifurcate near the umbilical margin, whilst the rest remain undivided. Near the umbilical margin of the inner whorls traces of tubercles are visible, from which these folds rise.

Number of ribs in the last whorl: 30.

In the specimen figured Pl. III. fig. 1, one-half of the last whorl belongs to the body-chamber.

In the inner whorls a portion of the shell is preserved. It shows the well-marked transverse growth-lines so characteristic of the Ceratites of the group of *Ceratites polaris*, Mojs. (Arktische Triasfaunen l. c. p. 30, 34).

Sutures.—There is a great resemblance between *Ceratites Hidimba* and *Ceratites Voiti*, Oppel, regarding the arrangement and general shape of the sutures. Two auxiliary lobes, and one quadripartite auxiliary saddle are situated outside the umbilical suture. The great height of the siphonal tubercle, which nearly equals the siphonal saddle, is very remarkable. The walls of the saddles are intersected by deep, finger-like indentations up to the middle of their height. The upper extremities of the saddles are but faintly serrated. In *Ceratites Voiti* both the brachyphyllic indentation of the saddles and the partition of the auxiliary saddle are further deve-

[1] This term has been introduced by E. von Mojsisovics ("Die Cephalopoden der Hallstætterkalke," p. 11) to express the change in the spiral line, which appears in the body-chamber whorl of adult specimens of some triassic genera (*Lobites, Didymites, Homerites, Jovites*, etc.). It shows itself either as a contraction near the margin of the aperture only, or, as for instance in Tropites and Jovites, over the larger part of the last whorl. In the latter case a shortening of the height, or at least a lessening of the ratio of increase of height, appears along with the egression. This *egression* or contraction of the whorl ought to be distinguished from the *evolution*, which term means the disjunction of the whorls, as in *Crioceras* or *Choristoceras*.

loped. In *Ceratites Hidimba* the auxiliary saddle shows a tripartite arrangement of serration. Of these three indentations, the central intersects it, it is true, somewhat deeper than the two others, but still without leading to an individualisation of the two parts, which would stamp each of them as forming an independent auxiliary saddle. In *Ceratites Voiti*, however, this incision is as deep as the first auxiliary lobe. There can be no doubt, therefore, about the existence of two independent auxiliary saddles in the last-mentioned species. In the septa immediately preceding the beginning of the body-chamber, the first leaf of a second auxiliary saddle appears outside the umbilical suture.

Locality, number of specimens examined.—East slope of Tsang Tsok La, Hop Gadh, Hundés, 1, Coll. Griesbach; Tibet (?), precise locality not known, 1, Coll. Schlagintweit (from the Palæontological Museum in Munich). East slope of the Marchauk Pass, N.-W. of Barahoti Encamping Ground (Painkhanda), 1, Coll. Griesbach.

10. Ceratites, sp. ind. ex. aff. C. Hidimba. Pl. III., fig. 3.

A species, probably very closely allied to *Ceratites Hidimba*, is represented by two rather fragmentary specimens. One of them consists of a fragment of an entirely chambered whorl, and belongs to the collection of the Geological Museum in Calcutta, and comes, I believe, from Spiti (the locality is not marked on the label). The other, an outer whorl, with a portion of the body-chamber, I collected myself near Kiunglung Encamping Ground, on the southern slopes of the Niti-Pass.

The principal difference between *Ceratites Hidimba* and this form consists in its considerably greater number of ribs. In the specimen from Kiunglung, having a diameter of 160mm. the ribs occur to the number of 18 on half of one circuit. In the (better preserved) fragment from the Geological Survey's collection the ribs swell into slight, protracted elevations near the middle portion of the lateral parts. Intermediate ribs sometimes occur.

Sutures.—This species has many affinities with *Ceratites Hidimba*, both in the structure of the lobe-line and in the lobes and saddles themselves. The saddles only differ by being somewhat broader. Their upper extremities are serrated. The bipartite character of the auxiliary saddle is more developed than in *Ceratites Hidimba*. The incision of this saddle is sufficiently deep to cause the individualisation of two independent auxiliary saddles.

11. Ceratites Dungara, nov. sp., Pl. II., fig. 2.

Dimensions.	
Diameter of the shell	88 mm.
Height of the last whorl	35 „
Thickness of the „ „	27 „
Diameter of the umbilicus	26 „

The following characters separate this species from *Ceratites Hidimba*, which it

closely resembles in general appearance, involution and sculpture. The transverse section is more rounded, almost elliptical, the siphonal area is narrow and highly rounded, the lateral parts are more convex, and covered with ribs which bear well-marked lateral tubercles and stronger prominences near the siphonal margin. In the last whorl these prominences take the shape of true marginal tubercles. Between the lateral and marginal tubercles the ribs run in a more strongly bent curve than in *Ceratites Hidimba*.

The occurrence of intermediate ribs is not limited to the inner whorls.

The specimens in my collection are entirely chambered.

Sutures.—Arrangement and shape of the sutures connect this species closely with *Ceratites Hidimba*. The bipartition of the auxiliary saddle is not sufficiently deep, to consider its two parts as independent saddles. As in *Ceratites Hidimba*, in the last whorl of the specimen figured Pl. II. fig. 2, a second auxiliary saddle appears outside the umbilical suture, and is divided by the latter.

Locality, number of specimens examined.—Lilang, Spiti, 1; Kuling, Spiti, 1; both from the Geological Survey's collection in Calcutta.

12. Ceratites Visvakarma, nov. sp., Pl. IV., fig. 2.

Dimensions.

Diameter of the shell	106 mm.
Height of the last whorl	41 „
Thickness of the „ „	26 „
Diameter of the umbilicus	39 „

The present species is distinguished by very slowly increasing whorls, overlapping each other not quite to a third part of their height. The shell is rather compressed, the last whorl high and rounded. In the beginning of the last and entirely chambered whorl the ventral area is still strongly curved. Only towards the extremity of the outer whorl it becomes more gently rounded. No marked border separates the siphonal area from the lateral parts. They gradually pass into each other, the convexity of the flanks increasing as they approach the ventral part. The umbilical margin is equally rounded in the outer whorl. The rather fragmentary preservation of the inner whorls in the only specimen known to me does not permit a more exact description of the umbilical region.

The sculpture consists of simple radial ribs, which occur to the number of 28 on the outer whorl. These ribs are but faintly marked in the beginning of the outer whorl and become more prominent only in the adult stage. They are slightly rounded on their edges and bend down symmetrically on both sides, towards the intervals separating them. The maximum of their height coincides with the middle portion of the lateral parts. Their arrangement is symmetrical on both sides of the siphonal area.

A more compressed shell, much more slowly increasing whorls and radial direction of the straight, undivided ribs, separate this species from *Ceratites Hidimba* to which it stands in some relationship.

Sutures.—The lobe-line closely resembles that of *Ceratites Hidimba* in its arrangement. The siphonal tubercle is bipartite. The siphonal lobe is divided by a deep indentation into two parts, the margins of which are serrated. The second lateral lobe is on a level with the siphonal lobe. The principal lateral lobe takes the deepest position. They all show strongly incised digitations along their base. The indentations affect the margins of the saddles, and leave but their upper extremities entire. The first auxiliary lobe is strongly indented, and divided along its base by a deeply incised denticulation, resembling in this respect the siphonal lobe. The saddles slope somewhat towards the umbilical region. The first auxiliary saddle is bipartite. The second auxiliary lobe is divided by the umbilical suture.

This species differs in the arrangement of the lobe-line from *Ceratites Hidimba* by the presence of two auxiliary saddles. The quadripartite auxiliary lobe of *Ceratites Hidimba* is developed in this form into two independent, bipartite saddles, separated by a deep, intervening denticulation.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground (Painkandha), 1, Coll. Diener.

13. Ceratites Arjuna, nov. sp., Pl. IV., fig. 1.

Dimensions.	
Diameter of the shell	122 mm.
Height of the last whorl	42 „
Thickness of the „ „	27 „
Diameter of the umbilicus	34 „

This beautiful species is distinguished by high, compressed, and slowly increasing whorls, overlapping each other to the extent of half their height, and bordered by softly curved lateral parts. The umbilicus is not completely preserved. So far as one may judge from the fragmentary state of the inner whorls, the shell seems to exhibit considerable egresssion from the spire in its last volution. The siphonal area is gently rounded and not sharply separated from the lateral parts. In the inner whorls an umbilical margin may be noticed, whilst in the last, entirely chambered whorl, no marked margin exists, but the lateral parts bend gradually and with continually increasing convexity down to the umbilical suture.

The last whorl bears 21 radially directed, gently curved ribs. They rise a little above the umbilical margin, attain their greatest height before reaching the middle of the lateral parts, and flatten out in the upper portion of the sides. They are slightly bent forward near the siphonal margin, where they spread considerably. They do not disappear completely when passing the ventral side, so much so, that the siphonal area in a longitudinal section shows a series of very flat broad waves, interrupted by depressions of the same shape. Even near their greatest height, the ribs possess rounded edges. They slope much more gently towards the aperture than to the reverse side, where their slope is steep. They increase in height and thickness as they approach the inner extremity of the body-chamber.

On the siphonal area thin transverse growth-lines may be seen, especially in those places, where the ribs pass it in the shape of flat, broad folds.

Sutures.—The examination of the details of the lobe-line is rather difficult in consequence of the bad preservation of the specimen. In the shape of the sutures *Ceratites Arjuna* differs considerably from all the other mentioned species of the "*Circumplicati*" group. The principal lateral lobe is very deep. The siphonal saddle and the two lateral saddles are situated on almost the same level. Their walls are strongly serrated up to the last entire arch. The second lateral saddle is followed by a very remarkable and long auxiliary lobe, whose denticulations, to the number of six or seven, are perfectly equal in size and shape. The second lateral lobe is but very little deeper than this auxiliary lobe.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 2, Coll. Diener.

14. CERATITES ONUSTUS, OPPEL. Pl. I., fig. 5.

1863. *Ammonites onustus*, Oppel, Palæontologische Mittheilungen aus dem Museum des K. bayr. Staates, 1863, Pl. 77. fig. 2, p. 277.
1865. *Ammonites Blanfordi*, Salter, Palæontology of Niti, Calcutta, 1865, p. 66, Pl. VI., fig. 2.
1865. *Ammonites Thuillieri*, Stoliczka *exparte*, Mem. Geol. Survey of India, Vol. V., Pt. I., p. 57.
1882. *Ceratites onustus*, E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, p. 44.

The only specimen of this species which I have seen, Oppel's type-specimen from the Schlagintweit collection, is the fragment of a chambered whorl, which consists of nearly half a volution. The specimen, to which according to modern practice no specific name ought to have been assigned, is so much damaged, that in the figure (Pl. I. fig. 5) the whorl appears higher at its outer, than at its inner, extremity. In a transverse section of the latter, the proportion of height to thickness is 41mm. to 28mm.

The ventral area is broad and gently rounded, neither carinate nor sharply separated from the lateral parts. The sides are almost flat and in the lower portion of the whorl bend gradually towards the umbilical suture. It is only quite near the latter, that their inclination becomes steeper. From the rounded umbilical margin rise simple radial ribs. Their direction is almost straight towards the siphonal margin, where they terminate without forming any tubercles, but turn slightly forward. The ribs are separated from each other by irregular intervals and are situated asymmetrically to a median plane along the siphonal area.

Sutures.—The arrangement of the sutures is similar to that in *Ceratites Thuillieri*, but differs inasmuch as the saddles are considerably broader in our species. As in *Ceratites Thuillieri*, the denticulations affect the marginal walls of the saddles up to their summits, which alone remain entire. Outside the umbilical suture a bipartite auxiliary lobe and a bipartite saddle is situated.

Locality, number of specimens examined.—Kuling, Spiti, 1, Coll. Schlagintweit in the Palæontological Museum in Munich (Oppel's type-specimen).

Remarks.—Stoliczka (l. c. p. 57) rightly remarks that fragments like Oppel's *Ceratites onustus*, are not worthy of specific names. He declares himself unable to distinguish it from *Ceratites Thuillieri*, an error that can only be explained by Oppel's rather unsatisfactory figure. In these two species, involution and sculpture are so absolutely different, that nobody who has had Oppel's type-specimens in his hands, will identify them for a moment.

A species probably identical with *Ceratites onustus* is *Ammonites Blanfordi*, Salter (l. c. p. 66). The figure (Pl. VI. fig. 2), representing a fragment of a somewhat smaller diameter than Oppel's type-specimen, agrees very well, although in *Ammonites Blanfordi* the sutures are not sufficiently preserved and the first auxiliary lobe especially is not visible. E. von Mojsisovics, who had the opportunity of examining Salter's type-specimen in the British Museum (Natural-history Museum) in London, pronounces its identity with *Ceratites onustus* and notices its affinities with *Ceratites Zezianus* v. Mojs. (Die Cephalopoden der Mediterranen Triasprovinz, Pl. XXXVII., fig. 3, 4, p. 44) from the "Buchensteiner Schichten" of the Mediterranean Trias.

15. Ceratites Vyasa, nov. sp., Pl. VI., fig. 1, 2.

Dimensions.

Diameter of the shell	170 mm.
Height of the last whorl	57 „
Thickness of the „ „	45 „
Diameter of the umbilicus	69 „

This large form seems to be closely allied to *Ceratites onustus*, Oppel, if it is permissible to draw any conclusions from the fragment, which Oppel has thought worthy of a specific name.

The slowly increasing whorls leave a wide, rather shallow umbilicus, and are distinguished by a considerable difference in the shape of the inner volutions and of the last whorl, containing the body-chamber. The inner whorls are very high and almost elliptical in section. In one of the specimens in my collection the height is 27mm., with a diameter of shell of 78mm., and thickness of 14mm. The siphonal part is quite rounded. In the last whorl which overlaps about one-third of the preceding one, the height and thickness of the transverse section increase much more rapidly. In the meantime the body-chamber becomes comparatively less compressed, and its ventral area grows flatter.

The inner whorls are separated from the stair-like umbilicus by a perpendicular, low wall. In the body-chamber the umbilical margin is marked only by a stronger convexity of the lateral parts.

In the specimen figured Pl. VI. fig. 1, one-half of the outer whorl belongs to the body-chamber.

The lateral parts of the inner whorls are provided with straight, radial ribs, directed sometimes slightly obliquely forward, and turning sharply forward near the siphonal margin, where they die out. The ribs are partly simple, partly bifurcate.

The bifurcation takes place in the umbilical margin. Frequently the real ribs are accompanied by narrow striae-like elevations, which may be plainly seen in fig. 2.

The sculpture of the last whorl consists of simple ribs only. They are prominent, roof-like, acute, with sharpened edges, and their slope is much steeper towards the aperture than backwards. They rise near the umbilical margin, become gradually more prominent in the lower portion of the lateral parts, where they are interrupted by a flat, wavy depression, and terminate near the siphonal margin in large, stout elevations. A section along the plane of one of these ribs shows an almost rectangular shape. The ribs stand asymmetrically to the median plane in all the specimens examined. Their direction is not radial as in *Ceratites onustus*, but strongly oblique, nor are they bent forward near the siphonal margin. The intervals which separate the ribs are larger in *Ceratites Vyasa*. In the last half volution the ribs occur to the number of 11.

Sutures.—The lobe-line bears a considerable resemblance to that of *Ceratites onustus*. The saddles are more protracted and a stronger serration affects their walls, leaving but the uppermost extremities entire. Three auxiliary lobes and two short, low, auxiliary saddles stand outside the umbilical suture. The auxiliary lobes are broader than in *Ceratites onustus*, which at the same height of the whorl has but one auxiliary saddle.

Siphuncle.—In the specimen figured Pl. VI. fig. 2, a siphuncle is seen which consists of longitudinal fibres and possesses a similar aspect to that found in *Ceratites Kamadeva*.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground (Painkhánda), 5, Coll. Diener; Bambanag cliffs, Girthi valley, 1, Coll. Diener.

Remarks.— *Ceratites Vyasa* is still more closely allied to *Ceratites Zezianus*, E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz, 1882, Pl. XXXVII, fig. 3, 4, p. 44), than *Ceratites onustus*, Oppel. Its shell is less compressed than in the Mediterranean species and the last whorl bears a considerably smaller number of ribs, which are separated by larger intervals.

16. Ceratites sp. ind. ex. aff. C. Vyasa. Pl. VII., fig. 6.

This species, of which only the fragment of an entirely chambered outer whorl is in my possession, may be compared with *Ceratites Vyasa*. This fragment, which comprises about a quarter of a volution, I obtained myself in the Muschelkalk of the Shalshal cliff near Rimkin Paiar Encamping Ground. From *Ceratites Vyasa*, which it resembles in general shape and involution of the shell, it differs by its sculpture and trapezoidal section of the whorls. The lateral parts are almost flat, rounded only near the umbilical region, and diverge considerably towards the siphonal margin. In this fragment the width of the aperture near the siphonal margin is 33mm. to 24mm. near the umbilical margin, the height of it being 4 mm. The flatly convex siphonal area is sharply separated from the lateral parts.

The ribs are broader and more bulky than in *Ceratites Vyasa*. They become very stout near the siphonal margin.

The arrangement of the sutures differs somewhat from *Ceratites Vyasa*. The saddles are broad and bulky. The whole siphonal saddle and a large portion of the principal lateral lobe is situated in the ventral area. The principal lateral lobe is deeply incised. The second lateral saddle is followed by a tripartite auxiliary lobe. The first auxiliary saddle is divided by the umbilical suture.

17. CERATITES nov. sp. ind. Pl. V., fig. 4.

Two fragments of body-chambers from the Muschelkalk of the Shalshal cliff near Rimkin Paiar Encamping Ground belong to this species, whose nearest allies may probably be found amongst the Ceratites of the group of *Ceratites Zoldianus*, E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz, Pl. X. fig. 5, 6, p. 39). The proportion of height to width of the aperture is 21 : 16 in the smaller of the two fragments, 28: 21 in the other. The shell is rather less compressed than in *Ceratites Zoldianus*, which species it resembles owing to its slowly increasing whorls and the character of its sculpture. The lateral parts are flat, converging towards the siphonal margin. The ventral area is flatly rounded.

The sculpture consists of numerous, tolerably broad, radial ribs, slightly curved forward near the siphonal margin. Most of the ribs are simple, in some of them, however, a bifurcation occurs in the lower portion of the lateral parts. The points of bifurcation are marked by tubercle-shaped prominences.

β. GROUP OF THE CERATITES NODOSI.

18. (1.) CERATITES THUILLIERI,* OPPEL. Pl. I., fig. 1, 2.

1863. *Ammonites Thuillieri*, Oppel: Palæontologische Mittheilungen a. d. Museum des Königl. bayr. Staates Stuttgart, 1863, Pl.. 77, fig. 3, p. 277.
1865. *Ammonites Thuillieri*, Stoliczka: *ex parte*, Mem. Geol. Surv. of India, V., Pt. I., p. 57.
1866. *Ammonites Thuillieri*, Beyrich: Abhandlgn. Königl. Akad. d. Wiss., Berlin, 1866, p. 109.
1882. *Ceratites Thuillieri*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, p. 30.

Dimensions.	(Pl. I, fig. 1.)
Diameter of the shell	77 mm.
Height of the last whorl	33 „
Thickness of the „ „	24 „
Diameter of the umbilicus	23 „

Ceratites Thuillieri is one of the few species of this genus in the Indian triassic province, which has very close affinities to a form of the Alpine Muschelkalk. There is no other form among the Indian Ceratites so closely allied to a European species, as *Ceratites Thuillieri* is to *Ceratites trinodosus*, E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz, Pl. VIII., fig. 5, 6, 7, 9, Pl. XXXVII., fig. 6, 7, p. 29).

The typical form of *Ceratites Thuillieri*, as is characteristically shown in Oppel's

* Professor Oppel named this species after Colonel Thuillier, at that time Surveyor-General in India, but spelt the name incorrectly; the name should be as adopted in this Memoir.
EDITOR.

figure (Pl. I., fig. 1 of this Memoir), agrees in general shape and involution with *Ceratites trinodosus*. The ventral area is broad, gently rounded, not carinate, and covered with thin, slightly forward-bent growth-lines, wherever portions of the shell are preserved. The slightly convex lateral parts bend with a strong convexity from the rounded umbilical margin to the umbilical suture. The umbilicus is rather deep in proportion to the diameter of the shell. The spire imparts a stair-like character to the whorls, which are sharply separated from each other.

As in *Ceratites trinodosus*, the sculpture consists of strong, broad ribs, which terminate near the siphonal margin in more or less well-marked, protracted, forward-bent tubercles. A second series of tubercles coincides with the umbilical margin, from whence the ribs rise. A third line of tubercles appears on the lateral parts a little above the lower third of their height. In Oppel's type-specimen these lateral tubercles form high, much-protracted prominences, near the base of which the ribs often bifurcate. As has been remarked by E. v. Mojsisovics, the augmentation of the ribs by bifurcation outside the line of lateral tubercles is, however, considerably less frequent than in *Ceratites trinodosus*.

In the latter species at least two, but very often even three, marginal tubercles correspond to one lateral tubercle. In Oppel's type-specimen of *Ceratites Thuillieri*, the number of umbilical and lateral tubercles is 23 on the last volution, the number of marginal tubercles 29. In a second specimen from Rimkin Paiar Encamping Ground the proportion of the lateral and marginal tubercles is 17 : 25, in a third specimen 7 : 14 to the last volution. In a fragment from the same locality, single and bifurcate ribs so regularly alternate, that seven umbilical and lateral tubercles correspond to eleven marginal ones. Another specimen (Pl. I., fig. 2) from Rimkin Paiar, however, exhibits a somewhat different sculpture. In this specimen the bifurcation of the ribs is not limited to the lateral tubercles, but occasionally occurs near the umbilical margin. But of the two ribs, rising in the same umbilical tubercle, only one bifurcates a second time in the line of lateral tubercles, the other remains undivided and bears no lateral tubercle, so that the number of umbilical and lateral tubercles remains equal, as seen in the typical forms of *Ceratites Thuillieri*. In this specimen the umbilical and lateral tubercles occur to the number of 11, the marginal tubercles to the number of 22 on one volution.

A characteristic difference between *Ceratites Thuillieri* and *Ceratites trinodosus* consists in the fact—mentioned first by E. von Mojsisovics—that in *Ceratites Thuillieri* the involution of the whorls takes place *outside*, in *Ceratites trinodosus* *inside* of the spiral line of lateral tubercles.

Sutures.—The arrangement of the lobe-line is similar to that in *Ceratites trinodosus*. The siphonal saddle is broader and lower than the principal lateral saddle and coincides with the marginal tubercles. The two lateral saddles are narrrow and elongated. The second lateral lobe is much shorter than the first and stands as deep as the two auxiliary lobes. The first auxiliary saddle is bipartite. Along the base of the first lateral lobe deeply incised narrow digitations are visible. The denticulations affect the marginal walls of the saddles, the upper extremities of

which are slightly serrated, whilst in *Ceratites trinodosus* the upper portion of the saddles remains entire.

Locality, number of specimens examined.—Muth, Spiti, 1, Coll. Schlagintweit, in the Palæontological Museum in Munich (Oppel's type specimen); Shalshal cliff near Rimkin Paiar Encamping Ground, 8, Coll. Diener; Utadura Pass (Johár), 1, Coll. Diener; Sunamarg, Kashmir, 1, Coll. Geological Museum, Calcutta.

Remarks.—*Ammonites Blanfordi*, Salter (Palæontology of Niti, Pl. VI., fig. 2, p. 66), which is identified with *Ceratites Thuillieri* by Stoliczka (l. c. p. 57), belongs most probably to *Ceratites onustus*, Oppel. Another similar fragment, described and figured by Salter (l. c. Pl. VII., fig. 5, p. 63) as *Ammonites Winterbottomi*, has been considered to be a young individual of *Ceratites Thuillieri* by Beyrich l. c. p. 110), whilst Stoliczka (l. c. p. 57) has some doubts as to the identity of the two species. E. von Mojsisovics, who had an opportunity of examining Salter's collection in the British Museum in London, thinks that *Ammonites Winterbottomi* belongs to the genus *Trachyceras*, and has not been collected in the Muschelkalk, but in the overlying strata of upper triassic age.[1]

19. (2.) Ceratites Himalayanus, Blanford. Pl. I., fig. 4.

1863. *Ammonites (Ceratites) Himalayanus*, Blanford: Journal Asiat. Soc. of Bengal, 1863, No. II. Pl. 2, fig. 7, p. 133.
1865. *Ammonites Thuillieri*, Stoliczka: *ex parte*, Mem. Geol. Surv. of India, Vol. V., Pt. I., p. 56.

Dimensions.

Diameter of the shell	37 mm.
Height of the last whorl	19 „
Thickness of the „ „	14 „
Diameter of the umbilicus	7·5 „

Like *Ceratites Thuillieri*, this species, of which I possess only one entirely chambered individual (Blanford's type-specimen), offers many affinities with *Ceratites trinodosus*, E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz, Pl. VIII., fig. 5, 6, 7, 9, Pl. XXXVII, fig. 6, 7, p. 29), both in general shape and sculpture. In the last volution 21 marginal tubercles correspond to 10 lateral ones. Outside the lateral row of tubercles a regular augmentation of the ribs occurs, partly by bifurcation, partly by the intercalation of intermediate ribs. The proportion of lateral and marginal tubercles is nearly the same as in *Ceratites trinodosus*. The involution of the whorls likewise takes place inside the spiral line along which the lateral tubercles are arranged, not outside, as in *Ceratites Thuillieri*, Oppel. The umbilical tubercles, if any exist, are but faintly marked, as is the case in the Lombardian variety of *Ceratites trinodosus*.

The ventral part is provided with a distinctly marked keel as in *Ceratites elegans*, v. Mojsisovics (l. c. Pl. IX., fig. 5, 6, p. 31). From the marginal tubercles the ribs continue as prolongations which are decidedly bent forward and towards the keel.

[1] *E. v. Mojsisovics*, "Arktische Triasfaunen," l. c. p. 142.

Sutures.—In shape and arrangement the sutures are similar to those of *Ceratites Thuillieri*, Oppel, although I have not been able to prepare them sufficiently to enable me to make out all details of their denticulations. One of the differences, which distinguish it from *Ceratites trinodosus* and *Ceratites Thuillieri*, consists in the existence of two strongly developed auxiliary saddles outside the umbilical suture. The first auxiliary saddle is an undivided arch. The second auxiliary lobe coincides with the umbilical edge as in *Ceratites elegans*. The marginal walls of the saddles seem to be serrated almost up to the summit.

Locality, number of specimens examined.—Spiti valley (exact locality not known), 1, Coll. of the Asiatic Society of Bengal in the Geological Museum in Calcutta.

Remarks.—Blanford, who first established the present species, has himself now identified it with *Ceratites Thuillieri*.[1] Stoliczka also enumerates it in his list of synonyma of *Ceratites Thuillieri* (l. c. p. 56). In the foregoing description, based on the examination of Blanford's type-specimen, the reader will find, I hope, sufficiently good reasons for considering *Ceratites Himalayanus* a proper species.

20. (3.) Ceratites Kamadeva, nov. sp. Pl. V., fig. 1.

Dimensions.

Diameter of the shell	90 mm.
Height of the last whorl	43 „
Thickness of the „ „	34 „
Diameter of the umbilicus	31 „

This beautiful species, of which I have but one entirely chambered specimen in my collection, resembles in its sculpture *Ceratites subnodosus*, E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz, 1882, Taf. X, fig. 9, 10, 11, p. 33), whilst in general shape and involution of the shell it differs remarkably from the Mediterranean form. The whorls are much less involute, and increase more rapidly in height and thickness. In the specimen figured, the height of the last whorl increases from 32 to 43 mm., the thickness from 24 to 34 mm. for one half of the last volution. The transverse section is almost rectangular. The flat ventral area is sharply separated from the lateral parts.

Like *Ceratites subnodosus* and *Ceratites nodosus*, the well-known fossil type of the German Muschelkalk, this species possesses, in its adolescent stage, strong umbilical tubercles and a well-marked umbilical edge. In later stages of growth the umbilical tubercles completely disappear, the umbilical edge becomes gradually rounded, and the lateral parts slope in a decided curve towards the umbilical suture.

The ornamentation of the lateral parts is especially remarkable. Strong, radial ribs, which become slightly flexuous near the siphonal margin, cover the upper portion of the sides and terminate in tubercle-shaped prominences, a little above

[1] Palæontology of Niti, p. 106.

the lower third of the height of the lateral parts. From this spiral line of lateral tubercles, which but exceptionally exhibit the features of genuine tubercles, the ribs continue as faintly marked folds towards the umbilical margin. In the inner whorls they bear stout umbilical tubercles which gradually disappear in later stages, as has been mentioned above. The transverse section of the ribs is rounded. They slope more gently on the side towards the aperture than on the reverse side, which is steeper. They terminate near the siphonal margin in strongly developed, obliquely protracted tubercles. The number of the lateral and marginal tubercles is equal. Intermediate ribs, as they occur in *Ceratites subnodosus* have not been noticed in the present specimen. Most of the ribs become more prominent half-way between the lateral and marginal tubercles, but not sufficient prominences are formed to impart the character of a second chain of lateral tubercles. The ribs do not pass over the siphonal area, which remains entirely smooth.

Siphuncle.—In the ventral area of the last whorl the siphuncle is clearly visible for a distance of 12 mm. It has the shape of a string and consists of longitudinal, frequently anastomosing fibres, coloured more darkly than the neighbouring parts of the matrix. It agrees perfectly with the figures and descriptions of some Arctic Ceratites given by E. v. Mojsisovics ("Ueber die Structur des Siphо bei einigen triadischen Ammoneen," Neues Jahrbuch f. Mineralogie 1885, Bd. II., p. 151).

Sutures.—The siphonal lobe is distinguished by its rather high position and divided by a high, delicately serrated, siphonal tubercle. The saddles are serrated up to their apices, which form entire arches. The siphonal saddle is shorter than the principal lateral, but higher than the second lateral saddle. The base of the first auxiliary lobe ends in two sharp points. Two auxiliary saddles are situated outside the umbilical suture.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground (Painkhanda), 1, Coll. Diener.

21. (4.) Ceratites Kuvera, nov. sp. Pl V., fig. 2.

Dimensions.

Diameter of the shell	85 mm.
Height of the last whorl	33 „
Thickness of the „ „	21 „
Diameter of the umbilicus	28 „

This species somewhat resembles *Ceratites Thuillieri*, Oppel, in general shape of the shell, involution and sculpture. The whorls, however, increase more slowly than in the latter species. The ventral area is flat and sharply separated from the lateral parts, as in *Ceratites Kamadeva*. The inner whorls are but imperfectly preserved. Near the inner extremity of the last whorl the sculpture of the lateral parts is formed by bifurcate ribs, which rise from the umbilical margin, and bifurcate into strong lateral tubercles. This series of lateral tubercles stands a little

above the lower third of the height of the last whorl. In later stages of growth the ribs remain undivided. They terminate in stout, marginal tubercles, which are prolonged in the direction of the aperture.

The involution of the whorls takes place far outside the spire of lateral tubercles, and near the lower third of the distance between the lateral and marginal tubercles.

The only specimen available is somewhat distorted and drawn out like all specimens from Kalapani, and is entirely chambered.

Sutures.—There are decided differences between our species and *Ceratites Thuillieri* in the arrangement of the lobe-line. The lateral lobes are considerably enlarged at their base, whilst they contract towards their upper portion. The principal lateral lobe shows plainly deep digitations, which affect likewise the marginal walls of the saddles. The extremely short siphonal saddle coincides with the marginal tubercles. The principal lateral saddle is oblique, and slopes towards the marginal side. The first, serrated, auxiliary lobe is followed by a bipartite auxiliary saddle, and a long sutural lobe, which is intersected by two deep indentations.

Locality, number of specimens examined.—North of Kalapani, Kali River valley (Byans), 1, Coll. Griesbach.

γ. Group of the CERATITES SUBROBUSTI.

22. (1.) Ceratites truncus, Oppel. Pl. I., fig. 7.

1865. *Ammonites truncus*, Oppel: Palæontologische Mitth., Pl. 86, fig. 3, p, 292.
1882. *Ceratites truncus*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, p, 44.
1886. *Ceratites truncus*, E. v. Mojsisovics: Arktische Triasfaunen, p. 21.

Oppel's type-specimen is the fragment of an outer whorl, consisting of four chambers, distinguished by an almost elliptical section. The thickness of the whorl is 34 mm., its height above the umbilical suture 40 mm. The lateral parts curve gradually towards the umbilical suture, as well as towards the siphonal area, and are separated from both of them by a sharp border. The ventral area is broad and flatly rounded. If one may judge from the curve of the fragment, the involution of the whorls seems to correspond approximately to that of *Ceratites Vyasa*.

The sculpture of the fragment is very remarkable. The lateral parts are provided with strong, radial ribs, which begin near the umbilical margin as faintly marked folds, and terminate near the siphonal margin in very stout, prominent tubercles. A second row of lateral tubercles of equal size and knob-like shape, coincides with the lower third of the height of the sides of the whorls. The intervals between the roof-like ribs, form regular arches in their transverse sections, as in *Ceratites Hidimba*. To a median plane through the siphonal area the ribs stand asymmetrically.

Sutures.—The extraordinarily long principal lateral lobe is much deeper than the siphonal and the second lateral lobe. The large rounded saddles are similar in

height, and not serrated in their upper portions. The denticulation affects the marginal walls only in the lower half of their height. The lobes are provided with deep, strongly developed digitations at their base. Two auxiliary lobes and one simple auxiliary saddle stand outside the umbilical suture. The second auxiliary lobe is serrated.

Locality, number of specimens examined.—Kuling, Spiti, **1**, Coll. Schlagintweit, in the Palæontological Museum in Munich, Oppel's type-specimen.

Remarks.—According to the opinion of E. von Mojsisovics (Arktische Triasfaunen, p. 21), *Ceratites truncus* belongs to the group of the *C. subrobusti*, at least in so far as one may be able to decide from its rather fragmentary state of preservation.

23. (2.) Ceratites, nov. sp. ex aff. C. Subrobustus. Pl. V., fig. 6.

This fragment of an entirely chambered outer whorl does not permit exact measurements of its dimensions. The height of the whorl at its aperture is 14 mm., the thickness 12 mm. The whorls are higher than in *Ceratites subrobustus*, E. v. Mojsisovics (Arktische Triasfaunen. Pl. VI, fig. 1, p. 44), to which ours species is closely allied, especially with referenee to its sculpture and sutures.

The lateral parts are strongly convex and bent towards the umbilicus in a steep curve. The siphonal area is somewhat raised into the shape of a roundish keel. Near the middle of their height the sides bear very prominent umbilical tubercles, in the numerical proportion of seven to one-half of the outer whorl. From these umbilical tubercles, distinctly marked ribs run towards the umbilical suture, as well as towards the siphonal margin, where they terminate in strong tubercles. In the present fragment a bifurcation of the ribs occurs three times in the umbilical tubercles; 8 marginal correspond to 5 umbilical tubercles.

Sutures.—The arrangement of the sutures is very similar to that in *Ceratites subrobustus*, with the exception of a second auxiliary lobe which is situated outside the umbilical suture. Only a part of the second lateral lobe is placed within the umbilical margin, whilst the umbilical tubercles are divided by the inner margin of the principal lateral saddle. The siphonal saddle coincides with the marginal tubercles as in *Ceratites subrobustus*. The siphonal lobe is less deep than the principal lateral lobe. The lobes are deeply serrated at their base. The indentations reach almost to the upper extremities of the saddles, which alone remain entire, whereas in *Ceratites subrobustus* a lower stage of development is marked by its less deeply serrated lobes and entire saddles. In the siphonal lobe of the present species 7 denticulations are counted on each side of the siphonal tubercle, and 8 in the principal lateral obe.

Locality, number of specimens examined.—Right border of Topidunga valley, near Topidunga Encamping Ground (Johár), 1, Coll. Diener.

24. (3.) CERATITES sp. ind. et aff. C. MIDDENDORFI. Pl. V, fig. 7.

Dimensions.

Diameter of the shell	37 mm.
Height of the last whorl	15 „
Thickness of the „ „	15 „
Diameter of the umbilicus	12 „

The only individual of this species, which was collected by myself in the Muschelkalk of the Shalshal cliff near Rimkin Paiar Encamping Ground, is unfortunately in too bad a state of preservation to allow of any specific determination. In its general shape it agrees perfectly with *Ceratites Middendorfi*, Graf Keyserling, from the Siberian Trias[1]. Its transverse section resembles that of the specimen figured by E. v. Mojsisovics in Pl. II., fig. 13. The lateral parts are greatly rounded, but become strongly curved towards the siphonal area. The height and width of the aperture are the same. The umbilical margin is marked by a strong convexity of the sides and by prominent tubercles, of which there are four in the last half volution. In the siphonal area transverse wrinkles may be noticed. The inner whorls are not preserved.

Sutures.—Unknown.

δ. GROUP OF THE CERATITES GEMINATI.

25. (1.) CERATITES NOV. SP. IND. Pl. V., fig. 3.

The only and rather imperfect fragment of this highly interesting species, is distinguished by a true keel, bordered by marked furrows. The proportion of height and thickness in a transverse section is as 8 : 5. The siphonal area is comparatively narrow, the sides are moderately rounded.

The sculpture of the lateral parts consists of numerous, nearly straight ribs, bent slightly forward near the siphonal margin. The umbilical region is not sufficiently well preserved to decide whether the ribs remain undivided, as I believe, and as is represented in my figure (Pl. V. fig. 3) or whether some of them bifurcate near the umbilical margin.

In the present specimen the sculpture is interrupted by five transitional mouth-borders, which rise in the umbilical region from the fore-part of the ribs, pass over the latter themselves near the siphonal margin, in the shape of strongly developed parabolic ears, and bending obliquely forward terminate towards the siphonal area.

Sutures.—Not known.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

Remarks.—No close relationship seems to exist between this form and the rest of the species of this group, described by E. v. Mojsisovics from the Spitzbergen Muschelkalk.

[1] E. v. Mojsisovics: Arktische Triasfaunen, l. c. Pl. II, fig. 12, 13, p. 38.

26. (2) CERATITES sp. ind. (?) Pl. V. fig. 5.

It seems rather doubtful whether it may be permissible to look upon this fragment of a body-chamber, as belonging to the group of the *Ceratites geminati*. A greatly corroded elevation in the middle of the ventral area may be supposed to represent a keel, as in a transverse section no separating area or fissure is visible between it and the rest of the shell. It may prove to be an inorganic deposit, however, which does not belong to the shell at all.

The lateral parts are low, flat and sharply separated from the broad ventral area. The siphonal part is strongly convex. The ribs rise from faint prominences near the umbilical margin. Their direction is radial in the lower portion of the lateral parts, where they swell into slight tubercles. In the upper portion of the sides they become falciform, and are strongly bent forward near the siphonal margin. They gradually die out, when passing over to the ventral area. Between two principal ribs an intermediate one is intercalated, which runs in a falciform direction towards the lateral tubercles, but without joining them completely.

The proportion of height and thickness of the aperture is 26 : 20, the height of the (doubtful) keel not counted.

Sutures.—Not known.

Locality, number of specimens examined.—Bambanag cliffs (Girthi valley), 1, Coll. Diener.

Sub-genus: DANUBITES, E. v. Mojsisovics.

The sub-genus *Danubites* was established by E. v. Mojsisovics (Die Cephalopoden der Hallstætter Kalke Vol. II., 1893, p. 398) for the two sections of the *Ceratites obsoleti* and *Ceratites Floriani*,[1] distinguished by barely overlapping whorls and a transverse sculpture, very similar to that in *Celtites*, E. v. Mojsisovics. *Danubites*, already known in the Mediterranean and Arctic-Pacific Trias, attains a certain importance in the lower Trias of the Himálayas, which I may note in anticipation of the publication of a monograph on the Cephalopoda of the Himálayan lower-triassic deposits. In the Muschelkalk of the main-region it has, however, only one typical representative, *Danubites Dritarashtra*, which is very closely allied to the Mediterranean group of *Danubites Floriani*, Mojs. Both its transverse sculpture, which consists of single radial ribs, confined to the lateral parts and interrupted by a thin thread-like siphonal keel, and the remarkably great distance of its septa, mark peculiar characteristics of our Indian species and of the Mediterranean forms of this group.

[1] *Danubites Floriani* was originally united with *Celtites* by E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz p. 145.), as the length of its body-chamber was not known at that time. Later examinations afforded evidence that it belongs to *Ceratites* by reason of its short body-chamber. (E. v. Mojsisovics "Über einige Japanische Trias-Fossilien," Beiträge zur Palæontologie Oesterreich-Ungarns, etc. Wien, Vol. VII, 1888, p. 170.)

1. Danubites Dritarashtra, nov. sp. Pl. VIII. fig. 1.

Dimensions.	
Diameter of the shell	49 mm.
Height of the last whorl	11·5 „
Thickness of the „ „	10 „
Diameter of the umbilicus	29 „

This form, belonging to the Mediterranean group of *Danubites Floriani*, v. Mojsisovics, is distinguished by its numerous, very slowly increasing whorls. Even *Danubites retrorsus*, E. v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz Pl. XXXIV. fig. 3, p. 146), which in this respect bears a greater affinity to our species than any other form of this group, possesses only a smaller number of whorls in specimens of the same diameter.

The whorls overlap each other but very slightly. They are higher than broad in full grown specimens, whilst in young individuals a transverse section is of equal height and width. The ventral area is steeply rounded and provided with a median, thin, thread-like elevation, taking the place of a keel. The front-view of the specimen figured in Pl. VIII., fig. 1, does not give a correct idea of its shape, the specimen being slightly distorted and drawn out so much, that its ventral part looks rather unnaturally sharpened. An examination of the body-chamber of this and other specimens clearly shows, that the siphonal area, although more convex than in *Danubites Floriani*, E. v. Mojsisovics (l. c. Pl. XXVIII. fig. 5, 6, 7, XXXI. fig. 4, p. 145), is not sharpened. The existence of a delicate, thread-like keel imparts, it is true, to the siphonal area the character of a somewhat obtuse edge, owing to its rather steep convexity. It seems doubtful, however, whether the oblique, elliptical shape depends entirely on a later deformation through pressure, as it is peculiar to all the specimens examined. But as specimens of different species from the same locality exhibit also this drawn out elliptical shape, being imbedded in soft calcareous shales, subjected to cleavage, this form may possibly be considered as accidental, and not characteristic of the species.

The lateral parts bend towards the umbilical suture in a very steep curve. They are covered with numerous, strong, simple, radial ribs which correspond on both sides of the siphonal keel. The ribs, of which about 35 are situated in one volution, are all single near the umbilical margin, already strongly developed, and then swell out to their greatest elevation in the middle portion of the sides. In the lower portion of the lateral parts they are narrow and terminate in a rounded edge. Near the siphonal margin they become considerably enlarged, as their elevation decreases. On both sides of the median siphonal keel, the sculpture is interrupted. In the specimen figured, Pl. VIII. fig. 1., the last half of the outer whorl belongs to the body-chamber.

Sutures.—Very similar to those of *Danubites Floriani*, but the denticulations at the base of the lobes are more developed. The siphonal lobe ends in two points; the principal lateral lobe is serrated up to the middle of the height of the bordering

saddles, with two deep indentations at its base. The second lateral lobe is bipartite and stands much higher than the deeply incised principal lateral lobe. Its height is almost equal to that of the first auxiliary lobe, the inner margin of which is touched by the umbilical suture. The siphonal saddle is larger than the principal lateral saddle.

The distance of the septa is unusually large even quite close to the body-chamber. In the figure mentioned above, the distance of the two last septa, followed by the body-chamber, is 8 mm.

Locality, number of specimens examined.—Utadurrha-Pass (Johár), in dark, calcareous shales, 3, Coll. Diener.

Remarks.—In *Danubites Dritarashtra* the lobe-line has attained a somewhat higher stage of development, than in any form of the Mediterranean group of *Danubites Floriani.* In this respect our species shows a close affinity to *Danubites Naumanni,* v. Mojsisovics ("Über einige Japanische Trias-Fossilien" l. c. p. 169, Pl. II. fig. 1) from the Trias of Japan, which has been found in geologically younger deposits.

Sub-genus: JAPONITES, E. v. Mojsisovics.

In his memoir on some triassic fossils from Japan, E. von Mojsisovics described and figured a species of *Ceratites, Ceratites planiplicatus* [1] distinguished by a sculpture peculiar to the *Dinarites* or *Ceratites spiniplicati* and by dolichophyllic sutures. This species, with which may be compared *Ammonites runcinatus,* described and figured by Oppel in 1865[2] is considered now by E. v. Mojsisovics to be the type of a special sub-genus, *Japonites.*[3]

According to the diagnosis of *Japonites planiplicatus* the following may be pointed out as sub-generic characters. Discoidal, flat shell, consisting of very numerous, slowly increasing whorls, overlapping each other but little, a wide umbilicus, a sculpture similar to that of the *Dinarites spiniplicati,* completely interrupted near the siphonal area, dolichophyllic sutures, a remarkable disproportion in the development of the high, deeply incised principal saddles and the low auxiliary saddles, scarcely surpassing the dimensions of the larger denticulations at the base of the principal lobes. Another character, which the forms included in this sub-genus have in common, is the club-like shape of the lateral saddles which become enlarged in their upper portions.

In the Indian triassic province the sub-genus *Japonites* is represented by three species, *Japonites runcinatus,* Oppel, *Japonites Sugriva,* nov. sp., *Japonites Chandra,* nov. sp. Of these *Japonites Sugriva* is very closely allied to *Japonites planiplicatus,* Mojs., from the Trias of Japan, especially if we consider the development of the sutures.

[1] *E. v. Mojsisovics* "Über einige Japanische Trias-Fossilien: Beiträge zur Geologie Oesterreich-Ungarns und des Orients; herausgegeben von. E. v. Mojsisovics und M. Neumayr, Vol. VII. Wien, 1888, Pl. IV. p. 170.

[2] *A. Oppel,* Palæont. Mitth. Vol. I. Pl. 84, fig. 2, p. 290.

E. v. Mojsisovics. "Die Cephalopoden der Hallstætter Kalke," II. 1893, p. 3, 503, 504.

Japonites forms probably a faunistic element exclusively peculiar to the Arctic-Pacific and Indian triassic provinces, although this fact is not yet beyond every doubt. Among the *Ceratitidæ* from the Bosnian Muschelkalk, described by F. v. Hauer (Beiträge zur Kenntniss der Cephalopoden aus der Trias von Bosnien. I. Neue Funde aus dem Muschelkalk von Han Bulog bei Sarajevo. Denkschr. Kais. Akad. d. Wiss. in Wien, Math.-Nat. Cl. LIX., 1892), *Ceratites striatus* (l. c. Pl. IV. fig. 1, p. 263), *Ceratites labiatus* (Pl. V. fig. 1, p. 266), *Ceratites evolvens* (Pl. V. fig. 3, p. 265) particularly resemble *Japonites* in their involution, sculpture and structure of the lobe-line. On the other hand, the existence of labiæ or contractions of the inner whorls of *Ceratites labiatus* seems to point to a close affinity between the three species mentioned above, with the genus *Proteites*, completely isolated up to now in the triassic deposits of Bosnia. Neither has the occurrence of longitudinal striae in the sculpture of *Ceratites labiatus* and *Ceratites striatus* been noticed in any of the species of *Japonites*. The relationship of *Proteites* to the group of *Ceratites decrescens*, v. Hauer (Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog bei Sarajevo. Denkschr. Kais. Akad. d. Wiss. Wien LIV., 1887 Pl. V. fig. 3, p. 24), closely allied to *Ceratites evolvens*, has been clearly pointed out by F. v. Hauer himself.

1. Japonites Sugriva, nov. sp. Pl. VII, fig. 1.

Dimensions.	
Diameter of the shell	114 mm.
Height of the last whorl	30 „
Thickness of the „ „	29 „
Diameter of the umbilicus	60 „
Height of the last whorl in the place of its greatest applanation	26 „
Thickness of the last whorl in the place of its greatest applanation	25 „
Corresponding diameter of the shell	93 „
Corresponding diameter of the umbilicus	48 „

In involution, sculpture and arrangement of the sutures the present species is closely allied to *Japonites planiplicatus*, v. Mojsisovics (l. c. Pl. IV. p. 170) from the triassic slates of Okatsuhama in Japan. *Japonites Sugriva* is distinguished by the obliquely elliptical shape of its shell, more slowly increasing whorls, which overlap each other scarcely to the third part of their height, and a wider, and shallower umbilicus.

The greatest thickness of the cordiform transverse section coincides with the umbilical margin. The sides are curved into a pointed arch and converge into a sharp siphonal area. In *Japonites planiplicatus* the siphonal part is sharpened in a similar manner, although in the specimen from Japan it seems rather difficult to decide how much of this is owing to the distortion and compression in the soft matrix. The umbilical margin is low and steeply rounded.

The inner whorls have suffered considerably owing to the matrix having splintered. In some places, however, the sculpture is clearly visible. It consists of very flat, broad folds separated by intercostal intervals of equal size. In the last, entirely chambered whorl the intercostal intervals can only be traced in the lower

portion of the lateral parts as very flat, radial furrows. They are more numerous but less strongly developed than in *Japonites planiplicatus*, which otherwise possesses the same simple sculpture, peculiar to the spiniplicate *Dinarites* and *Ceratites* of the Arctic Trias. The broad, flat folds, of which there are about 20 in the last volution, are somewhat more prominent near the umbilical margin, but are still very far from forming the tubercle-shaped elevations, which occur in a very large number of *spiniplicati*. The upper portion of the lateral parts is perfectly smooth. No fold touches the siphonal edge. In the inner circuits the sculpture is rather more strongly marked than in the last whorl.

Sutures.—Both in the arrangement and in the details of the dolichophyllic sutures there is great similarity to *Japonites planiplicatus*. The siphonal lobe is narrow and extraordinarily short, provided with three sharp points at its base and divided by an unusually high siphonal tubercle. The siphonal saddle is more slender than in *Japonites planiplicatus* and lower than the principal lateral saddle. The two lateral saddles are enlarged, club-shaped above, and one is provided with large digitations. A phylloid prominence is noticed at the inner margin of the second lateral saddle. The reduced auxiliary saddles are in sharp contrast to the large principal saddles owing to their rudimentary development. In the broad umbilical lobe three auxiliary saddles may be distinguished, among which the central one is bipartite. The principal auxiliary lobe terminates in two points and, as in *Japonites planiplicatus*, is placed lower down than the bipartite second lateral lobe. The principal lateral lobe is the deepest and ends in a central point.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

2. Japonites Chandra, nov. sp. Pl. X., fig. 4.

Dimensions.

Diameter of the shell	77 mm.
Height of the last whorl	23 „
Thickness „ „ „	21 „
Diameter of the umbilicus	38 „

Like the preceding species, *Japonites Chandra* possesses a discoidal shell, consisting of numerous whorls, overlapping each other scarcely to one third of their height, and a wide umbilicus. It differs remarkably, however, in shape from *Japonites Sugriva*, by its normal spiral. The transverse section is alike in both species, of nearly equal height and thickness, and in the shape of a pointed arch, with slightly curved sides. The siphonal area is highly rounded near the beginning of the last whorl, but sharpened in the body-chamber. The whorls have their greatest thickness near the umbilical margin, which is higher than in *Japonites Sugriva*, and imparts to the umbilical region a less shallow character.

Three-fourths of the last whorl belong to the body-chamber. In the outer extremity of the last whorl the mouth-border seems to be marked by a falciform, wavy transverse plane in the matrix. But as it coincides with a plane of cleavage, crossing the whole specimen, it may perhaps be accidental only.

The sculpture, visible only in the last whorl, consists of extremely delicate, wavy folds which bend gently backwards and disappear near the siphonal edge. As the surface of the specimen is partially corroded, this delicate radial sculpture has been preserved only in the place noted in the figure.

Sutures.—Dolichophyllic. Siphonal lobe very short and narrow, siphonal saddle slender and lower than the principal lateral saddle. The upper part of the latter is individualised by a deeply incised digitation at its inner margin. The second lateral saddle is of equal height with the siphonal saddle and provided with a phylloid prominence at its inner side. The large principal saddles are followed by an umbilical series of indentations, representing the auxiliary lobes and saddles. Among them only the bipartite first auxiliary lobe can be clearly distinguished. *Japonites Chandra* differs from *Japonites Sugriva* and *Japonites planiplicatus* by the position of the second lateral lobe, which is placed lower than the first auxiliary lobe. The low position of the first auxiliary lobe in the two preceding species cannot therefore be considered as a sub-generic character of *Japonites*.

The sutures marked in the figure (Pl. X. fig. 4) are the large septa preceding the body-chamber.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

3. JAPONITES RUNCINATUS, OPPEL, Pl. VII., fig. 2.

1865. *Ammonites runcinatus*, Oppel: Palæontologische Mittheilungen aus dem Museum des bayr. Staates I. Pl. 84, fig. 2, p. 290.

1888. *Ceratites (?) runcinatus*, E. v. Mojsisovics, "Uber einige Japanische Trias-Fossilien" Beiträge zur Palæontologie Oesterreich-Ungarns und des Orients, herausgegeben von E. v. Mojsisovics und M. Neumayr, VII. p. 171.

The outlines of the only individual of this species, an entirely chambered fragment of half a whorl, allow of the supposition, that in general shape and involution this form may resemble *Japonites Chandra*. The whorl overlaps the preceding one to the extent of one quarter of its height. The height of the transverse section is 24mm. Its width may be estimated at 13mm., but this cannot be determined with certainty, as only one of the lateral parts of the shell is preserved. The siphonal area is not sharp as in the other species of *Japonites* but moderately rounded. The sides are flatly convex and slope gradually towards the umbilicus. In spite of many injuries, which the surface of the shell has suffered, flat elevations, taking the shape of broad folds, may be recognised in the lower portion of the lateral parts. They are, it is true, so indistinctly marked, that they could not be represented in the drawing (Pl. VII. fig. 2) any more than in Oppel's figure. Their occurrence, however, clearly proves, that in *Japonites runcinatus* the same arrangement of sculpture prevailed as in other congeneric forms.

Sutures.—As has already been remarked by E. v. Mojsisovics, the lobe-line exhibits an arrangement peculiar to *Japonites*, although there is less complication

in the details of the sutures. To the long, slender, principal saddles rudimentary auxiliary saddles correspond, which unite with the first auxiliary lobe to form one single, broad umbilical lobe. The siphonal lobe is very broad, much deeper than in *Japonites Sugriva* and *Japonites Chandra* and divided by a high siphonal tubercle. Of the principal saddles, only the first lateral one shows continuous, but slightly serrated, outlines in its upper part. The siphonal saddle is perfectly dolichophyllic and has deep, tooth-like digitations. The second lateral saddle is provided with a phylloid prominence at its inner margin, as in the two preceding species. The second lateral lobe is placed on the same level as the first auxiliary lobe. In Oppel's figure the position of these two lobes is represented incorrectly.

Locality, number of specimens examined.—Shangra, east of Puling, Hundés, 1, Coll. Schlagintweit in the Palæontological Museum in Munich, Oppel's type-specimen.

Family: *TROPITIDÆ.*

Genus: ACROCHORDICERAS, Hyatt.

Of this genus,—not known from the Muschelkalk of the Himálayas up to now —two species have been lately discovered, which bear no nearer relationship to any form of the Alpine Muschelkalk.

1. Acrochordiceras Balarama, nov. sp. Pl. VII. fig. 3.

Dimensions.

Diameter of the shell	27 mm.
Height of the last whorl	11 „
Thickness „ „ „ „	16 „
Diameter of the umbilicus	8 „

The unusually thick whorls, in which this form differs from all congeneric species of the Mediterranean Trias, enclose a proportionately wide umbilicus. Near the umbilical suture rise strongly developed, broad ribs, partly bifurcating near the umbilical margin, partly remaining undivided. The sculpture extends uninterruptedly across the broad, rounded siphonal area, where the ribs attain their greatest elevation. Only in the last pair of ribs, arising from bifurcation near the umbilical margin, the point of bifurcation is marked by an umbilical tubercle. As the transverse diameter of the specimen is 26mm. at the point at which this umbilical tubercle occurs, the latter forms an element of sculpture but very lately acquired by this species, as is the case in *Acrochordiceras Carolinæ* v. Mojsisovics (Die Cephalopoden der Mediterranen Triasprovinz Pl. XXVIII, fig. 14, Pl. XXXVI, fig. 3, p. 141). In the last third portion of the outer whorl two simple intermediate ribs are inserted between two bifurcating ribs.

The whorls have their greatest width near the point of bifurcation of the ribs. The height of the umbilical wall is 4·5mm. (5·5mm. the height of the tubercle in-

cluded) near the extremity of the last whorl. The slope from the umbilical margin towards the umbilical suture is very steep. The arrangement of the ribs is symmetrical to a median plane. Only in the last portion of the outer whorl the details of the sculpture are well exhibited.

Sutures.—Not known.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

2. Acrochordiceras Joharense, nov. sp. Pl. VII. fig. 4.

The only specimen of this species is unfortunately incomplete and somewhat distorted through pressure. As I have not been able to take exact measurements, I must refer to the figure for dimensions and the general outline of the shell.

In this species the whorls seem to be a little higher than in *Acrochordiceras Balarama*; the width of the transverse section, however, still exceeds its height. The umbilicus is tolerably wide. The umbilical margin is lower and less steeply inclined towards the umbilical suture. Near the umbilical margin strongly developed tubercles rise near the points, where the dichotomous ribs bifurcate. They occur, however, in a considerably smaller number than the single ribs, bearing no umbilical tubercles. With a diameter of the shell of 38mm, four intermediate ribs occur between two pairs of ribs each bearing an umbilical tubercle. In a later stage of growth the number of intermediate ribs still increases, but the base of the umbilical tubercle sometimes becomes so large as almost to touch the next intermediate rib. A mere superficial examination therefore produces the impression, that occasionally even more than two ribs were united into one umbilical tubercle.

The strong, coarse ribs pass over the slightly flattened ventral area in a straight line and without diminishing in size. The greatest thickness of the whorls coincides with the row of umbilical tubercles as in *Acrochordiceras Balarama*. From the latter, *Acrochordiceras Joharense*, however, differs not only by its sculpture, but also by its whorls, which increase much more slowly. The outer extremity of the last whorl is not sufficiently well preserved to decide whether a portion of it does or does not belong to the body-chamber.

Sutures.—In general structure and arrangement of the sutures a remarkable similarity may be noticed with the lobe-line of a species of *Acrochordiceras* from the Bosnian Muschelkalk, described and figured by F. von Hauer (Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog bei Sarajevo, Denkschr. Kais. Akad. d. Wiss. Wien LIV. Bd., 1887, Pl. 5, fig. 2 c.).[1] The figure Pl. VII. fig. 4 c. represents the lobe-line of a specimen of a transverse diameter of 45

[1] It has already been remarked by E. v. Mojsisovics (Die Cephalopoden der Hallstætter Kalke II. Bd., 1893, p. 813) that the identification of this species with *Acrochordiceras Damesi* Noetling by F. v. Hauer will not stand a severe test.

mm. The siphonal lobe is deep and narrow and ends in a long drawn out point. The siphonal tubercle reaches half way up the siphonal saddle. The position of the principal lateral lobe is a very low one. This lobe terminates in long, narrow denticulations. Indentations affect the marginal borders of the saddles, the upper extremities of which are slightly serrated. The siphonal and the principal lateral saddles are of equal height. Two broad, deeply serrated auxiliary lobes are separated by a broad serrated saddle. A second auxiliary saddle of very small size stands outside the umbilical suture.

Locality, number of specimens examined.—South slope of Utadura Pass 1, Coll. Diener.

Genus : SIBIRITES, E. v. Mojsisovics.

The genus *Sibirites*, known in the Himálayas up to now from upper triassic strata only, is represented in the dark earthy limestone at the base of the Muschelkalk (zone of *Rhynchonella semiplecta* according to Griesbach[1]) by a richly ornamented species, which bears some affinity to the group of *Sibirites pretiosus* v. Mojsisovics from the Olenek-strata of Siberia.

The presence of this genus in the lower Muschelkalk of the Central Himálayas is of some interest. From Griesbach's section of the Shalshal it was known that *Sibirites* occurs in the upper triassic strata of the Himálayas, and in 1892 our expedition succeeded in discovering a good many species of this genus together with *Halorites*, *Jovites*, *Juvavites*, *Sirenites*, *Choristoceras*, *Cyrtopleurites* and other juvavic types in the upper triassic rocks of the Bambanag cliffs (Girthi valley). Below these beds with *Sibirites* a great mass of upper triassic rocks (*Daonella* beds of Griesbach) follows, characterised by the presence of *Sagenites*, *Cladiscites*, *Arcestes*, which has not yielded any species of *Sibirites*. Nor does *Sibirites* occur in the principal mass of the Muschelkalk or in the crinoid limestone, representing a homotaxial equivalent of the Alpine *Aonoides* beds in the Shalshal cliff. The period of its intermittence therefore comprises the entire upper Muschelkalk and the lower stages of the upper Trias. To what region *Sibirites* retired during this period of intermittence we do not know.

1. SIBIRITES PRAHLADA, nov. sp. Pl. VII., fig. 5.

Dimensions.	
Diameter of the shell	23 mm.
Height of the last whorl	9 „
Thickness „ „ „ „	10 „
Diameter of the umbilicus	9 „

This remarkable species is characterised by slowly increasing whorls, which overlap each other but very little, and by a broad rectangular transverse section.

[1] *C. L. Griesbach*, "Geology of the Central Himálayas" Mem. Geol. Surv. of India, XXIII., 1891. p. 71, 72.

The proportion of height to width of the latter is very similar in *Sibirites pretiosus* v. Mojsisovics (Arktische Trias-Faunen l. c. p. 61, Pl. X. fig. 10).

The affinities of *Sibirites Prahlada* to the Siberian species are strong, although considerable differences, especially owing to the richer ornamentation of the Indian form, separate them. The ventral area is broad, flattened, and includes an obtuse angle with the strongly curved lateral parts.

The rich, prominent sculpture consists of broad, straight lateral ribs, which reach to the upper third of the lateral parts, where they become divided by strongly developed lunular tubercles. These lunular tubercles (Pl. VII. fig. 5, e.) take the shape of small half-moon-like shields which slope gently from their concave side, whilst their convex part is bordered by steep walls. The bifurcating ribs become a little fainter near the lunular tubercles which mark the point of bifurcation, and pass over the siphonal margin, with a strong forward curve. They meet in a median line of the ventral area, forming the half of a circle with a radius of 3mm, its convexity being turned forward, whilst in *Sibirites pretiosus* and *Sibirites Eichwaldi* Keyserling (E. v. Mojsisovics l. c. Taf. X. fig. 1-9, p. 59), the ribs alternately meet at an acute angle in the middle of the siphonal area. Near the siphonal margin some of the bifurcate ribs become more prominent. In a more advanced stage of growth, these points may be distinguished by spines or tubercles as in the two Arctic forms of *Sibirites* before mentioned.

As the whorls overlap each other only to a very slight extent, the involution takes place far outside the lunular tubercles. The point of bifurcation of the lateral ribs is consequently not concealed by the outer whorl. There are 15 principal ribs on the last whorl and within the spiral line along which the lateral lunular tubercles are situated.

Sutures.—The very simple sutures point to the same stage of development as in the congeneric forms of the Arctic-Pacific province of the Trias. The siphonal lobe is placed nearly as deep as the principal lateral lobe and is simply divided by a short siphonal tubercle, without exhibiting any trace of denticulation. The principal lateral lobe, coinciding in its position with the lunular tubercles, appears slightly serrated under a magnifying glass. The siphonal saddle is distinguished by its considerable size. The second lateral saddle is very low and broad, and terminates near the umbilical suture. No auxiliary lobes.

In my specimen nearly two-thirds of the last whorl belong to the body-chamber.

Locality, number of specimens examined.—Zone of *Sibirites Prahlada*, Brachiopod-beds at the base of the Muschelkalk in the Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

Genus : ISCULITES, E. v. Mojsisovics.

In the Mediterranean triassic province the genus *Isculites* is only known from strata of upper triassic (carnic[1] and juvavic) age. Its occurrence in the Indian Mu-

[1] The terms Noric and Carnic have been used in this work in the sense attributed to them by Mojsisovics in the 2nd Volume of his work on the "Cephalopoden der Hallstaetter Kalke.

schelkalk is not beyond doubt. *Isculites Hauerinus*, Stoliczka, the only species of this genus from the Himálayan Trias, had been collected by Stoliczka near Lilang on the Lingti River in Spiti, but no satisfactory account is given of the exact horizon of the deposits in which these fossils were found. The only specimen under my observation, one of the two type-specimens of Stoliczka from the collection of the Geological Survey Museum in Calcutta, may, judging from the character of its matrix, as well belong to the Muschelkalk as to younger strata of upper-triassic age.

1. Isculites Hauerinus, Stoliczka. Pl. XXVII., fig. 3; Pl. XXXI, fig. 11.

1865. *Clydonites Hauerinus*, Stoliczka: Mem. Geol. Surv. of India Vol. V. Pt. I. Pl. IV. fig. 3, p. 50.
1886. *Isculites Hauerinus*, E. v. Mojsisovics: Arktische Trias-Faunen, Mem. de l'acad. impér. des sciences de St. Pétersbourg, VII. ser. T. XXXIII. Nr. 6, p. 154.
1893. *Isculites Hauerinus*, E. v. Mojsisovics: Die Cephalopoden der Hallstætter Kalke II. p. 69.

Dimensions.

Diameter of the shell	29 mm.
Height of the last whorl	13 „
Thickness „ „ „ „	16 „
Diameter of the umbilicus	7 „

According to E. v. Mojsisovics, *Isculites subdecrescens*, v. Mojsisovics, (Die Cephalopoden der Hallstætter Kalke, II., 1893, Pl. LXXXVII. fig. 5, 6, p. 68) is the nearest ally to this form among the congeneric species of the Mediterranean Trias, both as regards general shape and the egression of the umbilicus. The sub-globose shell, laterally somewhat compressed, possesses greatly overlapping whorls. The aperture is broader than high; its greatest thickness coincides with the umbilical margin. The egression of the umbilicus begins near the inner extremity of the last whorl and gradually increases towards its outer extremity. The thickness of the whorl, meanwhile, considerably decreases, so much so that in the figured specimen, as in *Isculites subdecrescens* the last whorl is thicker near its beginning than near its termination. The rounded siphonal area is provided with a slight median groove in the inner whorls, which disappears on the body-chamber.

The surface of the only specimen, which I had the opportunity of examining, is much weathered. The thin lines of growth mentioned by Stoliczka are only visible near the siphonal groove. This specimen—it is the same that has been figured by Stoliczka (Pl. IV. fig. 3)—shows two radial furrows in the volution preceding the last whorl, whilst Stoliczka mentions the existence of three contractions in the shell.

Sutures.—Stoliczka's figure of the lobe-line (Pl. IV, fig. 3 b.) is taken from a second specimen, which unfortunately is not among the material sent from Calcutta and handed over to me for examination. In his notes on *Isculites Hauerinus*, E. v. Mojsisovics expressed some doubts as to the correctness of Stoliczka's drawing (reproduced in this memoir, Pl. XXVII. fig. 3 c.). In order to clear up this question I tried to take off the body-chamber of the specimen

before me, and I succeeded in preparing the lobe-line of the last septum. A comparison of my figure (Pl. XXXI. fig 11 b.) with Stoliczka's drawing clearly shows that in the latter the sutures are not only represented in a reversed position, but that also their flat, wavy, non-serrated outlines, given in Stoliczka's figure, are totally incorrect. It was in all probability a much weathered septum, which served as the original for Stoliczka's illustration.

Isculites Hauerinus, differs from all its congeneric species of the Mediterranean Trias by the possession of two auxiliary lobes. The principal lobes are strongly serrated. The indentations affect the marginal walls of the saddles up to their rounded extremities. As in *Isculites subdecrescens* and *Isculites Heimi*, v. Mojsisovics (l. c. Pl. LXXXVII. fig. 13, p. 67), the siphonal saddle is only serrated on its slope, towards the principle lateral lobe, whilst its marginal wall nearest the siphonal lobe remains entire. The three principal lobes and saddles are of nearly equal height.

The present specimen is distinguished by a long body-chamber, measuring one and a half circuits in circumference.

Locality, number of specimens examined.—Lilang, on the Lingti River (Spiti), 1, Coll. Geological Survey Museum in Calcutta (Stoliczka's type-specimen).

B. AMMONEA LEIOSTRACA.

Family : *PINNACOCERATIDÆ.*

Sub-family : PTYCHITINÆ.

Genus : MEEKOCERAS, Hyatt.

The genus Meekoceras, already very common in the lower Trias of the Himálayas, reaches the culminating point of its development in the Muschelkalk. Most of the Himálayan forms are closely allied to Mediterranean species of the group of *Meekoceras Reuttense*, Beyrich, but exhibit partly a more highly developed, brachyphyllic serration of their lobe-line (*Meekoceras Khanikofi*, Oppel, *Meekoceras Kesava*). One of the Himálayan species is identical with *Meekoceras affine*, v. Mojsisovics, from the Arctic-Pacific region of the Trias.

Meekoceras Rudra and *Meekoceras Gangadhara* may be considered to be isolated forms. The latter is distinguished by a very long, serrated umbilical lobe, whilst *Meekoceras Rudra* shows an arch-shaped arrangement of its sutural elements.

None of the Indian species of this genus possesses less than two auxiliary lobes at least.

1. Meekoceras Khanikofi, Oppel, Pl. VIII., fig. 3; Pl. IX., fig. 1, 2, 3, 9.

1863. *Ammonites Khanikofi*, Oppel: Palæontologische Mittheilungen I, p. 275, Pl. 76, fig. 4.
1865. *Ammonites Khanikofi*, Stoliczka: Memoirs Geol. Surv. of India, Vol. V, Pt. I, p. 52.
1866. *Ammonites Khanikofi*, Beyrich: Abhand. kgl. Akad. d. Wiss. Berlin, 1866, p. 146.
1882. *Meekoceras Khanikofi*, E. v. Mojsisovics: Cephalopoden der Mediterranen Triasprovinz, p. 216.

	I. (Oppel's type-specimen.)	II. (Pl. VIII, f. 3.)	III. (Pl. IX, f. 1.)	IV. (Pl. IX, f. 2.)	V. (Pl. IX, f. 3.)
Dimensions.					
Diameter of the shell .	68 mm.	62	100	69	76
Height of the last whorl	37	36	52	35	41
Thickness „ „ „ „	21	20	27	22	21
Diameter of the umbilicus	7	9	14	9	9

My collection contains a rich material of this Ammonite, which, together with *Ptychites rugifer*, Oppel, may be considered to be the most important leading fossil of the Indian Muschelkalk. The examination of it proves, that the typical form (Oppel's type-specimen and Pl. VIII. fig. 3), is subject to slight variations in the shape of its transverse section, the width of the umbilicus and the details of the sculpture. But it is only right to add, that the different varieties are connected by so many intermediate gradations, that there is no reason to separate them into several specific forms.

The typical form possesses a flat, discoidal shell, in its outlines very similar to that of *Meekoceras Reuttense*, Beyrich; a narrow, sharply rounded siphonal part, and a rather high, perpendicular, umbilical wall, separated from the sides by a rounded umbilical margin. The lateral parts slope very gradually towards the siphonal area. The transverse section is widest across the middle of the sides.

The proportion of the height and width of the aperture is not constant. Whereas in the typical form of *Meekoceras Khanikofi* the aperture is a little lower than in *Meekoceras Reuttense*, the proportion is quite different in other specimens (Pl. IX. fig. 1, 3, 9). In adult individuals especially the aperture, as a rule, is very high, as in a later stage of growth, the height of the whorls increases proportionately more rapidly than their width. In the mean time the volutions, which show egression[1], leave the spiral line, as it is clearly seen in the specimen figured Pl. IX. fig. 1.

The flanks are covered by numerous delicate falciform folds, closely situated, especially at an early stage of growth. These folds are always, even in very young specimens, less strongly developed on the lower portion of the sides, where they completely disappear in adult individuals. In young specimens the folds describe strongly curved segments with their convexity turned backwards on the upper portion of the flanks. They usually reach almost as far as the siphonal edge. In some specimens they are rather broad, in others thin and narrow and slightly elevated either near the siphonal margin or in the middle portion of the sides.

The number of folds in one volution differs considerably. It is 18 in Oppel's type-specimen, whereas in others it ranges from 14 to 20. In adult specimens the number of folds decreases. In the specimen Pl. IX. fig. 1, f. i. the outer volution bears only 14 or 15 folds.

[1] See foot-note on page 14.

In specimens, in which part of the shell is preserved, the surface distinctly shows very numerous thin lines of growth in the direction of the falciform folds. They are especially well marked near the umbilical margin (compare Pl. IX, fig. 1.).

Sutures.—E. v. Mojsisovics mentions *Meekoceras Khanikofi* among the congeneric species distinguished by three lateral lobes, but the examination of a very rich material has convinced me, that it possesses only two lateral lobes. In a very few specimens only, the projection of the spiral of the preceding volution touches the inner portion of the second lateral saddle; in most of them it affects the apex, in some even the outer portion of the second lateral saddle. In one specimen even, the position of the projection of the spiral of the preceding whorl in relation to the sutural line is not constant. However in none of our specimens have more than two lateral lobes been observed. Four auxiliary lobes and three auxiliary saddles follow outside the umbilical suture.

The lobes are deeply serrated at their base. The siphonal lobe, distinguished by the presence of deep, clearly individualised fingers, is placed on a nearly equal level with the second lateral lobe. The siphonal saddle is considerably lower than the principal lateral saddle and of the same height as the second lateral saddle. The brachyphyllic indentation of the suture likewise affects the arches of the elongated, proportionately narrow saddles. In some specimens there is a marked tendency to individualise the upper portion of the saddles, which is distinctly separated from the narrow lower portion by some deeper incisions, surrounded by finger-like processes. This tendency, which likewise occurs in some of the Alpine *Meekoceratidæ* as in *Meekoceras maturum*, v. Mojs. (l. c. Pl. L. fig. 3. p. 219), especially affects the siphonal and second lateral saddles (compare Pl. IX, fig. 3 b.) In a later stage of growth the brachyphyllic character of the sutures extends to the apices of the auxiliary saddles.

In some specimens I was able to observe the presence of a deep internal lobe.

In the specimen, figured Pl. IX. fig. 1, one of the largest in my collection, nearly one half of the last whorl belongs to the body-chamber.

Variety.—The specimen, figured Pl. IX. fig. 2, distinguished by its elliptical shape and the occurrence of lateral tubercles in the middle portion of the sides near the beginning of the outer strongly developed part of the falciform folds, I consider provisionally as a variety. In this specimen from the Schlagintweit collection, the lateral tubercles first appear, the anterior end of the last whorl reaching the height of 34mm. In none of the other specimens did I observe distinctly marked lateral tubercles, although in some of them slight elevations in the middle portion of the flanks may be noticed.

Locality, number of specimens examined.—Kuling, Spiti, 4, Coll. Schlagintweit (from the Palæontological State-Museum in Munich); 1, Coll. Geological Survey Museum in Calcutta; Muth, Spiti, 2, Coll. Geological Survey Museum in Calcutta; 1, Coll. Griesbach; Shangra (E. of Puling), Hundés. 2, Coll. Schlagintweit from the Palæontological Museum in Munich (among them Oppel's type-

specimen); Rimkin Paiar, E. G., 11, Coll. Diener; Tsang-Tsok-La, Hop Gádh, Hundés, 1, Coll. Griesbach; Bambanag cliffs (Girthi Valley), Johár, 2, Coll. Diener.

Remarks,—The close relations, which exist between this species and *Meekoceras Reuttense*, Beyrich (Cephalopoden der Mediterranen Trias-provinz, Pl. IX. fig. 1, 2, 3, p. 215) have been clearly pointed out by E. v. Mojsisovics. There is indeed a great resemblance in general shape, involution and sculpture, although in the Indian form the number of folds on one circuit is usually a little greater. A more considerable difference consists in the arrangement of the sutures. *Meekoceras Reuttense* possesses three lateral lobes and only one auxiliary lobe outside the umbilical suture, which divides a bipartite auxiliary saddle. It also differs by its broader, less deeply serrated saddles.

2. Meekoceras Kesava, nov. sp. Pl. VIII. fig. 6.

Dimensions.

Diameter of the shell	51 mm.
Height of the last whorl	28 „
Thickness „ „ „ „	16 „
Diameter of the umbilicus	6 „

This form is very closely allied to *Meekoceras Khanikofi*, Oppel, but differs therefrom principally by its more slowly increasing whorls and a very narrow, deep umbilicus. A high perpendicular wall separates the latter from a sharply marked umbilical edge. The last volutions overlap so much, that the whole of the inner whorls are covered. No disjunction of the spiral line occurs. From the umbilical edge the flanks slope gradually in a very flat curve to the highly rounded siphonal part. The greatest thickness of the transverse section coincides with the lower portion of the sides.

The sculpture consists of numerous, very delicate falciform folds, which are but slightly curved and occur to the number of 20 in the last volution.

Sutures.—The arrangement of the lobe-line is similar to that in *Meekoceras Khanikofi*, but distinguished by a somewhat more highly developed brachyphyllic serration of the sutural elements. The tops of the high, elongated saddles are individualised by deep fingers which intersect the marginal walls and are strongly serrated. There are two lateral lobes as in *Meekoceras Khanikofi*. Two auxiliary lobes and as many saddles are situated outside the umbilical margin. It may therefore be assumed that yet another auxiliary lobe and saddle may be present between the umbilical margin and the umbilical suture.

Besides these, a very deep internal lobe has been observed in this specimen. The internal lobes of the different septa embrace each other in a funnel-shaped manner, as in a form of the *M. Hedenstroemi*-group, described by E. v. Mojsisovics.[1]

The present specimen is entirely chambered.

Locality, number of specimens examined:—Shalshal cliff, near Rimkin Paiar encamping ground; 1, Coll. Diener.

[1] Ueber einige arktische Trias Ammoniten des nördlichen Sibirien, Mém. de l'académie imp. des sciences de St. Pétersbourg, VII. sér. T. XXXVI. Nr. 5, 1888, p. 10.

3. MEEKOCERAS PROXIMUM, Oppel Pl. VIII., fig. 2.

1865. *Ammonites proximus*, Oppel: Palœontologische Mittheilungen I. Pl. 83, fig. 1, p. 291.
1882. *Meekoceras proximum*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, p. 216.

Dimensions.

Diameter of the shell	51 mm.
Height of the last whorl	30 „
Thickness „ „ „ „	12 „
Diameter of the umbilicus	5 „

This species, of which only one single specimen (Oppel's) is at present known was fully described by Oppel and E. v. Mojsisovics. As I do not possess any new material for comparison, I may confine myself to repeating the diagnosis given by these eminent authors.

Concerning the general shape *Meekoceras proximum* differs from *Meekoceras Khanikofi* by its very high and peculiar transverse section. From the rather less steeply rounded siphonal part the flanks run almost parallel as far as the middle portion of the sides, but diverge here with a flat convexity, so much so, that the upper portion of the aperture appears to be considerably narrower than the lower part. The egression is more strongly marked than in *Meekoceras Khanikofi*, the umbilical suture leaving the spiral at a much earlier stage of growth. At the same time the steepness of the umbilical wall, sloping almost perpendicularly in the inner volutions, gradually diminishes as has been pointed out by Oppel. The sharply marked umbilical margin, however, remains unchanged and does not become rounded.

As in *Meekoceras Khanikofi*, the flanks are covered by falciform folds, marked distinctly only in the upper portion of the sides. These folds, to the number of 20 in the outer volution, increase in size proportionately to the stage of growth and in the middle portion of the sides develop into strong lateral tubercles; the last whorl reaching a height of 30mm. This sort of sculpture exactly recalls the sculpture of the specimen, figured pl. IX. fig. 2, which I consider to be a variety of the typical *Meekoceras Khanikofi*.

Sutures.—At a very early stage of growth the sutures are absolutely similar to those of *Meekoceras Khanikofi*. The lobes are deeply incised, the saddles narrow and elongated, with brachyphyllic margins, and serrated up to their very tops, which alone remain entire. At a more advanced stage our specimen, which is totally chambered, exhibits some remarkable differences. The anterior end of the last whorl reaches a height of 20mm., the saddles diminish in length but broaden considerably in other dimensions. Near the termination of the last whorl, the auxiliary saddles especially are much broader than high, no further progress in their serration being visible. There are only two lateral lobes, as in *Meekoceras Khanikofi*; the vertical projection of the spiral of the foregoing volution touches the inner portion of the second lateral saddle. The last whorl having reached the height of 30mm, the sutural line consists of four auxiliary lobes and three auxiliary saddles, besides the principal lobes and saddles. In the adult stage a fourth auxiliary saddle seems to appear.

The remarkably strong deposit of organic material near the tops of the saddles has already been observed by E. v. Mojsisovics when describing our specimen.

Locality, number of specimens examined.—Shangra (E. of Poling), Hundes, 1, Coll. Schlagintweit in the Palæontological Museum in Munich (Oppel's type-specimen).

4. Meekoceras Nalikanta, nov. sp. Pl. IX., fig. 5, 6, 7.

Dimensions.	I. (Pl. IX, fig 5.)	II. (Pl. IX, fig. 6.)	III. (Pl. IX, fig. 7.)
Diameter of the shell . .	36 mm.	39 mm.	40 mm.
Height of the last whorl .	17 „	20 „	20 „
Thickness „ „ „ „ .	9 „	10 „	11 „
Diameter of the umbilicus .	9 7	7 „	8 „

Meekoceras Nalikanta is a small form, distinguished by a rather large umbilicus. In an early stage of growth, the whorls increase but slowly in height, but in later stages, however, the height of the last whorl increases more rapidly. In the specimen figured Pl. IX. fig. 5, f. i. the height of the aperture increases from 7 to 17mm. in the outer volution, of which more than one-third belongs to the body-chamber. As the thickness of the transverse section increases much more slowly, this form becomes very compressed in adult specimens, whereas in adolescent ones it is somewhat inflated. In the specimen figured Pl. IX. fig. 5, a thickness of 4mm. corresponds to a height of the last whorl of 4mm., 8mm. to a height of 10mm., 9mm. to a height of 17mm. Consequently a large full-grown specimen looks very different from the inner volutions.

The involution is rather small, the inner whorls overlapping each other only to the extent of two-thirds of their height.

The siphonal side is tolerably broad and rounded. The sides slope towards it in a very flat curve. The distance between them is greatest in the lower portion near the rounded umbilical edge. It is only in the body-chamber that the latter is well defined, and separated from the umbilical suture by a low umbilical wall. In the inner volutions the sides slope towards the umbilicus with a gradually increasing convexity, which is not interrupted by a clearly marked umbilical margin. So long as the aperture does not exceed 4mm. in height, the transverse section of the inner whorls is of an almost circular outline.

The surface of the sides is marked by *S*-shaped folds, of which there are about 20 in one circuit. At an early stage of growth, these folds are only visible on the lower portion of the sides, where they appear as slight convexities, which are turned forward. It is only in the body-chamber, that the folds also appear on the outer half of the sides, where their convexity is bent backwards rather more decidedly. Single and dichotomous folds are somewhat irregularly disposed. Frequently a faint one is intercalated between two stronger folds. Most of them increase in size, when approaching the siphonal margin, although not to any great extent.

Sutures.—The existence of only two lateral lobes may be concluded with certainty from the vertical projection of the periphery of the preceding volution to the septa of the last whorl near their lower parts. The lobes are provided with deep indentations, which affect the marginal walls of the narrow, elongated saddles up to the lower half of their height. The upper portion of the saddles remains entire. The position of the siphonal saddle is quite near the siphonal margin. The siphonal lobe does not reach half as high as the principal lateral lobe, which is situated very low. The deeply intersected, first auxiliary lobe, is followed by a bipartite auxiliary saddle, and a long umbilical lobe, consisting of different indentations, which in the last septa of the volution preceding the body-chamber divides into two distinct auxiliary lobes and saddles. The innermost of these auxiliary saddles is divided by the umbilical suture.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 2, Coll. Diener; Bambanag cliffs (Girthi valley), Johár 1, Coll. Diener.

5. Meekoceras Srikanta nov. sp. Pl. VIII, fig. 8, 9.

Dimensions.	I. (Pl. VIII, fig. 8.)	II. (Pl. VIII, fig. 9.)
Diameter of the shell	47 mm.	35 mm.
Height of the last whorl	26 „	19 „
Thickness „ „ „ „	14 „	10 „
Diameter of the umbilicus	6 „	5 „

This form bears a close resemblance to *Meekoceras Nalikanta*, from which it differs by greater involution, a more steeply rounded siphonal part, and folds which are almost radially arranged. The latter are only well developed on the middle portion of the sides, and are almost straight, but near the siphonal margin they describe a slightly falciform curve. In one of the specimens (Pl. VIII, fig. 8) 18 folds may be counted in the last volution, but no distinct bifurcations have been observed.

In the specimen fig. 9 nearly one half of the last whorl belongs to the body-chamber.

Sutures.—The sutural line is similar to that of *Meekoceras Nalikanta*. The saddles, however, are much broader and the principal lateral, compared to the siphonal lobe, is less deeply situated. There are two lateral and two auxiliary lobes. The second auxiliary lobe is divided by the umbilical suture.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar encamping ground, 2, Coll. Diener; Bambanag cliffs (Girthi valley), Johár, 1, Coll. Diener.

6. Meekoceras Narada, nov. sp. Pl. VIII, fig. 7.

Dimensions	
Diameter of the shell	51 mm.
Height of the last whorl	26 „
Thickness „ „ „ „	12 „
Diameter of the umbilicus	7 „

Like the foregoing, this species is very closely allied to *Meekoceras Nalikanta*, but differs therefrom by more slowly increasing volutions and a narrower, deeply sunk umbilicus. The only specimen of this form in my collection possesses an obliquely elliptical shape. As I have not more material at hand for comparison, I am unable to decide whether this is to be considered to be a constant specific feature, as seen in some species of the genus *Gymnites*, or as an accidental deformity. The latter does not seem probable to me, as all the other specimens, namely of *Meek. Khanikofi*, *Meek. Nalikanta* and *Meek. Srikanta*, were collected together with the individual in question and do not exhibit any trace of a similar deformity. In fact the fossils from the Muschelkalk of the Bambanag cliffs, where this specimen was found, are, as a rule, broken, but never deformed.

The sides are almost flat, and are separated from the umbilical suture by a perpendicular wall, which increases rapidly in the outer volution, and by a very sharp umbilical margin. The siphonal part is steeply rounded.

The sculpture consists of rather strong, broad folds, of which there are 20 in the last whorl. The folds are flexuous and describe an S-shaped curve, similar to those in *Meekoceras Nalikanta*. They are best developed near the middle part of the sides, and broaden out considerably in the body-chamber.

The shell is only partially preserved, but shows numerous thin radial striations which conform to the same direction as the folds.

In this specimen more than half of the outer volution forms part of the body-chamber.

Sutures.—Similar to those of *Meek. Nalikanta*, but they differ by a deeper position of the siphonal lobe, and slightly incised tops of the principal saddles. Three distinctly individualised, auxiliary lobes and an equal number of auxiliary saddles outside the umbilical suture. The second auxiliary lobe terminates in a single point and stands on a lower line than the first. The auxiliary saddles are quite entire.

Locality, number of specimens examined.—Bambanag cliffs, Girthi valley (Johár), 1, Coll. Diener.

7. MEEKOCERAS AFFINE, E. v. Mojsisovics. Pl. VIII, fig. 4, 5.

1886. *Meekoceras affine.*—E. v. Mojsisovics: Arktische Triasfaunen. Mém. de l'académie impér. des sciences de St. Pétersbourg sér. VII, T. XXXIII, No. 1, Pl. XI, fig. 17, p. 86.

Dimensions.	I. (Pl. VIII, fig. 4.)	II. (Pl. VIII, fig. 5.)
Diameter of the shell	31 mm.	24 mm.
Height of the last whorl . . .	16 „	13·5 „
Thickness „ „ „ „ . . .	8·5 „	7 „
Diameter of the umbilicus . . .	4 „	3·5 „

Both these specimens agree perfectly with *Meekoceras affine* from the Siberian Muschelkalk in shape, involution, sculpture and sutures.

The flat, discoidal shell is distinguished by its high aperture and narrow umbilicus. The sides are almost flat and pass gradually, but with quickly increasing convexity into the well-rounded siphonal part. The well-marked umbilical edge is separated from the umbilical suture by a perpendicular wall. In the larger of the two figured specimens, the umbilical edge becomes sharpened near the anterior termination of the last whorl, whilst it is obtuse in its posterior portion and in the inner volutions.

The sculpture consists of numerous, slightly curved, delicate folds, which broaden near the siphonal part, but become obsolete before they reach the siphonal margin. The surface of the folds is covered by very delicate striæ which run in the same direction. This striation is most distinctly seen in the preserved shell of the larger specimen (Pl. VIII, fig. 4), but is also visible in the cast.

In the larger specimen more than half, in the smaller one third, of the last volution belong to the body-chamber.

Sutures.—As has been pointed out by E. v. Mojsisovics, the lobe-line of *Meekoceras affine* is almost identical with that of *Hungarites triformis*, E. v. Mojsisovics, with the exception of the somewhat more minute incision of the auxiliary lobe and of the second lateral lobe. Our specimens agree perfectly with the description and figure of the sutures of *Hungarites triformis*, given by E. v. Mojsisovics (l. c. p. 88, Pl. XI. fig. 16). The deep siphonal lobe ends in three points and is situated very little higher than the principal lateral lobe. The latter is more deeply incised, and provided with seven points at its base. The second lateral lobe and the two auxiliary lobes are so faintly incised, that their serration is sometimes only visible by means of a magnifying glass. The second auxiliary lobe coincides with the umbilical margin. The saddles are rather elongated and lined by parallel marginal walls, their tops only being rounded into well-curved arches.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar encamping ground; 2, Coll. Diener.

8. Meekoceras Nanda, nov. sp. Pl. IX., fig. 8.

Dimensions.

Diameter of the shell	26·5 mm.
Height of the last whorl	14 „
Thickness „ „ „ „	8 „
Diameter of the umbilicus	5 „

This is the most graceful form among the Indian species of the genus *Meekoceras*. Its shell is rather less compressed that in *Meekoceras affine*, v. Mojs., from which it is further distinguished by slower increasing whorls, a greater width of the aperture, and a lesser involution. The siphonal part is narrow, well rounded, and sharply separated from the sides. Near the siphonal margin the latter are almost parallel to each other, as in *Meekoceras proximum*, Oppel, and only diverge near the middle portion of the shell, where they are slightly tumid. An obtuse

umbilical edge separates the flanks from a low but steep umbilical wall. The aperture reaches a height of 12 mm. and the umbilical suture shows considerable egression. This species differs from *Meekoceras affine* inasmuch as it shows a strongly marked tendency to disjunction of the spiral, in which respect it bears a close resemblance to *Meekoceras proximum*.

The sides exhibit a style of sculpture, which differs from that of any other Indian *Meekoceras*. They are covered with numerous rather strong folds or ribs which run in a straight, forward-directed line as far as the middle portion of the sides, and in the upper portion describe a falciform curve with its convexity turned backward. In the last volution about 25 ribs may be counted. Some of them bifurcate in the middle part of the sides, before becoming falciform, or may be said to divide into a stronger, principal rib and into a more faintly marked, secondary fold. The ribs reach their highest development near the point, where they change from a straight direction into a falciform curve. Here they swell out into elongated lateral tubercles or rather long drawn-out prominences, when the whorls have reached a height of 12 mm. The falciform portion of the ribs is, as a rule, less strongly developed than their lower, straight part. The ribs extend to the siphonal margin.

In the present specimen more than two-thirds of the outer volution belong to the body-chamber.

Sutures.—The sutural line is almost exactly identical with that of *Meekoceras affine*, v. Mojs., and *Hungarites triformis*, E. v. Mojs.*

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar encamping ground; 1 Coll. Diener.

ISOLATED FORMS.

9. Meekoceras Gangadhara, nov. sp. Pl. IX., fig. 4.

Dimensions.

Diameter of the shell	80 mm.
Height of the last whorl	42 „
Thickness „ „ „	19 „
Diameter of the umbilicus	8 „

The whorls increase so very slowly that they produce a small umbilicus, surrounded by a high, perpendicular umbilical wall. In the inner volutions the umbilical margin forms a sharp edge, whereas in the last volution it is somewhat rounded, and passes more gradually into the sides which are almost flat but curve gently towards the well-rounded siphonal part. The umbilical suture shows but very little egression when the whorls have reached a height of 45 mm.

In an early stage of growth the sculpture consists of flat, broad, falciform folds, of which 15 occur in one volution. In later stages—the whorl having reached a height of 30 mm—these folds bear delicate lateral prominences near the middle portion of the sides.

* *E. v. Mojsisovics*, Arktische Triasfaunen, l. c. p. 88, Pl. XI, fig. 16.

The extremely thin shell, which is but partially preserved in one of my specimens, is covered with numerous radial lines of growth which run in the same direction as the falciform folds.

Sutures.—In the figured specimen the existence of three lateral lobes has been proved with certainty from the vertical projection of the periphery of the last whorl but one, to the septa near the posterior termination of the body-chamber. The lobes are deeply incised. The elongated, narrow saddles are indented up to their very tops and possess brachyphyllic margins. The broad siphonal lobe is divided by a high siphonal tubercle. The third lateral lobe is followed by two auxiliary lobes, an equal number of saddles and a long, very remarkable umbilical lobe, the numerous denticulations of which slope obliquely towards the umbilical suture. It resembles closely the similar position of the auxiliary lobes in many species of the Triassic genera *Gymnites* and *Pinnacoceras*.

In our specimen more than two-thirds of the outer volution form part of the body-chamber.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar encamping ground; 2 Coll. Diener.

10. Meekoceras Rudra, nov. sp. Pl. X., fig. 1.

This species is represented by a rather fragmentary cast only, which does not permit of exact measurement.

In shape and sculpture it appears to be most closely allied to *Meekoceras Gangadhara*. The whorls increase very slowly, and apparently show little or no egression. The umbilicus is deep and surrounded by a steep umbilical wall. The transverse section seems to increase more rapidly in thickness than in *Meekoceras Gangadhara*. The siphonal part is narrow and steeply rounded.

As far as the weathered surface shows, the sides exhibit very indistinct, falciform folds, somewhat widely separated and confined to the outer portion of the sides. The surface of the body-chamber, to which one half of the last whorl belongs, bears well developed lateral tubercles near the middle portion of the sides.

Sutures.—The sutural line is characterised by a very peculiar, circular arrangement of its elements, which result in a low position of the siphonal lobe and in a bent direction of the auxiliary lobes. As the vertical projection of the spiral of the preceding whorl passes near the inner margin of the second lateral saddle of the next volution without touching it, our species must be placed among the forms with three lateral lobes. The extremely deep siphonal lobe is situated but very little higher than the principal lateral, and considerably lower than the second lateral lobe. The very low siphonal saddle is only half as high as the principal lateral one. The principal and second lateral saddles are of equal height, whereas the three lateral lobes are arranged in a semi-circular form. Three auxiliary lobes and an equal number of auxiliary saddles are outside the umbilical suture. The lobes are provided with long, finger-like indentations at their base, which affect likewise the marginal walls of the saddles. The tops of the latter seem to be but minutely incised.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar encamping ground; 1 Coll. Diener.

Genus: GYMNITES, E. v. Mojsisovics.

This genus is represented in the Muschelkalk of the Indian Triassic province by a considerable number of forms, which are more or less closely allied to Mediterranean types. Most of them have their nearest relations in the Alpine species of *Gymnites Humboldti* v. Mojs., *Gymnites incultus* Beyrich, and *Gymnites obliquus* v. Mojs.—*Gymnites acutus* v. Hauer from the Upper Muschelkalk of Han Bulog in Bosnia, apparently isolated up to now in the Mediterranean Trias, seems to be closely allied to the Himálayan *Gymnites Lamarki* Oppel. A very interesting group, entirely peculiar to the Indian Trias, which may perhaps justly claim a sub-generic rank, is constituted by *Gymnites* (*Buddhaites*) *Rama*, which in shape bears a remarkable resemblance to the Alpine genus *Carnites*.

1. GYMNITES JOLLYANUS, Oppel. Pl. X., fig. 7.; Pl. XI., fig. 1.; Pl. XII., fig. 1.

1863. *Ammonites Jollyanus*, Oppel: Paläontologische Mittheilgn. I. Pl. 75, fig. 4, p. 271.
1865. *Ammonites Jollyanus*, Stoliczka: Memoirs Geol. Surv. of India, Vol. V, Pt. I, p. 51.
1882. *Gymnites Jollyanus*, E. v. Mojsisovics: Cephalopoden der Mediterranen Triasprovinz, p. 235.

Dimensions.	(Pl. X, fig. 7.)
Diameter of the shell	84 mm.
Height of the last whorl	39 „
Thickness „ „ „	14 „
Diameter of the umbilicus	21 „

As has been pointed out by E. v. Mojsisovics, among the congeneric forms of the European Muschelkalk, *Gymnites Humboldti* v. Mojsisovics[1] is the nearest ally to this remarkable species. Like *Gymnites Humboldti* the latter has narrow compressed, high, and rather involute whorls. The anterior end of the last whorl, however, is still considerably higher in *Gymnites Jollyanus*.

The sides are very flat and slope gently towards the umbilical suture, without forming an umbilical edge. The siphonal part is narrow and well rounded. The volutions increase but slowly and overlap each other to two-thirds of their height. The umbilical area is shallow and wide. The greatest thickness of the volutions coincides with the middle portion of the sides.

Adult specimens of this form attain very large dimensions. A totally chambered fragment from Rimkin Paiar, comprising one-half of a volution, corresponds with a diameter of 230 mm. and, including the body-chamber, the diameter of this individual cannot have been much less than 40 cm.

When the whorls of this species have reached a height of 20 mm., radial ribs begin to appear on the lower part of the sides. They are slightly bent backwards and are stronger developed near the middle part of the sides, where they form flat pro-

[1] l. c. Pl. LV, fig. 1—3, p. 235.

minences, interrupted by deep, rounded intervals. Sometimes they are so much shortened, that they appear only along a spiral line which divides the sides in the middle, formed by a chain of long drawn-out tubercles. When the whorls exceed 90 mm. in height, these spiral tubercles gradually become obsolete, but their upper end, formerly marked by a spiral line is still present, and forms a continuous ridge.

The body-chamber is wanting in all my specimens.

Sutures.—In the lobe-line of adult specimens an extraordinarily rich ramification of all sutural elements predominates. The vertical projection of the spiral line of the preceding volution meets the second lateral saddle close to the centre line of the latter, but inside of it. The siphonal lobe is somewhat shorter than the principal lateral lobe and is divided by a low and narrow siphonal tubercle. The siphonal saddle is lower than the principal lateral saddle and is situated at the same level as the second lateral saddle. It is characterised by the development of a broad, secondary, outer branch, which in itself is likewise richly ramified. The specimen figured Pl. X. fig. 7 has three auxiliary lobes and an equal number of auxiliary saddles. In larger specimens the number of auxiliary lobes amounts to four. The auxiliary saddles are bipartite.

Locality, number of specimens examined.—Kuling, Spiti, 2 Coll. Schlagintweit from the Palæontological Museum in Munich (among them Oppel's type-specimens); Muth, Spiti, 2, Coll. Stoliczka, from the Geological Museum in Calcutta; Shalshal cliff near Rimkin Paiar encamping ground, 5, Coll. Diener.

Remarks.—*Ammonites plano discus*, figured by Salter (Palæontology of Niti, Pl. 8, fig. 5, 6), which Stoliczka (l. c. p. 52) considers to be a young specimen of *Gymnites Jollyanus*, does probably belong to *Xenodiscus* or *Ophiceras*.

2. GYMNITES VASANTASENA, nov. sp. Pl. XIII., fig. 2.

Dimensions.	
Diameter of the shell	79 mm.
Height of the last whorl	29 „
Thickness „ „ „	14 „
Diameter of the umbilicus	20 „

In its general shape and involution, this species, which is represented in my collection by a medium-sized entirely chambered specimen, is as closely allied to *Gymnites incultus* Beyrich[1] as *G. Jollyanus*, Oppel is to *G. Humboldti* v. Mojs. It differs therefrom, however, by its slowly increasing volutions overlapping each other only to the extent of one-third of their height. The siphonal part is more steeply rounded and its transverse section rather cardiform; the greatest width of this whorl coincides with the lower third of the sides. The umbilical margin is rounded, and the low umbilical wall is less steeply inclined than in *G. incultus*.

The surface of the inner volutions is perfectly smooth. In the outer whorl radial ribs appear on the sides, when the whorl reaches a height of 18 mm. They are only

[1] E. von Mojsisovics, Cephalopoden der Mediterranen Triasprovinz, p. 233, Pl. LIV, fig. 1—3.

visible on the lower portion of the sides and are most distinctly marked near the umbilical margin.

Sutures.—Similar to those of *Gymnites Jollyanus*, from which, however, they differ in some details. The shape of the principal lateral lobe furnishes a good characteristic of our species, as it divides near its base into two branches, which proceed from each side of the stem and terminate in long foliated portions, whereas the second lateral saddle terminates in one long branch with two equal branches on each side. Compared with the principal lateral lobe the second lateral lobe is situated considerably higher than in *G. Jollyanus*. The auxiliary lobes, also, are arranged along a more oblique line than in the latter species. Five auxiliary lobes in the last septa.

The vertical projection of the periphery of the preceding whorl touches the second lateral saddle in the next volution.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground; 1 Coll. Diener.

3. Gymnites Kibata, nov. sp. Pl. X., fig. 2, 3.

1865(?). *Ammonites Batteni*, Strachey: Palæontology of Niti, Pl. XI., fig. 2. (Provisional name without description of the fossil).

1865. *Ammonites Batteni*, Stoliczka, *ex parte*: Mem. Geol. Surv. of India, Vol. V., Pt. I., Pl. V., fig. 2., p. 59.

1867(?). *Ammonites Salteri*, Beyrich, *ex parte*: Ueber einige Cephalopoden aus dem Muschelkalk der Alpen, etc., Abhandlgn. Köngl. Akad. d. Wissensch. Berlin, 1866. p. 134.

1882. *Gymnites nov. sp. ex. aff. G. Palmai*, E. v. Mojsisovics: Cephalopoden der Mediterranen Triasprovinz, p. 235.

Dimensions.	I. (Pl. X., fig. 2.)	II. (Pl. X., fig. 3).
Greatest diameter of the shell	68 mm.	21 mm.
„ height of the last whorl	18·5 „	7·5 „
„ thickness of the last whorl	14 „	5 „
„ diameter of the umbilicus	40 „	9 „
Least height of the last whorl	16 „	5·5 „
„ thickness of the last whorl	11 „	4 „
Corresponding diameter of the shell	57 „	16 „
„ „ of the umbilicus	32 „	6·5 „

Strachey assigned the name *Ammonites Batteni* to a fragment, figured in the Palæontology of Niti (Pl., XI. fig. 2), which Blanford placed erroneously among the Jurassic Cephalopoda of the Spiti-Shales, without mentioning it in the text of his work. Later on Stoliczka retained Strachey's provisional name for a species of *Gymnites* from the Muschelkalk of Spiti on the strength of Blanford's authority, who believed that it agreed well with Strachey's fragment, which Blanford himself had found much too imperfect, and had therefore omitted noticing it in his descriptions. However it had already been mentioned by Beyrich, that Stoliczka had united two very different forms under the name of *Ammonites Batteni*,—one of which Beyrich considered to be identical with *Ammonites incultus* from the Alpine Muschelkalk. E. v. Mojsisovics is of opinion that Stoliczka's variety of the *Ammonites Batteni*

with narrow and thick whorls (Pl. V., fig. 2) bears a closer relationship to *Gymnites Palmai*, E. v. Mojsisovics, whereas the second variety with high and compressed whorls (Pl. VI., fig. 1), is more closely allied to the European *Gymnites obliquus*, v. Mojs.

An examination of the material sent to Vienna from Calcutta has convinced me that even a third form had been identified by Stoliczka with *Ammonites Batteni*, a form which differs from the two above-mentioned species by possessing radial ribs on the lower portion of the sides. In consequence of the very imperfect state and figure of the fragment, which was provisionally named *Ammonites Batteni*, it is absolutely impossible to decide with which of the three species united by Stoliczka it may actually be identical. It only remains to introduce entirely new names for the latter, and to restrict the name of *Ammonites Batteni* to the fragment figured in the "Palæontology of Niti."

I give the name of *Gymnites Kirata* to Stoliczka's so-called variety of *Ammonites Batteni*, with narrow but thick whorls, which according to E. v. Mojsisovics has its nearest ally among the forms of the Alpine Muschelkalk, in *Gymnites Palmai*, v. Mojsisovics.[1]

Both these species agree in the outline of their transverse section. The whorls, however, increase much more slowly in the Indian form, and are more evolute, overlapping each other only to the extent of one quarter their height. The outline of this species is elliptical, as in *Gymnites obliquus*, v. Mojs.

Stoliczka has already laid some stress on the fact, that the elliptical shape common to all his specimens of *Gymnites Batteni* could not be an accidental deformity, as it was observed in specimens coming from three different localities. E. v. Mojsisovics likewise considers the oblique, elliptical shape not accidental, but characteristic of the species, as the specimens of the elliptically shaped *Gymnites obliquus* examined by him were imbedded in a matrix, in which the outlines of all the other fossils found with this species were perfectly normal. The same reasoning applies to the occurrence of the three elliptical species which were included in Stoliczka's *Ammonites Batteni*. In the Muschelkalk of the Bambanag cliffs (Girthi valley) I found an elliptically shaped specimen of *Gymnites Sankara* (the high compressed variety of Stoliczka's *Ammonites Batteni*), imbedded together with some specimens of *Meekoceras Khanikofi* and *Meekoceras Nalikanta*, which did not exhibit the least trace of deformity through pressure. It is equally remarkable that even very young forms, as for instance the specimens figured Pl. X, fig. 3, show the same elliptical outlines.

The oblique elliptical shape of the shell is the consequence of periodical deviations in the growth of the volutions, occurring always in the same parts of the different circuits. E. v. Mojsisovics tries to explain it, by assuming that in these species periods of an accelerated growth regularly alternate with periods of retardation.

The siphonal part is moderately convex. The sides slope in a gently

[1] Die Cephalopoden der Mediterranen Triasprovinz, p. 234, Taf. LVII, fig. 1, 2, Taf LVIII.

rounded curve towards the very wide and shallow umbilical area. They are still perfectly smooth; the whorl reaches a height of 18 mm.

In neither of the specimens is the body-chamber preserved.

Sutures.—The sutural line is less richly ramified than in *Gymnites Jollyanus*. The very narrow pointed siphonal lobe is divided by a remarkably high siphonal tubercle. In the siphonal saddle the development of an outer secondary branch is but faintly marked. Four very steeply inclined auxiliary lobes outside the umbilical suture. The vertical projection of the outline of the preceding volution meets the inner margin of the deeply incised second lateral saddle in the succeeding whorl.

Locality, number of specimens examined.—Lilang, Spiti, 2 Coll. Stoliczka, from the Geological Museum in Calcutta.

4. GYMNITES SALTERI, Beyrich, Pl. XII., fig. 3.

1867. *Ammonites Salteri*, Beyrich: Ueber Einige Cephalopoden aus dem Muschelkalk der Alpen, Abhandlgn Königl. Akademie der Wissensch. Berlin 1866, Taf. III, fig. 2, p. 134.

A fragment in the collection of the missionary Prochnow was described by Beyrich under this name. It consists of two chambers and belongs to a species of *Gymnites* with rather high whorls. The shape of the transverse section recalls *Gymnites Kirata*. To a height of the whorl of 22 mm corresponds a width of 11 mm. On the lower portion of the sides indistinct traces of ribs are visible.

The lobe-line, which is but partially preserved, recalls *Gymnites Kirata*. The siphonal lobe is divided by a high siphonal tubercle. The siphonal saddle is provided with an outer secondary branch, which is less strongly individualised than in *Gymnites Jollyanus* or in *Gymnites Sankara*.

With this species Beyrich also identified the fragment, which was figured by Salter in his "Palæontology of Niti" (Pl. VI. fig. 3) and was erroneously compared by this author with *Ammonites neojurensis*, Quenst. or with *A. debilis*, v. Hauer. The sutures, however, do not sufficiently agree to justify this identification, as the lobe-line in Salter's fragment, if correctly represented in the figure, is distinguished by a remarkably large siphonal saddle without any outer secondary branch.

A more thorough comparison with *Gymnites Kirata*, a very close ally of this form, will only be possible on the ground of a richer and better preserved material. Nor can the question be decided whether *Gymnites Salteri* may be allowed to remain as a separate species.

Locality, number of examined specimens.—Ladakh (exact locality not known), 1 Coll. Prochnow, from the Museum für Naturkunde in Berlin.

5. GYMNITES SANKARA, nov. sp , Pl. XI., fig. 2.

1865.(?) *Ammonites sp. ind.* Salter : Palæontology of Niti, Pl. VI, fig. 3. p. 64.
1865.(?) *Ammonites Batteni*, Strachey : ibid. Pl. XI, fig. 2 (provisional name without description).
1865. *Ammonites Batteni*, Stoliczka, *ex parte* : Mem. Geol. Surv. of India, Vol. V, Pt. I, Pl. V, fig. 3 ; Pl. VI, fig. 1, p. 59.
1866. *Ammonites incultus*, Beyrich, *ex parte* : Ueber einige Cephalopoden aus dem Muschelkalk der Alpen etc., Abhandlgn. Königl. Akad. d. Wissensch. Berlin, 1866, p. 133.
1882. *Gymnites nov. sp. ex. aff. G. obliquus*, E. v. Mojsisovics : Cephalopoden der Mediterranen Triasprovinz, p. 237.

Dimensions.

Diameter of the shell	140 mm.
Greatest height of the last whorl	48 „
„ width of the last whorl	20 „
„ diameter of the umbilicus	58 „
Least height of the last whorl	39 „
„ width of the last whorl	19 „
Corresponding diameter of the shell	107 „
„ „ of the umbilicus	37 „

Gymnites Sankara agrees with the high, compressed variety of Stoliczka's *Ammonites Batteni*. Its relations to *Gymnites obliquus*, v. Mojs. from the Alpine Muschelkalk have been clearly pointed out by E. v. Mojsisovics. The elliptical outline is still more prominent in the Indian species, which is likewise distinguished by a higher and narrower whorl. The siphonal part is rounded. The sides are almost flat, and slope very gently towards the wide and shallow umbilicus. In none of my specimens have traces of ribs been observed.

This species differs from *Gymnites Kirata* by considerably greater involution and higher whorls. There are also some differences in the arrangement of the sutural line, especially in the shape of the siphonal lobe.

The body-chamber is wanting in my specimens.

Sutures.—The lobe-line bears a close resemblance to the sutures of *Gymnites incultus*, Beyrich. But the siphonal saddle is larger and characterised by the development of a broad, much ramified, outer branch, as in *Gymnites Jollyanus* or in *Gymnites* (*Buddhaites*) *Rama*. The siphonal lobe is but little shorter than the principal lateral lobe. Stoliczka's description of this species as being provided with a short siphonal lobe, is at variance with his figure (Mem., Vol. V, Pl. V, fig. 3), although this figure does not represent the relative size of the two lobes quite correctly. —Four auxiliary lobes, which are steeper inclined, than in *Gymnites incultus*. Especially the second of the bipartite auxiliary saddles is extensively denticulated.

Locality, number of specimens examined.—Lilang, Spiti, 1, Kuling, Spiti, 1, both from Stoliczka's collection in the Geological Museum in Calcutta ; Bambanag cliffs, Girthi valley, Johár, 1 Coll. Diener.

Remarks.—Beyrich[1] identified the high, compressed variety of Stoliczka's *Ammonites Batteni* with *Gymnites incultus*. This, however, does not seem justified considering the differences in shape of the whorls and the details of the sutural line.

The fragment figured by Salter may belong to *G. Sankara*, rather than to G *Kirata*. In the outline of its section and in the siphonal lobe it agrees with *Gymnites Sankara*. In Salter's drawing the outer branch of the siphonal saddle is

[1] l. c. p. 133.

wanting, but in young specimens of *Gymnites Sankara* this is not so distinctly individualised as in later stages of growth.

6. GYMNITES, NOV. SP. EX. AFF. G. SANKARA, Pl. XIII., fig. 1; var. Pl. X., fig. 5.

1865. *Ammonites Batteni* Stoliczka, *ex parte*: Mem. Geol. Surv. of India, Vol. V, Pt. I, p. 59.

Dimensions.

Diameter of the shell	150	mm.
Maximum height of the last whorl	60	„
„ width of the last whorl	30	„
Diameter of the umbilicus	50	„
Minimum height of the last whorl	43	„
„ width of the last whorl	23	„
Corresponding diameter of the shell	about 100	„
„ „ of the umbilicus	32	„

This species is very closely allied to *Gymnites Sankara*, but differs therefrom by rather more rapidly increasing whorls, a thicker transverse section, a less steeply rounded siphonal part and by the appearance of a row of lateral ribs in the lower portion of the sides, where the whorls reach a height of 25 mm. These very broad and flat ribs reach up to the middle part of the sides as in *Gymnites obliquus*, v. Mojs.[1] Our species bears a still nearer relationship to the latter than to *Gymnites Sankara*, but it differs in the sutures and possesses a more elliptical shape.

Sutures.—Very much like those of *Gymnites Sankara*, only somewhat broader and a little less ramified.

Locality, number of specimens examined.—Kuling, Spiti, 1 Coll. Stoliczka, from the Geological Museum in Calcutta; Shalshal cliff near Rimkin Paiar Encamping Ground, 1 Coll. Diener.

Remarks.—This species attains very remarkable dimensions. My specimen from Rimkin Paiar, which is unfortunately much injured, has a diameter of 340 mm, and the height of its last whorl is 147 mm. As it is entirely chambered, another three quarters of a volution must at least be reckoned for the body-chamber. Consequently the diameter of the adult individual could scarcely have been less than half a metre.

Variety.—I look upon a fragment from the Muschelkalk of the Utadhura in Johár as a variety of this species although it is distinguished by rather more rapidly increasing whorls, but it agrees perfectly in the details of the sutural line. The siphonal saddle shows a distinctly developed outer branch, where the whorl reaches a height of 6 mm. At the same time flat and broad radial folds begin to appear on the lower portion of the flanks. The body-chamber is wanting. The dimensions of this specimen, Pl. X, fig. 5, are as follows:—

Diameter of the shell	40	mm.
Maximum height of the last whorl	14	„
„ thickness of the last whorl	7·5	„
Diameter of the umbilicus	18	„
Minimum height of the last whorl	10	„
„ thickness of the last whorl	6	„
Corresponding diameter of the shell	27·5	„
„ „ of the umbilicus	11	„

[1] Die Cephalopoden der Mediterranen Triasprovinz, p. 236, Taf. LVI.

Another form, which is distinguished by smooth sides, is related to this species, with which it agrees in the shape of the whorls, but differs from *G. Sankara*. In my collection it is represented by the fragment of a body-chamber only, from the Shalshal cliff near Rimkin Paiar Encamping Ground.

7. Gymnites sp. ind. ex aff. G. Humboldti, v. Mojs., Pl. XII., fig. 2.

This is a fragment of a *Gymnites*, with high compressed whorls, which seems to be more closely allied to a species of the Alpine Muschelkalk than any of the Indian forms hitherto mentioned. In this fragment the height of the transverse section is 46 mm, the thickness about 20 mm. In the lower portion of the sides, traces of radial folds may be noticed.

The sutures seem to agree remarkably well with those of *Gymnites Humboldti* v. Mojs.[1] Especially the shape of the siphonal lobe and of the siphonal saddle are perfectly identical. The less rich ramification of the lateral saddles and of the but partly known, auxiliary saddles may be explained by the great weathering which this fragment has undergone.

Locality, number of specimens examined.—Bambanag cliffs, Girthi valley, Johár; 1 Coll. Diener.

8. Gymnites Lamarki, Oppel., Pl. X., fig. 6.

1863. *Ammonites Lamarki*, Oppel: Palæontologische Mittheilungen I, Taf. 75, fig. 3, p. 274.

1882. *Gymnites Lamarki*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, p. 235.

Dimensions.	
Diameter of the shell	40 mm.
Height of the last whorl	17 „
Thickness of the „ „	12 „
Diameter of the umbilicus	12 „

This interesting form recalls in its general outlines and involution some species of the genus *Ptychites* (e. g. *Ptychites Malietianus*, Stoliczka); but the arrangement of the sutures impart to it the character of a true *Gymnites*, as has already been noticed by E. v. Mojsisovics.

Gymnites Lamarki has a slightly elliptical outline, slowly increasing volutions, which although overlapping each other considerably, leave a proportionately wide umbilicus. During the adolescent stage the involution is remarkably less pronounced than in later stages of growth. When the whorl reaches a height of 14 mm it overlaps the preceding one almost completely.

The sides are separated from the steep umbilical wall by a well-marked, somewhat rounded, umbilical edge. The greatest thickness of the transverse section coincides with the lower portion of the sides. The latter converge towards the sharpened siphonal part in the shape of a pointed arch, as in *Gymnites acutus*, describ-

[1] E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Taf. LV, fig. 1, p. 235.

ed by F. v. Hauer from the Muschelkalk of Bosnia.[1] Oppel suggested that in more perfectly preserved specimens the sharpened siphonal part might be provided with an elevated, prominent keel. In the figured specimen however, I cannot find any traces of such a keel, which might justify this suggestion.

In the anterior part of the outer volution a portion of the shell has been preserved, which shows indistinct traces of broad, flat folds. Similar traces may be observed also at different places on the cast. Part of the posterior end of the body-chamber is preserved.

Sutures.—The lobe-line shows the typical arrangement of the sutures peculiar to the genus *Gymnites*. Siphonal lobe broad, at almost as low a level as the principal lateral lobe. Siphonal saddle exceeds the principal lateral saddle in size. Second lateral saddle bipartite and deeply incised. Probably four auxiliary lobes outside the umbilical suture. Considering the small size of this specimen the sutural line is not very complicated.

Locality, number of specimens examined.—Kuling, Spiti, 1 Coll. Schlagintweit, from the Palæontological Museum in Munich (Oppel's type-specimen).

Remarks.—Among all the congeneric species of the European Muschelkalk, only the above-mentioned *Gymnites acutus* v. Hauer from Han Bulog in Bosnia bears some resemblance to our Indian form. The sharpened siphonal part, which is found in no other *Gymnites*, known up to now from the Alpine Muschelkalk, the thick whorl, the strongly curved convexity of the sides and the proportionately deep, stairlike umbilicus, are characters common to both species. *Gymnites Lamarki*, however, is still more involute and differs also considerably in the shape of the sutures.

I do not consider the sharpened siphonal part to be a character of sufficient importance to justify the establishment of a new sub-genus for these two forms, as has been suggested by F. v. Haner. In closely allied species of the genus *Xenodiscus*, which may be considered to be the original form of *Gymnites*, similar differences in the shape of the siphonal part occur, without possessing the importance of sub-generic characters.

ISOLATED FORM.

(Sub-genus: BUDDHAITES, Diener.)

9. GYMNITES (BUDDHAITES) RAMA, nov. sp., Pl. XII, fig. 2; Pl. XIII., fig. 1. 2.

1865. *Ammonites floridus* Salter, *ex parte*: Palæontology of Niti, Pl. 6., fig. 1, p. 61.
1865. *Ammonites floridus* Stoliczka: Mem. Geol. Surv. of India, Vol. V, Pt. I, p. 51.
1882. *Gymnites nov.* sp. E. v. Mojsisovics: Cephalopoden der Mediterranen Triasprovinz, p. 227.

Dimensions.	I. (Pl. XIV, fig. 1.)	II. (Pl. XIV, fig. 2.)
Diameter of the shell	150 mm.	98 mm.
Height of the last whorl	90 „	56 „
Thickness of the „ „	32 „	17 „
Diameter of the umbilicus	9 „	8·5 „

[1] Beiträge zur Kenntniss der Cephalopoden aus der Trias von Bosnien I. Denkschr. Kais. Akademied. Wissensch. i. Wien, 1892, Bd. LIX, Taf. X, fig. 6, Taf. XI, fig. 2, p. 282.

This species, one of the most important leading fossils of the Himálayan Muschelkalk, is at an early stage of growth, just as in *Gymnites Jollyanus* Oppel, characterised by narrow, high, slowly increasing volutions and a rounded siphonal part. When the whorl attains a height of more than 8 mm., the involution and general shape of the shell changes in a very remarkable manner. The volutions overlap each other to two-thirds of their height so closely, that at a diameter of 30 mm the outer whorl covers the preceding one and the diameter of the umbilicus does not increase any more. Instead of a wide and shallow umbilicus, which is an important character in *Gymnites Jollyanus*, our species exhibits at later stages of growth a narrow, deep umbilicus, surrounded by a high, partially overhanging umbilical wall. The deep umbilicus, exposing only the innermost volutions in adult specimens, is separated from the flat sides by a rounded umbilical margin. Together with the stronger involution, the siphonal part becomes narrower and perfectly sharpened,—the whorl reaching a height of 20 mm. This sharpening of the siphonal part to a knife-like edge persists also in later stages and exhibits a very characteristic difference from *Gymnites Jollyanus*.

In this manner *Gymnites Rama* actually acquires in the adult stage a great external similarity with *Carnites floridus* Wulf. with which species it has often been confounded by former authors. But its sutures always retain the typical arrangement of the *Gymnites* lobe-line, although the shape of the shell considerably approaches that of the genus *Carnites* or *Pinnacoceras*. The stages of development are also entirely different in *G. Rama* and *Carnites floridus*, the latter passing from the *Meekoceras*-stage through the *Hungarites*-stage into the *Carnites*-stage.

Gymnites Rama develops ribs of the same size as does *Gymnites Jollyanus*. Only at an early stage of growth these ribs are confined to the middle portion of the sides; later they gradually pass across it. They are, however, not developed in the shape of straight, radial prominences, but form slightly falciform elevations, arranged along a spiral line, which gradually passes from the middle part into the upper portion of the sides. In very large specimens this spiral line appears as a continuous ridge in the outer whorl.

All the specimens figured in this memoir are entirely chambered. But there are a few fragments of body-chambers in my collection; the largest of these fragments shows a height of the last whorl of more than 120 mm.

Sutures.—The arrangement of the sutural line resembles that of *Gymnites Jollyanus* Oppel, although there are differences noticeable when comparing specimens of equal height of whorls. The siphonal saddle is much broader, and its outer secondary branch still further individualised. In this respect the sutures approach the arrangement of the lobe-line in *Carnites floridus*, in which this individualisation of the outer secondary branch has developed into a proper adventitious saddle.

The inclination of the auxiliary lobes is less steep than in *Gymnites Jollyanus*. The richly ramified, second lateral saddle is provided with a broad, inner secondary branch. Five auxiliary lobes outside the umbilical suture. Auxiliary saddles with

several incisions. The vertical projection of the outline of a whorl meets the apex of the second lateral saddle in the succeeding volution.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1 Coll. Griesbach; 5 Coll. Diener; Silakank-Pass, Painkandha, 1 Coll. Griesbach; East slope of Marchauk Pass, near Barahoti Encamping Ground, Hundes, 1 Coll. Griesbach; Lilang, Spiti, 1 Coll. Stoliczka, from the Geological Survey Museum in Calcutta; North of Kalapani, Kali River Valley, Byans, 4 Coll. Griesbach.

Remarks.—*Gymnites Rama* has been mistaken for *Carnites floridus* Wulf. by Suess, Salter and Stoliczka. Beyrich[1] already proved this identification to be erroneous and compared our species to a *Gymnites* described by F. v. Hauer. According to E. v. Mojsisovics the specimens, described by Salter as *Ammonites floridus*, belong to two different genera, *Gymnites* and *Hungarites*. His figure[2] corresponds to a specimen of *Gymnites Rama*. To this form are likewise to be added all the ammonites, identified with *Carnites floridus* by Stoliczka and Griesbach.[3]

In the genus *Gymnites* the present species represents a distinct group, differing so considerably from the rest of the congeneric forms, that it may properly be considered to be the type of a special sub-genus. As sub-generic characters are to be mentioned the gradual changes in the shape of the umbilical area and of the siphonal part in proportion to the progressing growth of the individual. For this sub-genus I propose the name of *Buddhaites*. The question whether close affinities actually do exist between this new sub-genus and *Carnites*, which is completely isolated in the fauna of the Alpine Triassic province, I must leave undecided.

Genus: STURIA, E. v. Mojsisovics.

STURIA SANSOVINII, E. v. Mojsisovics. Pl. XV.

1882. *Sturia Sansovinii* E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. Taf. XLIX, fig. 5, 6, 7, Taf. L, fig. 1, p. 241.
1887. *Sturia Sansovinii* F. v. Hauer: Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog bei Sarajevo, Denkschr. Kais. Akad. D. Wissensch. Wien. Bd. LIV, p. 46.
1892. *Sturia Sansovinii* F. v. Hauer: Beiträge zur Kenntniss der Cephalopoden aus der Trias von Bosnien ibidem Band LIX. Taf. X, fig. 7, p. 283.

Dimensions.

Diameter of the shell	247 mm.
Height of the last whorl	148 „
Thickness of the „ „	65 „
Diameter of the umbilicus	4 „

This species, peculiar to the zone of *Ceratites trinodosus* in the Alpine Muschelkalk is represented in the Himálayan collection by a specimen, which perfectly and in every respect agrees with the description and figure given by E. v. Mojsisovics.

[1] Abhandlgn. Königl. Akad. d. Wissensch. Berlin, 1866, p. 46.
[2] Palæontology of Niti, Pl. VI. fig. 1.
[3] Geology of the Central Himálayas, Mem. Geol. Surv. of India, Vol. XXIII, 1891.

In the shape of its transverse section this specimen corresponds to the sub-lenticular form figured by that eminent author in his Pl. XLIX, fig. 5. The sides are rather strongly curved, the greatest thickness of the whorl still coincides with the lower portion of the lateral parts. A rounded umbilical margin separates the umbilical wall, which becomes perpendicular in the outer volutions, and encloses the very narrow, almost completely closed umbilicus. The siphonal side is much compressed and highly rounded.

The sculpture of the shell exhibits the typical spiral striations which are arranged in three different groups as it were. In the siphonal part and near the siphonal margin the striations are narrow, sharply edged and separated from each other by interstices of only 1 mm distance. In this section they are consequently very numerous, thin and arranged close to each other. In the upper portion of the sides they are a little broader, flat and but slightly prominent, separated by interstices of $1\frac{1}{2}$ to 2 mm in distance. In the lower portion of the lateral parts they are, on the contrary, strongly developed and elevated. There the spiral striations and the intervening furrows are of equal size, being about 2 mm each in width. A strong contrast is noticeable therefore between the very broad and stout striations near the umbilical margin, and the thinner, less prominent striations on the upper portion of the sides. In our specimen this character is not less remarkable than in E. v. Mojsisovics' type-specimen from the Mediterranean Trias.

On the lower portion of the sides the furrows between some of the stout spiral striations are partly divided by very thin thread-like spiral lines, such as have been observed by F. v. Hauer in some individuals of this species from the Bosnian Muschelkalk.

The spiral striations are not confined to the shell, but are also marked on the surface of the cast.

Sutures.—Are absolutely identical with the lobe-line of the species figured by E. v. Mojsisovics (Pl. XLIX, fig. 7), as may be seen from a comparison with our figure. Proportionately to the greater size of our specimen, there are seven auxiliary lobes, corresponding to a height of the last whorl of 105 mm (whereas there are six in the type-specimen of E. v. Mojsisovics, corresponding to a whorl of 60 mm). The bifid termination of the principal lateral lobe is a good specific character.

Our specimen is entirely chambered.

As I could not detect any characters in which this species differs from *Sturia Sansovinii*, I am compelled to identify it with the latter. This determination has been confirmed by Dr. E. v. Mojsisovics, who kindly examined my Himálayan specimen, and likewise thinks it to be identical with the Alpine form.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1 Coll. Diener.

Genus: PTYCHITES, v. Mojsisovics.

Among the five sections, into which the forms belonging to the genus *Ptychites*, from the Alpine Muschelkalk, may be divided, only one, the group of the *P.*

subflexuosi, has not yet been discovered in the Indian Triassic province, whereas representatives of the *P. rugiferi*, *megalodisci*, *opulenti* and *flexuosi* are abundant.

The group of the *Ptychites rugiferi* predominates, and some of its forms belong to the most common fossil types, as for instance, *P. rugifer*, Oppel. This species and its nearest ally, *P. tibetanus*, v. Mojsisovics, show close relationship to some Spitzbergen forms. Another species of this group, *P. cognatus*, Oppel, may be compared to the European *P. Stachei*, v. Mojsisovics. The rest of the species belonging to the section of the *Rugiferi* are new. Among them *P. Mangala*, *P. Asura* and *P. Sukra* are more closely allied to the Indian *P. rugifer*, than to any Mediterranean forms, whereas *P. Govinda* may be considered an isolated type.

The group of the *Ptychites megalodisci* is represented by three species. Two of them, *P. impletus*, Oppel, and *P. Sahadeva*, bear some affinities to *P. Pauli*, v. Mojsisovics. The third, *P. Sumitra*, differs but in very subordinate details from the Alpine *P. megalodiscus*, Beyrich.

The group of the *Ptychites opulenti* has three representatives in the Indian Trias, all allied to the Alpine species *P. opulentus*, v. Mojs., and *P. progressus*, v. Mojs. Of the two forms, which must be placed in the group of the *P. flexuosi*, *P. cochleatus*, Oppel, may be compared with *P. Studeri*, v. Hauer, whereas *P. Mahendra* is a close relation of *P. flexuosus*, v. Mojs., from the Mediterranean Muschelkalk.

Besides these groups, two additional sections may be distinguished among the Himálayan *Ptychites*, which have not been discovered up to now either in the Mediterranean or in the Arctic-Pacific province, but must be considered as faunistic elements peculiar to the Indian Trias.

One of these groups, which I propose to call *Ptychites orbilobi*, has two lateral lobes and is distinguished by the semi-circular arrangement of the laterally forward-curved sutures, which remind me of the lobe-line in *Cyclolobus*, Waagen, or in *Joannites*, E. v. Mojsisovics. *Ptychites Gerardi*, Blanford, ought to be taken as a type of this group.

The second of these groups is represented by *P. Malletianus*, Stoliczka, and its relations. The species of this section are provided with two lateral lobes and differ especially by their numerous low volutions, which do not overlap each other much, and the extraordinarily wide umbilicus. This character in which they differ from the typical forms of the genus *Ptychites* is so important, that Beyrich[1] thought himself justified in placing *Ammonites Malletianus* among the group of *Gymnites incultus*. The arrangement of the sutures, however, imparts to this ammonite the character of a true *Ptychites* and clearly establishes its generic position.

Among the 18 species, which are described in the following section of this Memoir, 7 belong to the group of the *P. rugiferi*, 3 to the group of the *P. megalodisci*, an equal number to that of the *P. opulenti*, 2 to the group of the *P. flexuosi*, one to the group of the *P. orbilobi*, 2 to the group of the *P. Malletiani*.

[1] Ueber einige Cephalopoden aus dem Muschelkalk der Alpen, etc., Abhandlgn. Königl. Akademie d. Wissensch Berlin, 1866, p 134.

a. Group of the PTYCHITES RUGIFERI.

1. PTYCHITES RUGIFER, Oppel., Pl. XXII, fig. 1, 2; Pl. XXIII, fig. 1, 2; Pl. XXIV, fig. 1, 2.

2. PTYCHITES TIBETANUS, E. v. Mojsisovics. Pl. XXIV, fig. 3.

1865. *Ammonites rugifer*, Oppel: Palaeontolog. Mitthlgn. I. Taf. 85, figs. 2, 3, p. 293.
1865. *Ammonites Studeri*, v. Hauer, *ex parte*: Die Cephalopoden der unteren Trias der Alpen, Sitzgsber. Kais. Akad. d. Wissensch. Wien, Math. Nat. Classe Bd. LII., p. 629, 639.
1865. *Ammonites Gerardi*, Stoliczka, *ex parte*: Mem. Geol. Surv. of India, Vol. V, Pt. I, p. 54.
1867. *Ammonites Gerardi*, Beyrich, *ex parte*: Ueber einige Cephalopoden aus dem Muschelkalk der Alpen, etc Abhandlgn. Königl. Akad. d. Wissensch. Berlin, 1866, p. 125.
1882. *Ptychites rugifer*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. kk. Geol. Reichsanst. Vol. X, p. 247.
1886. *Ptychites Tibetanus*, E. v, Mojsisovics, Arktische Triasfaunen, Mém. Acad. des sciences de St. Pétersbourg VII. sér. T. XXXIII. No. 6, Taf. XIV, fig. 5, p. 96.

Dimensions.	I. (Pl. XXII, fig. 2)[1]	II.[2]
Diameter of the shell	93 mm.	86 mm.
Height of the last whorl	46 „	40 „
Thickness „ „ „ „	51 „	58 „
Diameter of the umbilicus	15 „	12·5 „

Oppel's type-specimen of *Ptychites rugifer* is of a more globose shape than any form of the group of the *P. rugiferi* from the Alpine Muschelkalk. It has a broadly rounded siphonal area, and a rather wide umbilicus, surrounded by a steep umbilical wall. In young specimens this umbilical wall is, as a rule, less steeply inclined than in adult ones. The sharply defined, somewhat obtuse umbilical margin, which in later stages of growth becomes slightly rounded, marks the region, where the whorl attains the maximum of its thickness. In the last volution, 17 proportionately strong folds or ribs are noticeable. They begin somewhat outside the umbilical margin and are considerably broader when approaching the siphonal area, which most of them cross in the shape of flat swellings. Some of them, however, are arranged asymmetrically on both sides of the siphonal part.

The type-specimen of *Ptychites tibetanus*, E. v. Mojsisovics, differs from Oppel's type-specimen of *P. rugifer* by its still more globose shape, greater thickness of the last whorl and a considerably larger number of radial ribs (25). But the sutural line agrees perfectly in the two forms.

My examination of a very rich material has convinced me, that the differences between the two forms are not very prominent. The greater number of radial ribs is certainly not peculiar to the typical *P. tibetanus*. The same remark applies to the proportions in the last whorl of *P. rugifer*, which are so various, that even *P. tibetanus* might justly be regarded as a mere variety of extraordinary thickness.

In the following list the measurements in a series of specimens are grouped

[1] Oppel's type-specimen of P. rugifer.
[2] E. v. Mojsisovics' type-specimen of P. tibetanus.

together, showing the amount of variation in the dimensions of the last whorl and in the number of ribs:—

	I.[1] (Pl. XXII. fig. 2)	II.	III.
Diameter of the shell	93 mm.	120 mm.	109 mm.
Height of the last whorl	46	61	53
Thickness of the last whorl	51 +5	63 +2	56 +3
Number of radial ribs	17	18	18

IV. (Pl. XXIII, fig. 1.)	V.	VI. (Pl. XXIII, fig. 2.)	VII. (Pl. XXII, fig. 1.)	VIII.	IX.
118 mm.	76 mm.	92 mm.	123 mm.	106 mm.	97 mm.
60 / 63 +3	37 / 46 +9	47 / 55 +8	59 / 58 −1	50 / 48 −2	46 / 45 −1
13	12	23	18	13	21
(to the last half volution.)	(to the last half volution.)			(to the last half volution.)	

X. (Pl. XXIV, fig. 2.)	XI. (Pl. XXIV, fig. 1.)[2]	XII. (Pl. XXIV, fig. 3.)[3]
70 mm.	70 mm.	86 mm.
37 / 45 +8	37 / 48 +11	40 / 58 +18
17	19	5

This list shows clearly that the number of radial ribs is as large in *P. Tibetanus* as in forms with a still higher whorl than that in Oppel's type-specimen of *P. rugifer*. The number of ribs cannot therefore be accepted as decisively characteristic of one of the two forms. Concerning the proportions of their transverse sections, the specimens grouped in the present list, with the exception of No. XII, are connected by so many links, that apparently they do not contain two distinct species, but must all be identified with Oppel's *P. rugifer*. Within this species merely more or less globose varieties may be distinguished, as in *P. flexuosus*, the last whorl of which also varies considerably in thickness.[1]

The type specimen of *P. Tibetanus* differs, however, in the proportion of height and thickness of the outer volution so remarkably from all the rest of the *Rugiferi* that for the present it may be looked upon as a distinct species. But in this case the term *P. Tibetanus* ought only to be applied to extremely globose forms, in which a similar abnormal proportion in height and thickness of the last whorl prevails.

Sutures.—The very short and narrow siphonal lobe is divided by a low siphonal tubercle. From the principal lateral lobe the lobe-line rises obliquely to the umbilical margin. The lateral and auxiliary lobes are divided at their base, each by two converging points. The siphonal saddle is richly ornamented and provided with a distinctly individualised foliaceous branch which is situated at the upper portion of the saddle, near the junction with the principal lateral lobe. At the opposite side to this

[1] Oppel's type-specimen.
[2] Identified by E. v. Mojsisovics with *P. tibetanus*.
[3] The type-specimen of E. v. Mojsisovics.

branch corresponds a similar one, near the base of the principal lateral saddle. This individualisation of two foliaceous branches, on both sides of the principal lateral lobe, takes place, however, only in advanced stages of growth. The saddles are asymmetrical. The top of the second lateral saddle is deeply incised. The first auxiliary saddle is bipartite, the second coincides with the umbilical margin. One more auxiliary lobe and saddle follow outside the umbilical suture.

Locality, number of specimens examined.—α *Ptychites rugifer.*—Kuling, Spiti, 3 Coll. Schlagintweit, from the Palæontological Museum in Munich (among them Oppel's type-specimen); Spiti, 2 Coll. Schlagintweit, in the Museum für Naturkunde in Berlin; S. E. of Muth, Spiti, 3, Coll. Griesbach, Geological Survey Museum in Calcutta; Lilang, Spiti, 1, Coll. Geological Survey Museum in Calcutta; Shalshal cliff near Rimkin Paiar encamping ground, 18 Coll. Diener.

β *Ptychites Tibetanus.*—Spiti, 1 Coll. Schlagintweit, from the Palæontological Museum in Munich (E. v. Mojsisovics' type-specimen).

Remarks.—E. v. Mojsisovics has already pointed out the close relationship of *Ptychites Tibetanus* to some species of the *Rugiferi* group, from the Daonella-limestone of Spitzbergen, especially to *P. latifrons*, v. Mojs., and to *P. Nordenskjoeldi*, v. Mojs. The Indian species is more closely allied to *Ptychites Nordenskjoeldi* in the arrangement of the sutural line than to any other form of this group. In the Spitzbergen species[1] the sutures are, however, more richly ornamented, the lateral branches of the saddles being bordered by deep indentations, which enter so deeply, that only the interior-stem is left entire. Another difference is in the first auxiliary saddle, which is bipartite in the Indian species.

Among the congeneric forms of the Mediterranean Muschelkalk none is closely allied to *P. rugifer* or to *P. Tibetanus*, although *P. eusomus*, Beyrich, bears some resemblance to the first in its general shape.

3. Ptychites Mangala, nov. sp., Pl. XXVII., fig. 1.,

Dimensions.

Diameter of the shell	97 mm.
Height of the last whorl	49 „
Thickness of the „ „	42 „
Diameter of the umbilicus	16 „

This species is very closely allied to *P. rugifer*, Oppel, but differs from it in a less globose shape, a more shallow umbilicus, surrounded by an obliquely inclined wall, and in details of the sutural line. The siphonal part is considerably narrower than in *P. rugifer* and steeply rounded. The greatest thickness of the last whorl coincides with the rounded umbilical margin. From the latter the umbilical wall slopes obliquely towards the proportionately wide umbilicus, whereas in individuals of *P. rugifer* of an equal stage of growth it is almost perpendicular.

This specimen has 21 radial folds in the last volution. They rise close outside the umbilical margin and disappear near the siphonal part, which remains perfectly smooth.

[1] E. v. Mojsisovics, Arktische Triasfaunen, l. c. Taf. XIII, fig. 3, p. 93.

Sutures.—The sutural line of this species agrees generally with that of *P. rugifer*. The principal difference consists in the shape of the first auxiliary saddle, being entire in *P. Mangala*, whereas in *P. rugifer* it is bipartite.

In the figured specimen a little more than one quarter of the last volution belongs to the body-chamber.

Locality, number of specimens examined.—Spiti (locality not precisely known), 1 Coll. Schlagintweit, from the Palæontological Museum in Munich.

4. Ptychites Sukra, nov. sp., Pl. XXVII., fig. 2.

Dimensions.

Diameter of the shell	67 mm.
Height of the last whorl	34 „
Thickness of the „ „	29 „
Diameter of the umbilicus	11 „

In this species the whorls are still more compressed than in *P. Mangala*. Its general shape and sculpture remind one somewhat of the well-known *P. Studeri*, v. Hauer, which, however, has three lateral lobes.

From the rounded umbilical margin, which coincides with the region of the maximum thickness, the sides slope with moderate convexity towards the highly rounded siphonal part. The stair-like umbilicus is surrounded by a steeply inclined umbilical wall.

There are 18 folds or ribs in the last whorl of the figured specimen; they are curved backwards near the siphonal margin, as in the true *P. Studeri, v.* Hauer.[1] They rise near the umbilical margin and become obsolete in the siphonal part, but some few cross it in the shape of very indistinct prominences.

Sutures.—In consequence of the unfavourable state of the matrix, I have not succeeded in tracing the sutural line in all its details. So far as I am able to judge it seems to agree with the lobe-line of *P. rugifer* Oppel. The first auxiliary saddle is bipartite.

Three quarters of the last volution belong to the body-chamber.

Locality, number of specimens examined.—Spiti (locality not known exactly) 1 Coll. Schlagintweit, from the Palæontological Museum in Munich.

5. Ptychites cognatus, Oppel, Pl. XVIII., fig. 5, 6.

1863. *Ammonites cognatus*, Oppel: Palæontolog. Mitthlgn. I. Taf. 81, f. 3, Taf. 85, fig. 4, p. 285.
1865. *Ammonites Gerardi*, Stoliczka *ex parte*: Mem. Geol. Surv. of India, Vol. V, Pt. I, p. 54.
1882. *Ptychites cognatus*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k. k. Geol. Reichsanst., Vol. X, p. 247.

Dimensions.	I. (Pl. XVIII, f. 5.)	II. (Pl. XVIII, f. 6.)
Diameter of the shell	59 mm.	61 mm.
Height of the last whorl	35 „	32 „
Thickness of the „ „	40 „	35 „
Diameter of the umbilicus	9 „	7 „

[1] *E. v. Mojsisovics*, Die Cephalopoden der Mediterranen Triasprovinz, Abhandlungen kk. Geol. Reichsanstalt. Vol. X, Taf. LXIII, fig. 1, p. 260.

Ptychites cognatus has been erroneously identified with *P. Gerardi*, Blanf., by Blanford and Stoliczka, but it is more closely allied to *P. Stachei*, v. Mojs.,[1] as has been stated by E. v. Mojsisovics. It differs from the Alpine form by its more globose shape, the thickness of its last whorl and its narrow umbilicus, whereas sculpture and sutures are very similar in the two species.

Most of the specimens, which I have examined, were more or less deformed and crushed, so much so, that a correct idea of the shape of the shell cannot be formed from the measurements alone. The slowly increasing globose volutions are thickest around the slightly rounded umbilical margin. A high and perpendicular umbilical wall separates the latter from the umbilical suture. The involution of the whorls takes place exactly outside the umbilical margin. The very narrow and deep umbilicus is one of the most remarkable features of this species and permits of an easy distinction from *P. rugifer*, which for the rest bears a great external resemblance to *P. cognatus*. The siphonal area is broadly rounded.

The numerous, straight, radial folds rise close outside the umbilical margin and become obsolete, when approaching the siphonal area, which remains perfectly smooth. The number of radial folds in the last volution of my specimens is from 20 to 23.

All my specimens are entirely chambered.

Sutures.—The vertical projection of the outline of the penultimate volution meets the apex of the second lateral saddle.

The sutural line resembles that of *P. Stachei*, v. Mojs., but differs by its two lateral lobes which are provided with two converging points rising from their base. The ornamentation of the saddles does not affect the stems so deeply as in *P. rugifer* and in *P. Tibetanus*. The lobes are placed at an equal level. The short, narrow, siphonal saddle is provided with a low siphonal tubercle. The first auxiliary saddle is deeply incised and bipartite. The second auxiliary saddle coincides with the umbilical margin. Two more auxiliary lobes and an equal number of saddles follow outside the umbilical suture.

Locality, number of specimens examined.—Kuling, Spiti, 4 Coll. Schlagintweit, from the Palæontological Museum in Munich; Spiti (locality not exactly known), 4 Coll. Geological Survey Museum in Calcutta; Spiti and Shángra (Hundés), 2 Coll. Schlagintweit, from the Museum für Naturkunde in Berlin.

6. PTYCHITES ASURA, nov. sp., Pl. XXVII., fig. 5.

1865. *Ammonites Ausseanus*, Stoliczka, *ex parte* : Mem. Geol. Surv. of India, Vol. V, Pt. I, p. 53.

Dimensions.

Diameter of the shell	33 mm.
Height of the last whorl	16 „
Thickness of the „ „	30 „
Diameter of the umbilicus	5(?)„

The generic relations of a globose ammonite, which Stoliczka erroneously identified with *Ammonites Ausseanus*, have been elucidated by an examination of

[1] Die Cephalopoden der Mediterranen Triasprovinz, l. cit. Taf. LXII, fig. 3, p. 247.

the sutures, which I succeeded in tracing out by splitting off a part of the shell. Our specimen evidently belongs to the genus *Ptychites* and must be regarded as an extremely globose representative of the *Rugiferi*-group. Its general shape actually recalls *Arcestes*, excepting in the umbilical region, which, to judge from its rather fragmentary state of preservation, seems to agree with that of *P. rugifer*, Oppel.

The shell is entirely smooth, without trace of folds or furrows.

The last third of the outer volution belongs already to the body-chamber.

Sutures.—Resembling the sutures in *P. rugifer* at an equal stage of growth. But the siphonal saddle is distinguished by its abnormally small size and all the lobes are placed on the same level. Three auxiliary lobes outside the umbilical suture.

Locality, number of specimens examined.—Lilang, Spiti, 1 Coll. Stoliczka; from the Geological Survey Museum in Calcutta.

7. Ptychites Govinda, nov. sp., Pl. XXI., fig. a, b, c.

Dimensions.

Diameter of the shell	196 mm.
Height of the last whorl	92 „
Thickness of the „ „	83 „
Diameter of the umbilicus	52 „

This beautiful species is distinguished by its rapidly increasing whorls, a highly rounded siphonal part, and a wide, funnel-shaped umbilicus. The inner wall of the umbilicus is obliquely inclined, at an angle of about 45 degrees, as in *P. cochleatus*, Oppel. The involution takes place exactly at the umbilical margin. Nothing is therefore exposed of the inner volutions, except their umbilical edge, which is visible inside the umbilicus in the shape of a screw-like spiral line.

The greatest thickness of the last whorl coincides with the umbilical margin. From this the sides converge towards the narrow siphonal part with a moderate convexity. In the inner volutions the umbilical margin forms a sharply marked obtuse edge, which becomes somewhat rounded in the last whorl.

The sides are covered with broad, radial folds which rise outside the umbilical margin and become obsolete in the siphonal area. There are 22 of them on the last volution.

In spite of its remarkable size the figured specimen is entirely chambered. The partly preserved shell is 2·5 mm. in thickness and exhibits a layer, wrinkled in the direction of the radial folds.

Sutures.—Whereas in *P. rugifer* and its allies the sutural line is characterised by an oblique arrangement of the lobes, rising from the principal lateral lobe, which is the deepest towards the umbilical margin, in *P. Govinda* the two lateral lobes are placed at the same level and the sutural line is deepest in the first auxiliary lobe, which is richly serrated and enlarged at its base. Siphonal lobe very short, terminating in a deep point. The second lateral and the first auxiliary saddle are highly foliaceous, especially so on the stems, which are rather deeply incised. From

the inner margin of the second lateral saddle rises a highly foliaceous and well-individualised secondary branch, as in the group of *P. Malletianus*, Stoliczka. The second auxiliary lobe is situated at the umbilical margin. Between this and the umbilical suture there is a second, branched, auxiliary saddle and two more auxiliary lobes, interrupted by a short saddle.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1 Coll. Diener; East Slope of Tsang-Tsok-La, Hop gadh, (Hundés), 1 Coll. Griesbach, from the Geological Survey Museum in Calcutta.

β. Group of the PTYCHITES MEGALODISCI.

8. (1) PTYCHITES IMPLETUS, Oppel., Pl. XVIII, fig. 4

1865. *Ammonites impletus*, Oppel: Palæontologische Mitthlgn. I. Taf. 85, fig. 5, p. 294.
1882. *Ptychites impletus*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsaust., Vol. X, p. 251.

Dimensions (of the inner volutions).

Diameter of the shell	47 mm.
Height of the last whorl	15 „
Thickness of the „ „	30 „
Diameter of the umbilicus	18 „

Oppel's type-specimen is an entirely chambered, much crushed cast; it was compared by E. v. Mojsisovics with the European *P. Pauli* v. Mojs., but it is considerably thicker than any of the Alpine forms of this group.

The figured fragment (Oppel's type-specimen) is of a very globose shape, the thickness of the last whorl being twice as great as the height. It has a proportionately wide umbilicus, by which it is easily distinguished from the Indian *Ptychites* of the "*Opulenti*" group, which it resembles somewhat in general shape. The inner wall of the umbilicus is high and steeply inclined; the umbilical margin forms a distinctly marked edge. The greatest thickness of the last whorl coincides with the latter. From the umbilical margin the sides slope gently to the siphonal part, which is rounded into the shape of a pointed arch. The volutions overlap as far as the umbilical margin.

No folds or ribs have been noticed on the sides; the last whorl attains a height of 20 mm.

Sutures.—The sutural line is not completely known, but seems to agree in general with the sutures of *P. Pauli*, v. Mojs.[1] The siphonal lobe is short, but the siphonal saddle only very little less high than the principal lateral saddle. The second lateral saddle is bipartite and deeply incised. The second auxiliary lobe coincides with the umbilical margin. The saddles and lobes are highly foliaceous and their lateral branches much more strongly developed than in *P. Pauli*.

Locality, number of specimens examined.—Kuling, Spiti, 1 Coll. Schlagintweit, from the Palæontological Museum in Munich.

[1] Cephalopoden der Mediterranen Triasprovinz, Taf. LXII, fig. 2, p. 251.

9. (2) PTYCHITES SAHADEVA, nov. sp., Pl. XXV., fig. 1, 2.

Dimensions.	I. (fig. 1.)	II. (fig. 2.)
Diameter of the shell	113 mm.	48 mm.
Height of the last whorl	59 „	21 „
Thickness of the „ „	51 „	35 „
Diameter of the umbilicus	21 „	10 „

The young individuals of this species closely resemble *Ptychites Pauli*, E.v. Mojsisovics,[1] and *P. impletus*, Oppel, in general shape and involution. But whereas these two species are distinguished through persistence of the adolescent character in later stages of growth, in *P. Sahadeva* the volutions become more compressed and higher in the adult stage. This change is clearly seen in the figured specimens, but it is still more remarkable in larger ones. In my largest specimen the diameter of the shell is 220 mm, the outer whorl 118 mm in height and only 68 mm in thickness. The difference of shape in adult and in young individuals is rather considerable.

In spite of the change which the proportions of the last whorl undergo, *P. Sahadeva* is more closely allied to the two above-mentioned species, than to any of the flatter discoidal forms of the group of the "*Megalodisci*," the flattening of the volution not being combined with a contraction of the umbilicus.

The deep umbilicus is surrounded by a steeply inclined inner wall, separated from the sides by a sharp umbilical margin. The sides converge almost without convexity towards the siphonal part, which is slightly sharpened in young individuals, but becomes slightly rounded in later stages of growth. The involution takes place quite close to the umbilical margin, but in very large specimens the outer volution exhibits egression and apparently leaves the spiral line.

In the specimen figured Pl. XXV, fig. 1, the last whorl shows 15 flat, straight folds, which pass across the siphonal part in the shape of wavy, flexuous elevations. In young specimens the surface of the shell is almost smooth, exhibiting faint grooves near the umbilical edge only, which correspond to the depressions between the different folds. These grooves gradually die out when approaching the siphonal part.

The elliptical outline of this specimen is probably not a specific character, but is an accidental deformity due to crushing. All the fossils which come from this locality, as *Ceratites Kuvera*, *Gymnites* (*Buddhaites*) *Rama*, *Nautilus Griesbachi*, are deformed and crushed in a similar manner.

In the largest of my specimens, with a diameter of 220 mm, three fourths of the outer volution form part of the body-chamber.

Sutures.—Similar to those of *P. Pauli*, v. Mojs., but the lateral branches of the saddles are further developed. The principal lateral saddle especially is provided with individualised and richly foliaceous secondary branches. The siphonal saddle is considerably shorter than the principal lateral one. The second lateral and the

[1] Cephalopoden der Mediterranen Triasprovinz Abh. Geol. Reichsaust., Vol. X, Taf. LXII, fig. 2, p. 251.

first auxiliary saddles are deeply incised above, bipartite, and provided with narrow stems at their base. The second auxiliary lobe is divided by the umbilical edge. Two bipartite auxiliary saddles follow outside the umbilical suture. Siphonal lobe short, with a high siphonal tubercle.

The rest of the lobes are each divided at their base by two converging points, giving them a trifid termination.

Siphuncle.—In the ventral area of the specimen figured Pl. XXV, fig. 1, the narrow siphuncle, consisting of anastomosing fibres, is partly exposed.

Locality, number of specimens examined.—North of Kalapani, Kali River Valley (Byans), 7. Coll. Griesbach (Geological Survey Museum in Calcutta).

10. (3) PTYCHITES SUMITRA, nov. sp., Pl. XXVI.

Dimensions.

Diameter of the shell	260 mm.
Height of the outer whorl	142 „
Thickness of the „ „	80 „
Diameter of the umbilicus	6 „

The present species, one of the largest of the "*Megalodisci*" group, is very closely allied to *P. megalodiscus*, Beyrich,[1] from which it only differs by its more broadly rounded siphonal part, by a rounded umbilical margin, and in some details of the sutural line. The umbilicus is narrow, funnel-shaped and surrounded by a steep inner wall, distinctly defined by a rounded umbilical margin, whereas in *P. megalodiscus* the umbilical margin retains a sharp edge even at later stages of growth. The siphonal part is highly rounded but never sharpened. The whorls are rather less compressed than in *P. megalodiscus*, the outer whorl being proportionately lower. For the rest, the outlines and the involution of the shell agree perfectly in the two species.

The shell, which is but partially preserved, is smooth, exhibiting only very thin and indistinct lines of growth. The cast is entirely smooth.

The body-chamber occupies three-fourths of the last volution. The margin of the aperture is partly preserved. It forms a deep lateral depression in the lower portion of the shell, which is followed by a flat lappet turned forward. In the outer portion of the shell a second slight depression marks the beginning of a rather narrow siphonal process. This process is partly broken off in this specimen. To this projecting ventral process a contraction of the shell in the siphonal part corresponds, encircling its topmost portion. There is a considerable similarity with the mouth borders of *P. eusomus*, Beyr., and of *P. acutus*, E. v. Mojs.[2]

Sutures.—Very much like those of *P. megalodiscus*, but differing in the shape of the saddles, which have broader and stronger stems. The siphonal saddle especially is less richly ornamented. The siphonal lobe is at a somewhat higher level

[1] E. Beyrich, Ueber einige Cephalopoden aus dem Muschelkalk der Alpen, etc., Abhandlgn. Kgl. Akad. d. Wiss. Berlin, 1866. Taf. II., p. 135; E. v. Mojsisovics, Cephalopoden der Mediterranen Triasprovinz Abh. Geol. Reichsanst. Vol. X, Taf. LXXVII, fig. 1, Taf. LXXVIII, f. 1, 2, p. 253.

[2] l. c. Taf. LXIX, LXVI, fig. 6 *a*.

than in *P. megalodiscus*. Siphonal tubercle large, pyramidal, and strongly serrated Siphonal saddle lower than the principal lateral saddle. Second lateral and auxiliary saddles bipartite. Number of auxiliary lobes 5 (as in Beyrich's type-specimen of *P. megalodiscus* from Reutte), corresponding to a height of the outer whorl of 80 mm. A comparison with the figure of the sutural line given by Beyrich, shows clearly the greater progress in the ornamentation of the siphonal and of the principal lateral saddles in the European species.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

γ. Group of PTYCHITES MALLETIANUS.

11. (1) Ptychites Malletianus Stoliczka, Pl. XVII., fig. 1.

1865. *Ammonites Malletianus* Stoliczka: Mem. Geol. Surv. of India Vol. V. Pt. I.—Pl. 5, fig. 1, p. 58.

Dimensions.

Diameter of the shell	108 mm.
Height of the outer whorl	39 „
Thickness „ „ „ „	43 „
Diameter of the umbilicus	43 „

This interesting species differs from all congeneric forms hitherto known, by its numerous, low, slowly increasing whorls, which, however, do not overlap to any great extent, and by its extraordinarily wide umbilicus. The volutions overlap each other to the extent of a little more than one-third of their height, the greater part of them being therefore exposed within the umbilical area. The maximum thickness of the volutions coincides with the sharp umbilical margin, from which a high perpendicular wall slopes down to the umbilical suture. The sides are moderately convex, the siphonal side is rounded.

This specimen,—Stoliczka's type,— has 26 to 28 flatly convex folds within the last volution, which are arranged close to each other and rise only at some distance from the umbilical margin. They are radially directed and disappear, as they approach the siphonal margin; they broaden out and flatten gradually, but without becoming flexuous.

The specimen is entirely chambered.

Sutures.—The sutural line is characterised by a remarkably reduced size of the auxiliary saddles and the development of a strongly individualised secondary branch rising from the inner margin of the second lateral saddle. Two lateral lobes. Siphonal lobe short, siphonal saddle nearly as high as the second lateral saddle. Lobes and saddles richly ornamented. First auxiliary saddle very short and tripartite, like the second, which is considerably broader. The second auxiliary lobe coincides with the umbilical margin. Two auxiliary lobes outside the umbilical suture. Third auxiliary saddle entire.

Locality, number of specimens examined.—Lilang, Spiti, 1, Coll. Stoliczka, Geological Survey Museum in Calcutta (Stoliczka's type-specimen).

Remarks.—No allied forms of *P. Malletianus* have hitherto been discovered. Like *P. Gerardi* it represents an isolated type peculiar to the Indian Trias.

12. (2) Ptychites Nov. Sp. Ind.

Ex. Aff. Pt. Malletiano. (Pl. XVII., fig. 2.)

This is a form, related to *P. Malletianus* Stol., which is likewise distinguished by low, not much overlapping volutions and a wide umbilical area. The only specimen available is unfortunately fragmentary. To a diameter of the shell of 54 mm corresponds a diameter of the umbilicus of 23 mm. The thickness of the transverse section is considerably greater than in *P. Malletianus*. The sides pass gradually into the broadly rounded, siphonal area. A high, perpendicular, umbilical wall separates the obtusely rounded umbilical edge from the umbilical suture.

The sculpture consists of folds or ribs, better defined than in *P. Malletianus*. There are nine of them on the outer volution and they rise close to the umbilical margin. Approaching the siphonal margin, they become less prominent but broaden out gradually. They do not completely disappear in passing across the siphonal area.

As this entirely chambered specimen is much deformed, I have not been able to take exact measurements. As to its dimensions I must therefore refer to the figure.

Sutures.—Similar to those of *P. Malletianus*, but the inner secondary branch of the second lateral saddle is still more strongly developed. Only one auxiliary lobe outside the umbilical margin. The latter coincides with the short but richly ornamented first auxiliary saddle. The second deeply incised auxiliary saddle is higher than the first one. Three auxiliary lobes between the umbilical margin and the umbilical suture.

Locality, number of specimens examined.—North of Padam, Spiti, 1, Coll. Geological Survey Museum in Calcutta.

δ. Group of the PTYCHITES ORBILOBI.

13. (1) Ptychites Gerardi Blanford Pl. XVIII. fig. 1, 2, 3; Pl. XXV., fig. 3.

1863. *Ammonites Gerardi*, Blanford: Journal Asiatic Soc. of Bengal, XXII. p. 132, Pl. II. fig. 6.
1865(?). *Ammonites Gaytani* Salter: Palæontology of Niti, Pl. 7, fig. 7, 8, p. 65.
1865. *Ammonites Gerardi*, Stoliczka. *ex parte*: Mem. Geol. Surv. of India, Vol. V. Pt. I. p. 54.
1882. *Ptychites Gerardi*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. p. 247.

Dimensions.	I. (Pl. XVIII. f. 1.)	II. (Pl. XVIII. f. 2.)	III. (Pl. XVIII. f. 3.)[1]
Diameter of the shell . . .	67 mm	56 mm.	51 mm.
Height of the outer whorl . .	36 „	30 „	26·5 „
Thickness „ „ „ „ . .	32 „	31 „	28 „
Diameter of the umbilicus . .	8 „	7 „	8 „

This often-mentioned species has been repeatedly confounded with several

[1] Blanford's type specimen.

other forms of the "*Rugiferi*" group, which occur in the same horizon, although Blanford has already given a sufficiently good description of his type-specimen and has clearly pointed out the peculiar shape of the—rather badly figured—sutural line. Oppel is therefore perfectly right in not identifying a single form among the *Ptychitidæ*, collected by the brothers Schlagintweit with the true *Ptychites Gerardi*, and E. v. Mojsisovics justly remarks in opposition to Beyrich[1] "that among the rich material of Indian triassic ammonites in the Schlagintweit collection not one single specimen is met with, which agrees with the description and figure of *Ptychites Gerardi*, Blanford." As I have sufficient material of this species at hand, partly from Stoliczka's, partly from my own collections, besides Blanford's type-specimen, its diagnosis presents no difficulty.

The typical form of *Ptychites Gerardi* is distinguished by an almost triangular shape of the section of its outer whorl; the sides slope from the umbilical margin, where they are most distant, towards the narrow but rounded siphonal area, with tolerably even convexity. Young individuals are of a more globose shape and provided with a broadly rounded siphonal part (Pl. XXV. fig. 3). The higher the form grows in later stages, the more sharpened becomes the siphonal part and the more characteristically appears the peculiar shape of the section of the outer whorl, recalling some *Ptychites* of the "*Megalodisci*"-group, which Blanford justly designates as "trigona." The clearly defined umbilical margin is but slightly rounded. The umbilical wall is steep. The width of the umbilicus varies considerably. In one of my specimens from Rimkin Paiar the diameter of the umbilicus is 14 mm, corresponding to a diameter of the shell of 68mm. In another specimen from the same locality the diameter of the shell is 80 mm the diameter of the umbilicus only 10 mm. The involution does not take place exactly at the umbilical margin, but parts of the inner volutions are exposed in the stair-like umbilicus, recalling *P. Studeri* v. Hauer.

At an early stage of growth the shell is perfectly smooth. When the outer whorl reaches a height of 25 mm, very flat, radial folds are noticed, covered with numerous thin and delicate striations, corresponding to growth-lines. They rise outside the umbilical margin and broaden out considerably towards the siphonal part. In the specimen figured Pl. XVIII. fig. 1, nine to ten of these radial folds may be counted in the last half volution. The sculpture is always much more delicate than in *P. cognatus* or in *P. rugifer*, which have sometimes been mistaken for this species.

Sutures.—Differ from all the rest of the congeneric species hitherto known by their semi-circular arrangement, their convexity being laterally curved forward. The vertical projection of the outline of the penultimate volution meets the inner margin of the second lateral saddle. Consequently *P. Gerardi* must be placed among the forms with two lateral lobes. The siphonal lobe is very short and narrow and provided with a high siphonal tubercle. The lateral lobes end with elongated terminal points with lateral digitations symmetrically arranged on each side. The second lateral and the first auxiliary saddles are of nearly equal size and

[1] Abhandlgn. Koenigl. Akademie d. Wissensch. Berlin. 1866, p. 125.

provided with two terminal lateral branches. Four auxiliary lobes outside the umbilical suture. The second and third auxiliary saddles are also bipartite. A fourth auxiliary saddle is divided by the umbilical suture, when the outer whorl reaches a height of 20 mm.

Locality, number of specimens examined.—Spiti Valley, 3, coll. Asiatic Society of Bengal (among them Blanford's type-specimen); Shalshal Cliff near Rimkin Paiar Encamping Ground, 4, coll. Diener; Bambanag Cliffs, Girthi Valley, Johár, 1, coll. Diener.

Remarks.—In a later memoir Blanford erroneously identified *P. Gerardi* with *P. cognatus* Oppel,[1] a view which was accepted by Stoliczka. *P. cognatus* belongs, however, to the group of *P. Stachei*, v. Mojs., as was pointed out by E. v. Mojsisovics, and may be easily distinguished from this species by its broadly rounded siphonal part and the absolutely different arrangement of the lobe-line. Beyrich went still further in uniting not only all the different species of Himálayan *Ptychites*, established by Oppel, but even some forms from the European Muschelkalk in one single species, which he called *Ammonites Gerardi.*

The two ammonites figured by Salter[2] as *Ammonites Gaytani* are probably young specimens of *P. Gerardi*, judging from the arrangement and shape of their sutures.

No allied form of *P. Gerardi* has hitherto been discovered, neither among the Mediterranean, nor among the Indian congeneric species.

ε. Group of the PTYCHITES OPULENTI.

14. (1) Ptychites Everesti, Oppel. Pl. XIX. fig. 1; Pl. XX., fig. 1, 6.

1863. *Ammonites Everesti*, Oppel: Palæontolog. Mitthlgn. I. Taf. 81. fig. 1, 2, p. 284.
1865. *Ammonites Everesti*, v. Hauer: Die Cephalopoden der unteren Trias der Alpen. Sitzgsber. Kais. Akad. d. Wissensch. Wien, Math. Nat. Cl. LII. Bd. p. 639.
1867. *Ammonites Gerardi*, Beyrich, *ex parte*: Ueber einige Cephalopoden aus dem Muschelkalk der Alpen, etc. Abhandlgn. Koenigl. Akad. d. Wiss. Berlin 1866. p. 126.
1882. *Ptychites Everesti*, E. v. Mojsisvics: Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. p. 260.

Dimensions.	I. (Pl. XIX. f. 1)	II. (Pl. XX. f. 2).
Diameter of the shell	168 mm.	63 mm.
Height of the outer whorl	75 „	32 „
Thickness „ „ „ „	85 „	41 „
Diameter of the umbilicus	37 „	12 „

This form is closely allied to the European representatives of the "*Opulenti*" group from the Alpine Muschelkalk, but differs in the sculpture of its shell and the acutely rounded siphonal part.

[1] Oppel's type-specimen. [2] Palæontology of Niti, p. 106. [3] Ibid. Pl. 7, fig. 7, 8.

The section of the outer whorl is almost triangular, similar to that of *P. Gerardi*, but the latter has considerably higher and more compressed whorls. The maximum thickness of the whorls coincides with the umbilical margin, from which the slightly convex sides converge towards the acutely rounded siphonal part, which in young individuals is sometimes even sharpened. In *P. Gerardi*, as I have mentioned before, just the opposite development takes place, the siphonal part being rounded at an early stage of growth, but becoming sharper in adult individuals.

The deep umbilicus is bordered by a steep inner wall. The steepness increases in proportion to the stage of growth. In very large specimens (Pl. XIX. fig. 1) the umbilical wall is quite perpendicular in the last whorl, whereas it is steeply inclined in the inner volutions. The involution takes place exactly at the umbilical margin, the inner volutions being only defined inside the umbilicus by a screw-shaped, spiral line. In young specimens the umbilical margin is, as a rule, more definitely rounded than at later stages of growth. In large specimens it is always sharper although never edged.

F. v. Hauer describes the sculpture of the shell as consisting of radial grooves or furrows, which rising close outside the umbilical margin are indeed a much more characteristic element of its sculpture than the interstices between them. But even the latter are more or less of the shape of folds or ribs, and more so, than in any of the *Ptychites* of the "*Opulenti*"-group from the Alpine Muschelkalk. In Oppel's type-specimen the number of folds, in the last volution, is 11, whereas it is 14 in the specimen from Rimkin Paiar, figured in Pl. XIX., corresponding to a diameter of the shell of 168 mm. The broad, deep grooves disappear near the siphonal part, differing in this respect from the European *P. opulentus*, v. Mojs. [1] and *P. progressus*, v. Mojs.,[2] in which they pass across the siphonal part. The intervals between the grooves, corresponding to folds, are proportionately narrower near the umbilical margin, but broaden out considerably towards the siphonal margin.

The shell, as far as preserved, is covered with numerous wrinkly striations, which, though somewhat wavy, run generally parallel to the folds.

Sutures.—In *P. Everesti* the peculiar shape and arrangement of the sutures in the group of the *P. opulenti* is well exemplified. The principal lateral lobe is divided at its base by a large central point, causing it to terminate in two equal-sized digitations. The remaining lobes end in single terminal, with corresponding lateral, digitations, being each divided at their base by two large, converging points. The tops of the saddles are bipartite, the saddles themselves being shaped symmetrically.

From the sutures of *P. progressus*, which E. v. Mojsisovics believes to be most closely allied to our form among all the species of the Mediterranean Muschelkalk, the lobe-line of *P. Everesti* differs especially by a higher siphonal

[1] Abh. k.k. Geol. Reichsanst. Pl. LXXIII, fig. 1, 2, 3, 4, p. 259.
[2] l. c. pl. LXVII, fig. 4, 6, p. 259.

saddle. The siphonal lobe is very short and narrow. The vertical projection of the outline of the penultimate whorl meets the third lateral lobe in the outer volution. Third lateral saddle bipartite, and terminates in two symmetrical branches. One auxiliary lobe and saddle outside the umbilical margin.

Locality, number of specimens examined.—Shangra, E. of Poling, Hundés, 2, Coll. Schlagintweit, from the Palæontological Museum in Munich (among them Oppel's type-specimen); Shalshal cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener; Spiti, 1, Coll. Schlagintweit from the Palæontological Museum in Munich.

15. (2) PTYCHITES VIDURA nov. sp. Pl. XX., fig. 2, 3, 4, 5.

1882. *Ptychites nov. sp. ex aff. Pt. Everesti*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. p. 260.

Dimensions.	I. (Pl. XX. f. 4.)	II. (Pl. XX. f. 3.)
Diameter of the shell	50 mm.	66 mm.
Height of the outer whorl	25 „	34 „
Thickness „ „ „ „	26 „	31 „
Diameter of the umbilicus	10 „	11 „

Mojsisovics compared this species with *P. opulentus* v. Mojs. from the Muschelkalk of the Schreyer Alpe, but it differs therefrom chiefly by its more compressed whorls and its remarkable sculpture. The difference in the proportions of the last whorl is already noticeable at early stages of growth. Whereas in *P. opulentus* height and thickness of the last whorl become equal when the volution reaches a height of 34 mm; there are specimens among my material of this species, in which the volutions become higher than thick, even when the height of the last whorl reaches 20 mm only (Pl. XX. fig. 5). The specimen figured Pl. XX. fig. 4, is distinguished by a proportionately thick transverse section, but yet it is still more compressed, than individuals of *P. opulentus* with an equal height of the last whorl.

The wide and funnel-shaped umbilicus is surrounded by an obliquely inclined inner wall, which is separated from the sides by a rounded umbilical margin.

The sculpture consists of numerous, straight ribs which pass across the siphonal part. Stronger alternate with weaker folds, but not in a regular series.

Sutures.—Agree almost entirely with those of *P. opulentus*, the saddles being only very little broader. Nor do the lateral branches cut so deeply into the stems. Siphonal saddle very short and bulky. Third lateral saddle bipartite. The first auxiliary saddle coincides with the umbilical margin.

Locality, number of specimens examined.—Spiti, 1, Shangra, Hundes, 7; all from the coll. Schlagintweit in the Palæontological Museum in Munich.

16. (3) PTYCHITES DRONA nov. sp. Pl. XVI., fig 3.

Dimensions	
Diameter of the shell	65 mm.
Height of the last whorl	33 „
Thickness „ „ „ „	35 „
Diameter of the umbilicus	15 „

Ptychites Drona differs from the two other Indian species of this group by its globose shape and the broad rounded siphonal area. The outlines of the shell and the proportions of the last whorl recall *P. rugifer*, Oppel, but our form possesses three lateral lobes and its sutures are characterised by an arrangement peculiar to the group of the *P. opulenti*.

The umbilical margin is rather rounded, but sharply defined; umbilicus comparatively wide and umbilical walls high and steep. The involution takes place close to the umbilical margin; the inner volutions are exposed inside the umbilicus in the shape of a very narrow spiral band.

The surface of the shell is covered with numerous, delicate folds, which cross the sides and the siphonal part in the shape of rings. There are 22 of them in the last whorl.

Sutures.—The sutural line recalls the characters peculiar to the group of the *P. opulenti*. The siphonal saddle is even shorter than in *P. progressus*, v. Mojs. Both the second and the third lateral saddles end in two terminal branches, which, however, are not very strongly individualised. One auxiliary lobe outside the umbilical margin. The latter divides the first auxiliary saddle, when the last whorl reaches a height of 20mm. Two auxiliary lobes and an equal number of simple auxiliary saddles outside the umbilical suture.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 1, coll. Diener.

ζ. Group of the PTYCHITES FLEXUOSI.

17. (1) PTYCHITES COCHLEATUS, Oppel PL. XVII., fig. 3.

1865. *Ammonites cochleatus*, Oppel: Palaeontologische Mittheilgn. I Taf. 85, fig. 1, p. 294.

1865. *Ammonites Studeri*, v. Hauer, *ex parte*: Die Cephalopoden der unteren Trias der Alpen, Sitzgsber. Kais. Akad. d. Wiss. Wien LII. Bd. I. Abth. p. 629.

1867. *Ammonites Gerardi*, Beyrich, *ex parte*: Ueber einige Cephalopoden aus dem Muschelkalk der Alpen etc. Abhandlgn. Koenigl. Akad. d. Wiss. Berlin 1866, p. 127.

1882. *Ptychites cochleatus*, E. v. Mojsisovics.: Die Cephalopoden der Mediterranen Triasprovinz Abh. k.k. Geol. Reichsanst. Vol. X. p. 261.

Dimesions.

Diameter of the shell	85 mm.
Height of the last whorl	45 „
Thickness „ „ „ „	38 „
Diameter of the umbilicus	15 „

The group of *Ptychites flexuosi* is represented in the Indian Muschelkalk by a form, which is closely allied to *P. Studeri*, v. Hauer, from the *Binodosus*—beds of the Mediterranean Triassic province. It has already been mentioned by E. v. Mojsisovics, that the Indian form differs in having thicker volutions and in the shape of its umbilicus. The latter is much wider than in *P. Studeri*, is funnel-shaped and surrounded by a high, obliquely inclined inner wall. The involution takes place quite close to the umbilical margin, and the umbilical walls of the inner volutions are arranged in one and the same plane. Inside the umbilicus the inner volutions are therefore only visible as a spiral line. The maximum thickness

of the whorls coincides with the umbilical margin. From this the slightly convex sides slope gently towards the rounded siphonal part.

The sculpture consists of radial folds, of which there are 18 to 20 on the last volution (whereas there are 22 to 24 in *P. Studeri*). In none of my specimens have I noticed a backward curved convexity in these folds near the siphonal margin, as is the case in *P. Studeri*. In both species, however, broad folds reach close to the umbilical margin, whilst less prominent, secondary ribs occur between them. None of the folds actually reach the umbilical margin proper. They also die out near the siphonal part, which remains perfectly smooth.

All my specimens are entirely chambered.

Sutures.—The vertical projection of the outline of the penultimate whorl meets the outer margin of the third lateral saddle in the outer whorl. Shape and arrangement of the sutural line almost agree with those in *P. Studeri*. Siphonal lobe very short and small, provided with a high siphonal tubercle. The principal lateral lobe is divided at its base into two symmetrical digitations by a larger point, as in *P. Studeri*. The following lobes end in a single terminal digitation, bordered symmetrically by lateral branches on each side. When the outer whorl reaches a height of 27mm the second auxiliary lobe coincides with the umbilical margin. Three auxiliary lobes and an equal number of bipartite auxiliary saddles outside the umbilical suture. The small narrow siphonal saddle is situated on the siphonal part.

Siphuncle.—In my two specimens from Rimkin Paiar I have been able to observe the narrow, horny siphuncle, provided only with single longitudinal fibres. Its structure agrees with the description given by E. v. Mojsisovics of the siphuncle of his species *P. Nordenskjoeldi*.[1]

Locality, number of specimens examined.—Kuling, Spiti, 1, coll. Schlagintweit, from the Palæontological Museum in Munich (Oppel's type-specimen); Shalshal cliff near Rimkin Paiar Encamping Ground, 2, coll. Diener; west slope of the Silakank Pass (Painkándha), 1, coll. Griesbach, Geological Museum in Calcutta.

18. (2) PTYCHITES MAHENDRA nov. sp. Pl. XVI., fig. 1, 2.

1865. *Ammonites Studeri*, Stoliczka: Mem. Geol. Surv. of India, Vol. V, Pt. I, p. 55.

Dimensions.	(Fig. 1.)
Diameter of the shell	107 mm.
Height of the outer whorl	58 „
Thickness „ „ „ „	30 „
Diameter of the umbilicus	10·5 „
Diameter of the umbilicus of the cast	12 „

This species, which according to the number of its lateral lobes belongs to the '*Flexuosi*''-group, recalls in its general shape and involution *P. flexuosus*, E. v. Mojs.,[2] from the Mediterranean Muschelkalk.

P. Mahendra has a flat, discoidal shell, a narrow, highly rounded siphonal part,

[1] Neues Jahrb. f. Miner. 1885, Vol. II. p. 151.

[2] Abh. k.k. Geol. Reichsanst. Vol. X, Pl. LXIII, fig. 2-8; Pl. LXIV, fig. 1, 2, 3; Pl. LXVI, fig. 2, 3, p. 261.

and a funnel-shaped umbilicus, surrounded by an obliquely inclined inner wall. The umbilicus is narrower than in *P. cochleatus*, Oppel. The involution does not take place exactly at the umbilical margin. The inner volutions are exposed inside the umbilicus in the shape of narrow spiral bands, as in *P. Studeri*.

The transverse section of the two specimens of *P. Mahendra* resembles that of the flat, compressed variety of *P. flexuosus*, v. Mojs. The greatest thickness of the outer whorl about coincides with the middle portion of the sides. From this region the sides slope with a gentle convexity towards the siphonal part and to the somewhat rounded, though well-defined, umbilical margin.

The last volution possesses about 15 broad and flat ribs which rise exactly outside the umbilical margin and run in a straight and almost radial direction as far as the middle portion of the lateral parts. In the outer portion of the sides they are bent into a more or less strongly marked falciform curve with its convexity turned backwards, as in *P. flexuosus*. In the specimen from Muth (fig. 1) this flexuous curve of the folds in the upper portion of the sides corresponds with a height of the outer whorl of only 25 mm. On the inner volutions of my specimen from Rimkin Paiar with an equal height of the outer whorl, are perfectly straight ribs. It is only in the last volution that a slight falciform curve of the folds in the outer portion of the sides may be observed.

The rather well preserved shell is covered by numerous thin radial striations parallel to the direction of the folds; they are wrinkly and somewhat wavy, as in *P. flexuosus*. The growth-lines are bent forward obliquely on the inner wall of the umbilicus.

Sutures.—The vertical projection of the outline of the penultimate whorl meets the apex of the third lateral saddle on the outer whorl. The sutures of *P. Mahendra* differ from the lobe-line of *P. flexuosus* by more elongated and slender saddles and by the remarkable size of the siphonal saddle, which surpasses the second lateral saddle in height. The siphonal lobe is short and provided with a high pyramidal, denticulated siphonal tubercle. Five auxiliary lobes. Third auxiliary saddle bipartite.

Locality, number of specimens examined.—Muth, Spiti, 1, Coll. Geol. Survey Museum in Calcutta (Stoliczka's type-specimen); Shalshal Cliff near Rimkin Paiar Encamping Ground, 1, Coll. Diener.

Family: *ARCESTIDÆ*.

Sub-family: LOBITINÆ.

Genus: LOBITES. E. v. Mojsisovics.

The presence in the Muschelkalk of the Himálayas of the genus *Lobites* v. Mojs. appears as doubtful as that of the genus *Isculites* v. Mojs. The only hitherto known specimen of *Lobites Oldhamianus*, Stol., which represents this genus in the Indian Triassic province, has been collected in a dark limestone of unknown age at

Lilang on the Lingti River in Spiti. To judge from the matrix of the fossil I am rather disposed to refer it to upper triassic beds, than to Muschelkalk. Nor has the genus *Lobites* been met with in the Mediterranean Triassic province in lower horizons than in the Wengen beds of southern Tyrol, where it forms part of the Norian stage.

LOBITES OLDHAMIANUS Stoliczka. Pl. XXVII., fig. 4.

1865. *Clydonites Oldhamianus* Stoliczka: Mem. Geol. Surv. of India, Vol., Pt. I. p. 50; Pl. IV. fig. 4.

1873. *Lobites Oldhamianus*, E. v. Mojsisovics: Das Gebirge um Hallstatt I. Th., Abhandlgn. K. K. Geolog. Reichs-Anstalt, Bd. VI, p. 156.

1892. *Lobites Oldhamianus* E. v. Mojsisovics: Vorläufige Bemerkungen über die Cephalopoden-Faunen der Himalaya Trias; Sitzgsber. Kais. Akad. d. Wiss., Wien Bd. CI., 1. Abthlg. p. 376.

Dimensions.

Diameter of the shell	27 mm.
Height of the outer whorl	13 „
Thickness „ „ „ „	20 „
Diameter of the umbilicus	3 „

This specimen consists of a cast which unfortunately is entirely chambered. In the absence of the body-chamber a satisfactory diagnosis of the species is therefore impossible, and it is an open question, to which of the Mediterranean groups *Lobites Oldhamianus* may be most closely allied.

Characteristic of this species, besides its considerable size, is the very thick globose shape, with broad section of the last whorl and the proportionately wide open umbilicus, surrounded by a tolerably high, steeply inclined inner wall.

The sculpture consists of numerous, delicate radial ribs, which are partly single and partly rise in pairs from near the umbilical margin. On the sides, some of these ribs become dichotomous.

Sutures.—The septa are remarkably distant even in the outer volution. The arrangement of the sutural line recalls *L. ellipticus* v. Hauer. [1]

Two lateral lobes as in the congeneric species of the Mediterranean Triassic province. Siphonal lobe terminates in two points, provided with a broad siphonal tubercle. The remaining lobes lanceolate. The saddles are strongly contracted at their base. The principal lateral saddle is remarkably small. Two auxiliary lobes and an equal number of auxiliary saddles. The broad second auxiliary saddle is divided by the umbilical suture.

Locality, number of specimens examined.—Lilang, Spiti, 1, Coll. Geolog. Survey Museum in Calcutta (Stoliczka's type-specimen).

Sub-family: ARCESTINÆ

Genus: PROARCESTES, E. v. Mojsisovics.

In the Himálayan Trias the sub-family of the *Arcestinæ* plays a far inferior roll than in the equivalent Mediterranean deposits. This fact is very clearly seen in the Upper Trias of the Himálayas, where the genus *Arcestes* is extremely poor in

[1] E. v. Mojsisovics, Das Gebirge um Hallstatt I. Th. l. c. Taf. LXIX, fig. 3, p. 161.

number of species, as well as in individuals. A similar remark applies to the geologically older genus *Proarcestes* which is represented in the Indian Muschelkalk by only two species; one of them *Proarcestes Balfouri*, Oppel, belonging to the European group of *Proarcestes Bramantei*, v. Mojs.

1. Proarcestes Balfouri Oppel. Pl. XXVII., fig. 6, 7.

1863. *Ammonites Balfouri*. Oppel: Palæontologische Mitth. I. Taf 80. fig. 5, p. 285.
1865. *Ammonites Ausseanus*, Stoliczka *ex parte*: Mem. Geol. Survey of India, V. Pt. I. p. 53.
1882. *Arcestes Balfouri*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. 162.

Dimnesions.	I.	II.
Diameter of the shell	59 mm.	47 mm.
Height of the last whorl	27 „	21 „
Thickness „ „ „ „	45 „	37 „
Diameter of the umbilicus	4 „	?

Mojsisovics noticed the very close resemblance, which this form bears to *Proarcestes Escheri*, v. Mojs., [1] from the Muschelkalk of the Schreyer Alpe (Salzkammergut). This resemblance is so great, that the question, whether these forms are not altogether identical, will have to remain open till specimens of *P. Balfouri* with body-chamber are found.

Besides Oppel's entirely chambered type-specimen, I possess a second specimen from the Tsang-Tsok-La in Hundés for description, of which nearly one half of the outer volution belongs to the body-chamber. Even this specimen, however, is not in a good enough state of preservation to decide the question raised by E. v. Mojsisovics, as the deep contractions, so characteristic in *Proarcestes Escheri* are only found in the anterior part of the body-chamber of full-grown individuals. In the preserved portion of the body-chamber and in the inner volutions neither *labiae* nor *varices* are seen. The surface of the cast is perfectly smooth. The only difference between the two forms seems to consist in a greater thickness of the outer whorl in *Proarcestes Balfouri*.

In the specimen from the Tsang-Tsok-La an open umbilicus is associated with a diameter of 59 mm.

The shell is partly preserved in Oppel's type-specimen and is seen to be covered with very numerous and delicate transverse striations, which run from the umbilicus across the sides in a forward bent direction and pass across the siphonal area in a straight line.

Sutures.—Perfectly identical with those of *P. Escheri*, even in the minor details of ornamentation. Three auxiliary lobes outside the umbilical margin.

Locality, number of specimens examined.—Dras (?), Hundés (locality somewhat doubtful), 1, Coll. Schlagintweit, from the Palæontological Museum, Munich (Oppel's type-specimen), Tsang-Tsok-La, Hop Gádh, Hundés, 1, Coll.

[1] l.c. Taf. XLVI. fig. 7, 8, 9. p. 162 and Das Gebirge um Hallstatt I. Theil Abh. kk. Geol. Reichs. Vol. VI. Pl. LVIII. fig. 18, p. 112.

Griesbach, Geological Survey Museum, Calcutta; Lilang, Spiti, 1, Coll. Stoliczka, Geological Survey Museum, Calcutta.

2. Proarcestes bicinctus E. v. Mojs. Pl. XXVIII. fig. 1.

1865. *Ammonites diffissus*, Stoliczka: Geol. Surv. of India, Vol. V. Pt. I. p. 53; Pl. V. fig. 4.
1882. *Arcestes bicinctus*, E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. p. 167.

Dimensions.

Diameter of the shell	39 mm.
Height of the outer whorl	19 „
Thickness „ „ „ „	37 „
Diameter of the umbilicus	6·5 „

Stoliczka identified this form erroneously with *Jcannites diffissus*, v. Hauer. Its relationship to the genus *Arcestes viz.*, *Proarcestes*, was first noticed by Mojsisovics, who in 1873 [1] proved that the forms identified with *Ammonites diffissus* by Salter and by Stoliczka[2], differ from the genuine *Joannites diffissus*, v. Hauer, and from each other. Mojsisovics proposed the name *Proarcestes bicinctus* for this form on the ground of Stoliczka's figure of its sutural line. This figure however, does not give a correct idea of its sutural elements, as may be easily seen from a comparison with Pl. XXVIII. fig. 1c.

The only specimen which serves for description—Stoliczka's type-specimen—is but imperfectly preserved and not sufficient for a satisfactory diagnosis of the species. It is scarcely worthy to be distinguished by a specific name. Only the posterior part of the body-chamber is preserved, including about one-fourth of the last volution. Thus it cannot be decided, to which of the Mediterranean groups of *Proarcestes* this species belongs.

P. bicinctus, E. v. Mojs., may be said to be chiefly characterised by the extraordinary thickness of the outer whorl, which is almost equal to the diameter of the species, the contractions in the last volution and a comparatively wide and deep umbilicus, bordered by a high, perpendicular inner wall. Umbilical margin rounded. Only one flat contraction is seen in the last whorl immediately before the posterior termination of the body-chamber. It reaches from the umbilical margin across the lateral parts, but becomes obsolete in the siphonal area.

Shell not preserved.

Sutures.—Neither the siphonal lobe nor the siphonal saddle could be traced. The most important elements for a comparison with the sutural lines of Mediterranean *Arcestinæ* are therefore wanting. Saddles less richly ramified than in the group of *P. Bramantei* v. Mojs. The vertical projection of the outline of the penultimate whorl meets the inner margin of the second lateral saddle of the outer volution. Three auxiliary lobes outside the umbilical suture, which divides the third auxiliary lobe.

Locality, number of specimens examined.—Lilang, Spiti, 1, Coll. Geological Survey Museum in Calcutta (Stoliczka's type-specimen).

[1] Das Gebirge um Hallstatt I. Theil. l.c. p. 86.
[2] Palæontology of Niti, p. 64 Pl. 7, fig. 3.

NOV. GENUS IND. EX. FAM. ARCESTIDARUM sp. ind. Pl. XXVIII. fig. 2, 3.

Dimensions.	
Diameter of the shell	27 mm.
Height of the outer whorl	15 „
Thickness „ „ „ „	28 „
Diameter of the umbilicus	0 „

This form differs so considerably from *Proarcestes* in some of its essential characters, especially in the complete absence of *labiæ* or *varices*, and in the shape of its sutures, that it cannot be left in this genus.

The type of *Arcestinæ* is principally shown in its outlines. It is very globose similar to *P. bicinctus*, v. Mojs., but the volutions overlap still more closely and are so thick, that the width of the outer whorl amounts to almost double its height. The siphonal area is obtusely rounded. The sides are almost smooth provided only with very delicate spiral striations.

The umbilicus is closed by a callosity. Neither *labiæ* nor *varices* have been noticed in my specimens, although in one of them, the body-chamber is almost entirely preserved.

The body-chamber consists at least of one and a half volutions. The last volution does not differ in its shape from the inner ones.

Sutures.—The arrangement of the sutural elements is the same as in *Proarcestes*, but the saddles are distinguished by their extraordinary slenderness. Their stems do not divide into horizontal, bifurcating branches, as in *Proarcestes*, but are dolichophyllic and terminate in a pointed sphærophyllic foliation, as they do in the representatives of the genus *Monophyllites*.

This form has only two auxiliary lobes.

Locality, number of specimens examined.—Shalshal cliff near Rimkin Paiar Encamping Ground, 2, coll. Diener.

Remarks.—The shape of the saddles is so entirely different from that of any species of *Proarcestes*, that this form must undoubtedly be considered to hold an independent generic position. Unfortunately my material is too poor to allow more than a statement of this fact.

II. NAUTILEA.

Family: *NAUTILIDÆ.*

Sub-family: NAUTILINÆ.

Genus: NAUTILUS, Breynius.

1. NAUTILUS GRIESBACHI nov. sp. Pl. XXVIII., fig. 6, 7.

Dimensions.	I. (fig. 7.)	II. (fig. 6.)
Diameter of the shell	88 mm.	49 mm.
Height of the outer whorl	49 „	25 „
Thickness „ „ „ „	27 „	19 „
Diameter of the umbilicus	17 „	11 „

This species has rapidly increasing volutions, which overlap each other to the extent of more than half their height. The greatest thickness of the outer whorl coincides with the umbilical margin. The umbilical margin is slightly rounded and separated from the umbilical suture by a high and perpendicular inner wall. The siphonal area is flatly rounded. The elliptical shape of the figured specimens is probably due to later deformation in the matrix.

The shell, as far as it could be examined, is smooth and provided with simple striae of growth.

Sutures.—Lateral lobe deeply sinuous, rounded below, siphonal lobe very shallow. Internal lobe present.

Siphuncle.—Below the centre of the septum.

Remarks.—Among the *Nautili* of the Alpine Muschelkalk, *N. Palladii* v. Mojs.,[1] is very closely allied to this species. *N. Griesbachi*, however, has more compressed whorls, a higher aperture and a deep umbilicus, surrounded by a perpendicular inner wall.

Locality, number of specimens examined.—North of Kalapani, Kali River Valley, Byans, 3, coll. Griesbach, Geological Survey Museum, Calcutta.

2. Nautilus sp. ind. ex aff. N. Griesbachi, Pl. XXVIII., fig. 4.

The figure refers to a fragment from the Muschelkalk of the Shalshal cliff near Rimkin Paiar Encamping Ground, which belongs to a *Nautilus* closely allied to the preceding species. The arrangement of the sutures agrees almost entirely. The siphonal area is flat and is more distinctly separated from the lateral parts than in *Nautilus Griesbachi*. The principal difference consists in the greater thickness of the outer whorl which is equal to the height of the volution, *i.e.* 46 mm.

3. Nautilus Spitiensis Stoliczka. Pl. XXVIII., fig. 5.

1865. *Nautilus Spitiensis* Stoliczka: Mem. Geol. Surv. of India. V. Pt. I. p. 49, Pl. IV. fig. 2.
1882. *Nautilus Spitiensis* E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. p. 286.

Dimensions.

Diameter of the shell	42mm.
Height of the outer whorl	18 „
Thickness „ „ „ „	16 „
Diameter of the umbilicus	12 „

This species is nearly allied to the Alpine *N. Lilianus*, which was pointed out by E. v. Mojsisovics.[2] It has slowly increasing volutions which scarcely overlap, flat and parallel sides, a broadly rounded siphonal area and a wide umbilicus, bordered by a steep inner wall. The umbilical margin is rounded. Transverse section sub-angular.

The shell consists of only two volutions. The outer whorl contains the posterior termination of the body-chamber.

[1] Abh. k.k. Geol. Reichsanst. Vol. X. Pl. XCII. fig. 2, p. 285.
[2] Abh k.k. Geol. Reichsast. Vol. X. LXXXII. Pl. fig. 3, 4, p. 286.

The shell, which is but partly preserved, is covered with numerous, thin transverse striæ.

Sutures.—The septa are comparatively close to each other and pass in an almost straight line across the siphonal area. The deepest point of the distinctly defined but shallow, lateral lobe, coincides with the middle of the sides. Internal lobe present.

Siphuncle.—Above the centre of the septum.

Locality, number of specimens examined.—Lilang, Spiti, 1, Geological Survey Museum, Calcutta,—Stoliczka's type-specimen.

Family. *ORTHOCERATIDÆ.*

Genus ORTHOCERAS Breynius.

1. Orthoceras cf. campanile, E. v. Mojsisovics. Pl. XXVIII., fig. 8.

1882. *Orthoceras campanile* E. v. Mojsisovics: Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Vol. X. p. 291, Taf. XCIII. fig. 1, 2, 3, 4, 11.

The only somewhat better preserved specimen of *Orthoceras* which I collected in the Himálayan Muschelkalk, agrees in all essential characters with *Orthoceras campanile* from the Mediterranean Trias as far as an exact determination is possible. Central position of the siphuncle and closely situated septa characterise our specimen. The distance of the different septa from each other equal to two-thirds of the diameter of the lower chamber. To a diameter of the last preserved septum of 12·5mm, corresponds a height of the lower chamber of 9·5mm.

Angle of emergency about 4°. Shell not preserved.

Locality, number of specimens examined.—Southern slope of the Uta-Dhura Pass (Johár), 1, Coll., Diener.

2. Orthoceras sp. ind. ex. aff. O. Campanile, v. Mojsisovics Pl. XXVIII. fig. 10.

1865. *Orthoceras dubium* Stoliczka, Mem. Geolog. Survey of India, Vol. V. Pt. I p. 48.

Among the Triassic Cephalopoda in the collection of the Geological Survey Museum in Calcutta, there are a good many chambered fragments of an *Orthoceras*, which Stoliczka erroneously identified with *Orthoceras dubium*, v. Hauer. This *Orthoceras* apparently agrees with *Orthoceras campanile*, v. Mojs.[1] in some of its essential characters, but differs therefrom by a lesser distance between the septa being only equal to one-half of the diameter of the preceding chamber.

Transverse section circular. Siphuncle central, only in consequence of later deformation apparently eccentric in the figured specimen. Shell not preserved.

Locality, number of specimens examined.—Parang Pass (Spiti), 2, Lilang, Spiti, 1, coll. Geological Survey Museum in Calcutta; Shalshal cliff near Rimkin Paiar encamping ground, 1, Coll. Diener.

Remarks.—The fragments, identified with *Orthoceras lateseptatum*, v. Hauer,

[1] l. c. p. 291.

and with *Orthoceras salinarium* by Stoliczka[1] are too badly preserved to permit specific determination.

DIBRANCHIATA.

Family: *BELEMNITIDÆ.*

Sub-family: AULACOCERATINÆ.

Genus ATRACTITES, Gümbel.

ATRACTITES sp. ind. Pl. XXVIII. fig. 9.

In order to prove that *Atractites* occurs in the Muschelkalk of the Central Himálayas, I have figured the fragment of a chambered phragmocone from the Parang Pass in Spiti.

Phragmocone with a circular section and with an angle of divergency of about 15°. Septa close to each other and running straight across the ventral side. Their distance is considerably less than half the diameter of the preceding chamber.

Shell smooth, as far as preserved.

Locality, number of specimens examined.—Parang Pass, Spiti, 2, Coll. Geological Survey Museum in Calcutta.

FAUNISTIC RESULTS.

The fauna of the cephalopoda of the Muschelkalk in the main region of the Himálayas comprises the following forms:—

1. *Ceratites Wetsoni*, Oppel.
2. „ *sp. ind. ex aff. C. Wetsoni.*
3. „ *Voiti* Oppel.
4. „ *Ravana*, Diener.
5. „ *nov. sp. ind. ex aff. C. Ravana.*
6. „ *nov. sp. ind. ex aff. C. Ravana.*
7. „ *Airavata*, Diener.
8. „ *nov. sp. ind.*
9. „ *Hidimba*, Diener.
10. „ *sp. ind. ex aff. C. Hidimba.*
11. „ *Dungara*, Diener.
12. „ *Visvakarma*, Diener.
13. „ *Arjuna*, Diener.
14. „ *onustus* Oppel.
15. „ *Vyasa*, Diener.

[1] l. c. p. 4.

16. *Ceratites sp. ind. ex aff. C. Vyasa.*
17. „ *nov. sp. ind. ex aff. C. Zoldiano*, v. Mojs.
18. „ *Thuillieri*, Oppel.
19. „ *Himalayanus*, Blanf.
20. „ *Kamadeva*, Diener.
21. „ *Kuvera*, Diener.
22. „ *truncus*, Oppel.
23. „ *nov. sp. ex aff. C. subrobusto*, v. Mojs.
24. „ *sp. ind. ex aff. C. Middendorfi*, Keyserl.
25. „ *nov. sp. ind. ex aff. C. Geminato*, v. Mojs.
26. „ *sp. ind. ex aff. C. Geminato* (?).
27. *Danubites Dritarashtra*, Diener.
28. *Japonites Sugriva*, Diener.
29. „ *Chandra*, Diener.
30. „ *runcinatus*, Oppel.
31. *Acrochordiceras Balarama*, Diener.
32. „ *Joharense*, Diener.
33. *Sibirites Prahlada*, Diener.
(?) 34. *Isculites Hauerinus*, Stoliczka.
35. *Proarcestes Balfouri*, Oppel.
36. „ *bicinctus*, E. v. Mojs.
37. *Nov. genus ind. ex fam. Arcestidarum sp. ind.*
(?) 38. *Lobites Oldhamianus*, Stol.
39. *Meekoceras Khanikofi*, Oppel.
40. „ *Kesava*, Diener.
41. „ *proximum*, Oppel.
42. „ *Nalikanta*, Diener.
43. „ *Srikanta*, Diener.
44. „ *Narada*, Diener.
45. „ *affine*, E. v. Mojs.
46. „ *Nanda*, Diener.
47. „ *Gangadhara*, Diener.
48. „ *Rudra*, Diener.
49. *Gymnites Jollyanus*, Oppel.
50. „ *Vasantasena*, Diener.
51. „ *Kirata*, Diener.
52. „ *Salteri*, Beyrich.
53. „ *Sankara*, Diener.
54. „ *nov. sp. ex aff. G. Sankara.*
55. „ *sp. ind. ex aff. G. Humboldti*, v. Mojs.
56. „ *Lamarki*, Oppel.
57. *Buddhaites Rama*, Diener.
58. *Sturia Sansovinii*, E. v. Mojs.
59. *Ptychites rugifer*, Oppel.
60. „ *Tibetanus*, E. v. Mojs.
61. „ *Mangala*, Diener.
62. „ *Sukra*, Diener.
63. „ *cognatus*, Oppel.
64. „ *Asura*, Diener.

65. *Ptychites Govinda*, Diener.
66. „ *impletus*, Oppel.
67. „ *Sahadeva*, Diener.
68. „ *Sumitra*, Diener.
69. „ *Malletianus*, Stoliczka.
70. „ *nov. sp. ind. ex aff. P. Malletiano.*
71. „ *Gerardi*, Blanf.
72. „ *Everesti*, Oppel.
73. „ *Vidura*, Diener.
74. „ *Drona*, Diener.
75. „ *cochleatus*, Oppel.
76. „ *Mahendra*, Diener.
77. *Nautilus Griesbachi*, Diener.
78. „ *sp. ind. ex aff. N. Griesbachi.*
79. „ *Spitiensis*, Stol.
80. *Orthoceras cf. campanile*, E. v. Mojs.
81. „ *sp. ind. ex. aff. O. campanile.*
82. *Atractites* sp. ind.

The character of this fauna fully justifies the opinion of Beyrich, E. v. Mojsisovics, Griesbach a. o., who correlated the beds containing these fossils with the European Muschelkalk. The assemblage of species from these beds forms indeed a typical Muschelkalk fauna. One look at the representatives of the genera *Ceratites*, *Meekoceras*, *Gymnites*, and *Ptychites* is sufficient to prove the correctness of this view. The above list includes only two genera, *Lobites* and *Isculites*, confined to upper-triassic beds in the Alpine province, but I am not satisfied that these two forms were really obtained in the Muschelkalk of Spiti by Stoliczka.

In the fauna of the Himálayan Muschelkalk two species also occur elsewhere in beds of the same horizon, namely: *Sturia Sansovinii*, E. v. Mojs., the well-known leading fossil of the zone of *Ceratites trinodosus* in the Mediterranean Trias, and *Meekoceras affine*, E. v. Mojs., in the Muschelkalk of Mengilæch on the Olenek River in North-Eastern Siberia. Most probable is also the identity of an *Orthoceras* from the Utadhura pass in Kumaon, with *Orthoceras campanile*, v. Mojs., from the Upper Alpine Muschelkalk. Also *Proarcestes Balfouri*, Oppel may possibly be included in this list, as according to our present state of knowledge, no essential difference is known between this form and *Proarcestes Escheri*, v. Mojs., from the red limestone of the Schreyer Alpe (zone of *Ceratites trinodosus*).

As has already been observed by E. v. Mojsisovics[1] in 1886, the Muschelkalk of the Indian Triassic province takes an intermediate position between the Arctic-Pacific and the Mediterranean[2] Muschelkalk. This view is not only confirmed by

[1] Arktische Triasfaunen, Mém. de l' académie impér. des sciences de St. Pétersbourg, VII Sér. T. XXXIII, No. 6, p. 154.

[2] The term "Mediterranean" is here used in the same sense as by Neumayr, who speaks of a Central Mediterranean Sea of the Jurassic age. To this Jurassic Mediterranean Sea a similar Triassic Sea corresponds, which reached from the Ebro valley eastwards. The Alpine Trias is to be considered as a standard type of its deposits.

the present investigations, but it appears now even possible to trace out more completely the relations which connect the faunas of these three provinces during the Muschelkalk stage.

The relations with the Mediterranean Muschelkalk are most clearly indicated by the occurrence of numerous closely allied forms in the two areas belonging especially to the genera *Gymnites* and *Ptychites*. It has been said before, that *Sturia Sansovinii*, and probably also *Orthoceras campanile* and *Proarcestes Balfouri* (—*Escheri*= ?) are identical.

Among the *Ceratites* two species of the "*Nodosi*", *Ceratites Thuillieri*, Oppel and *Ceratites Himalayanus*, Blanf., are very closely allied to *Ceratites trinodosus*, v. Mojs. The *Ceratites nodosi*, it is true, play a rather subordinate roll in the Indian Triassic province and in number of species are far surpassed by the group of the "*Circumplicati*," comparatively rare in the Alpine Trias. But it is just among the latter that two isolated Alpine types, *Ceratites Erasmi*, v. Mojs., and *Ceratites Zezianus*, v. Mojs., are represented in the Himálayas by closely allied forms.

The only species of *Danubites* hitherto known from the Muschelkalk in the Central Himálayas, belongs to the Mediterranean group of *Danubites floriani*, v. Mojs.

In this respect the presence of the genus *Acrochordiceras* in the Indian Muschelkalk is equally remarkable, although neither of the two Indian species possesses a closer relationship to any form of the Alpine Trias. In the Arctic-Pacific province the genus *Acrochordiceras* is not known from beds of Muschelkalk age, but makes its first appearance in the lowest division of the Star-Peak-group of California and Nevada, considered by v. Mojsisovics as an equivalent of the Norian stage. In the Ceratite-beds of the Salt-range, forming part of the Indian Triassic province, the oldest representative of this genus has been found even in lower triassic[1] beds.

The genus *Meekoceras*, which is distinguished in the Indian Muschelkalk by its richness in forms, contains a considerable number of species, which are very closely allied to the Alpine *M. Reuttense*, Beyrich. Most of the numerous species of *Gymnites* also bear a close relationship to Mediterranean forms, especially to *Gymnites Humboldti*, v. Mojs., and *G. obliquus*, v. Mojs., and *G. incultus*, Beyrich. G. *acutus*, v. Hauer, from the upper Muschelkalk of Bosnia, which, till now, was isolated in the Mediterranean Trias, has an Indian ally in *G. Lamarki*, Oppel, which is equally distinguished by a sharpened siphonal area.

Among the *Ptychites* it is principally the group of the *Megalodisci*, in which the faunistic relations between the two zoo-geographical provinces are most distinctly marked. The Himálayan *P. Sumitra* differs from the Alpine *P. megalodiscus*, Beyrich, only in very subordinate details, whereas the two other Indian species of this group, *P. impletus*, Oppel, and *P. Sahadeva*, belong to the relationship of *P. Pauli*, v. Mojs. The group of the *Opulenti* is represented in the Himálayan Muschelkalk

[1] W. Waagen: Vorläufige Mittheilung über die Ablagerungen der Trias in der Salt-Range, Jahrbuch K. K. Geolog. Reichs-Anstalt 42. Bd., 1892, p. 380.

exclusively by forms closely allied to *P. progressus*, v. Mojs., or to *P. opulentus* v. Mojs., from the Upper Alpine Muschelkalk. Among the *Rugiferi*, *P. cognatus*, Oppel, has its nearest relation in *P. Stachei*, v. Mojs., from the *Trinodosus* beds of the Bakony forest in Hungary. In the group of the *Flexuosi* a relationship may be observed between *P. cochleatus*, Oppel, and *P. Studeri*, v. Hauer, on one hand, and between *P. Mahendra* and P. *flexuosus*, v. Mojs. on the other.

Among the *Nautilidæ* of the Himálayan Muschelkalk *N. Griesbachi*, is related to *N. Palladii*, v. Mojs., and *N. Spitiensis*, Stol., to *N. Lilianus*, v. Mojs

The faunistic relations between the Himálayan Muschelkalk and the Arctic-Pacific Trias are almost equally close. Most likely these relations would appear much more evident if we knew more of the cephalopod-bearing strata of the Muschelkalk of the latter province. Only the fauna of the *Daonella* limestone of Spitzbergen and the faunulæ from Mengilaech on the mouth of the Olenek river and from the Magyl rocks on the lower Jana, which are assumed to be equivalents of the European Muschelkalk, permit a direct comparison. The *Posidonomya* limestone of Spitzbergen represents probably a very low horizon of the Muschelkalk. The Olenek beds of Eastern Siberia with *Ceratites subrobustus*, v. Mojs., are homotaxial with the Werfen beds of the Alps, as was pointed out by v. Mojsisovics. In Western America the "*Meekoceras* beds" of Idaho approach the Olenek beds closely as regards their geological position. The Star-Peak-group of California and Nevada, as well as the cephalopod-bearing strata of the Sakawa basin and of Rikuzen in Japan, are considered by v. Mojsisovics ("Arktische Triasfaunen," l. c. p. 148, and "Ueber einige Japanische Trias-fossilien," Beiträge zur Palæontologie Osterreich-Ungarns und des Orients, Vol. VII, Wien 1888) to be a homotaxial equivalent of the Norian stage. According to more recent communications of A. Hyatt (Jura and Trias of Taylorville, California, Bulletin of the Geological Society of America, Vol. 3, Rochester, 1892, p. 395), however, the Trias in the Western States of North America seems to include several horizons of different ages. The cephalopod-bearing strata of the Star-Peak-Range itself (Humboldt Region, Nevada), Hyatt correlates with the Muschelkalk, although without giving decisive proofs for his suggestion. The Trias of Taylorville (California), on the contrary, contains a good number of Carnian and Juvavic types, pointing to a doubtless younger age. To judge from fossils lately described by J. F. Whiteaves, especially from the *Protrachyceras*, (Pl. XVIII, fig. 4, Contributions to Canadian Palæontology, Vol. I, Pt. II, Montreal, 1889, p. 127 ff,) the triassic fossiliferous rocks of British Columbia, Vancouver, and Queen Charlotte Islands may be approximately correlated with the Noric stage. A genuine Muschelkalk fauna has not been detected yet in the countries surrounding the modern Pacific Ocean.

I may at once state my opinion, based on the examination of the lower-triassic cephalopoda of the Himálayas, that apparently close faunistic relations exist between the lower Trias of the Himálayas and the Olenek beds of Siberia; *Ceratites subrobustus* v. Mojs., one of the leading species of the Siberian Trias, being present in the Himálayas below the Muschelkalk between the horizon of *Sibirites Prahlada*

and the *Otoceras* beds of Griesbach. If we knew a fauna of the *Muschelkalk* as rich in cephalopoda as that of the Olenek beds from the area of the Pacific basin, probably there might appear a much closer faunistic connection between the two neighbouring provinces than we are at present able to prove.

E. v. Mojsisovics emphasises the remarkable fact that the Mediterranean genus *Tirolites* is not present in these two regions.[1] The genus *Balatonites*, which is most probably derived from *Tirolites*, is missing in the Spitzbergen Muschelkalk, nor has it been found in the equivalent deposits of the Himálayas.[2] As regards the relations between the Indian and Arctic-Pacific Muschelkalk faunas, we must observe the predominance of the *Ceratites* of the *Circumplicati*-group, especially of forms derived from *Ceratites polaris*, v. Mojs., or allied species. With regard to this point, I may refer to my remarks in the introduction to the description of *Ceratites*. There are, moreover, some analogous species in the Himálayan Muschelkalk among the groups of *Ceratites subrobusti* and *Ceratites geminati* which are peculiar to the Trias of the Arctic-Pacific province. Most interesting is the presence of the subgenus *Japonites*, represented in the Himálayan Trias by three species, one of which (*Japonites Sugriva*) is very closely allied to *Japonites planiplicatus*, v. Mojs., from the triassic deposits of Japan. In the Mediterranean Triassic province the genus *Sibirites* makes its first appearance in beds of the Juvavic stage, but it is present in the lower triassic Olenek beds of Siberia. In the Himálayas it characterizes the lower division of the Muschelkalk, and in the Ceratite beds of the Salt Range it also occurs in numerous species, as may be seen from Waagen's preliminary notes.[3] The close relations of the Indian *Ptychites* of the *Rugiferi* group to the congeneric forms of the Spitzbergen Muschelkalk have been noticed by E. v. Mojsisovics in his paper on the Arctic fauna of the Trias,[4] and was shown more fully in the preceding descriptions of *Ptychites rugifer*, Oppel, and *Ptychites Tibetanus*, v. Mojs.

The presence of *Meekoceras affine*, v. Mojs., in the Muschelkalk of the Indian Triassic province is of still greater importance.

This species, which in its general shape and in the development of its sutures resembles closely the congeneric forms of the European Muschelkalk, was collected by Czekanowski in a dark limestone below Mengilaech, near the mouth of the Olenek river, together with *Hungarites triformis*, v. Mojs., and *Monophyllites sp. ind.*—E. v Mojsisovics, who examined Czekanowski's collections, suggested that this fauna occupies a higher geological position in the general sequence than the true Olenek beds.[5] This view was afterwards confirmed by the discovery of a cephalopod fauna in the Magyl rocks on the lower Jana by Baron E. Toll. This fauna is geologically younger than that of the Olenek beds, and according to its geological character

[1] Arktische Triasfaunen, l. c. p. 149.

[2] According to Waagen (Jahrb. K. K. Geol. Reichs. Anst. 42, Bd. 1892, p. 382), in the Bivalve beds of the Salt Range the genus *Balatonites* is probably represented, although by a rather doubtful species.

[3] L. c. p. 382.

[4] Arktische Triasfaunen, L. c, p. 142.

[5] L. c. p. 88, 96.

points to Muschelkalk age: it also contains *Meekoceras affine* v. Mojs., and *Hungarites triformis*[1]. The presence of *Meekoceras affine* in the true Muschelkalk of the Himálayas satisfactorily proves the correctness of this suggestion, which is based on palæontological evidence only.

It results from these facts that the Himálayan Muschelkalk forms a connecting link between the equivalent deposits of the Arctic-Pacific and Mediterranean provinces. It contains, however, a considerable number of peculiar faunistic elements which impart to the Indian Triassic province the character of a zoo-geographical region of its own.

To these faunistic elements peculiar to the Indian Trias belongs principally the strange group of *Gymnites Rama*, which appeared to me to justify the establishment of a special sub-genus (*Buddhaites*). In my description of this form I have pointed to its relationship with *Carnites*, hitherto likewise isolated in the Mediterranean Trias. Among these faunistic elements peculiar to the Indian Trias must be mentioned the groups of *Ptychites Malletianus*, Stol., and of *Ptychites Gerardi*, Blanf. representing types which differ completely from the *Ptychites* of the Mediterranean and Arctic-Pacific provinces. Among the *Ptychites* of the *Rugiferi* group I have to mention here *Ptychites Govinda* and *Ptychites Asura*. In the genus *Meekoceras* we meet two isolated forms—*Meekoceras Gangadhara* and *Meekoceras Rudra*. The first of them is distinguished by its obliquely sloping, serrated umbilical lobe; the second by a circular arrangement of its sutures. Among the *Ceratites circumplicati* there exists a great divergence between the form figured Pl. IV., fig. 4, which is but imperfectly known, and the rest of the Indian species of this group. The like applies to *Ceratites Kamadeva* in the group of the *Cerarites nodosi*. It has already been mentioned that none of the Indian representatives of the genus *Acrochordiceras* bears a closer relation to any of the Mediterranean congeneric species.

As to their number, the *Ceratites* play the most important roll in the Himálayan Muschelkalk. They are represented by 26 species, among which the *Circumplicati* (with 17 species) by far predominate, and thus show clearly the close relations to the Arctic-Pacific Trias. Remarkable in richness of forms are the genera *Meekoceras* and *Gymnites*. The first of these two genera, which appear already in the lower Trias of the Himálayas in several species, reaches here the height of its development (with ten species). *Gymnites* (with 8, or rather 9, species) and *Ptychites* are confined exclusively to the Himálayan Muschelkalk. The genus *Ptychites*, represented by 18 species, with exception of the *Subflexuosi*, comprises all the groups known hitherto in the Mediterranean Trias, and besides them two more, peculiar to the Indian province. Compared with the above mentioned genera, all the rest remain far behind. They are of importance, however, because in the Himálayas *Japonites*, *Acrochordiceras*, and *Sturia* are exclusively characteristic

[1] *E. v. Mojsisovics*, Ueber einige arktische Trias-ammoniten des nordlichen Sibirien, Mém. del'acad. impér. des sciences de St. Pétersbourg VII. sérn. T. XXXVI, No. 5, 1888, p. 20.

of the Muschelkalk, and have never been met with, either at a higher or at a lower horizon. The absence of the genus *Monophyllites* in the main region of the Central Himálayas is rather strange, it being represented by a considerable number of species in the limestones of Chitichun (Hundés), which is equivalent to lower Muschelkalk.

It has been mentioned in the introduction that in the main region of the Central Himálayas the Muschelkalk may stratigraphically be divided into two sections. The lower division, rarely more than 3, never more than 6 ft. in thickness, consists of dark, sometimes earthy limestones, and is mostly of a brachiopod facies with a fauna rich in individuals, but very poor in species. In this division only one single Ammonite has been found, *Sibirites Prahlada*, with sutures still in a low stage of development, as in the Arctic *Sibirites*, but distinguished by a remarkably rich sculpture, which recalls geologically younger forms from the Juvavic stage.

That these beds form part of the Muschelkalk is proved by their close stratigraphical connection with the latter and by my observations in the section of the Shalshal cliff near Rimkin Paiar encamping ground. In this section between the *Otoceras*-beds of Griesbach and the dark limestone with *Sibirites Prahlada* a lower-triassic horizon is intercalated, distinguished by the presence of numerous *Danubites* and of *Ceratites subrobustus*, v. Mojs. This horizon may consequently be considered as a homotaxial equivalent of the Olenek-beds or of the Alpine Werfen-beds. As the limestones with *Sibirites Prahlada* occupy a higher place in this sequence, they may be correlated approximately to the lowest Muschelkalk.

The overlying main mass of the Muschelkalk, a hard, frequently concretionary limestone, is principally represented by a cephalopod-facies and forms a very important guide to the geologist in the Central Himálayas, owing to its regular occurrence and to its wide-spread distribution. Frequently some of its layers are completely filled with the shells of *Ceratites*, *Ptychites* or *Meekoceras*, but owing to the tough nature of the matrix it is rarely possible to obtain well preserved specimens. Compared with the cephalopoda, other fossils are extremely rare. No further subdivisions can be distinguished in this rock group, which has a thickness of 15 to 40m., as its beds contain all one and the same fauna. In the section of the Shalshal cliff, where I collected systematically, the *Meekoceratidæ* occupy mostly a lower position and the *Ptychitidæ* a higher one. Some of the topmost beds especially are distinguished by the presence of a great number of large *Ptychites*, belonging to the *Rugiferi*-group. But the rest of the fossils are distributed throughout the entire series of beds without any regularity.

Fossiliferous beds of Muschelkalk age are widely spread throughout the mesozoic belt of the Himálayas. They have been traced from Ladákh and Kashmir to Byans on the Nepalese frontier. But it is only in two districts that they have been examined more carefully,—in the classical sections of Spiti, and in the Niti area, where the section of the Shalshal cliff near Rimkin Paiar encamping ground, has been thoroughly studied by Griesbach and by our expedition in 1892. The faunas of these two areas are not quite identical.

Among the more important cephalopoda the following are peculiar to the Niti-area :—

Ceratites Vyasa, Diener.
„ *Airavata*, Diener.
„ *Ravana*, Diener.
„ *Visvakarma*, Diener.
„ *Kamadeva*, Diener.
„ *sp. ind. ex aff. C. Middendorfi.*
„ *nov. sp. ind. ex aff. C. Geminato.*
„ *Arjuna*, Diener.
„ *nov. sp. ind. ex aff. C. Wetsoni.*
Japonites Sugriva, Diener.
„ *Chandra*, Diener.
Sturia Sansovinii, E. v. Mojsisovics.
Acrochordiceras Baladrama, Diener.
Meekoceras Kesava, Diener.
„ *Gangadhara*, Diener.
„ *affine*, v. Mojsisovics.
„ *Rudra*, Diener.
„ *Nalikanta*, Diener.
„ *Nanda*, Diener.
„ *Srikanta*, Diener.
Gymnites Vasantasena, Diener.
Ptychites Drona, Diener.
„ *Govinda*, Diener.
„ *Sumitra*, Diener.

Among these species, two only, it is true, *Ceratites Ravana* and *Ceratites Vyasa* are rather frequent in the Muschelkalk of the Shalshal cliff. The absence of the rest in the collections brought from Spiti ought not to be overrated, as in Spiti the Muschelkalk has never been made the object of so thorough an examination as in the Shalshal cliff, where our expedition spent a fortnight in collecting fossils in the triassic rocks. It is of greater importance, however, that a good many of the cephalopoda from Spiti have not been met with in the Muschelkalk of the Shalshal cliff. These cephalopoda are the following :—

Nautilus Spitiensis, Stoliczka.
Ceratites onustus, Oppel.
„ *truncus*, Oppel.
„ *Wetsoni*, Oppel.
„ *Dungara*, Diener.
„ *Himalayanus*, Blanford.
Ptychites Malletianus, Stoliczka.
„ *cognatus*, Oppel.
„ *Tibetanus*, v. Mojsisovies.
„ *impletus*, Oppel.
„ *Vidura*, Diener.
„ *Mangala*, Diener.

Ptychites Sukra, Diener.
„ *Asura*, Diener.
Gymnites Lamarki, Oppel.
„ *Kirata*, Diener
„ *Sankara*, Diener.
Proarcestes Balfouri, Oppel.
„ *bicinctus*, v. Mojsisovics.

Among these species *Ptychites cognatus*, Oppel, and *Ptychites Vidura*, Diener, are rather common in Spiti and seem indeed to be confined to this district.

There are, however, not less than 10 species, common to both areas, among them nearly all the important leading fossils of this horizon. These are:—

Ceratites Voili, Oppel.
„ *Thuillieri*, Oppel.
Meekoceras Khanikofi, Oppel.
Gymnites Jollyanus, Oppel.
Buddhaites Rama, Diener.
Ptychites rugifer, Oppel.
„ *Gerardi*, Blanford.
„ *cochleatus*, Oppel.
„ *Everesti*, Oppel.
„ *Mahendra*, Diener.

To these forms *Gymnites Sankara*, Diener, may be added, being present in the Muschelkalk of the Bambanag cliffs in the Girthi Valley (Johár).

Two other Muschelkalk localities are distinguished by a rather peculiar fauna. One of them is the Southern slope of the Utadhura Pass (Johár), which leads from Milam to the Girthi Valley. The fauna found in these beds is composed as follows:—

Ceratites nov. sp. ex aff. C. Ravana.
„ *cf. Ravana*, Diener.
„ *Thuillieri*, Oppel.
„ *div. sp. ind.*
Acrochordiceras Joharense, Diener.
Danubites Dritarashtra, Diener.
Gymnites nov. sp. ind. ex aff. G. Sankara.
Ptychites sp. ind.
Proarcestes sp. ind.
Orthoceras cf. campanile, E. v. Mojsisovics.

The second locality is situated north of Kalapani encamping ground (Kali River Valley), in Byans, near the *triplex confinium* of Kumaon, Hundés and Nepal. At this place a good many fossils were collected by Griesbach, who mistook them for upper-triassic. All the fossils are of an obliquely elliptical shape, apparently owing to a later deformation in the matrix. This fauna is rich in individuals, though not

in species. The cephalopoda, of which there will probably be an interesting harvest, if once these beds are systematically searched, are the following :—

Nautilus Griesbachi, Diener.
Ceratites Kuvera, Diener.
Buddhaites Rama, Diener.
Ptychites Sahadeva, Diener.

This fauna decidedly shows the character of the Muschelkalk, one of the leading species in both, *Buddhaites Rama* being identical.

It is a pity that so few fossils only have been collected in the triassic rocks of Kashmir. Among the collection of the Geological Survey Museum in Calcutta, sent to Vienna, there is only one fairly preserved specimen of *Ceratites Thuillieri* from Sunamarg which points to the presence of Muschelkalk.

As far as palæontological analogies exist between the faunas of the Mediterranean and the Indian Muschelkalk, they are confined almost exclusively to such forms as are peculiar to the zone of *Ceratites trinodosus* (Upper Muschelkalk) in the Mediterranean Triassic province. This remark principally applies to the most frequent species, which ought to be considered as the real type fossils of the Himálayan Muschelkalk, *viz.*, *Ceratites Thuillieri*, Oppel, *Meekoceras Khanikofi*, Oppel, *Gymnites Jollyanus*, Oppel, etc. The species in the two zoo-geographical areas identical or almost so, namely, *Sturia Sansovinii*, v. Mojs., *Proarcestes Balfouri*, Oppel (=*Escheri* v. Mojs. ?) and *Orthoceras campanile*, v. Mojs., are found exclusively in the Upper Muschelkalk of the Alpine Trias. Only two Indian species are allied to Mediterranean forms from the zone of *Ceratites binodosus, viz., Ceratites Wetsoni*, Oppel, is allied to *Ceratites Erasmi*, v. Mojs., and *Ptychites cochleatus*, Oppel, to *P. Studeri*, v. Hauer, whereas one single species, *Ceratites Vyasa*, is the nearest ally to *Ceratites zezianus*, v. Mojs., from the Buchensteiner Schichten, that is to say from the zone of *Protrachyceras Curionii*, which follows immediately above the *Trinodosus*-horizon.

So far as such palæontological analogies may be permissible in correlating formations geographically so widely separated, we may consider the main mass of the Himálayan Muschelkalk to be an equivalent of only the Upper Alpine Muschelkalk of the Mediterranean triassic province. The horizon of *Sibirites Prahlada* naturally belongs to a lower stage, which follows immediately above the beds with *Ceratites subrobustus* and corresponds to the Alpine Werfen-beds. Thus the evidence points to a correlation with the Lower Alpine Muschelkalk.

Although the question of the probable age of the Indian Muschelkalk-fauna seems thus to be easily solved, it becomes rather complicated, if we consider its relation to the faunas of the Himálayan groups of upper-triassic age, which follow higher up.

In the Central Himálayas of Gurhwal and Kumaon the Muschelkalk is regularly and conformably overlaid by a mighty system of limestones and shales, which has yielded cephalopoda of the Carnian and Juvavic stage. In my preliminary notes and in accordance with Griesbach's description I called this

system "*Daonella*-beds." A somewhat lower cephalopod-bearing horizon may perhaps be represented by the *Tropites*-beds of Kalapani (near the Nepalese frontier) in Byans. According to E. v. Mojsisovics[1] it corresponds approximately to the zone of *Tropites subbullatus*, but our expedition in 1892 did not succeed in finding it anywhere in the *Daonella*-beds in the Central Himálayas of Painkhánda, Johár and the adjoining parts of Hundés. I was, however, fortunate enough to trace out another upper-triassic rock-group in the section of the Shalshal cliff near Rimkin Paiar Encamping Ground. It consists of crinoid-limestones only a few metres in thickness which follow immediately above the topmost *Ptychites* beds of the Muschelkalk. The lithological demarcation from the main mass of the Muschelkalk is very slight, but its fauna is a perfectly different one. As Dr. E. von Mojsisovics tells me, it contains several species of *Trachyceras* and *Joannites*, very nearly allied, if not identical, with Alpine forms from the zone of *Trachyceras Aonoides* (Raibl-beds). Therefore it has to be considered as homotaxial with the *Aonoides*-beds of the Carnian stage.

The sequence recalls in a very remarkable manner the analogous conditions which prevail in the Reifling-and Partnach-development of the Alpine Trias and also in the Hallstatt-development of the Salzkammergut (Austria). There also follows, above the Muschelkalk, the zone of *Trachyceras Aonoides* as the next fossiliferous horizon; but the entire Norian stage and the St. Cassian-beds are either not developed at all or only represented by deposits extremely small in thickness and very poor in fossils.[2]

Nowhere in the Himálayan Trias have deposits of Norian or Lower-Carnian age been met with between the Muschelkalk and the *Daonella*-beds. In the section of the Shalshal cliff the topmost *Ptychites*-beds of the Muschelkalk are conformably overlaid by the crinoid-limestone with the *Aonoides*-fauna, the most intimate structural and lithological continuity existing between them. Thus the question arises, whether there is indeed no palæontological representation of the Norian stage in the Himálayan Trias, or whether the Muschelkalk in the Himálayas may contain also some Norian elements and in the Indian Triassic province may comprise the Norian stage together with the *Trinodosus*-horizon.

The relations which exist between the faunas of the Indian and the Mediterranean Muschelkalk are, however, not favourable to an affirmative answer to this. Among all the Cephalopoda of the Himálayan Muschelkalk one species only, *Ceratites Vyasa*, is closely allied to an Alpine form of lower Norian age. It may be noticed in support of this suggestion, that some Himálayan *Meekoceratidæ* belonging to the group of *Meekoceras Reuttense* (*M. Khanikofi*, Oppel, *M. Kesava*, etc.) are distinguished by a richer brachyphyllic ornamentation of their sutures than their Alpine allies.

[1] Vorläufige Bemerkungen über die Cephalopodenfaunen der Himálaya-Trias: Sitzgsber. Kais. Akad. d. Wiss. Wien, math. nat. cl. Bd. CI., 1. Abth. p. 374.

[2] E. v. Mojsisovics, Die Hallstätter Entwicklung der Trias: Sitzgsber. Kais. Akad. d. Wiss., Wien 1892 Bd. C.I. 1. Abth., p. 777.

A comparison with the allied forms of the Arctic-Pacific province also offers but little support on behalf of this suggestion. In this respect the most important type is *Japonites Sugriva*, the sutures of which species are exactly of the same rather advanced type of development as those in *Japonites planiplicatus*, v. Mojs., from the geologically younger triassic beds of Japan. Among the *Ceratites circumplicati* of the *Polaris*-group, there are several species, which combine brachyphyllic sutures with a far advanced development of sculpture, as for instance *Ceratites Ravana*, *C. Voiti*, Oppel, *C. Airavata*. No further conclusions can be derived, however, from this fact, because their Arctic ancestors from the Spitzbergen Posidonomya Limestone belong to a very low horizon of the Muschelkalk.

It results from these reflections, that there is little to support the suggestion that representatives of Norian types exist in the fauna of the Indian Muschelkalk. Our present knowledge of the palæontological evidence does not justify us in considering the Himálayan Muschelkalk as a homotaxial equivalent of the Muschelkalk and of the Norian stage of the Mediterranean province. But, on the other hand, there remains the difficulty of explaining the absence, in the Indian Triassic province, of a faunistic representative of the entire Norian and lower Carnian stage between the zones of *Ceratites trinodosus* and *Trachyceras Aonoides*.

No faunistic relations are apparent between the Himálayan Muschelkalk and the triassic beds of the Salt-Range (Punjáb). Such relations are confined to the lower triassic strata of the Himálayas, as has already been noticed by Waagen and E. v. Mojsisovics. A fauna analogous to that of the Ceratite-beds in the Salt-Range is contained in the Himálayan deposits between the *Otoceras*-beds and the horizon of *Sibirites Prahlada*, distinguished by the presence of *Ceratites subrobustus*, v. Mojs., one of the leading fossils of the Siberian Olenek-beds.[1]

A very interesting Triassic fauna was discovered by L. Loczy north of the great Buddhist temple of Tchungtien in the Kingcha-kiang valley.[2] Sandstones and argillaceous shales yielded the following fossils :—

Myophoria elegans, Dunker.
„ *cf. chenopus*, Laube.
„ *cf. cardissoides*, Schloth.
Loxonema cf. subornata, Münst.
Encrinus liliiformis.

This fauna shows the greatest affinity with the German Muschelkalk, although *Myophoria cf. chenopus* and *Loxonema cf. subornata* point to the Alpine Trias.

This evidence, however, is too vague to permit conclusions to be formed on the relations which may exist between these deposits and those in the Himálayas.

[1] This subject will be further discussed in Pt. 1. of this series, which will appear later on.

[2] Die wissenschaftlichen Ergebnisse der Reise des Grafen Béla Széchenyi in Ostasien 1877-1880. Wien E. Hölzel, 1893, I. Bd., p. 738.

PART III.

THE CEPHALOPODA OF THE TRIASSIC LIMESTONE-CRAGS OF CHITICHUN.

North of the main region of the Himálayan Trias and amidst the Tibetan zone of Spiti Shales and Gieumal Sandstones, are found triassic rocks, which occur under very peculiar conditions. They appear in the neighbourhood of the Balchdhura pass (near Laptal encamping ground) and in the range of Chitichun No. I, (17,740 feet) in Hundés; they form "Klippen," detached outcrops, of the nature of the "blocs exotiques" of Switzerland, in the midst of much younger sediments and are without apparent connection with the triassic beds of the main region. Their lithological character strongly reminds one of the Hallstatt facies of rocks, and differs entirely from that of the triassic rocks of the neighbouring area.

These triassic crags which were most carefully studied by the expedition in 1892 are those situated near the peak Chitichun No. I. (17,740 feet) in the Tibetan province of Hundés. Griesbach has already published a preliminary description of the geological features of this interesting country.[1]

The main mass of the top of Chitichun No. I. consists of a white, more or less crystalline limestone, alternating with layers of red, arenaceous or earthy limestones and with lenticular intercalations of a red crinoid limestone. It forms a crag or block of 100 to 150 metres in height which seems to rest on the Spiti Shales, which constitute the base of the whole range, and are disturbed and traversed by eruptive rocks in common with the Spiti Shales. In this limestone a very rich fauna of brachiopods, corals and Bryozoa has been collected. A few remains of trilobites and ammonites have been found. Among the latter is a very well preserved specimen of a species of the genus *Popanoceras* Hyatt, which is closely allied to *Popanoceras* (*Stacheoceras*) *mediterraneum* Gemellaro, from the Permian rocks of Sicily. The trilobites are represented by two new species of the genus *Phillipsia*. Among the numerous brachiopods, the genera *Productus* (*P. semireticulatus* Mart., *P. lineatus*, W., *P. gratiosus*, W., *P. cancriniformis*, *P. Abichi* W.), *Spirifer* (*S. musakhelensis* Dav., *S. Wynnei* W.), *Enteletes*, *Marginifera* *Notothyris*, *Hemiptychina*, *Athyris*, *Martinia*, *Reticularia*, *Spiriferina*, (*S. cristata* Schloth.), *Dielasma* (D. acutangulum W.,) *Lyttonia*, *Aulosteges*, are represented. Most of the forms are identical or very closely allied to species of the middle Productus-Limestone of the Salt-Range. Although a more thorough examination of the rich material must be waited for, to form the base of an exact determination of its age, the whole character of the fauna is such a one, that it can only be a question, whether it is to be placed into the Permo-carboniferous or into the Permian.

Besides the top of Chitichun No. I., which forms a crag of undoubtedly palæo-

[1] *C. L. Griesbach*, Notes on the Central Himálayas, Records Geol. Surv. of India, Vol. XXVI, Pt. I, 1893, p. 19.

zoic age, numerous other masses of limestone rise from the Spiti-Shales and the igneous rocks associated with them, in the shape of cliffs or crags, or are imbedded in the younger strata in the shape of detached blocks. Some of these crags or blocks, which differ greatly in size, have been proved by their fossil contents to be also of palæozoic age. Two other crags to the north-east of Chitichun No. I. are probably of rhaetic or of liassic age. In three instances a triassic fauna has been met with in small detached blocks of no apparent connection with the principal mass of Chitichun No. I. These three crags were completely surrounded by Spiti-Shales and of proportionately small size.

The first find consisted of only a few blocks and is situated near the low pass west of the peak Chitichun No. I. on the route from the Kiogarh Chaldu Pass (17,440 feet) to Chitichun encamping ground. It is the same block, which is mentioned by Griesbach[1] as containing numerous, though badly preserved, ammonites in sections. As later examinations have proved, these ammonites belong to the triassic genera *Xenodiscus* and *Monophyllites*.

The second block is in a narrow ravine on the eastern slope of Chitichun No. I, to the west-north-west of Lochambelkichak encamping ground. This was discovered by Mr. Middlemiss, at some distance from the crags of Chitichun No. I., and is completely imbedded in Spiti-Shales. I am obliged to lay special stress on the fact, that this block is entirely separated from all the palæozoic blocks on the same hill-side and that no connection between them could be observed, as in a foot-note added by Dr. W. King to Griesbach's preliminary description (l. c. p. 25), it has been suggested that the cephalopoda collected by Mr. Middlemiss in these crags were found in the same beds, as the palæozoic fossils mentioned by Griesbach from the main mass of the Chitichun limestone. It may be stated once more, that the fauna of this small crag is entirely different from that of the top mass of Chitichun No. I., that not one single form is identical in the two, and that the crags themselves are separated by the crushed and disturbed beds of the Spiti-Shales which surround Mr. Middlemiss' crag on every side and impart to it the character of a detached block. Mr. Middlemiss' crag consists of only a small number of blocks, of a red or red and white coloured limestone, with but very little admixture of argillaceous material. Occasional layers of a red crinoid limestone are seen to be intercalated. It is especially this latter, which contains many cephalopoda, gastropods and bivalves. Among the gastropods and bivalves only very small forms are found. Among the cephalopoda species of rather small size prevail, although large ones are not totally absent. The state of preservation of the specimens is as a rule an excellent one. Whereas in the region of the normal development of the Himálayan Trias individuals with preserved shell are but exceptionally met with,—in the upper-triassic deposits this is even much more the case than in the Muschelkalk,—they are very common in the triassic deposits of this locality. Complete specimens, however, are rather rare, and some blocks consist almost entirely of crushed shells only.

I discovered a third triassic crag north of Lochambelkichak encamping ground,

[1] l. c. p. 23.

and near the pass which leads into the valley of the Chaldu River. It also contains several blocks formed of *lumachellæ* of *Xenodiscus* and *Monophyllites*.

The cephalopoda, described in the following pages, have been collected, almost without exception, at the second of the three above-mentioned localities (west-north-west of Lochambelkichak encamping ground). The fossiliferous blocks of this small crag have been almost completely cleared of their fossil remains by Mr. Middlemiss and myself during our repeated excursions.

In the following pages I describe the cephalopoda of this collection:—

I. AMMONEA.

A. AMMONEA TRACHYOSTRACA.

Family: *CERATITIDÆ*.

Sub-family: DINARITINÆ.

Sub-genus: DANUBITES, E. v. Mojsisovics.

1. DANUBITES KANSA nov. sp. Pl. XXIX., fig. 1.

Dimensions.

Diameter of the shell	89 mm.
Height of the outer whorl	33 „
Thickness of the „ „	27 „
Diameter of the umbilicus	39 „

In the fauna of the triassic crags of Chitichun the sub-genus *Danubites* is represented by two typical forms, distinguished by slowly increasing, but very slightly overlapping volutions, by simple, straight ribs, confined to the lateral parts, and the absence of any sculpture in the siphonal area.

One of these two forms, *D. Kansa*, has a remarkable resemblance to *D. Naumanni*, E. v. Mojs., from the Trias of Japan.[1] The general shape of these two species is almost identical; the umbilical suture passes inside the siphonal saddle of the next inner whorl. The whorls are higher than thick, and have moderately convex sides, which pass gradually into the rounded umbilical margin and into the likewise rounded siphonal area.

The lateral parts are covered with numerous, single, radial ribs, which become obsolete both towards the umbilical margin and the siphonal area. None of the ribs reach the umbilical suture. The sculpture does not correspond on both sides and is completely interrupted on the siphonal side, which remains smooth. Ribs and intercostal depressions are of nearly equal width, as in *D. Naumanni*. The number of ribs which occur on the last, entirely chambered volution, is 39 (whereas there are about 50 in *D. Naumanni*).

Sutures.—The septa are very distant, as in *D. Naumanni* or in the Mediterranean group of *D. floriani*, v. Mojs. The arrangement of the lobe-line likewise reminds of *D. Naumanni*. The lobes are deep and comparatively narrow, the

[1] Ueber einige japanische Triasfossilien, Beiträge zur Palæontologie Oesterreich-Ungarns und des Orients, herausgegeben von E. v. Mojsisovics und M. Neumayr, Vol. VII. Wien 1888, Taf. II, fig. 1, p. 169.

saddles are high and slender. Slightly incised indentations affect the marginal walls of the principal saddles up to the middle of their height. The upper portion of the saddles is entire. In this respect the two species are in almost the same stage of development.

The lobes are provided with deep, strong digitations at their base. The principal lateral lobe is the deepest and contrasts remarkably with the extremely short siphonal lobe, divided by a low siphonal tubercle. One bifid auxiliary lobe outside the umbilical suture. The principal lateral saddle is higher than the siphonal saddle, whereas exactly the reverse is the case in *D. Naumanni*.

Number of specimens examined.—One.

2. DANUBITES AMBIKA nov. sp. Pl. XXIX., fig. 2.

Dimensions.

Diameter of the shell	43 mm.
Height of the outer whorl	15 „
Thickness of the „ „	14·5 „
Diameter of the umbilicus	18 „

This species is represented by only a single specimen, entirely chambered. It differs from *Danubites Kansa* in its general shape by more slowly increasing and also thicker volutions, and a more flatly curved siphonal area. The latter is separated from the comparatively flat lateral parts by a rounded edge. A low but perpendicular inner wall borders the rounded umbilical margin.

The character of sculpture is identical with that of the last-mentioned species. In one-half of the penultimate whorl about 20 ribs may be counted. The ribs broaden out towards the siphonal margin, and there gradually disappear.

In the inner volutions several transitional margins of apertures are visible They intersect the ribs in the form of a sweeping curve well turned backwards which is followed by a forward-turned, small process near the umbilical margin.

Sutures.—The sutural line differs remarkably from that in *D. Kansa* and recalls much more the sutures peculiar to the Mediterranean group of *D. floriani*. The contrast between the high, elongated, siphonal saddle and the low, flat lateral saddles is most striking. Two broad lateral lobes, provided with sharply pointed, proportionately strong indentations at their base. The principal lateral lobe is the deepest. The short, broad siphonal lobe is serrated at its base. In the outer volution when reaching a height of 35$^{mm.}$ the first auxiliary lobe appears outside the umbilical suture.

Number of specimens examined.—One.

Family: *TROPITIDÆ.*

Genus: SIBIRITES E. v. Mojsisovics.

SIBIRITES PANDYA nov. sp. Pl. XXIX., fig. 3.

Dimensions.

Diameter of the shell	27 mm.
Height of the outer whorl	10 „
Thickness of the „ „	9 „
Diameter of the umbilicus	12 „

The close relationship of this interesting species, to the genus *Sibirites*, v. Mojs., is proved by its very characteristic sculpture and arrangement of the sutures, in spite of some considerable differences which exist between it and the congeneric forms, hitherto described from the Mediterranean and Arctic-Pacific provinces.

The slowly involute whorls overlap each other down to the bifurcation of the ribs and enclose a tolerably wide, stairlike umbilicus. In the inner volutions the umbilical margin is rounded and not well defined from the sides, as is the case in the outer whorl. In the body-chamber the siphonal part is likewise distinctly separated from the sides. The shape of the transverse section is therefore almost circular in the inner volutions, but becomes gradually rectangular near the posterior termination of the body-chamber. The siphonal area however remains well rounded even in the anterior termination of the last whorl, although the lateral parts flatten considerably.

The sculpture consists of numerous, coarse, radial ribs. But very few of them cross the siphonal area without bifurcating. In most of them a bifurcation takes place near the siphonal margin. The two new ribs, originating at the bifurcation of one single lateral rib, are considerably weaker and narrower than the original. They cross the siphonal area as one straight, and uninterrupted line as in the geologically younger forms from the upper triassic beds of the Alps or of the Himálayas. Also the ribs, which remain undivided, become very faint in crossing the siphonal area, the sculpture of which is therefore distinctly separated from that of the lateral parts. In some ribs a slight prominence is formed at the point of bifurcation, but it does not develop into a distinctly defined tubercle.

The whorls overlap each other exactly down to the bifurcation of the ribs, and in the inner volutions only the simple, radial sculpture is visible. In the last volution, two-thirds of which belongs to the body-chamber, there are 28 radial ribs.

In the penultimate whorl two transitional mouth-borders are seen. In these mouth-borders one large backward-turned convexity coincides with the middle portion of the sides, whereas in the umbilical and siphonal margins their direction, which differs from the normal sculpture, is curved forward.

Sutures.—The arrangement of the sutural line is the same as in the congeneric species from the Arctic-Pacific province. The siphonal lobe terminates in two points and is divided by a short siphonal tubercle. It stands only a little higher than the principal lateral lobe. The latter is provided with distinct indentations which may even be noticed without the help of a magnifying glass. It coincides with the bifurcation of the ribs. The second lateral lobe is at the same level as the siphonal lobe and a little outside the rounded umbilical margin. The principal lateral saddle is comparatively high and slender and resembles the siphonal saddle in this respect. The two saddles are perfectly entire. The second lateral saddle is broad and flat.

There are only two lateral but no auxiliary lobes. The figure (fig. 3c.) must

be corrected in this respect, as the second lateral saddle reaches to the umbilical sutures, without the intervention of any further lobe.

Number of specimens examined.—One.

B.—AMMONEA LEIOSTRACA.

Family : *PINNACOCERATIDÆ.*

Sub-family : LYTOCERATINÆ.

Genus : MONOPHYLLITES E. v. Mojsisovics.

This genus plays a considerable part in the Trias of Chitichun, but it has as yet not been found in the Himálayan Muschelkalk of the main region. There are altogether six species in the collection from this locality. Three of them belong to the European group of *Monophyllites Suessi* v. Mojs., whilst an equal number are forms of the group of *Monophyllites sphærophyllus* v. Hauer.

Group of MONOPHYLLITES SUESSI v. Mojs.[1]

1. MONOPHYLLITES PRADYUMNA nov. sp. Pl. XXXI, fig. 3, 4.

Dimensions.	I. (fig. 3).	II. (fig. 4).
Diameter of the shell	42 mm.	26 mm.
Height of the outer whorl.	12·5 „	9 „
Thickness of the „ „	10 „	9 „
Diameter of the umbilicus	21 „	12 „

This species may be looked upon as the type of the Indian representatives of the Mediterranean group of *M. Suessi* v. Mojs., to which form it is closely allied, but distinguished from it by its smooth shell and its comparatively simple sutures.

It is quite as evolute as the European species and overlaps not more than the siphonal part of the preceding whorl. Corresponding to a diameter of 30 mm., the outer whorl is of equal height and thickness, but in later stages of growth the height of the volution increases more rapidly. The siphonal area and the umbilical margin are evenly rounded and pass gradually into the sides.

The surface of the shell is almost smooth and exhibits as a rule only very delicate striæ of growth near the umbilical margin. These striæ are not nearly so well and distinctly shown as in the group of *M. sphaerophyllus.*

In some specimens, periodical exterior fimbriæ have been noticed. They are in the shape of prominent fringed ribs as in the genus *Lytoceras*, and occur more frequently in the two outer whorls at certain intervals whilst they are rarer in the inner volutions. The specimen, figured Pl. XXXI, fig. 3, possesses 3 of these narrow, radially directed fimbriæ in the last, and 4 in the penultimate volution. The fimbriæ are most prominent near the siphonal margin, where they are bordered on each side by a sharp edge.

[1] *E. v. Mojsisovics*, Die Cephalopoden der Mediterranen Triasprovinz, Abh. k.k. Geol. Reichsanst. Pl. LXXIX, fig. 4, p. 205.

Sutures.—The sutures are very similar to those of *M. Suessi*, but differ in having a distinctly developed third lateral lobe. They are in a still lower stage of development than in *M. Suessi*, which represents the simplest type of the genus hitherto known in the Mediterranean triassic province. The monophyllic saddles are narrow, entire and enlarged above. At the base of the siphonal saddle as well as of the principal lateral saddle is a single and very small indentation. The two first lateral lobes are each provided with three simple indentations at their base. The siphonal lobe is almost as deep as the principal lateral one.

In the specimen figured Pl. XXXI, fig. 3, nearly one-half of the last volution forms part of the body-chamber.

Number of specimens examined—Six.

MONOPHYLLITES CONFUCII, nov. sp. Pl. XXX, fig. 7, Pl. XXXI, fig. 1, 2.

Dimensions.	I. (Pl. XXX. f. 7).	II. (Pl. XXXI. f. 2).
Diameter of the shell	54 mm.	23 mm.
Height of the outer whorl	13 „	6 „
Thickness of the „ „	9 „	5 „
Diameter of the umbilicus	30 „	14 „

This is by far the most common species among the Indian *Monophyllites*. From *M. Suessi* and *M. Pradyumna* it differs principally by its much more slowly increasing volutions. Already *M. Suessi* is very different in this respect from all the other congeneric species of the Mediterranean Trias, but remains still far behind the present form. The specimen figured in Pl. XXXI, fig. 2, has nine volutions besides the clearly marked embryonal cell, corresponding to a diameter of 23 mm., whereas in a specimen of *M. Suessi*, with a diameter of 28 mm., E. v. Mojsisovics counted seven volutions only.

The whorls are rather compressed, higher than broad and overlap only the siphonal part of the preceding volution. The sides are flatly curved and gradually pass into the highly rounded siphonal area. The umbilical margin is rounded, the shell perfectly smooth.

Neither fimbriæ nor varices (interior laminae of the shell) have been noticed in any of the specimens.

The figured specimens are entirely chambered.

Sutures.—Almost identical with those of *M. Pradyumna*. Three lateral lobes. Only at the base of the siphonal saddle one small indentation on each side. The siphonal lobe terminates in two deep points and is divided by a high siphonal tubercle.

Number of specimens examined.—Twenty-one.

3. MONOPHYLLITES PITAMAHA nov. sp. Pl. XXXI, fig. 5, 7, 8.

Dimensions.	
Diameter of the shell	55 mm.
Height of the outer whorl	17 „
Thickness of the „ „	8·5 „
Diameter of the umbilicus	24 „

This species is closely allied to *M. Pradyumna* as regards involution, but differs from it by very flat, compressed and high whorls, and also by showing some traces of transverse folds on the outer volutions. These broad, flat folds cover the lower portion of the sides only, and are slightly curved backwards. They vary much in strength and appear at different stages of growth in different individuals. In the figured specimen fig. 7, the two sides of the shell are even perfectly asymmetrical and their sculpture is completely different.

The two figured specimens are entirely chambered.

Sutures.—Almost identical with those of *M. Pradyumna*. The monophyllic shape of the saddles is especially well marked in the siphonal saddle which is provided at its base with a short indentation on each side.

Number of specimens examined.—Seven.

B. Group of MONOPHYLLITES SPHÆROPHYLLUS, v. Hauer.

4. (1) Monophyllites Hara nov. sp. Pl. XXXI., fig. 9.

Dimensions.

Diameter of the shell	51 mm.
Height of the outer whorl	21 „
Thickness of the „ „	16 „
Diameter of the umbilicus	18 „

This species is very closely allied to the Mediterranean *M. sphærophyllus*, v. Hauer,[1] not only in general shape, but also in involution and sculpture. But the shape of serration of the sutural line constitutes an essential difference. This is still simpler in the Indian form than in *M. sphærophyllus*, which may be considered to be the oldest hitherto known member of a group of forms which continue through the whole of the Mediterranean Trias, from the Muschelkalk to the zone of *Trachyceras Aonoides*.

The high, compressed whorls, which overlap the siphonal area only, have very flatly curved lateral parts and a moderately rounded siphonal area, which is distinctly separated from the sides by a steeply rounded siphonal edge. The umbilical margin slopes suddenly towards the perpendicular umbilical wall. The umbilicus is deep and stair-like.

The lateral parts are covered with numerous, narrow, faintly marked radial folds, which pass across the siphonal area, although considerably weakened. They are not merely confined to the *ostracum* of the shell like the numerous delicate, transverse striæ of growth, but may be noticed also on the surface of the cast. The shell being but partly preserved in the outer volutions of this specimen, the direction of these very densely crowded striæ of growth has not been ascertained completely. A decided forward-bent curve in the siphonal area, as in *M. sphærophyllus*,

[1] *E. v. Mojsisovics*, Die Cephalopoden der Mediterranen Triasprovinz Taf. LXXIX, fig. 1-3, p. 206.

is not visible. On the contrary, they pass radially across the sides and across the siphonal area and parallel to the faint transverse plications.

Both specimens are entirely chambered.

Sutures.—Differ from the sutures of *M. sphærophyllus* by a less rich ornamentation principally and by the absence of a third lateral saddle. The third lateral lobe is in the position of a large much drawn-out umbilical lobe. The narrow, bifid siphonal lobe is divided by a high siphonal tubercle. The principal lateral lobe is much deeper. The denticulations on the outer margins of the two principal lateral lobes, adjoining the base of the preceding saddles, are considerably less individualised than in *M. sphærophyllus*. The saddles themselves are consequently less slender and less deeply laced at their base. The serration of the base of the principal lateral lobe is identical in both species. The siphonal saddle terminates in one broad, circular foliation. The principal lateral saddle is higher, the second lower than the siphonal saddle. Both form long drawn-out foliations rounded above.

Number of specimens examined.—Two.

Remarks.—An undescribed species from the Russian Island (Eastern Siberia) is very closely allied to *M. Hara* as regards the development of its sutural line. It belongs to a collection of triassic cephalopoda from Eastern Siberia which Oberbergrath E. v. Mojsisovics has entrusted to me for description. This Siberian *Monophyllites* has also two lateral saddles only, and the third lateral lobe assumes the shape of an umbilical lobe, which cannot be divided any further.

5. (2) Monophyllites Kingi nov sp. Pl. XXXI, fig. 10.

Dimensions.

Diameter of the shell	57 mm.
Height of the outer whorl	21 „
Thickness of the „ „	12 „
Diameter of the umbilicus	22 „
Height of the whorl in the place of its greatest aplanation	16 „
Thickness of the whorl in the place of its „ „	11 „
Corresponding diameter of the shell	43 „
Corresponding diameter of the umbilicus	17 „

This form is very closely allied to *M. Hara*, but differs therefrom by its obliquely elliptical outline, by more compressed whorls, and by a narrow, high but rounded siphonal area. The latter gradually passes into the flatly curved lateral parts. The umbilicus is shallower than in *M. Hara*.

Sculpture and sutures are almost perfectly identical in the two species.

This type is represented by a single specimen, one half of the outer whorl of which is part of the body-chamber.

6. (3) Monophyllites nov. sp. ind. Pl. XXXI. fig. 6.

The figured fragment belongs to a species, which is probably closely allied to *M. Hara* but is distinguished by its sutures, which exhibit a more advanced stage

of development. The two first lateral saddles are more slender, remarkably contracted at their base, and provided, each one, with a distinct indentation on their inner margins. The fragmentary state of the specimen did not reveal the presence of a third lateral saddle.

Part of the shell is preserved in the siphonal area. As it is covered with numerous densely crowded and very delicate lines of growth, it seems beyond doubt that this fragment belongs to the group of *Monophyllites sphærophyllus*. The fragmentary inner volution is covered with numerous, faint, radial plications.

Sub-family PTYCHITINÆ.

Genus: XENODISCUS, Waagen.

The genus *Xenodiscus*, distinguished from *Gyronites* Waagen (synonymous with *Ophiceras*, Griesbach) by its long body-chamber, has two representatives in the fauna of the triassic limestones of Chitichun. Both belong to a much more advanced stage of development, than all hitherto known forms of this genus from the Indian and Arctic-Pacific provinces. One of them is distinguished by ceratitic sutures, in which the marginal walls of the saddles are serrated up to the middle of their height, whereas in the congeneric species of the Himálayan Lower Trias the lobes are denticulated only at their base. The second species, of which unfortunately only a fragment has been found, recalls the genus *Gymnites* in the character of its sculpture.

1. XENODISCUS MIDDLEMISSI nov. sp. Pl. XXX, fig. 6.

Dimensions.

Diameter of the shell	55 mm
Height of the outer whorl	18 „
Thickness of the „ „	8 „
Diameter of the umbilicus	24 „

This species has a very flat, discoidal shell, with numerous, slowly increasing whorls. In this respect it can only be compared among the congeneric species of the lower Trias, with *Xenodiscus demissus* Oppel.[1] But it differs therefrom by more compressed volutions and by higher whorls. All the rest of the Indian or Siberian species of *Xenodiscus* are characterised by more rapidly increasing volutions.

The lateral parts are flat and aplanate. The narrow, rounded siphonal area is more or less distinctly separated from the sides by an obtuse edge. The sides slope flatly convex to the shallow umbilicus.

Surface of the shell smooth, partly interrupted by very faint and indistinct radial plications.

[1] Palæontologische Mittheil. I. 1865, Pl. 86, fig. 1, p. 290. It is, however, doubtful, whether this species may be included in the genus *Xenodiscus*.

In this specimen one-third of the last whorl belongs to the body-chamber.

Sutures.—The vertical projection of the outline of the penultimate whorl meets the inner margin of the second lateral saddle of the succeeding volution. Siphonal lobe short, only half as deep as the principal lateral lobe, and provided with a high siphonal tubercle. Lobes and saddles comparatively narrow and elongated. The second lateral saddle is very low. Lobes provided with deep digitations, which affect the marginal walls of the saddles up to the middle of their height; they are especially well developed at the inner margins of the siphonal and of the principal lateral saddles. Second lateral saddle followed by a long, serrated umbilical lobe, with two deep points near the inner margin of the saddles on both sides.

Number of specimens examined.—One.

2. Xenodiscus nov. sp. ind. Pl. XXX., fig. 4.

The fragment,—body-chamber and part of the penultimate whorl—belongs to a highly interesting form, the sculpture of which corresponds to that peculiar to the genus *Gymnites*, which is most probably descended from *Xenodiscus*. The only species of *Xenodiscus* with a similar sculpture, *X. dentosus* E. v. Mojs.[1] has long tubercles, spirally protracted and arranged along the sharply edged siphonal margin, corresponding to an equal number of faint, broad radial plications, which completely die out near the umbilical margin. But whereas in *Gymnites* this sculpture is as a rule confined to the lower portion of the sides, in *X. dentosus* the lower part of the sides is smooth and the sculpture most distinct between the middle of the lateral parts and the siphonal margin.

In this fragment, however, the sculpture agrees almost perfectly with that of *Gymnites Jollyanus* Oppel. Faint, broad, radial plications, which are bent somewhat backward, appear along the middle of the sides in the shape of prominences, arranged along an elevated spiral line. The transverse plications are interrupted by shallow, rounded depressions and become obsolete before reaching the umbilical margin, whereas the spiral elevation is continuous, or ridge-like.

The surface of the shell is covered with strongly developed lines of growth, which become indistinct in the upper portion of the sides, where they describe a slight, falciform curve.

This form, like *X. Middlemissi*, is characterised by rather slowly increasing volutions, and by a wide and open umbilicus. The whorls are compressed and high. To a height of the aperture of 35 mm. corresponds a thickness of 15 mm. The sides are flatly convex and pass gradually into the rounded siphonal area. The greatest thickness of the outer whorl coincides with the middle of the lateral parts. The umbilical margin is marked by an obtuse edge and separated from the umbilical suture by a low, perpendicular inner wall.

Sutures.—The rather unfavourable state of preservation permits only a generic

[1] Arktische Triasfaunen: Mém. Acad. Imp. des Sc. de St. Pétersbourg VII^{e} sér. Vol. XXXIII, 1886. Pl. XI. fig. 12, p. 78.

identification. The siphonal saddle is remarkably large. The second lateral saddle is nearly as high as the principal one. The lobes are broad and, so far as can be as certained, provided with deep digitations at their base. There seems to be only one single auxiliary lobe.

Number of specimens examined.—One.

Genus GYMNITES. E.v. Mojsisovics.

GYMNITES UGRA nov. sp. Pl. XXX., fig. 5.

Dimensions.

Diameter of the shell	60 mm.
Height of the outer whorl	24 „
Thickness of the „ „	12 „
Diameter of the umbilicus	23 „

This species is one of the most interesting forms in the small fauna of the Triassic limestones of Chitichun, because it represents the oldest type hitherto known of the genus *Gymnites*, the sutural line of which is still in a very low stage of development and has only just passed from the *Xenodiscus*-stage into that of *Gymnites*.

It recalls in general shape and involution *Gymnites incultus* Beyrich[1] among the European, and of *G. Vasantasena* among the Indian congeneric species. The numerous, slowly increasing volutions, which overlap each other to one half of their height, are compressed and bordered by almost flat lateral parts. The narrow and rounded siphonal area passes gradually into the sides. An obtuse edge marks the umbilical margin, from which a short but steep inner wall slopes towards the umbilical suture.

The sculpture consists on the inner volutions of broad, transverse plications, which are almost as broad as the intervening depressions; they are narrower and less distinctly shown on the last whorl. Along the centre of the sides, a series of tubercular prominences,—the terminations of the folds,—appear as a chain or raised band.

Sutures.—In the figured specimen, which consists almost entirely of air-chambers, the vertical projection of the outline of the penultimate volution touches the inner margin of the second lateral saddle. The short siphonal lobe is divided by a broad pyramidal siphonal tubercle, the height of which nearly equals that of the siphonal saddle. The principal lateral lobe is the deepest.

The ramification of the lobes and saddles is not so far advanced as in the young individuals of G. *incultus*, figured by E. v. Mojsisovics.[2] The saddles are dolichophyllic, and at the top of the siphonal saddle a deeper incised, rounded branch starts from the outer margin. This is the only trace of a more advanced ramification in the broad saddles. The lobes are provided with deep digitations at their base, which, however, are simpler than in the young specimens of *G. incultus*. In

[1] E. v. Mojsisovics, Die Cephalopoden der Mediterranen Trias-Provinz: Abh. k.k. Geol. Reichsanst. Vol. X, Pl. LIV, fig. 1—3, p. 233.

[2] l. c. Taf. LIV, fig. 3c.

the latter, every single digitation is already denticulated, when corresponding to a height of the outer whorl of 9 mm.

The arrangement of the auxiliary lobes is very characteristic. The second lateral saddle is perfectly individualised and followed by a deep incision, which marks the first auxiliary lobe. The two next larger branches slope obliquely towards the umbilical suture. These two auxiliary saddles are entire. The broad sutural lobe which follows is serrated but does not permit tracing out its further elements. These well-individualised obliquely-shaped auxiliary lobes differ from the more simple sutures of *Xenodiscus* and justify the determination of this species as *Gymnites*, in spite of the simpler development of the other sutural elements.

Number of specimens examined.—Two.

Genus STURIA E.v. Mojsisovics.

STURIA MONGOLICA nov. sp. Pl. XXIX., fig. 4.

Dimensions.

Diameter of the shell	69 mm.
Height of the outer whorl	37 „
Thickness of the „ „	21 „
Diameter of the umbilicus	8 „

This species, which does not seem to show any relationship to any of the Mediterranean congeneric forms, differs from the latter by a comparatively wide, open umbilicus, and by simpler sutures.

The volutions exhibit considerable egression and are separated from the umbilicus by a high and perpendicular umbilical wall. The umbilical margin is a sharp edge, already distinctly marked in the inner volutions.

The lateral parts are moderately convex. Siphonal area narrow, rounded, and passing gradually into the sides. The outer whorl is thicker than in most of the congeneric species from the Alpine Muschelkalk. As in *Sturia semiarata* E. v. Mojs.,[1] flat radial folds are strongly developed on the surface of the lateral parts, especially on their lower portion.

In the only specimen of this form in my collection the shell is but partly preserved and I am therefore not quite satisfied about the sculpture on its surface. On the outer volution the siphonal striations have been observed; they are numerous, thin and bordered by a sharp edge, as in *S. Sansovinii*, E. v. Mojs.

Sutures.—The sutures of this specimen, which is entirely chambered, typically exhibit the shape and arrangement of the sutures peculiar to the genus *Sturia*. The vertical projection of the outline of the penultimate whorl touches the inner margin of the second lateral saddle. Five auxiliary lobes outside the umbilical edge. The broad siphonal tubercle, stretching from the siphonal area over the lateral parts, is only half as high as the siphonal saddle. The latter stands at equal height with the second lateral saddle. The two lateral lobes are considerably longer than the

[1] Die Cephalopoden der Mediterranen Triasprovinz: Abh. Geol. Reichs-Anst. Vol. X, Pl. XLVIII. fig. 8; Pl. XLIX, fig. 1, 3; Pl. L, fig. 2, p. 242.

siphonal lobe. Their termination is bifid. The pyramid-shaped saddles are very slender, their branches being incised so deeply, that only the very stems remain entire. The ornamentation of the branches is, however, not nearly so rich as in *S. semiarata*, *S. Sansovinii* or *S. forojuliensis*. In the siphonal saddle the strong outer branch, peculiar to the two first-mentioned species, is missing. Altogether the sutures of *S. mongolica* may be said to be on a somewhat lower level of development than the Mediterranean representatives of this genus in the Alpine Muschelkalk.

Number of specimens examined.—One.

Family: *ARCESTIDÆ.*

Sub-family: JOANNITINÆ.

Genus: PROCLADISCITES E. v. Mojsisovics.

This genus was hitherto only known from the Upper Muschelkalk and from the zone of *Protrachyceras Archelaus* in the Mediterranean Triassic province, but is represented in the triassic fauna of Chitichun by a form which is very closely allied to the European species of *Procladiscites Brancoi*, E. v. Mojs.

PROCLADISCITES YASODA nov. sp. Pl. XXX. fig. 1, 2, 3.

Dimensions.

Diameter of the shell	60 mm.
Height of the outer whorl	32 „
Thickness of the „ „	14 „
Diameter of the umbilicus	8 „

This handsome species is evidently closely related to *P. Brancoi* E. v. Mojs.[1] from the Upper Muschelkalk of the Alpine Trias (zone of *Ceratites trinodosus*). The agreement between the two species is remarkable not only in involution, but also in sculpture and arrangement of the sutural line.

P. Yasoda has as high and compressed whorls as its European ally; a narrow rounded siphonal area and flat lateral parts, which pass gradually into the siphonal area. An essential difference from *P. Brancoi* consists in the shape of the umbilicus. As E. v. Mojsisovics has remarked, the shape of the umbilicus in *P. Brancoi* is not accurately known. "There seems to have existed a narrow, open umbilicus; it may however, be possible, though not probable, that the umbilicus was closed, as in the greater number of the species of *Cladiscites*." But *P. Yasoda* has a comparatively wide open umbilicus, which exposes the numerous inner volutions as narrow, spiral-bands. In the young specimen, figured Pl. XXX., fig. 2, to a diameter of the shell of 26mm. corresponds an umbilicus of 4mm. In this respect this species recalls *P. macilentus*[2] from the Muschelkalk of Han Bulog in Bosnia.

[1] Abh. kk. Geol. Reichsanst. Vol. X. Pl. XLVIII, fig. 1, 2, p. 171.

[2] F. v. Hauer, Beitraege zur Kenntniss der Cephalopoden der Trias von Bosnien. I. Neue Funde aus dem Muschelkalk von Han Bulog bei Sarajevo: Denkschr. Kais. Akad. d. Wiss. Wien, math. nat. Cl. LIX. 1892, Taf. X, fig. 2, p. 280.

The sculpture of the shell agrees perfectly with that of *P. Brancoi.* The numerous and thin spiral ribs are somewhat narrower than the intervening depressions.

Sutures.—Very similar to the sutures of *P. Brancoi.* Three lateral lobes. The second lateral lobe is the deepest. Siphonal lobe short, although rather deeper than in the European species. Siphonal saddle lower than the two first lateral saddles. All terminate in one single rounded lapel growing narrower towards the top. The number of auxiliary lobes cannot be ascertained, but is probably less than in *P. Brancoi.* The ornamentation of the lobes and of the branches of the saddles is simpler in the details.

In the specimen figured Pl. XXX. fig. 3, one half of the outer volution belongs to the body-chamber.

Number of specimens examined.—Ten.

II. NAUTILEA.

Family: ORTHOCERATIDÆ.

Genus: ORTHOCERAS, Breynius.

ORTHOCERAS sp. ind. Pl. XXIX., fig. 5.

This figure refers to a fragment of a body-chamber 95 mm. long and points to a form which was distinguished by a long body-chamber and by a circular transverse section. The diameter of the body-chamber is 15·5 mm. at its posterior termination and 20 mm. at its anterior margin where broken off. Angle of emergency about 4°.

The shell is smooth. In the upper portion of the cast the existence of a flat transverse band is noticed.

The central position of the siphuncle, as drawn in the figure (fig. 5b), is rather doubtful.

Number of specimens examined.—Two.

CONCLUSIONS.

The fauna of cephalopoda from the Triassic limestone of Chitichun contains the following species :—

1. *Danubites Kansa*, Diener.
2. „ *Ambika*, Diener.
3. *Sibirites Pandya*, Diener.
4. *Monophyllites Pradyumna*, Diener.
5. „ *Confucii*, Diener.
6. „ *Pitamaha*, Diener.
7. „ *Hara*, Diener.
8. „ *Kingi*, Diener.
9. „ *nov. sp. ind.*
10. *Procladiscites Yasoda*, Diener.
11. *Xenodiscus Middlemissi*, Diener.
12. „ *nov. sp. ind.*
13. *Gymnites Ugra*, Diener.
14. *Sturia mongolica*, Diener.
15. *Orthoceras sp. ind.*

The genera which are represented in this fauna may be divided into three groups.

The first group is represented by the genus *Xenodiscus*, which has hitherto only been found in younger palæozoic or in lower triassic strata. The second group comprises the genera *Monophyllites*, *Procladiscites*, *Gymnites* and *Sturia*, none of which have ever been found in a lower horizon of the Mediterranean Trias than in the Muschelkalk. To the third group belong *Danubites* and *Sibirites*, which make their first appearance in lower triassic or even in Permian(?) beds, but ascend into upper triassic horizons.

The most important feature of this triassic fauna are the genera of the second group. So far as numbers go, the genus *Monophyllites* and among that the species allied to *M. Suessi*, v. Mojs., play the principal part. The sutures of the Himálayan forms belonging to this section are on a somewhat lower level of development, than in *M. Suessi*, the simplest type of this genus in the Mediterranean province. In *M. Hara* and in *M. Kingi*, belonging to the group of *M. sphærophyllus*, v. Hauer, the ornamentation of the sutures is likewise far less advanced than in their European ally from the Alpine Muschelkalk. Only the *Monophyllites* figured in Pl. XXXI, fig. 6, which is unfortunately in a rather fragmentary state of preservation, has a sutural line of similar development to *M. sphærophyllus*.

There are similar relations between *Sturia mongolica* and the congeneric species of the Mediterranean Triassic province, as between the above-mentioned Indian *Monophyllites* and their European allies. In *S. mongolica* the sutures are also of a somewhat lower character of development than in the geologically oldest congeneric forms from the upper Alpine Muschelkalk. But it is distinguished from the latter by a wide, open umbilicus and the egression of the outer volution.

The antique character of the Indian representatives of the genera peculiar to the Muschelkalk in the Mediterranean Triassic province is still more clearly shown in *Gymnites Ugra*, the sutures of which have only just completed the transition from the *Xenodiscus*—into the *Gymnites*-stage.

The most advanced faunistic element among the triassic cephalopoda of Chitichun is *Procladiscites Yasoda*, which is very closely allied to the Mediterranean *P. Brancoi*, *v.* Mojs. from the Upper Alpine Muschelkalk, differing therefrom only in quite subordinate details of the sutural line.

The genus *Sibirites*, and especially *Sibirites Pandya*, does not afford any clue to the age of the triassic fauna of Chitichun. The existence of *Danubites Kansa* however, which is closely allied to the Japanese *D. Naumanni* v. Mojs., is evidence decidedly in favour of a younger horizon than Lower Trias. Forms of *Danubites* with such highly developed sutures, the marginal walls of their saddles even being partly provided with indentations, have never been collected hitherto, either in the Olenek-beds of Siberia, nor in the lower Trias of the Himálayas.

The genus *Xenodiscus*, it is true, has hitherto only been met with in the Permian rocks of the Salt Range, in the lower Trias of the Himálayas, in the Siberian Olenek-beds and in the homataxial Meekoceras-beds of Idaho in the United States of North America. In the Mediterranean Muschelkalk its place is taken by the genus *Gymnites*, most probably descended from *Xenodiscus* as has been pointed out by v. Mojsisovics. In the Muschelkalk of the main region of the Himálayas, *Xenodiscus* is likewise missing, and the forms of *Gymnites* peculiar to this horizon are all distinguished by richly ramified sutures. It ought however to be taken into consideration, that the fauna of the Muschelkalk of the Central Himálayas contains almost exclusively such types of cephalopoda only as are peculiar to the upper Mediterranean Muschelkalk, whereas the lower portion of the Himálayan Muschelkalk is represented by a fauna rich in brachiopods and bivalves, from which as yet only one single ammonite, *Sibirites Prahlada* is known. It must, moreover, be borne in mind, that the two species of *Xenodiscus* belonging to the triassic fauna of Chitichun, point to a far more advanced stage of development than any of the congeneric forms from the lower Trias. This not only refers to *Xenodiscus Middlemissi*, the ceratitic lobes of which are serrated up to the middle of the marginal walls of their saddles, but also to the second but indifferently preserved species, which is distinguished by a perfectly "*Gymnitic*" sculpture.

Judging by its general zoological character, the fauna of the triassic limestone of Chitichun can only be looked upon as a Muschelkalk fauna. The presence of the genus *Xenodiscus*, otherwise confined to lower triassic beds, but associated with a far greater number of types peculiar to the Muschelkalk, cannot influence this decision and so much the less, since together with *Xenodiscus* the oldest hitherto known representative of the geologically yourger genus *Gymnites* makes its first appearance.

The Muschelkalk types, which are in predominating numbers, are all of a development, which points to a lower horizon than that of the Muschelkalk of the main region of the Central Himálayas. This view is especially confirmed by the

character of the *Monophyllites*, of *Sturia mongolica* and of *Gymnites Ugra*, which impart to the triassic cephalopoda of Chitichun the appearance of a fauna of the lower Muschelkalk. The triassic limestones of Chitichun may therefore be considered as forming a lower division of the Indian Muschelkalk, corresponding possibly to the horizon of *Sibirites Prahlada* in the main region of the Himálayas. With this view the occurrence of *Xenodiscus* agrees best. The persistence of the geologically older type of *Xenodiscus* in the triassic beds of Chitichun is counterbalanced by the isolated occurrence of *Procladiscites Yasoda*, which is very closely allied to a species of the upper Alpine Muschelkalk.

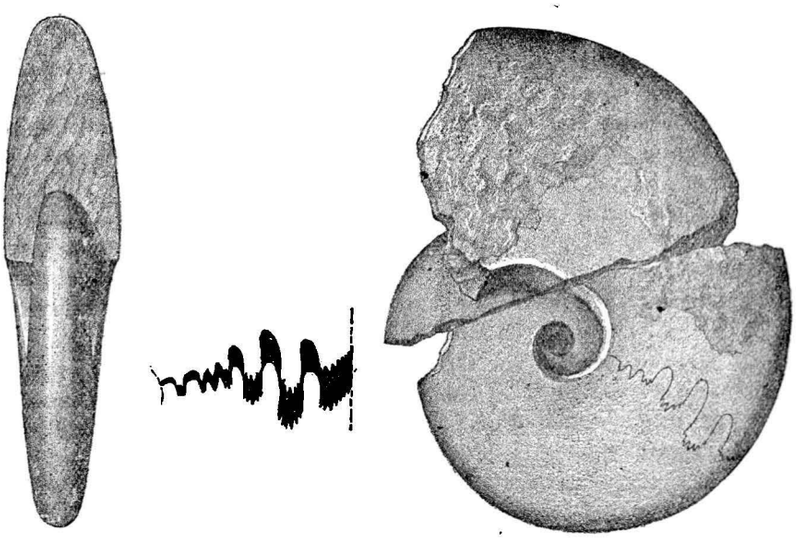
The considerable predominance of the *Ammonea leiostraca* in this fauna is rather remarkable. Each of the three species of *Trachyostraca* is only represented by one single specimen in my collection. Among the *Leiostraca*, *Monophyllites* prevails, which is missing in the Muschelkalk of the main region of the Himálayas. But in the triassic limestones of Chitichun not a single species of *Ptychites* or of *Meekoceras* has been met with, whereas these two genera afford, besides the *Ceratites*, the most important leading forms of the Muschelkalk in the main region; the latter are only represented in the fauna of Chitichun by the sub-genus *Danubites*.

This sharp palæontological separation of the two faunas is to be explained principally, as I believe, by a difference of facies. The Muschelkalk of the main region of the Himálayas is a normal sediment, spread equally over a large area, whereas the triassic limestones of Chitichun and the geologically younger rocks to the east of the Balchdhura Pass of upper-triassic age, characterised by the occurrence of the genus *Jovites* E. v. Mojs., seem to be a local development and to represent the Hallstatt-facies in the Indian triassic province.

The relations between the triassic fauna of Chitichun and the Mediterranean Muschelkalk are clearly indicated by *Procladiscites Yasoda* and in some of the species of the genus *Monophyllites* allied to *M. Suessi* v. Mojs. or to *M. sphaerophyllus* v. Hauer. On the other hand the occurrence of the genus *Sibirites* and of *Danubites Kansa*, closely allied t the Japanese *D. Naumanni* v. Mojs. points to a close relation with the Arctic-Pacific Province of the Trias.

APPENDIX TO PART II.

To the representatives of the subgenus *Aspidites* in the Himálayan trias a species from the triassic limestone crags of Chitichun must be added, the description of which has not been given in the second part of this volume. To this species I attribute the name:



ASPIDITES KOSSMATI nov. sp.

Triassic Limestone of Chitichun.

a. Side view, *b*. Front view, *c*. Sutural line.

The specimen, on which this species is founded, was accidentally discovered by Dr. Kossmat, Assistant at the Geological Museum of the University of Vienna, amongst the collections from Chitichun. I had at first mistaken it for *Procladiscites Yasoda*, but as it seemed rather insignificant, being only an internal cast, did not consider it good enough to develope its sutures and umbilical region. It was only after carefully preparing the latter that its true generic position was revealed.

Among the Salt Range species of *Aspidites* there is none more closely allied to ours than *Aspidites magnumbilicatus*, Waagen (Fossils from the Ceratite Formation, Pl. XXVI, fig. 5 a, b, c, p. 221).

In general shape it is rather similar to this species and the umbilicus is but little smaller in the Chitichun form. The involution is nearly identical, the overlap of the last volution over the penultimate whorl occupying less than two thirds of the entire height of the latter and exactly two sevenths of the height of the last volution.

The transverse section of our species differs from *A. magnumbilicatus* especially by its sides being flatter and converging from the umbilical margin towards the siphonal area in an almost even, scarcely convex slope. The largest transverse diameter corresponds to the umbilical margin, which in more advanced stages of growth becomes slightly elevated and divided from the adjoining sides by a very shallow circular depression.

The siphonal area is regularly rounded and unites gradually with the sides without forming subangular edges. Such are, however, distinctly marked in the juvenile stage and correspond to a diameter of 20 mm. The umbilical margin is perfectly sharp and surrounded by a comparatively high, perpendicular umbilical wall, but the latter does not overhang, as in *A. magnumbilicatus*.

As the specimen under description is only internal cast, the shell surface is unknown. The

cast is nearly smooth, with indistinct traces of falciform ribs. The shell seems to have been covered with faint falciform folds, similar to the sculpture exhibited on the shell of *A. magnumbilicatus* the internal cast of which is described by Waagen as being entirely smooth.

The present specimen, attaining a diameter of 74 mm. is composed of air chambers only, no part of the body chamber having been preserved.

Sutures.—This species is a typical representative of the subgenus *Aspidites*, by reason of the arrangement of the auxiliary series in its sutural line. It belongs to Waagen's section of the *polymeri* the denticulations of the first auxiliary lobe being of unequal size and not symmetrically arranged.

The sutural line, which is very well preserved, differs from that of *A. magnumbilicatus* only in minor details, especially in the arrangement of the auxiliary elements, following the first auxiliary lobe. The siphonal lobe is remarkably broad, provided with irregular indentations and divided by a broad pyramid shaped median prominence. The two lateral lobes are considerably narrower, and provided with strong denticulations at their base, but of unequal number in the different septa. Both in the siphonal and lateral saddles the highest point is shifted towards the umbilical side. The saddles are more slender and narrow than in *A. magnumbilicatus*, the siphonal saddle is bordered by parallel margins, not phylloid in its outlines. The principal lateral saddle is but slightly longer than the second lateral and siphonal saddles. The first auxiliary lobe is less broad than the adjoining lateral saddle, and bears four denticulations below. Among them those nearer to the umbilical side of the lobe are the larger ones, imparting to the lobe a somewhat sloping character. The next auxiliary lobes and saddles likewise slope towards the umbilical suture. The first and second auxiliary saddles are perfectly conical in shape and are separated by a sharply pointed lobe. The third auxiliary lobe is equally pointed but the adjoining saddle is obliquely rounded above, and even provided, as it seems, with a few slight indentations. It is divided by the umbilical edge. The fourth auxiliary lobe is situated on the umbilical wall, and exhibits in opposition to the preceding lobes a strongly bifid termination. It is followed by another small rounded saddle, which reaches down to the umbilical suture.

As the specimen is cut into two by a fissure which has caused a displacement of the portions on both sides, I cannot give the measurements of the entire specimen, but only such as correspond to a diameter of the shell of 58 mm.

These measurements are as follows :—

Diameter of the shell		58 mm.
„ „ „ umbilicus		10
Height of the last volution	from the umbilical suture	28
	„ preceding whorl	20
Height of the umbilical wall		4·5
Thickness of the last volution		app. 17

Locality.—Triassic limestone crags of Chitichun in Tibet.

Remarks.—The presence of a representative of the subgenus *Aspidites* in the fauna of the triassic limestone crags of Chitichun is of special interest. In the description of this fauna, contained in the last chapter of the second part of this volume I observed that the majority of its elements are muschelkalk types, but that they are associated with forms bearing a more antique character than the general geological character of the fauna, I therefore drew the conclusion that the triassic limestone of Chitichun may be considered to form a lower division of the Indian muschelkalk. This view is confirmed by the presence of *Aspidites* which is a geologically older type than the *Meekoceratidæ* of the muschelkalk. Up to now species of *Aspidites* have only been found in the upper division of the lower trias of the Indian region. The Salt Range species of this subgenus are all confined to the Ceratite sandstone, where they make their first appearance in its middle division, the Stachella beds. The occurrence of *Aspidites* and of *Xenaspis* consequently confers a rather antique aspect to the fauna of the triassic Chitichun limestones, whereas the occurrence of *Procladiscites Yasoda* has the contrary effect.

From all this it appears to me in accordance with my former views on this subject that the rocks containing the triassic fauna of Chitichun must be placed rather low in the Muschelkalk series. It cannot, however, be decided whether they are on a level with the horizon of *Sibirites prahlada* in the main region of the Himálayas, or with the upper Ceratite limestone of the Salt Range.

LIST OF ERRATA IN PAL. IND. SERIES XV, VOL. II, PART 2.

Page 27 line 16 from top, *for* ours *read* our.
„ 27 „ 17 „ „ „ referenee *read* reference.
„ 27 „ 3 „ bottom „ obe „ lobe.
„ 28 „ 1 „ top „ et „ ex.
„ 37 „ 18 „ „ „ Shalshal *read* Shalshall cliff.
„ 59 foot-note „ Akademied „ Akademie d.
„ 60 line 21 from top „ Pinnacoceras „ Pinacoceras.
„ 63 last line „ Malletiani „ Malletianus.
„ 65 in the table XII, the number of radial ribs should be 25 and not 5.
„ 67 foot-note *for* Reichsaustalt *read* Reichsanstalt.
„ 70 line 13 from above „ „ „ „
„ 71 foot-note „ „ „ „
„ 72 „ „ „ „ „
„ 76 below II, in the table of dimensions *for* (Pl. XX, fig. 2), *read* (Pl. XX, fig. 1).
„ 76 foot-note [1] should be [3] and refers to the above II.
„ 76 „ [2] „ [1]
„ 76 „ [3] „ [2]
„ 88 „ *for* 4 *read* 48.
„ 94 „ „ nordlichen *read* nördlichen.
„ 101 heading, „ Part III „ Chapter II.
„ 101 line 14 from bottom, *for* Gemellaro *read* Gemmellaro.
„ 118 „ 2 „ „ „ t *read* to.

PLATE I.

Fig. 1*a*, *b*, *c*. Ceratites Thuillieri, Oppel; Muth (Spiti), Coll. Schlagintweit, Palæontological Museum in Munich. Oppel's type-specimen.

Fig. 2. Ceratites Thuillieri, Oppel var.; Shalshal Cliff near Rimkin Paiar E. G.; Coll. Diener.

Fig. 3*a*, *b*. Ceratites nov. sp. ind. ex. aff. C. Wetsoni, Diener, fragment of outer whorl; Shalshal Cliff near Rimkin Paiar E. G.; Coll. Diener.

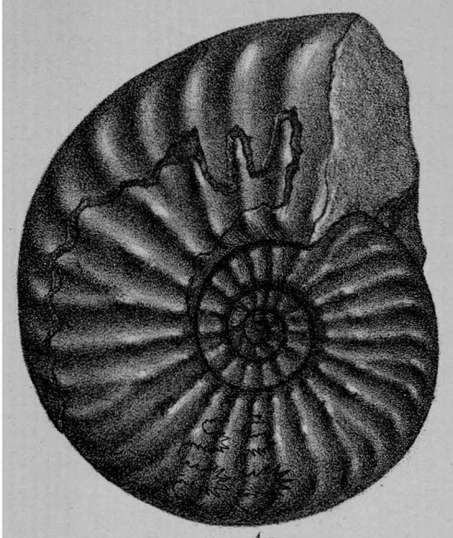
Fig. 4*a*, *b*. Ceratites Himalayanus, Blanford; Spiti (locality unknown); Coll. Asiat. Soc. of Bengal. Blanford's type-specimen.

Fig. 5. Ceratites onustus, Oppel, fragment of outer whorl; Kuling (Spiti); Coll. Schlagintweit, Palæontological Museum in Munich. Oppel's type-specimen.

Fig. 6*a*, *b*. Ceratites Wetsoni, Oppel, fragment of outer whorl; Spiti; Coll. Schlagintweit. Palæontological Museum in Munich. Oppel's type-specimen.

Fig. 7*a* *b*. Ceratites truncus, Oppel, fragment of outer whorl; Kuling (Spiti); Coll. Schlagintweit, Palæontological Museum in Munich. Oppel's type-specimen.

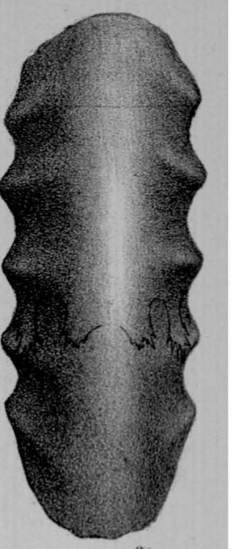
MUSCHELKALK, HIMALAYA (CEPHALOPODA)



1a

1b

3a



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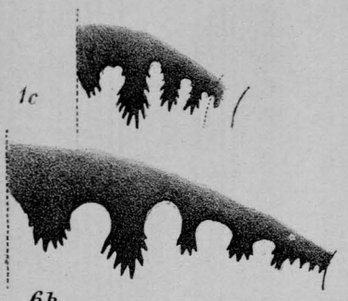

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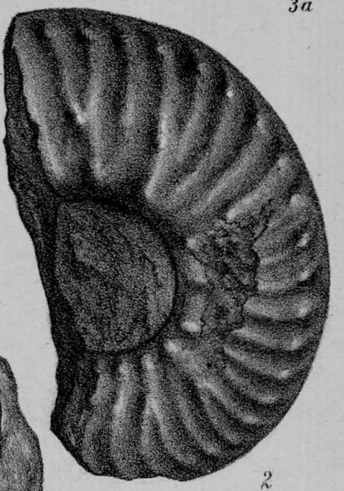

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4a

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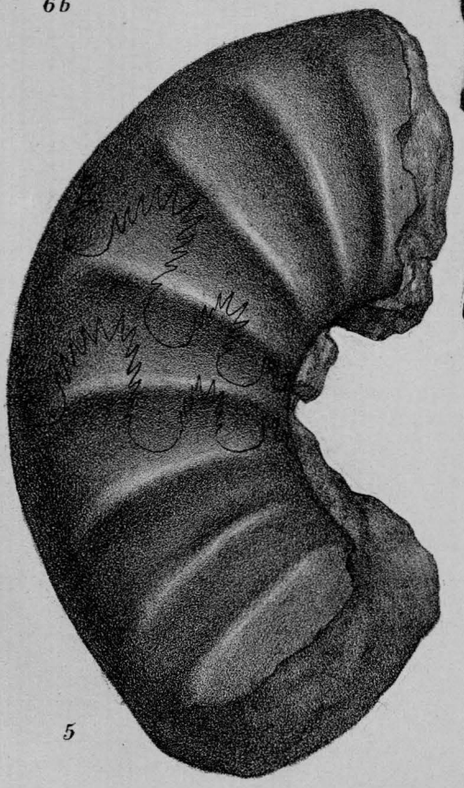

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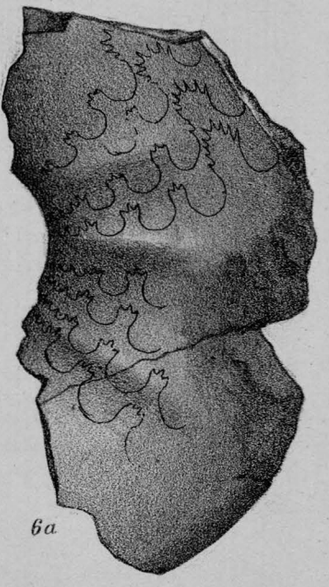
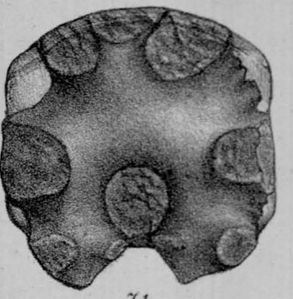
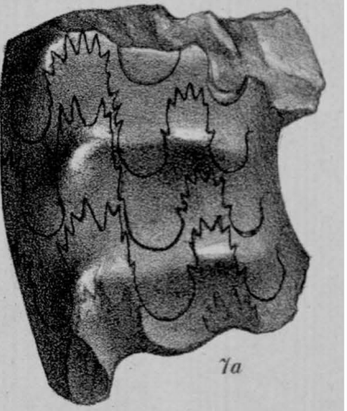


6a



7b



7a

A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE II.

Fig. 1*a*, *b*. Ceratites Voiti, Oppel; Kuling (Spiti), Coll. Stoliczka, Geological Survey Museum in Calcutta.

Fig. 2*a*, *b*. Ceratites Voiti, Oppel; a portion of the ventral side restored, after the specimen figured as 1a; Kunzum Pass (Spiti), Coll. Schlagintweit, Palæontological Museum in Munich; Oppel's type-specimen.

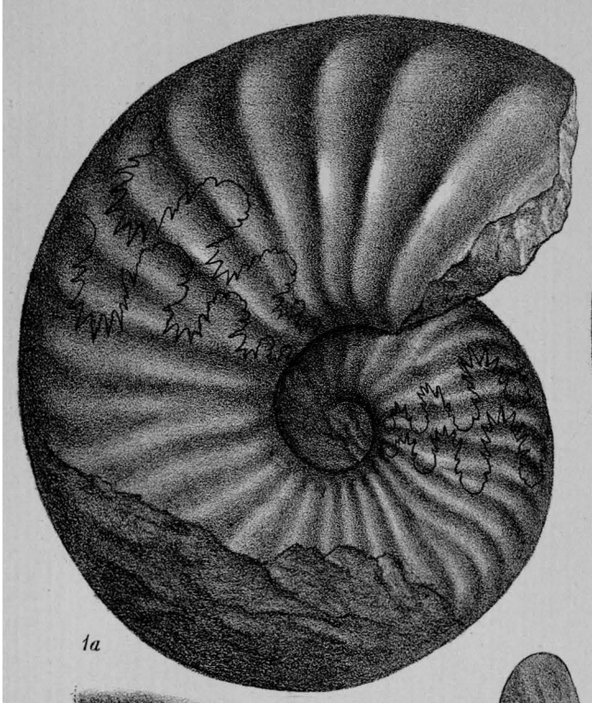
Fig. 3*a*, *b*. Ceratites Ravana, Diener, var; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 4*a*, *b*. Ceratites nov. sp. ind. ex. aff. C. Ravana, Diener; fragment of outer whorl; Utadhura (Johar), Coll. Diener.

Fig. 5*a*, *b*. *c*. Ceratites Ravana, Diener; Shalshal Cliff near Rimkin Paiar E. G.; Coll. Diener.

Fig. 6. Ceratites nov. sp. ind. ex. aff. C. Ravana, Diener; Spiti, Coll. Schlagintweit, Palæontological Museum in Munich.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



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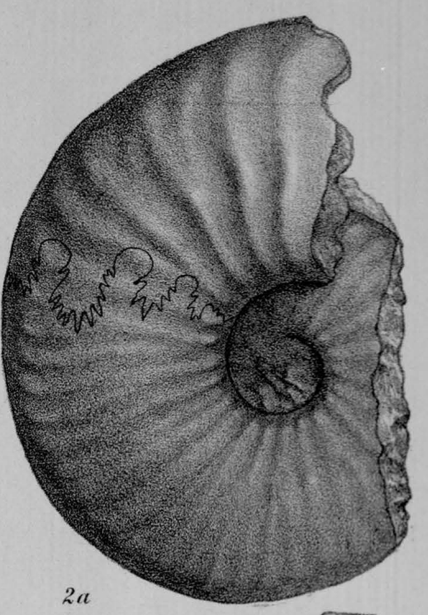

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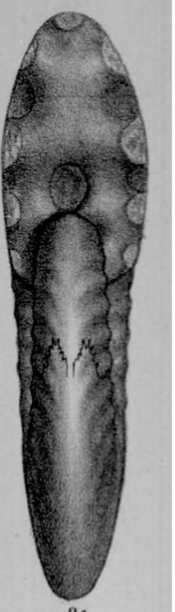

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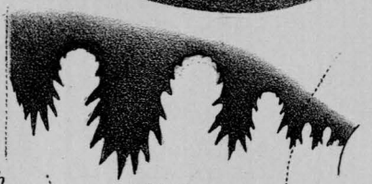

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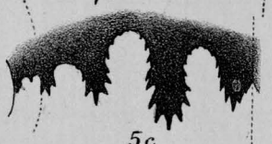

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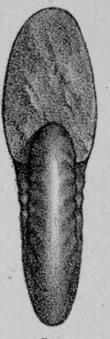

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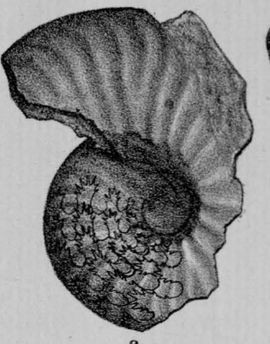

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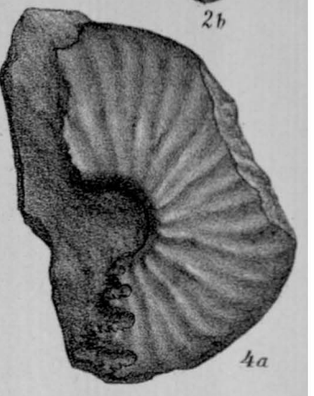

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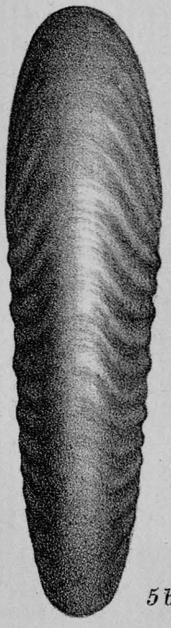

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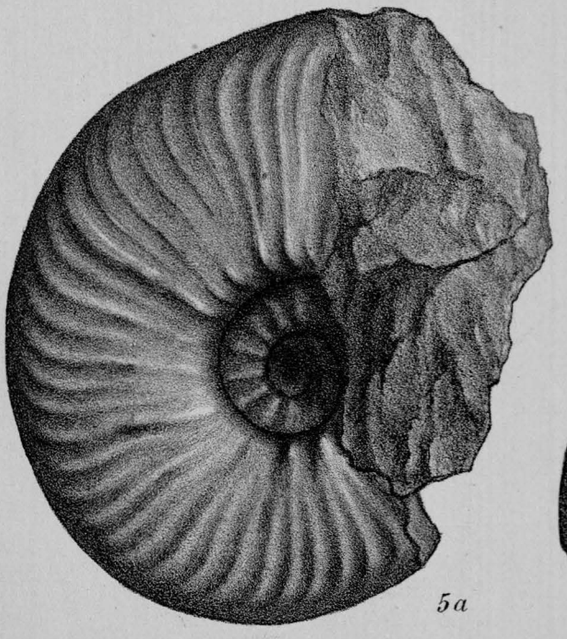

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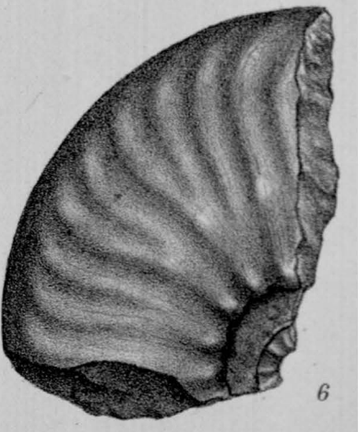
3c

4b



6

A. Swoboda del. et lith.

Th. Bannwarth print.

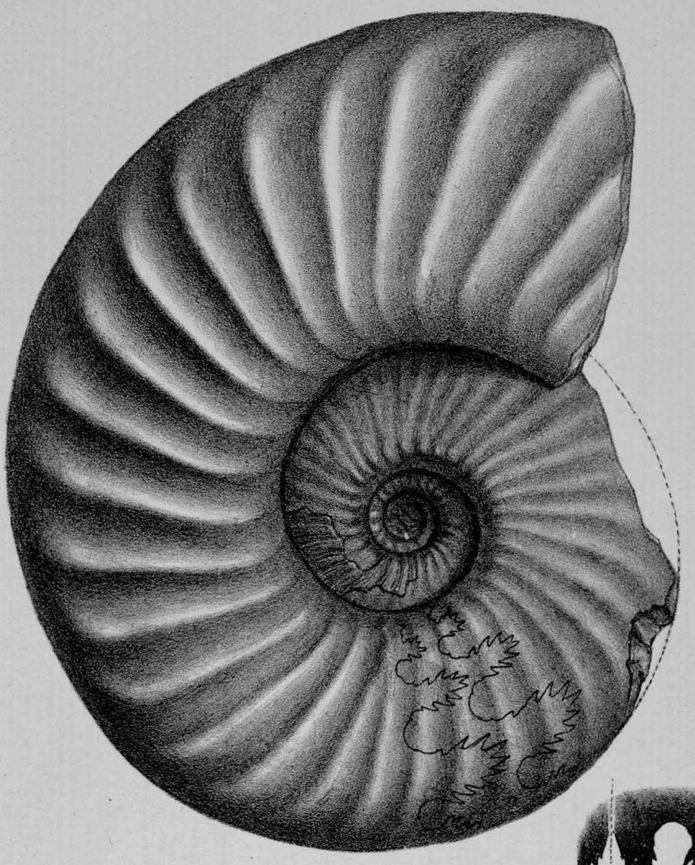
PLATE III.

Fig. 1*a*, *b*, *c*. Ceratites Hidimba, Diener; full-grown specimen, with a portion of the shell preserved. East slope of Tsang Tsok La, Hop Gadh (Hundés), Coll. Griesbach, Geological Survey Museum in Calcutta. p. 13

Fig. 2*a*, *b*, *c*. Ceratites Dungara, Diener; Kuling (Spiti), Coll. Geological Survey Museum in Calcutta.

Fig. 3. Ceratites sp. ind. ex. aff. C. Hidimba, Diener; probably from Spiti, Coll. Geological Survey Museum in Calcutta.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



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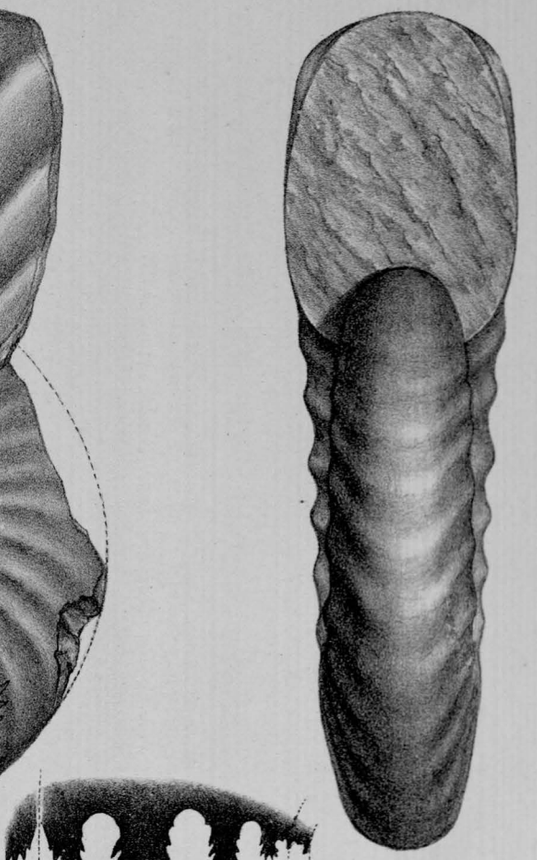

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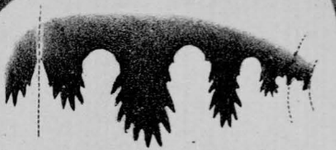

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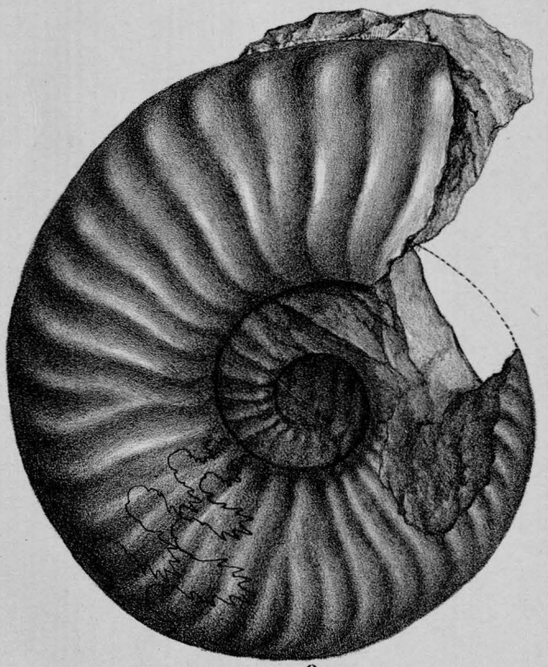

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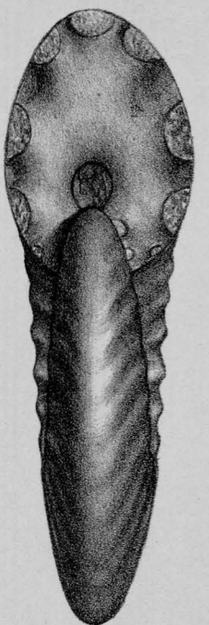
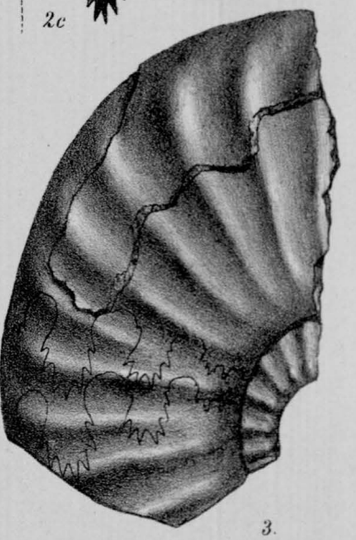


2b

2c



3.

A. Swoboda del. et lith. Th. Bannwarth print.

PLATE IV.

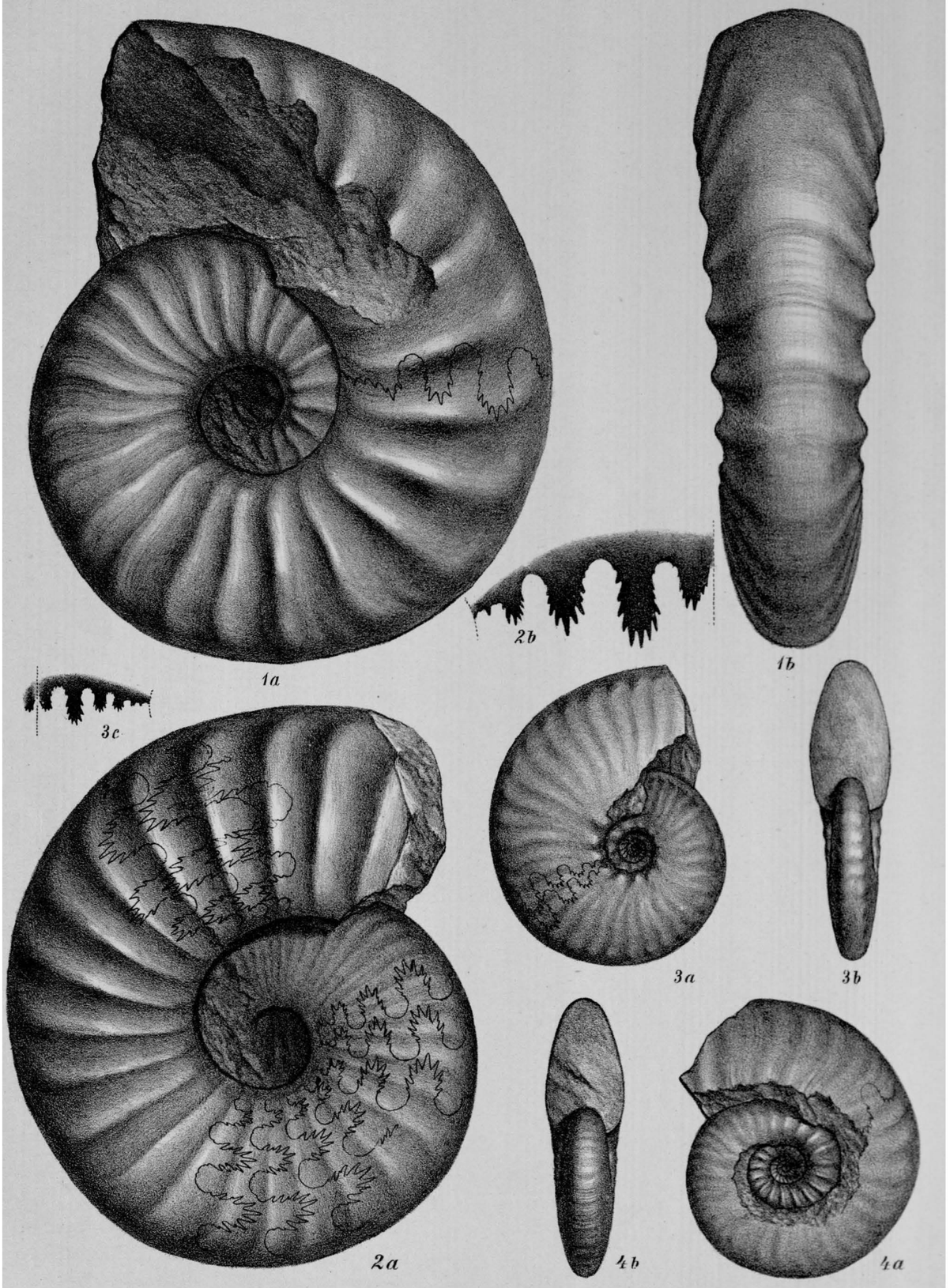
Fig. 1*a*, *b*. Ceratites Arjuna, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

Fig. 2*a*, *b*. Ceratites Visvakarma, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

Fig. 3*a*, *b*, *c*. Ceratites Airaváta, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

Fig. 4*a*, *b*. Ceratites nov. sp. ind., Diener (group of Ceratites circumplicati); Shalshal Cliff near Rimkim Paiar, Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith. Th. Bannwarth print.

PLATE V.

Fig. 1*a*, *b*, *c*, *d*. Ceratites Kamadeva, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 2*a*, *b*, c. Ceratites Kuvera, Diener; N. of Kalapani, Kali River Valley (Byans), Coll. Griesbach, Geol. Survey Museum in Calcutta.

Fig. 3*a*, *b*. Ceratites sp. ind. from the group of Ceratites Geminati, Mojs.; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

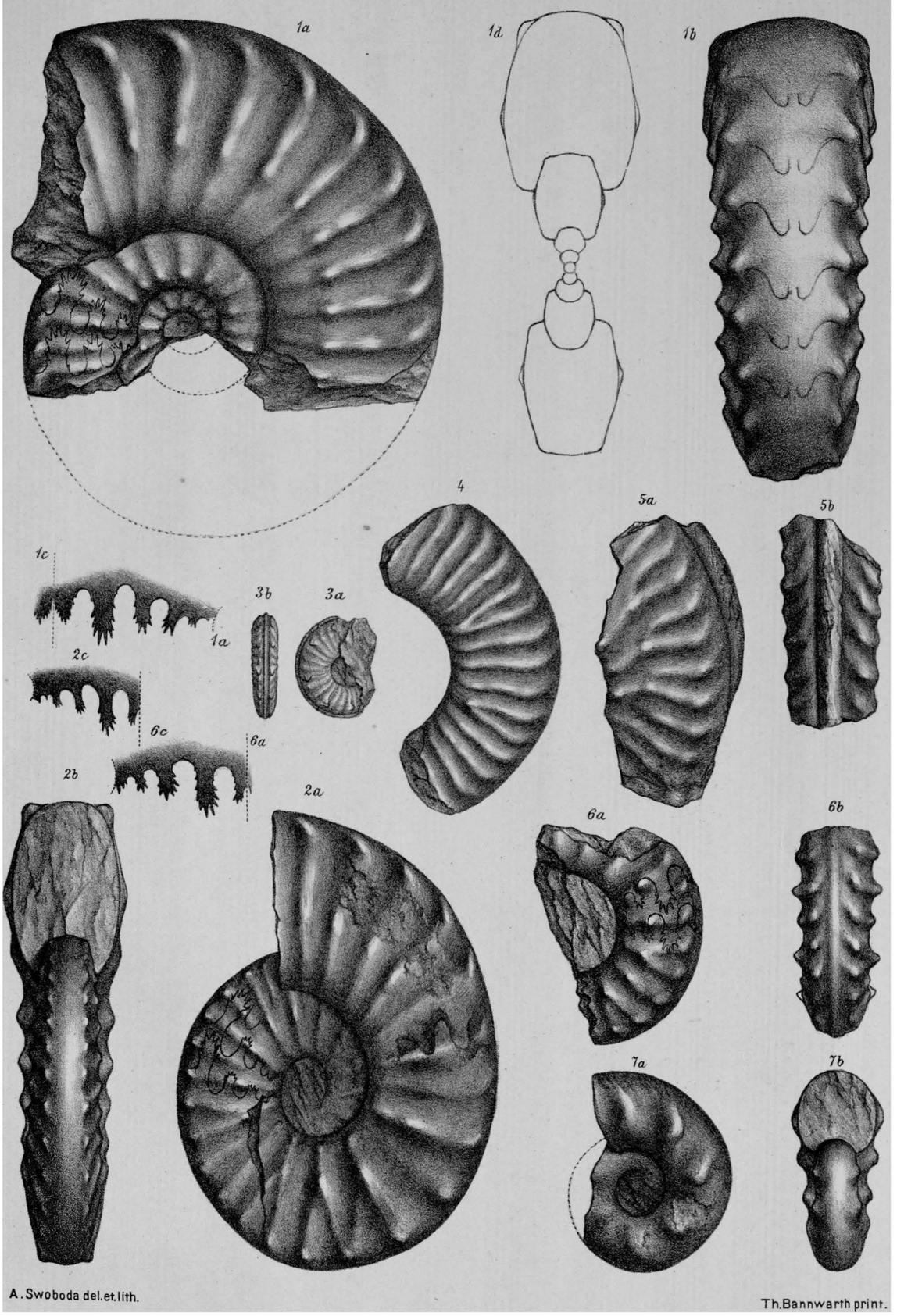
Fig. 4. Ceratites sp. ind.; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 5*a*, *b*. Ceratites sp. ind. (group of Ceratites Geminati Mojs. (?); Bambanag Cliffs, Girthi Valley (Johár), Coll. Diener.

Fig. 6*a*, *b* Ceratites nov. sp. ind. from the group of Ceratites subrobusti, Mojs.; fragment of outer whorl; Topidunga Valley (Johár), Coll. Diener.

Fig. 7*a*, *b*. Ceratites sp. ind. ex. aff. C. Middendorfi, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith.

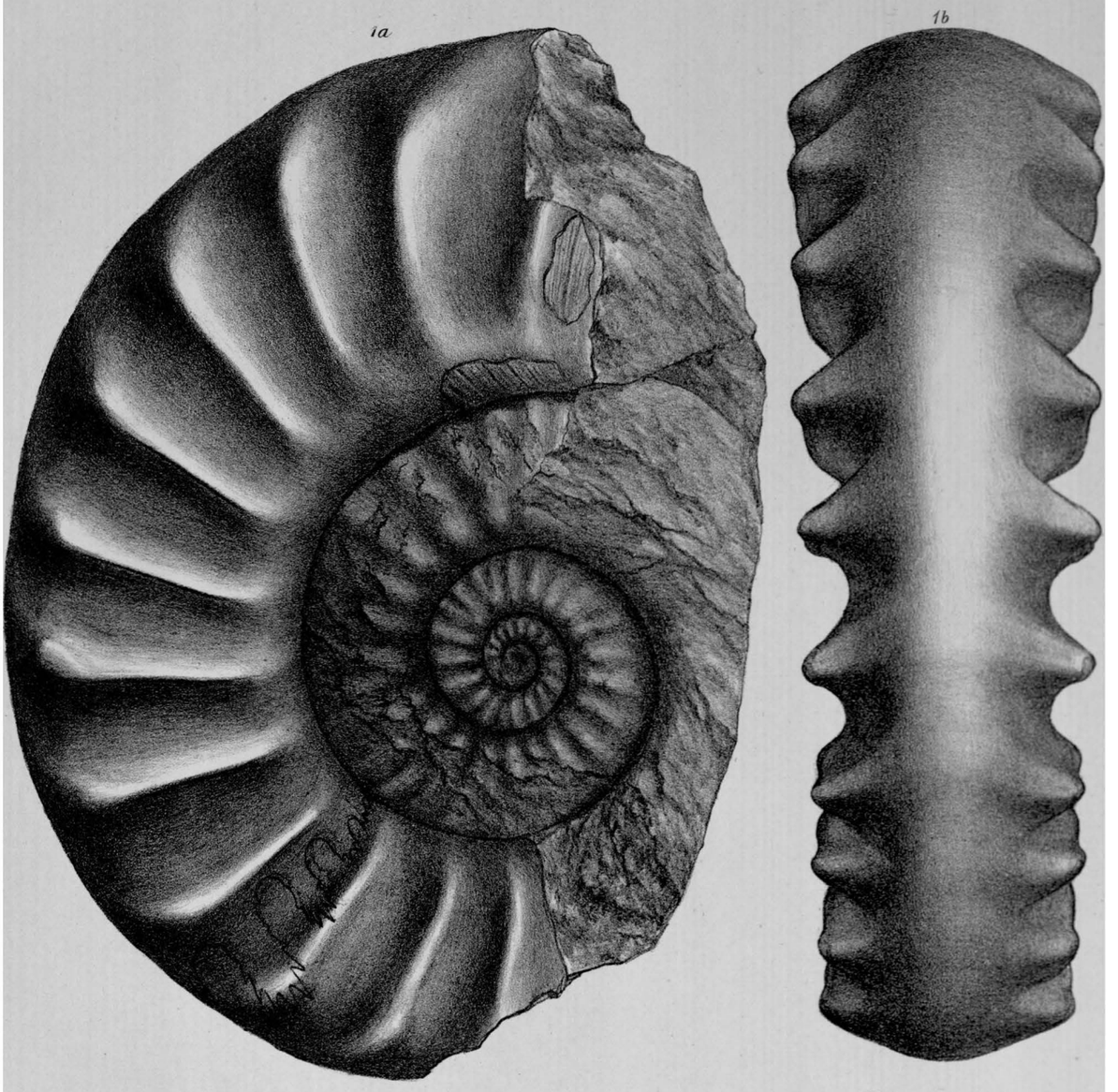
Th. Bannwarth print.

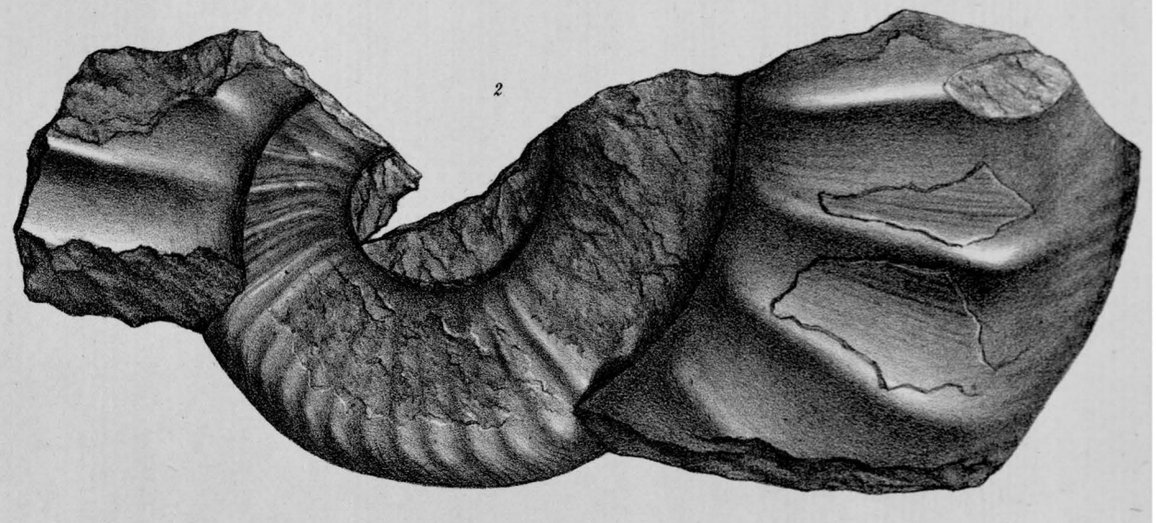
PLATE VI.

Fig. 1*a*, *b* Ceratites Vyasa, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 2 Ceratites Vyasa, Diener, cast, with shell partly preserved. Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)





A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE VII.

Fig. 1*a*, *b*, *c*. Japonites Sugriva, Diener. Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 2*a*, *b*. Japonites (?) runcinatus, Oppel, fragment of outer whorl; Shangra (Hundes), Coll. Schlagintweit, Palæontological Museum in Munich; Oppel's type-specimen.

Fig. 3*a*, *b*, *c*. Acrochordiceras Balarama, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

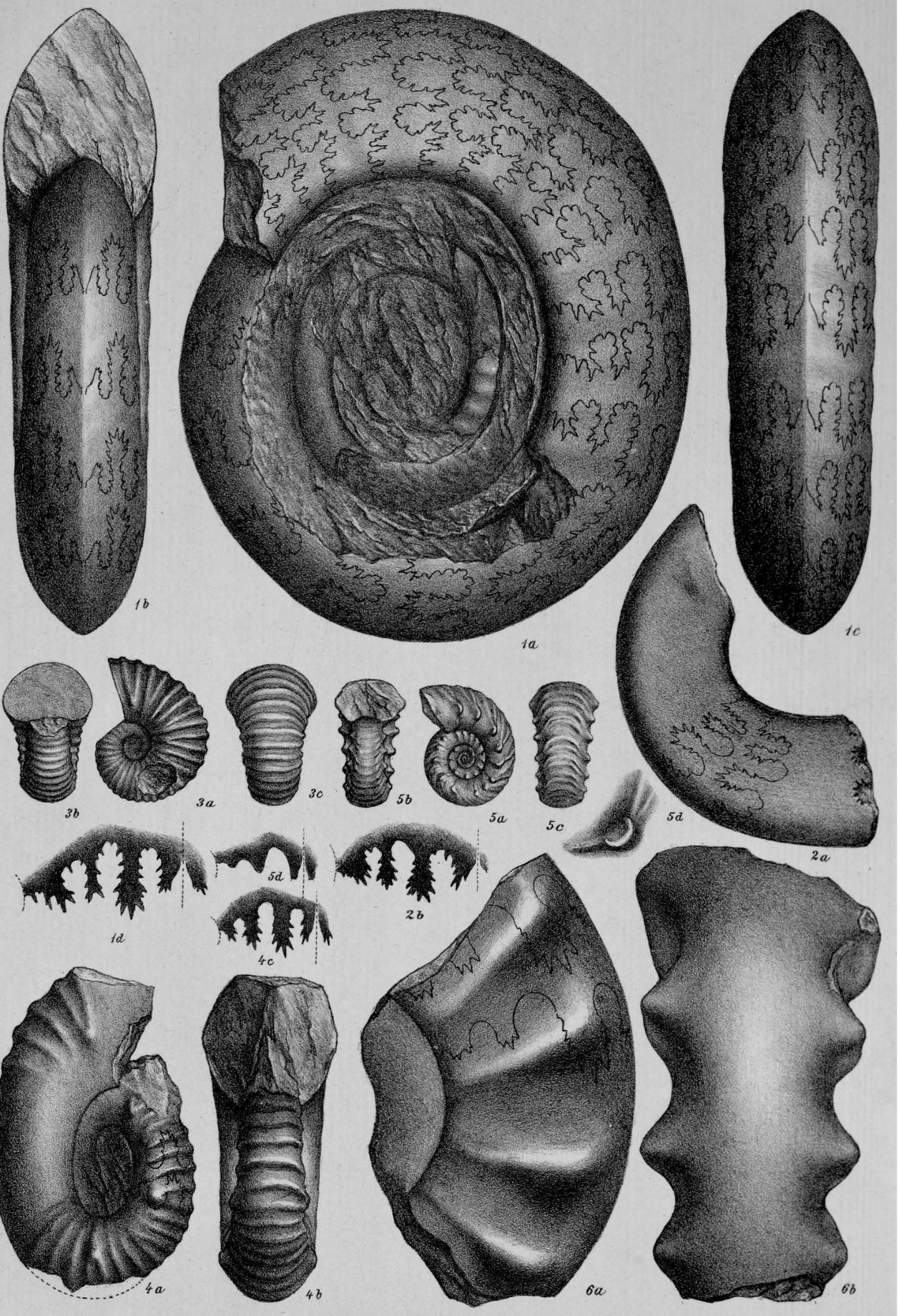
Fig. 4*a*, *b*, *c*. Acrochordiceras Joharense, Diener; Utadhura (Johár), Coll. Diener.

Fig. 5*a*, *b*, *c*, *d*. Sibirites Prahlada, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

Fig. 5 *e*. Tubercle with ribs and lunula of the same specimen, doubly enlarged.

Fig. 6*a*, *b*. Ceratites sp. ind. ex. aff. C. Vyasa, Diener, fragment of outer whorl; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE VIII.

Fig. 1*a*, *b*, *c*. Danubites Dritaráshtra, Diener; Utadhura (Johár), Coll. Diener.

Fig. 2*a*, *b*, *c*, *d*. Meekoceras proximum, Oppel; Shangra (Hundés), Coll. Schlagintweit, Palæontological Museum in Munich; Oppel's type-specimen. Fig. *a* and *b* show the view of the specimen from left and right side.

Fig. 3*a*, *b*, *c*. Meekoceras Khanikofi, Oppel; Shangra (Hundés), Coll. Schlagintweit, Palæontological Museum in Munich.

Fig. 4, 5*a*, *b*, *c*, *d*. Meekoceras affine, E. v. Mojs.; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

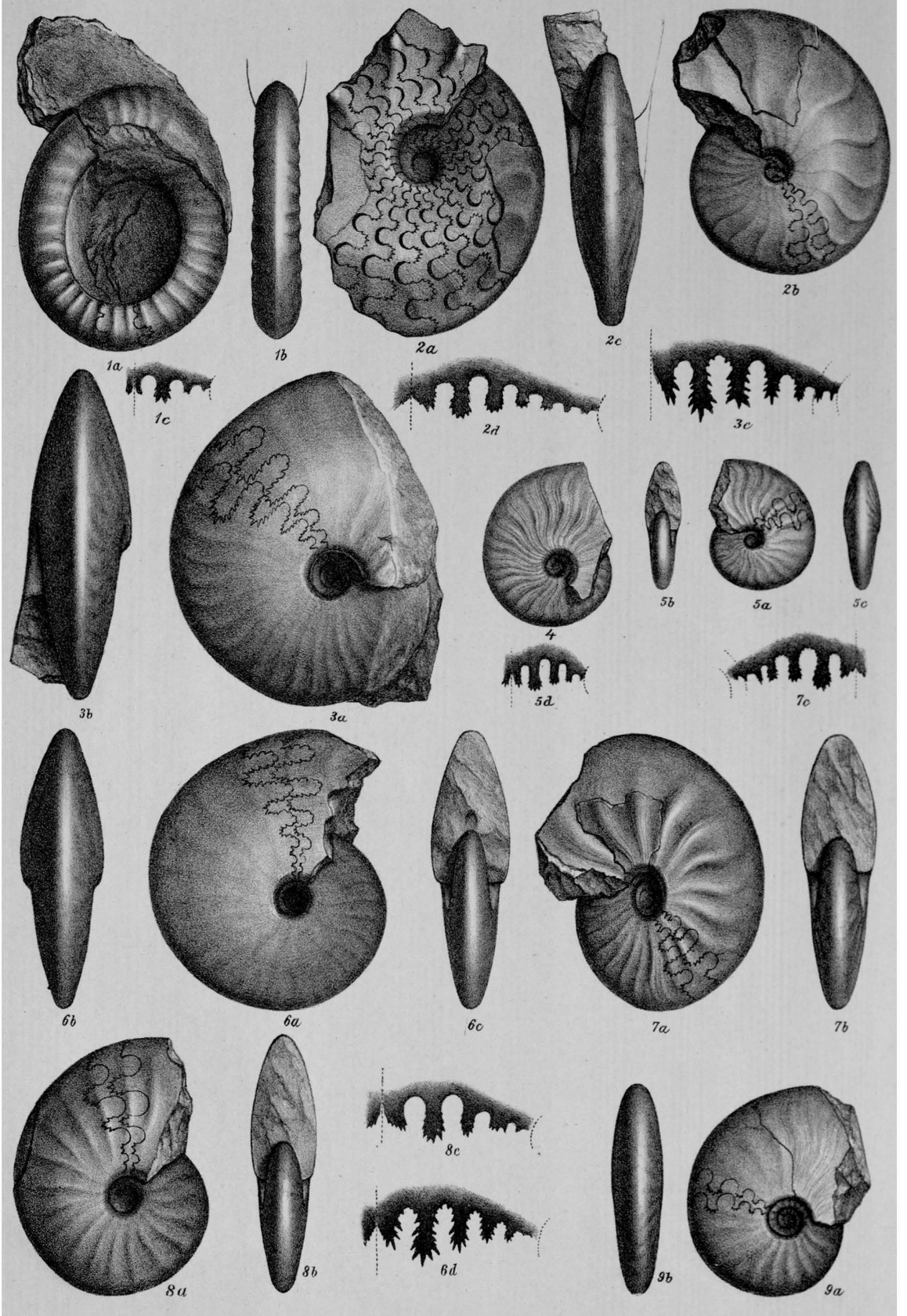
Fig. 6*a*, *b*, *c*, *d*. Meekoceras Kesava, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 7*a*, *b*, *c*. Meekoceras Narada, Diener; Bambanag Cliffs, Girthi Valley (Johár), Coll. Diener.

Fig. 8*a*, *b*, *c*. Meekoceras Srikanta, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 9*a*, *b*. Meekoceras Srikanta, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith. Th. Bannwarth print.

PLATE IX.

Fig. 1*a*, *b*. Meekoceras Khanikofi, Oppel, full-grown specimen, with shell preserved. Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 2. Meekoceras Khanikofi, Oppel, variety, with tubercles; Kuling (Spiti), Coll. Schlagintweit, Palæontol. Museum in Munich.

Fig. 3*a*, *b*. Meekoceras Khanikofi, Oppel; S. E. of Muth (Spiti), Coll. Griesbach, Geological Survey Museum in Calcutta.

Fig. 4*a*, *b*, *c*. Meekoceras Gangadhara, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 5*a*, *b*, *c*. Meekoceras Nalikanta, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 7. Meekoceras Nalikanta, Diener, sutures of a full-grown specimen; Shalshal Cliff, Coll. Diener.

Fig. 8 *a*, *b*, *c*. Meekoceras Nanda, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 9. Meekoceras Khanikofi, adolescent stage; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)

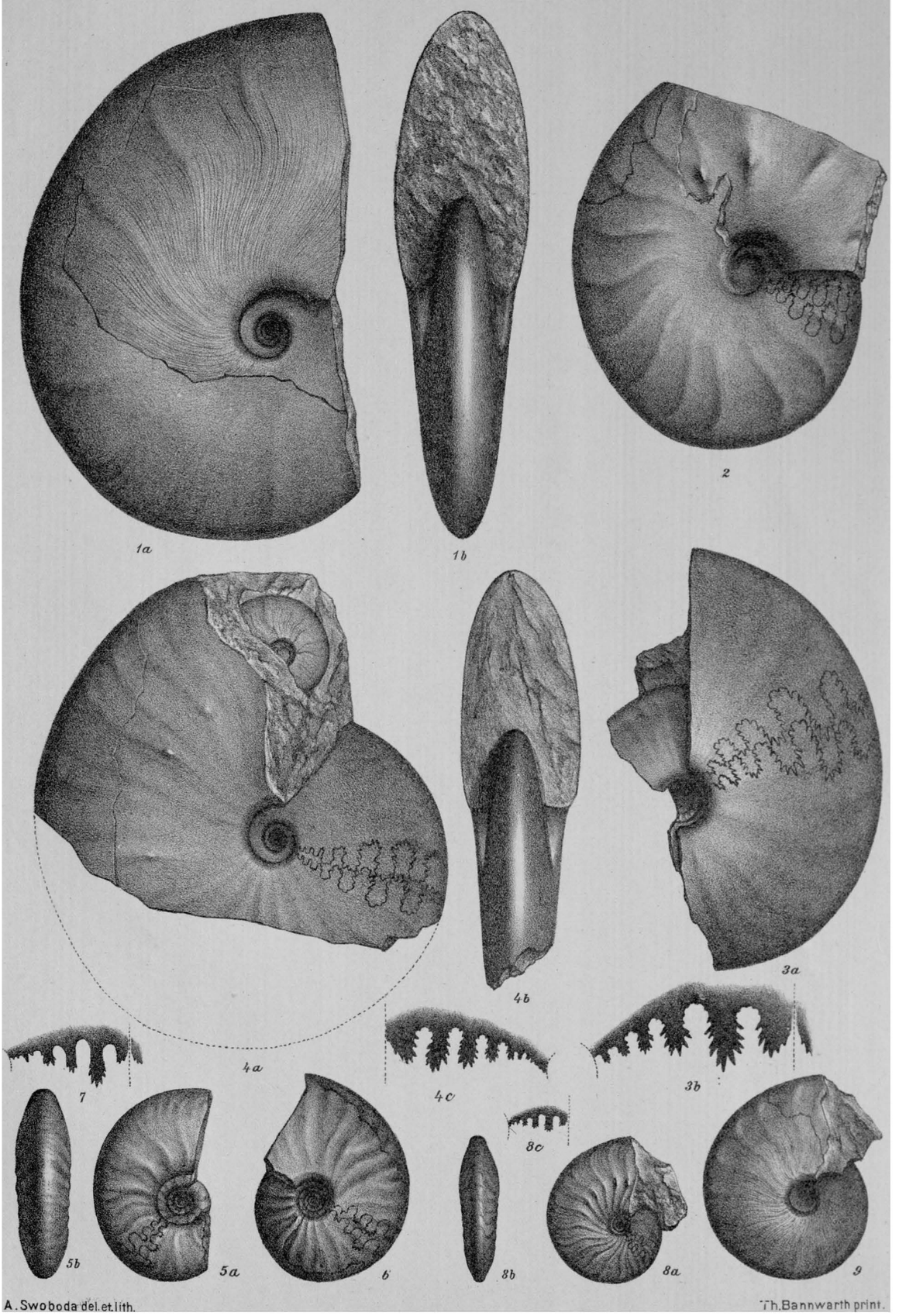


PLATE X.

Fig. 1*a*, *b*. Meekoceras Rudra, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 2*a*, *b*, *c*. Gymnites Kirata, Diener; Lilang (Spiti), Coll. Stoliczka, Geological Survey Museum in Calcutta.

Fig. 3*a*, *b*. Gymnites Kirata, Diener, adolescent form; Lilang (Spiti), Geological Survey Museum in Calcutta.

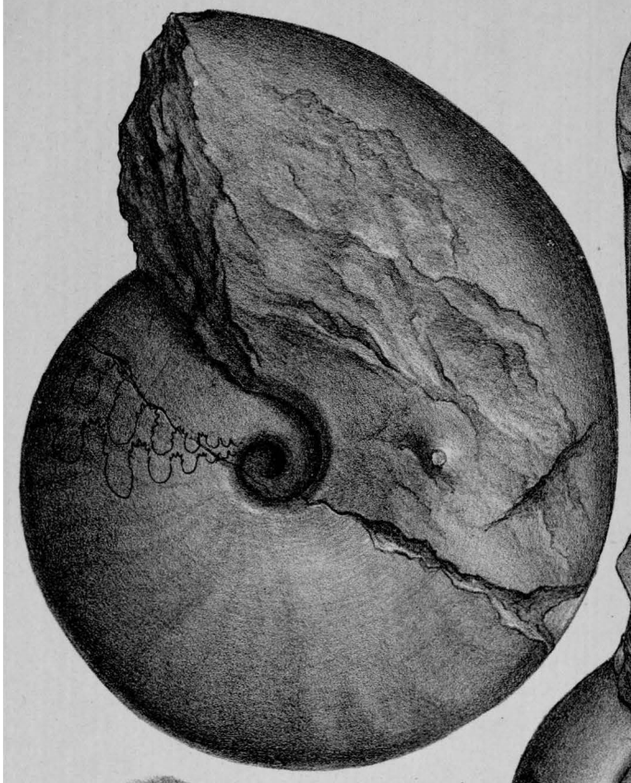
Fig. 4*a*, *b*, *c*. Japonites Chandra, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

Fig. 5*a*, *b*. Gymnites nov. sp. ind. ex. aff. G. Sankara, Diener; Utadhura (Johár), Coll. Diener.

Fig. 6*a*, *b*, *c*. Gymnites Lamarki, Oppel; Kuling (Spiti), Coll. Schlagintweit, Palæontological Museum in Munich. Oppel's type-specimen.

Fig. 7*a*, *b*, *c*. Gymnites Jollyanus, Oppel; Muth (Spiti), Geological Survey Museum in Calcutta.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)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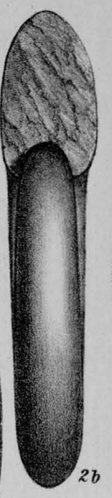
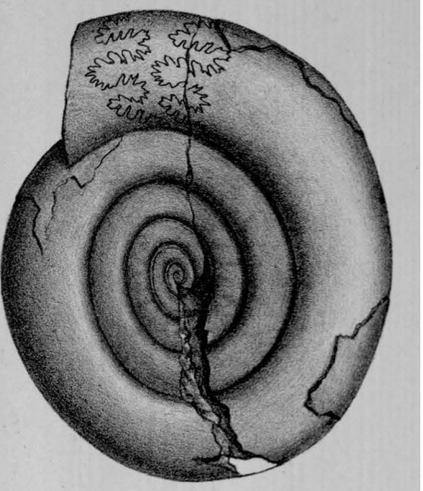
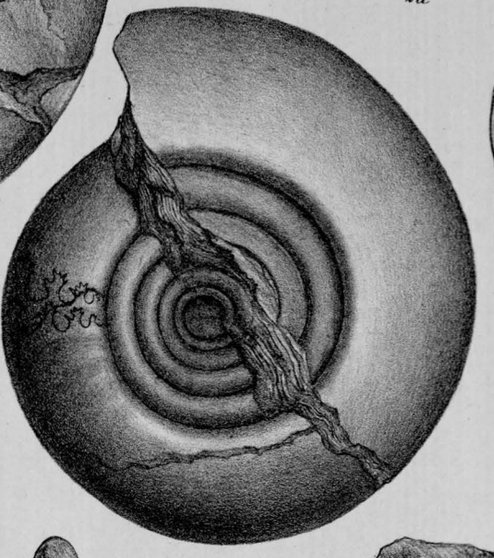

2b


2a


4a

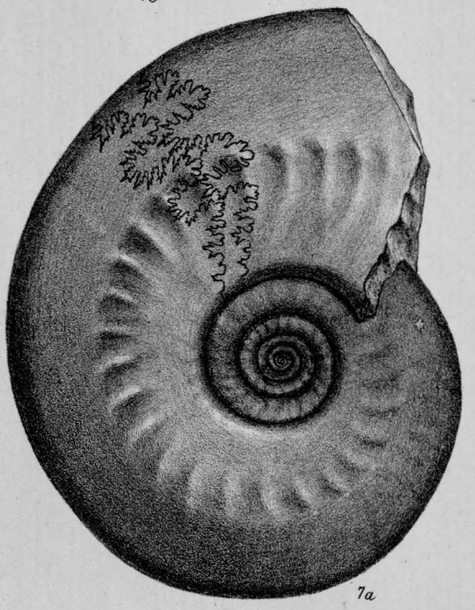

4b


1b


2c

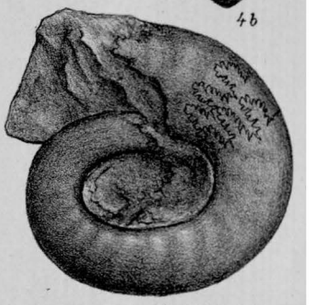

7c

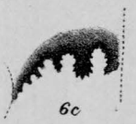

4c


7a


7b

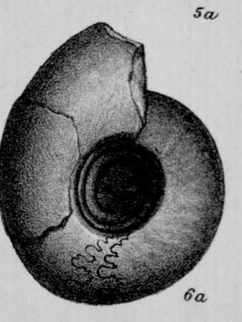

5b


5a


6c


3a


3b


6a


6b

A. Swoboda del. et lith.

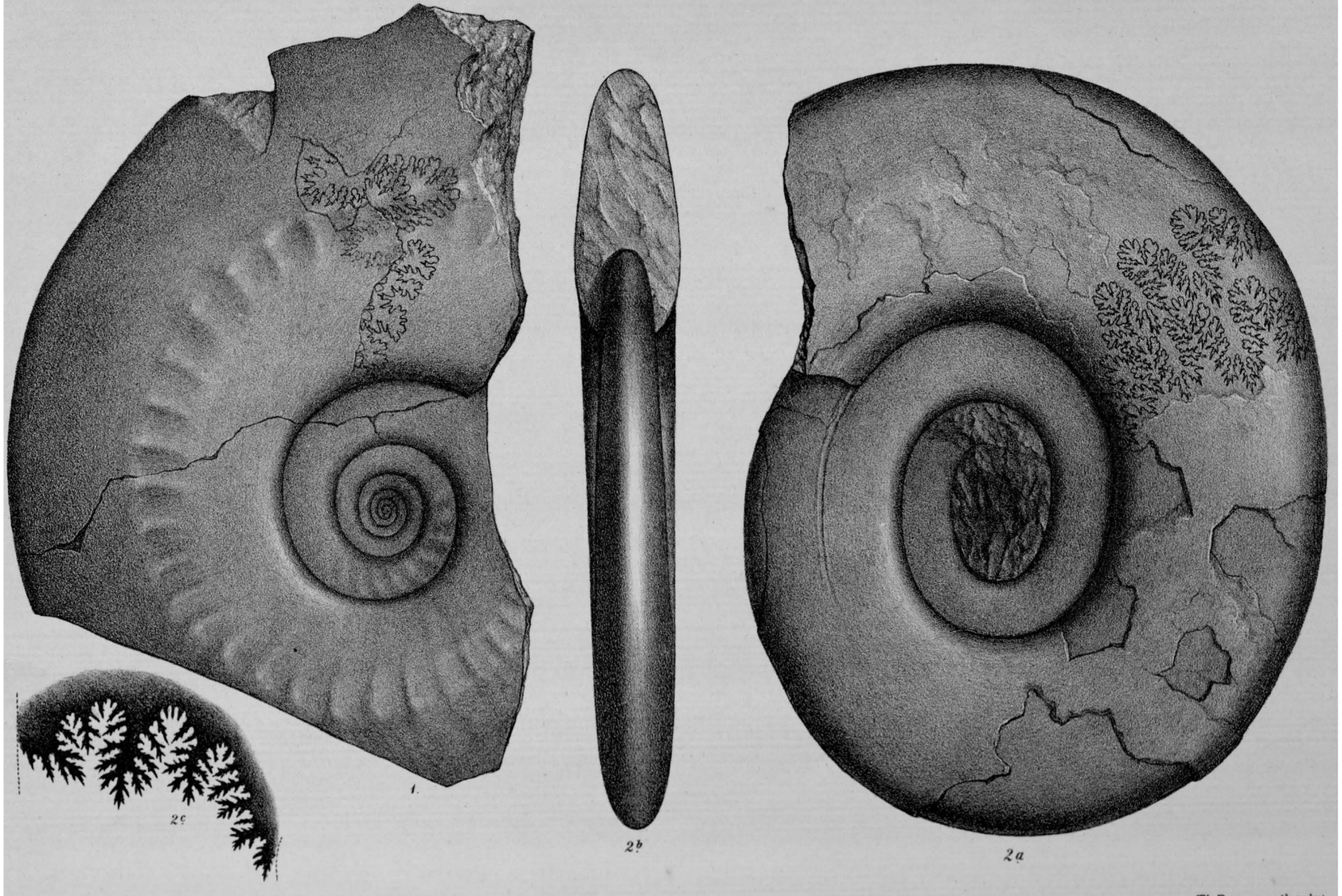
Th. Bannwarth print.

PLATE XI.

Fig. 1*a*, *b*. Gymnites Jollyanus, Oppel; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 2*a*, *b*, *c*. Gymnites Sankara, Diener; Lilang (Spiti), Coll. Stoliczka, Geological Survey Museum in Calcutta.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith.

Th. Bannwarth print.

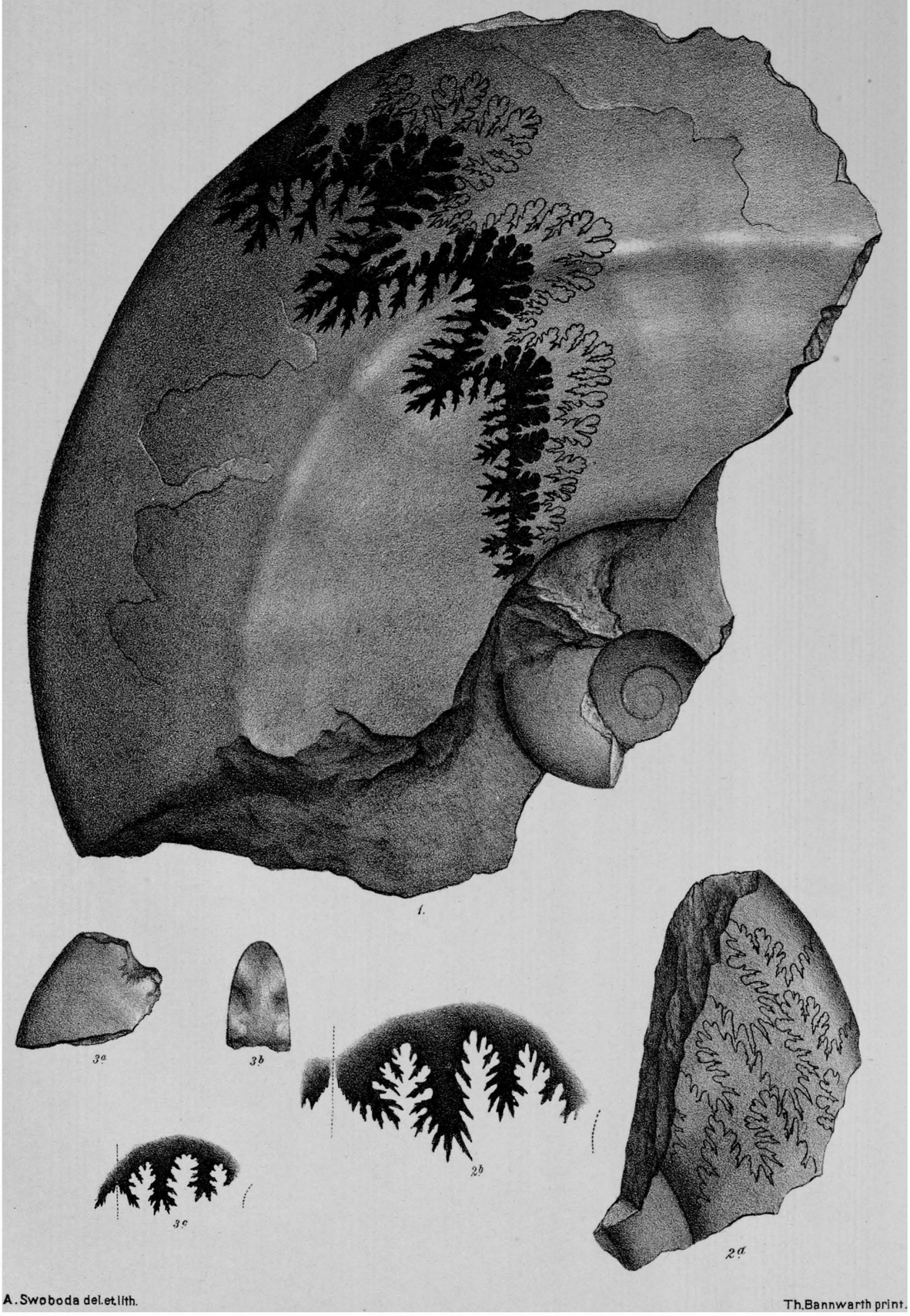
PLATE XII.

Fig. 1. Gymnites Jollyanus, Oppel, sutures of a full-grown specimen; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 2*a*, *b*. Gymnites sp. ind. ex. aff. G. Humboldti, Diener; fragment of outer whorl. Bambanag Cliffs, Girthi Valley (Johár), Coll. Diener.

Fig. 3*a*, *b*, *c*. Gymnites Salteri, Beyrich; Ladakh, Coll. Prochnow, Museum für Naturkunde, Berlin. Copy of a plaster cast after Beyrich's type-specimen.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith.

Th. Bannwarth print.

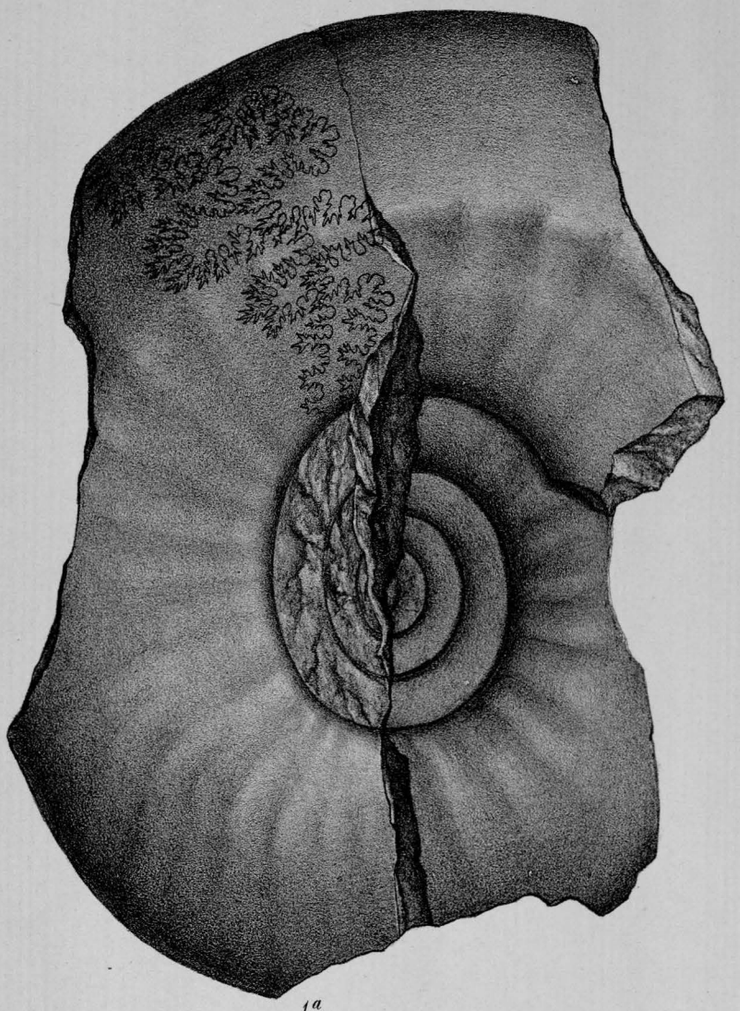
PLATE XIII.

Fig. 1*a*, *b*, *c*. Gymnites nov. sp. ex. aff. G. Sankara, Diener; Kuling (Spiti), Coll. Geological Survey Museum in Calcutta.

Fig. 2*a*, *b*, *c*. Gymnites Vasantasena, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

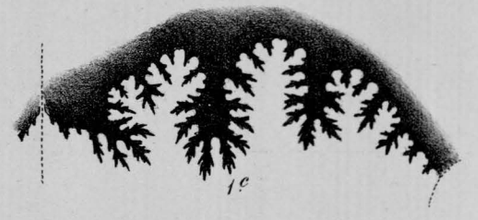
Fig. 3. Gymnites (Buddhaites) Rama, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Griesbach, Geological Survey Museum in Calcutta. Sutures of a middle-sized specimen.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



1a

1b



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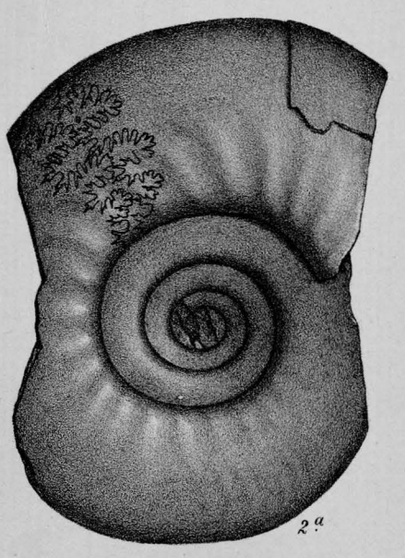
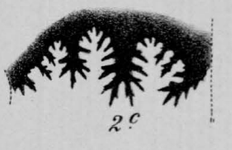


2a

2b



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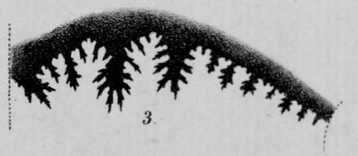


3

A. Swoboda del. et lith.

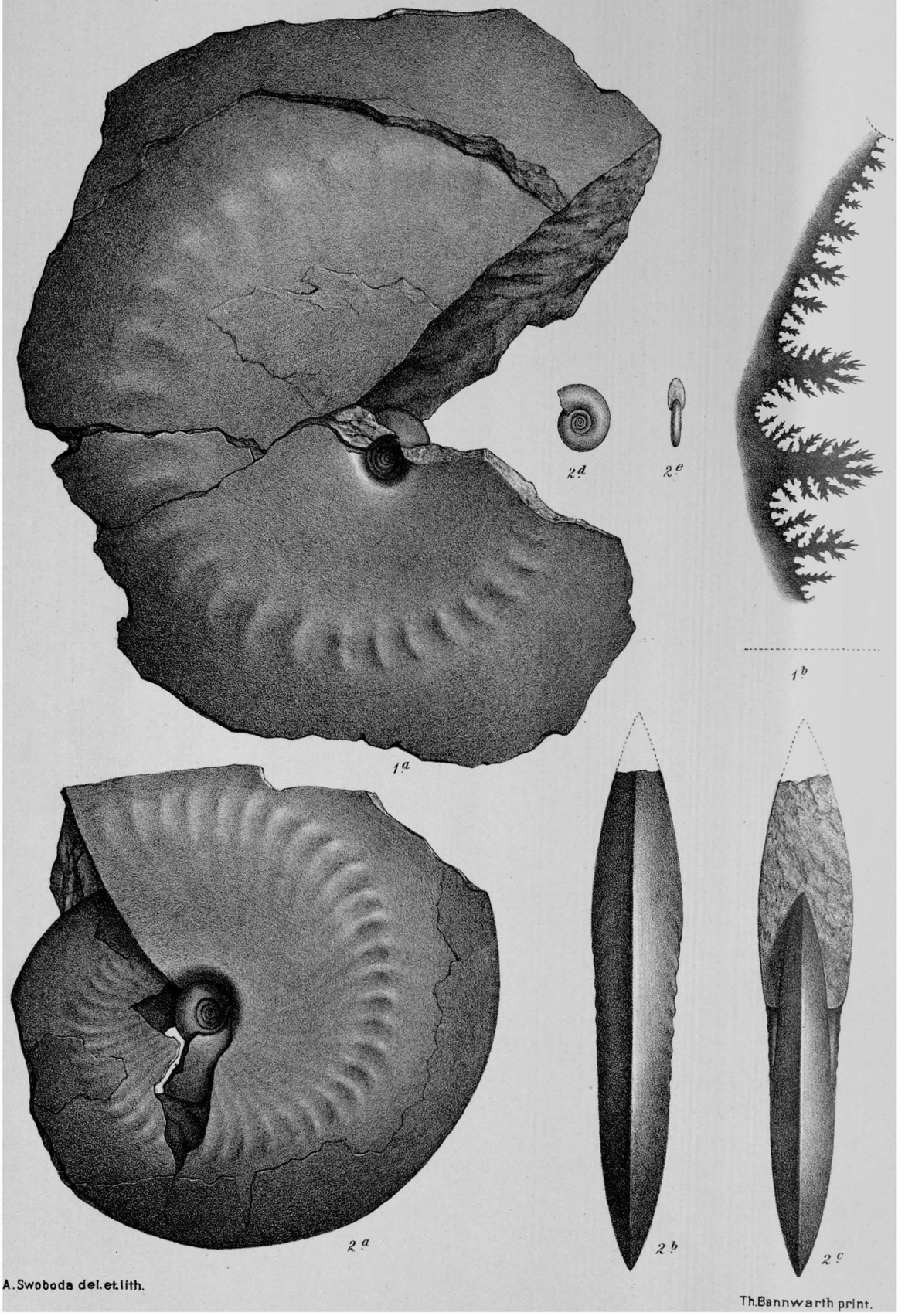
Th. Bannwarth print.

PLATE XIV.

Fig. 1*a*, *b*. Gymnites (Buddhaites) Rama, Diener; west slope of the Silakank Pass, Coll. Griesbach, Geological Survey Museum in Calcutta. In the sutural-line the outer branch of the siphonal saddle and the siphonal lobe are missing.

Fig. 2*a*, *b*, *c*, *d*, *e*. Gymnites (Buddhaites) Rama, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener; *d* and *e* inner whorls of the same specimen.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith.

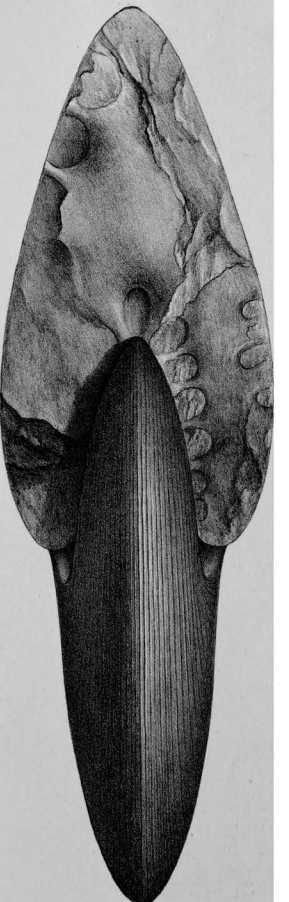
Th. Bannwarth print.

PLATE XV.

Fig. 1*a*, *b*. Sturia Sansovinii, E. v. Mojsisovics; Shalshal Cliff near Rimkin Paiar, Coll Diener. Large specimen with shell preserved.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)

a



b

A. Swoboda del. et lith.

Th. Bannwarth print.

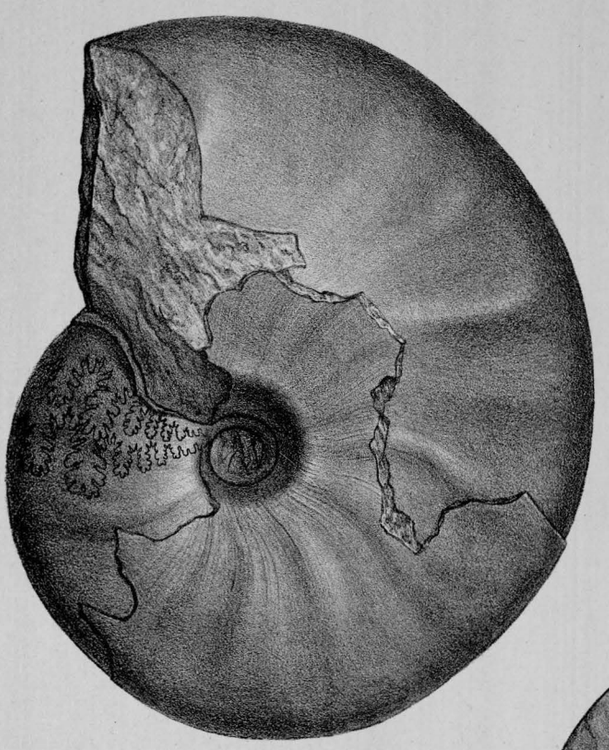
PLATE XVI.

Fig. 1*a*, *b*, *c*. Ptychites Mahendra, Diener; Muth (Spiti), Coll. Geological Survey Museum in Calcutta.

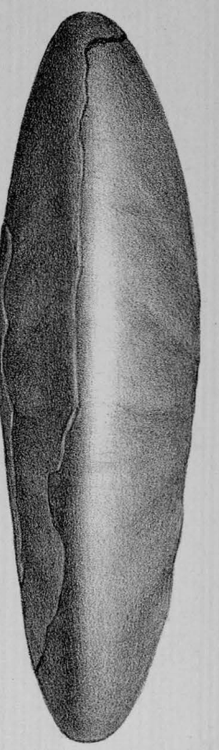
Fig. 2*a*, *b*. Ptychites Mahendra, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener. 2*b*. front-view of the inner whorls of the same specimen.

Fig. 3*a*, *b*, *c*. Ptychites Drona, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)

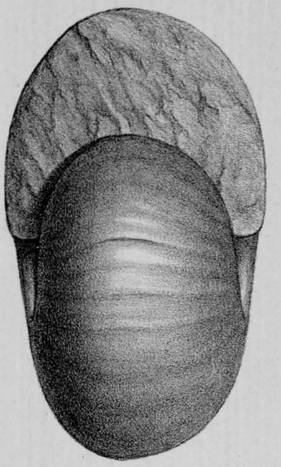


1a.

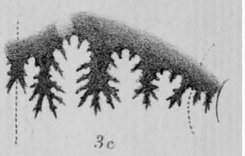


1b

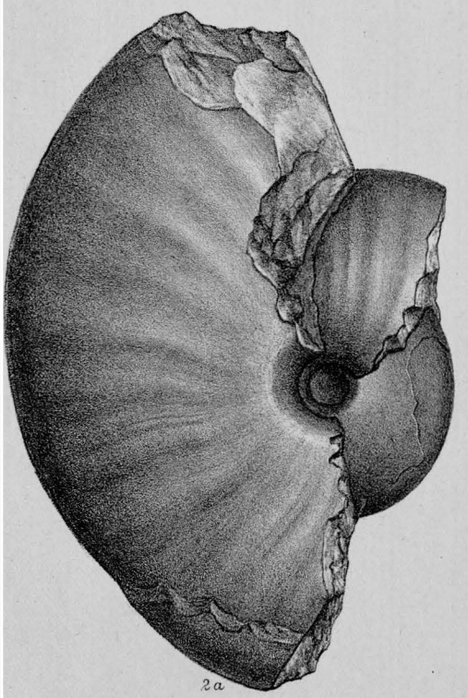
1c



3b

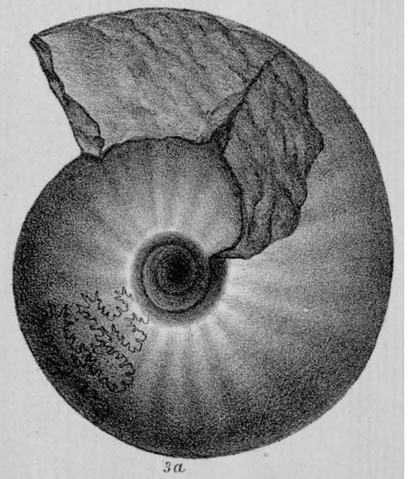


3c



2a

2b



3a

A. Swoboda del. et lith.

Th. Bannwarth print.

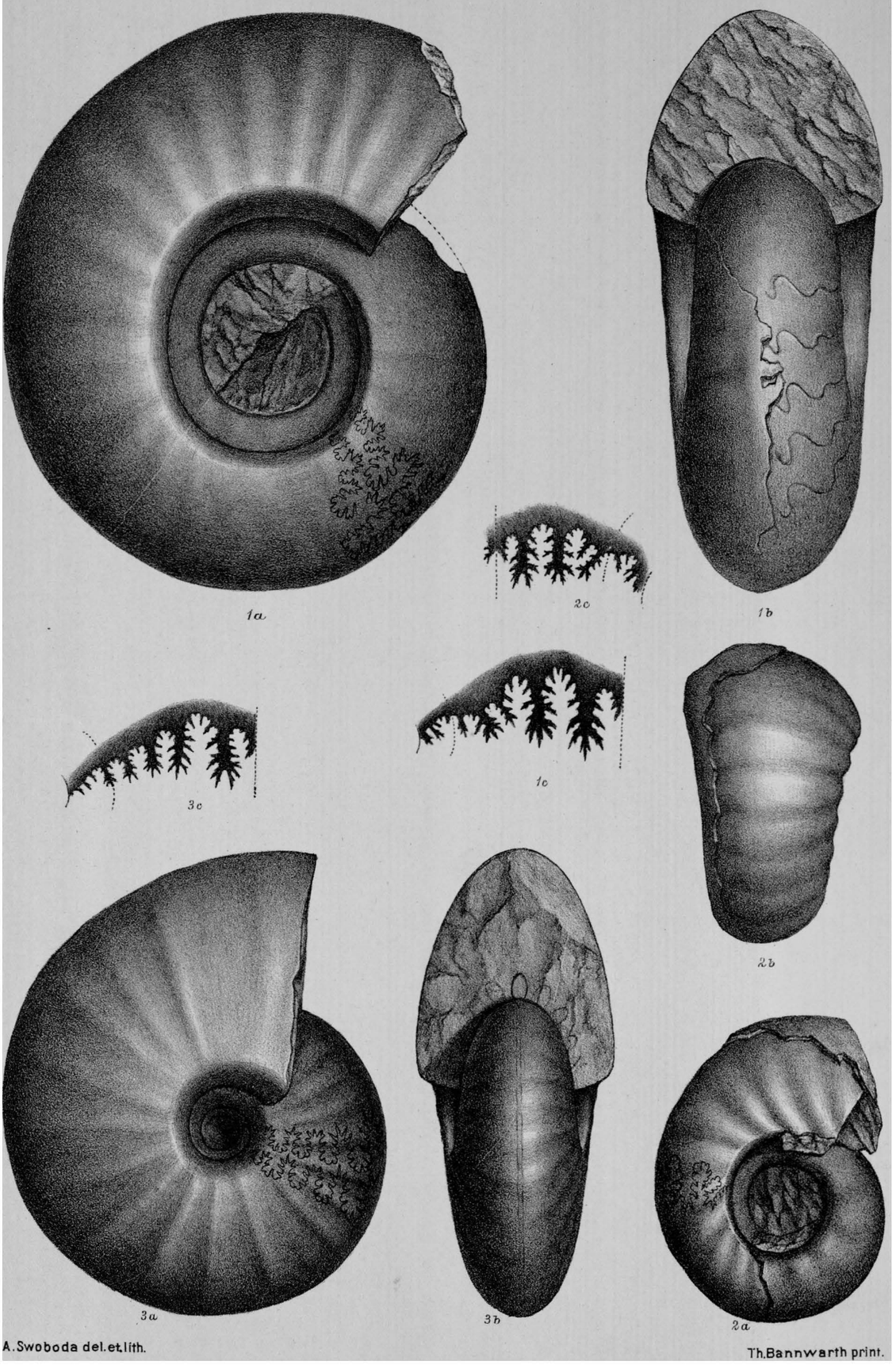
PLATE XVII.

Fig. 1*a*, *b*, *c*. Ptychites Malletianus, Stol.; Lilang (Spiti) Coll. Geol. Survey Museum in Calcutta. Stoliczka's type-specimen.

Fig. 2*a*, *b*, *c*. Ptychites nov. sp. ex. aff. Malletianus, Diener; north of Padam, Spiti, Coll. Geol. Survey Museum in Calcutta.

Fig. 3*a*, *b*, *c*. Ptychites cochleatus, Oppel; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE XVIII.

Fig. 1. Ptychites Gerardi, Blanford; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener. Specimen with shell partly preserved.

Fig. 2*a*, *b*, *c*. Ptychites Gerardi, Blanf.; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

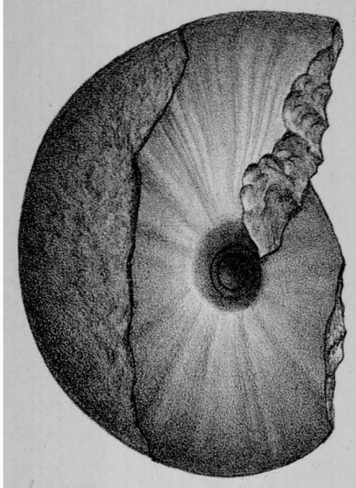
Fig. 3. Ptychites Gerardi, Blanf.; Spiti Valley, Coll. Geol. Survey Museum in Calcutta (from the Asiatic Society of Bengal). Blanford's type-specimen.

Fig. 4*a*, *b*. Ptychites impletus, Oppel; Kuling (Spiti), Coll. Schlagintweit, Palæontological Museum in Munich. Oppel's type-specimen.

Fig. 5. Ptychites cognatus, Oppel; Kuling (Spiti), Coll. Schlagintweit, Palæontological Museum in Munich.

Fig. 6*a*, *b*. Ptychites cognatus, Oppel; Kuling (Spiti), Coll. Schlagintweit, Palæontological Museum in Munich.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



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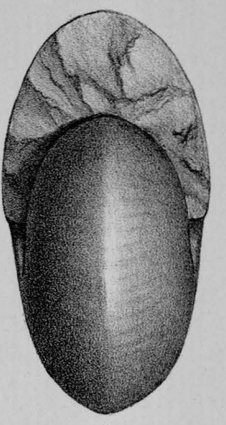

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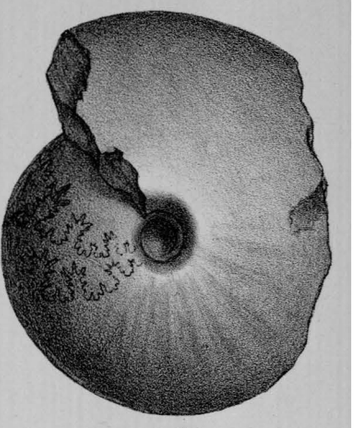
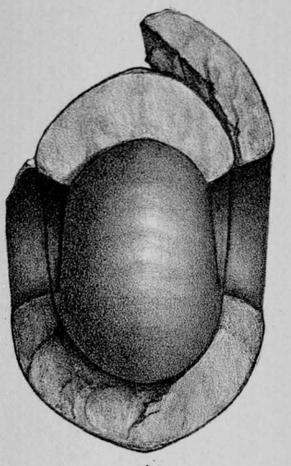


2a

2c



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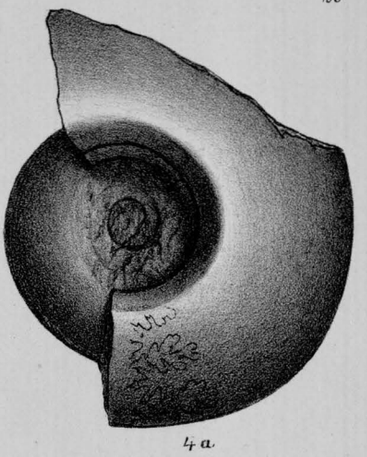
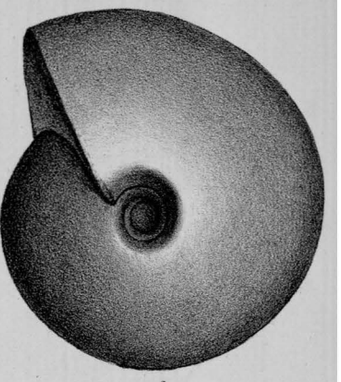


4a



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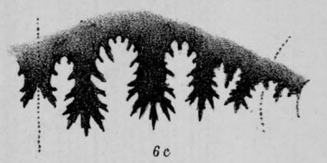
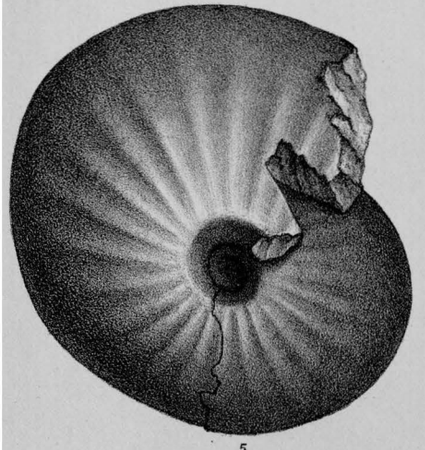


6c



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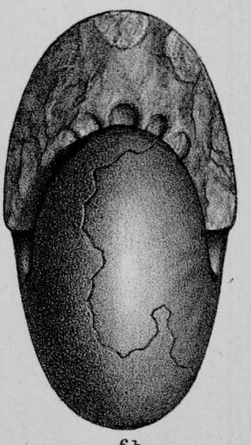

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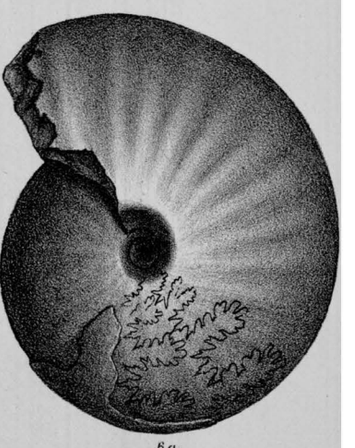


6a

A. Swoboda del. et lith. Th. Bannwarth print.

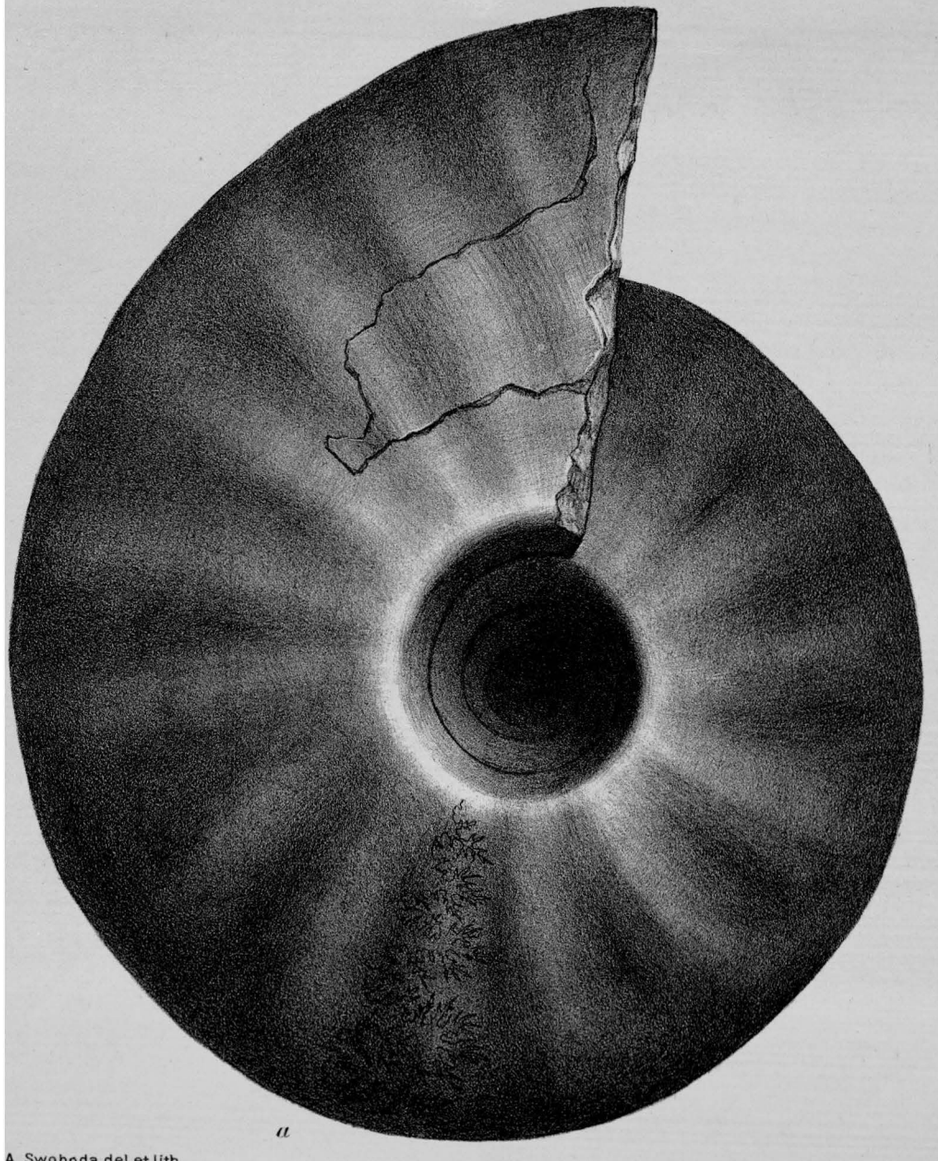
PLATE XIX.

Ptychites Everesti, Oppel; full-grown specimen; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

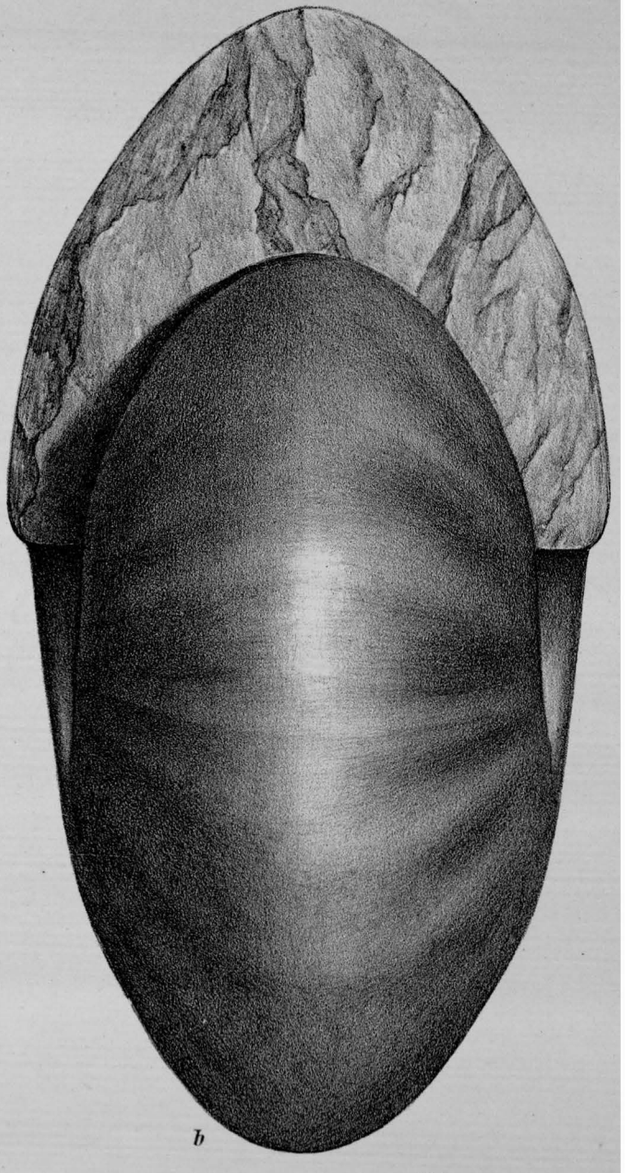
Geol. Surv. of India.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)

Pl. XIX.



a



b

A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE XX.

Fig. 1*a*, *b*. Ptychites Everesti, Oppel; Shangra (Tibet). Oppel's type-specimen.

Fig. 2*a*, *b*. Ptychites Vidura, Diener; Hundés.

Fig. 3*a*, *b*. Ptychites Vidura, Diener; Spiti.

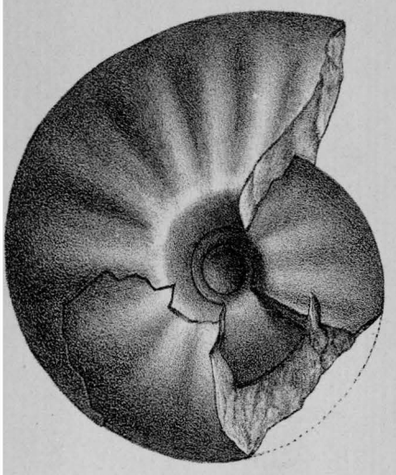
Fig. 4*a*, *b*, *c*. Ptychites Everesti, Oppel; Spiti.

Fig. 5*a*, *b*. Ptychites Vidura, Diener; Hundés.

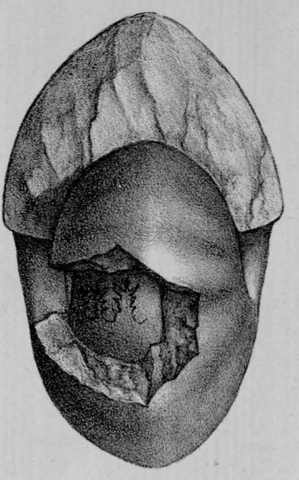
Fig. 6. Ptychites Vidura, Diener; sutural line, Hundés.

All specimens, figured on this plate, from the Schlagintweit-collection, Palæontological Museum in Munich.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)

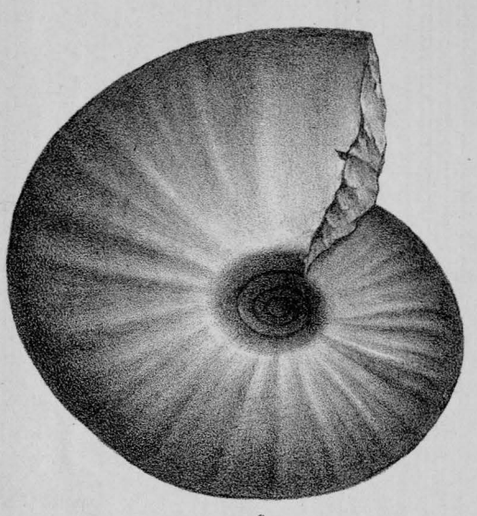


1a

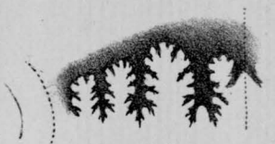


1b

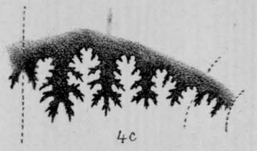
2a



3a

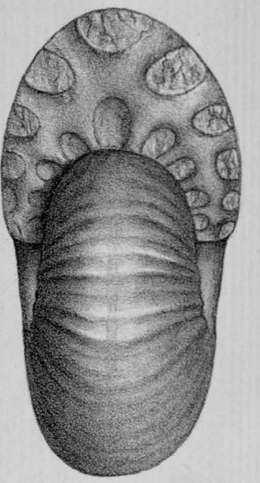


2b



4c

6



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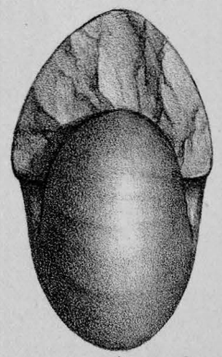

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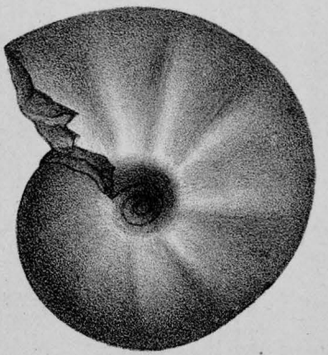
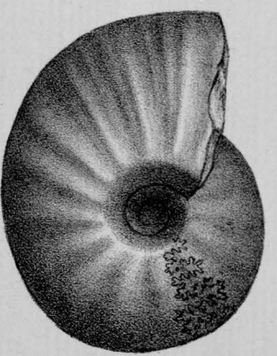
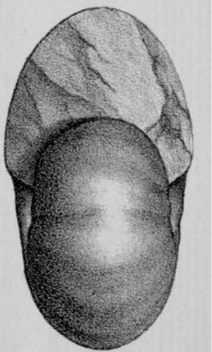


4a



5a



5b

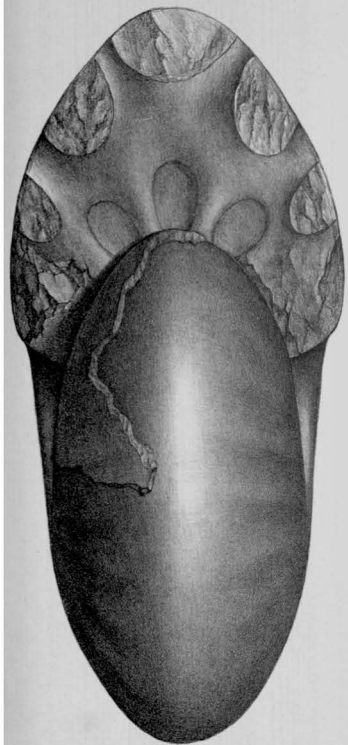
A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE XXI.

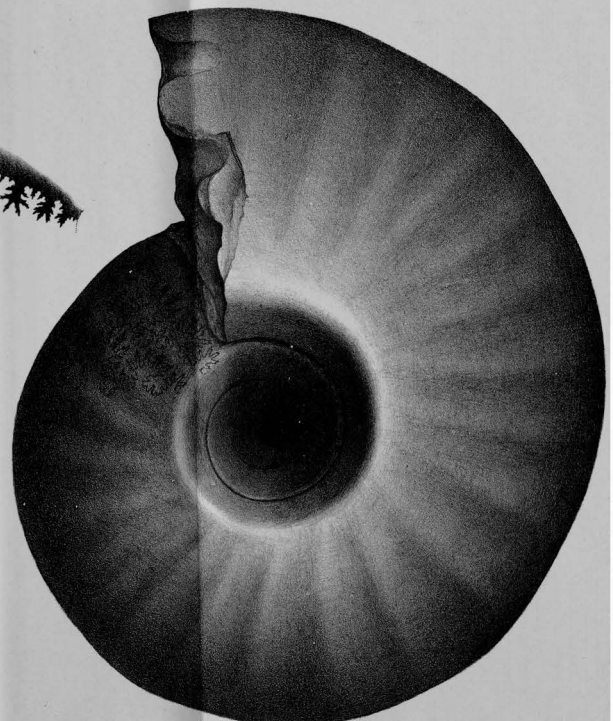
Ptychites Govinda, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



b

c



a

A. Swoboda del. et lith.

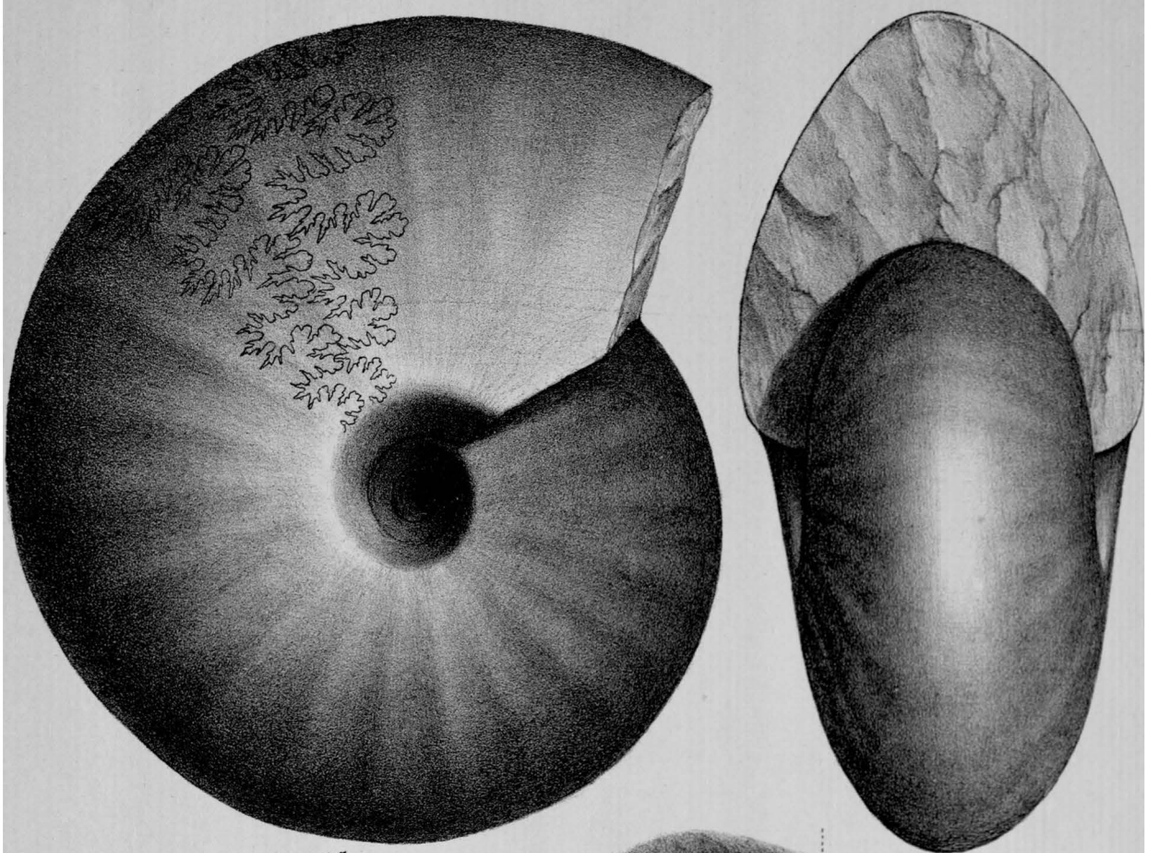
Th. Bannwarth print.

PLATE XXII.

Fig. 1*a*, *b*. Ptychites rugifer, Oppel ; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

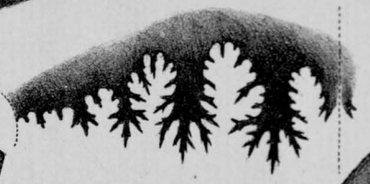
Fig. 2*a*, *b*, *c*. Ptychites rugifer, Oppel; Kuling (Spiti), Coll. Schlagintweit, Palæontological Museum in Munich. Oppel's type-specimen.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)

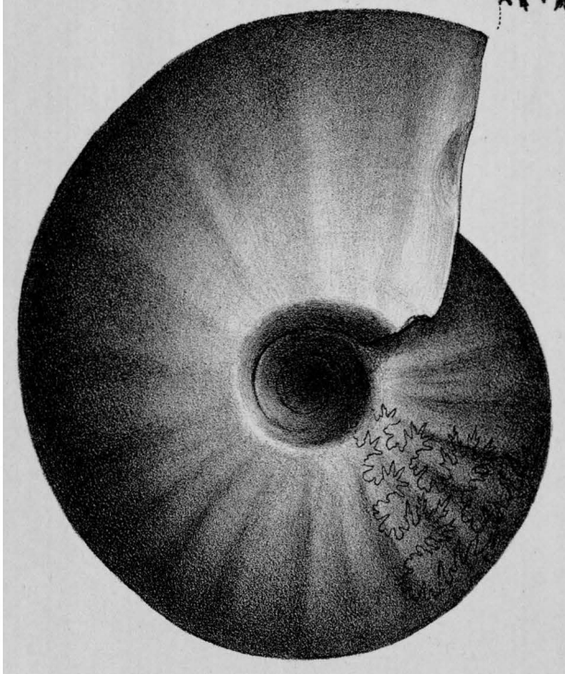


1a

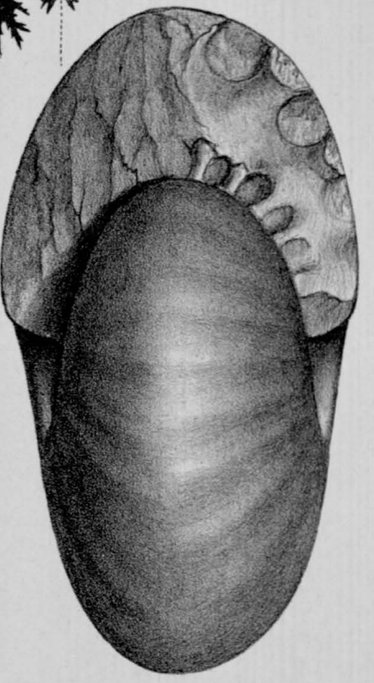
1b



2c



2a



2b

Th. Bannwarth print.

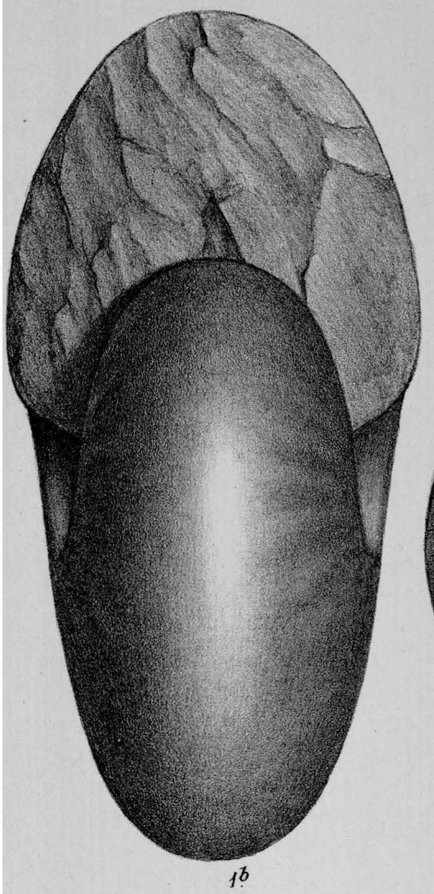
A. Swoboda del. et lith.

PLATE XXIII.

Fig. 1*a*, *b*. Ptychites rugifer, Oppel; S. E. of Muth (Spiti), Coll. Griesbach, Geolog. Survey Museum in Calcutta.

Fig. 2*a*, *b*. Ptychites rugifer, Oppel; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



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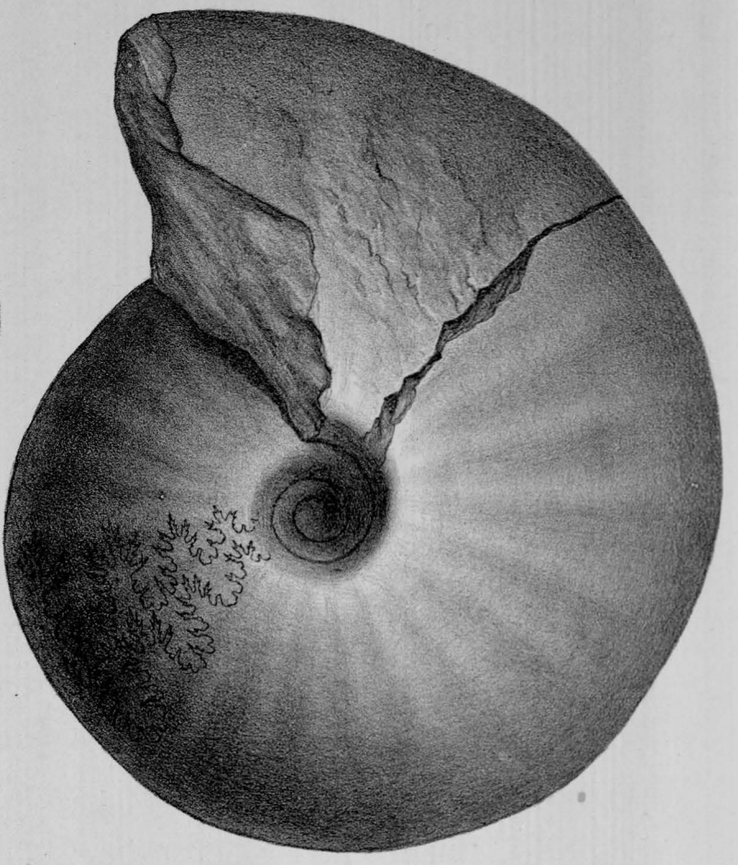
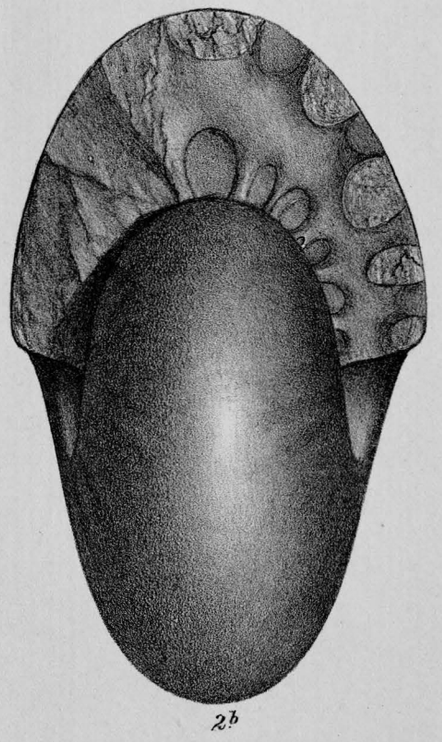


1a



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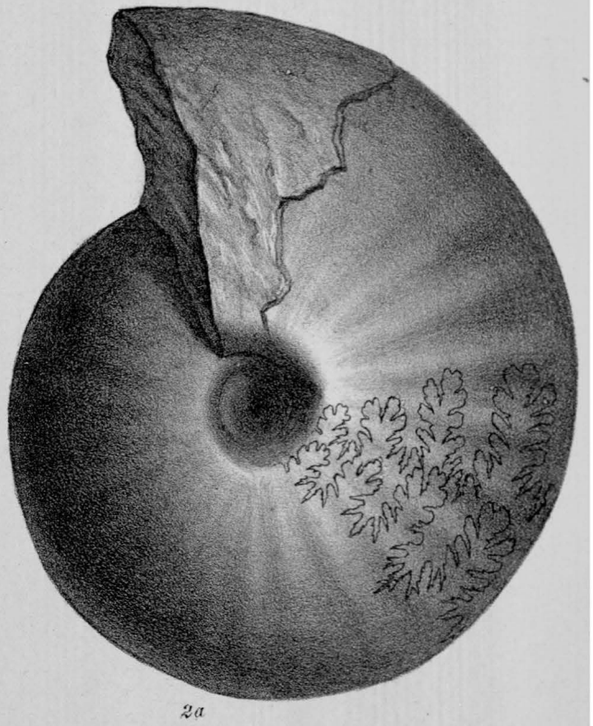


2a

A. Swoboda del. et lith.

Th. Bannwarth print.

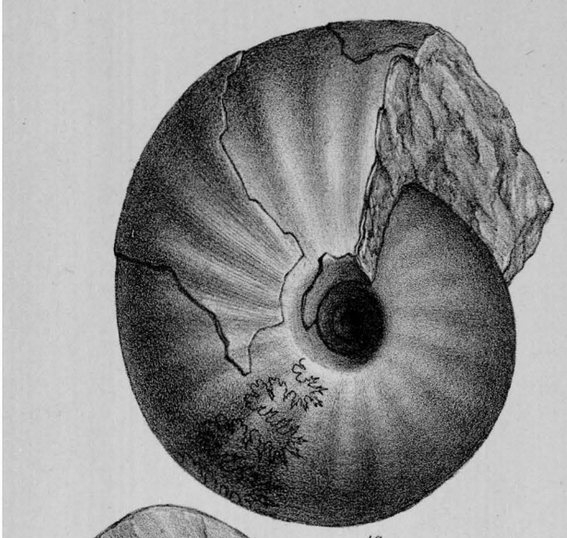
PLATE XXIV.

Fig. 1*a*, *b*. Ptychites rugifer, Oppel ; Spiti, Coll. Schlagintweit, Palæontological Museum in Munich.

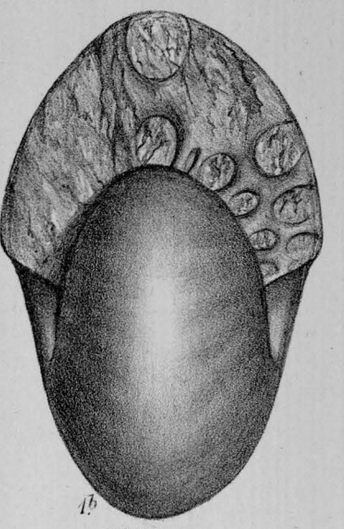
Fig. 2*a*, *b*, *c*. Ptychites rugifer, Oppel ; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 3*a*, *b*, *c*. Ptychites tibetanus, Mojs. ; Spiti, Coll. Schlagintweit, Palæontological Museum in Munich. E. v. Mojsisovics' type-specimen.

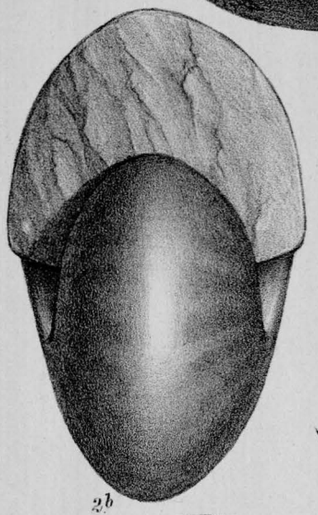
MUSCHELKALK, HIMALAYA (CEPHALOPODA)



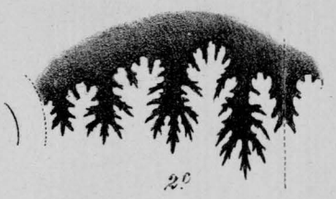
1a



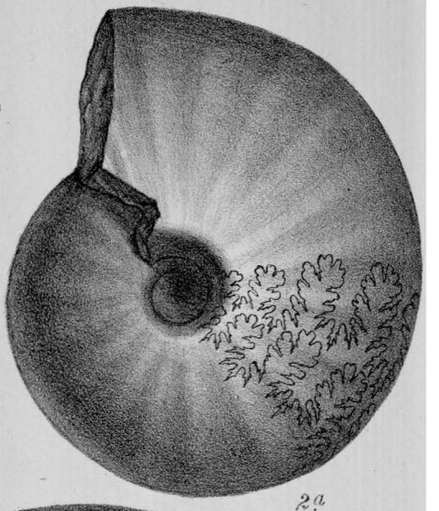
1b



2b



2c



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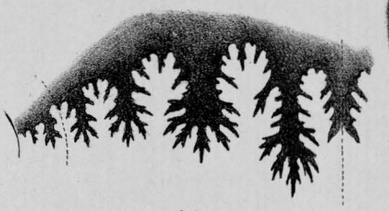
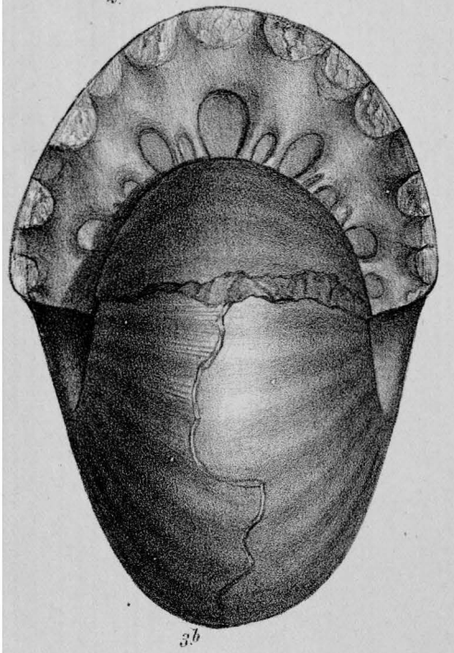


3c



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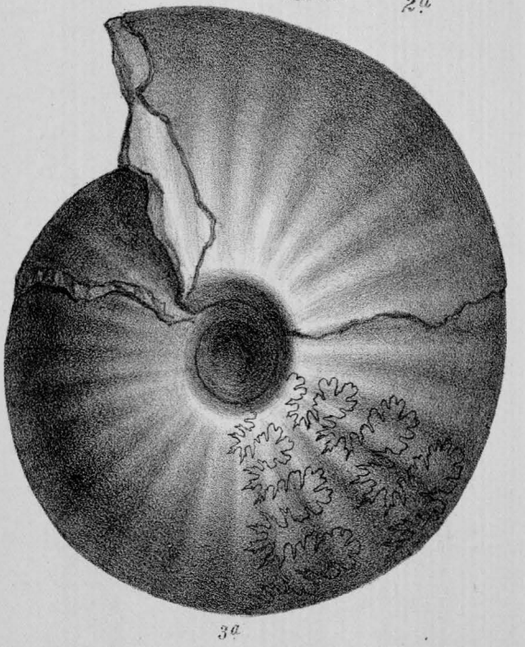


3a

A. Swoboda del. et lith.

Th. Bannwarth print.

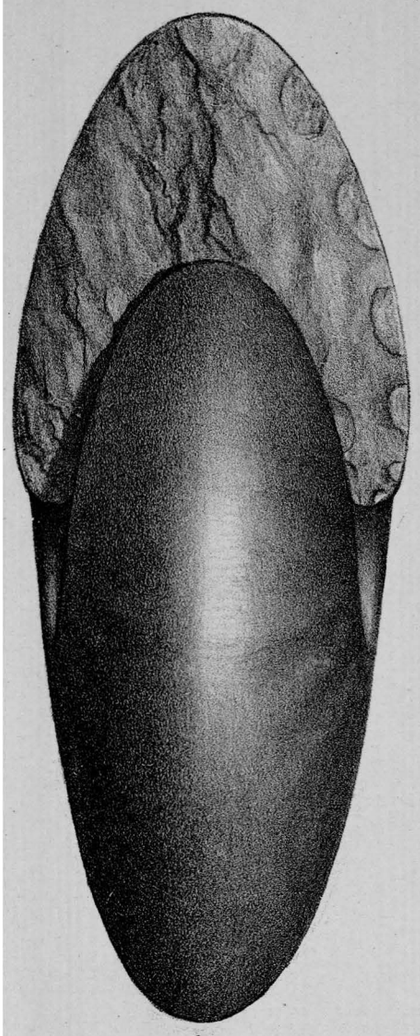
PLATE XXV.

Fig. 1*a*, *b*, *c*. Ptychites Sahadeva, Diener; N. of Kalapani E. G., Kali River Valley (Byans), Coll. Griesbach, Geological Survey Museum in Calcutta.

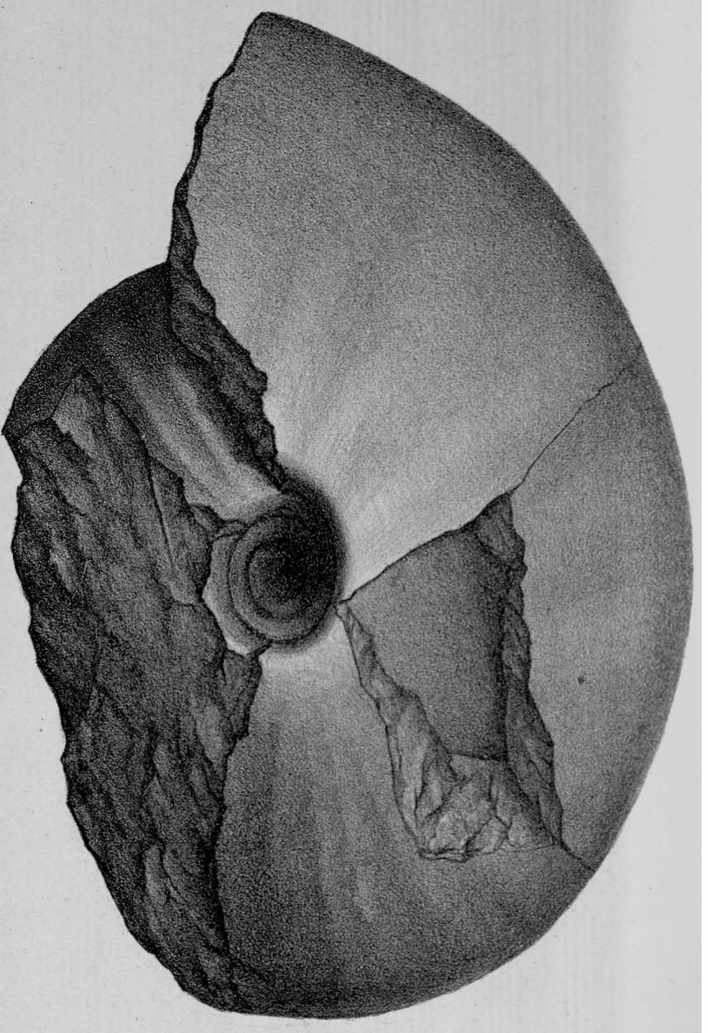
Fig. 2*a*, *b*. Ptychites Sahadeva, Diener, adolescent stage. Same locality.

Fig. 3*a*, *b*. Ptychites Gerardi, Blanford, adolescent stage. Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

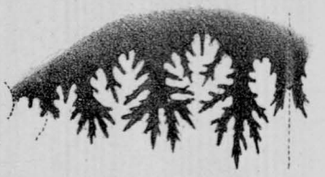
MUSCHELKALK, HIMALAYA (CEPHALOPODA)



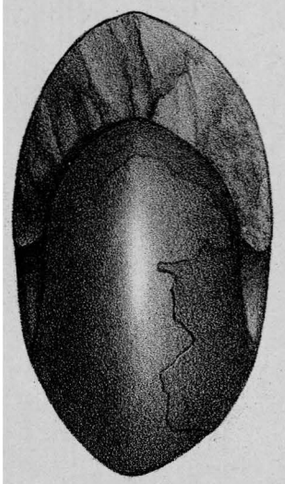
1b



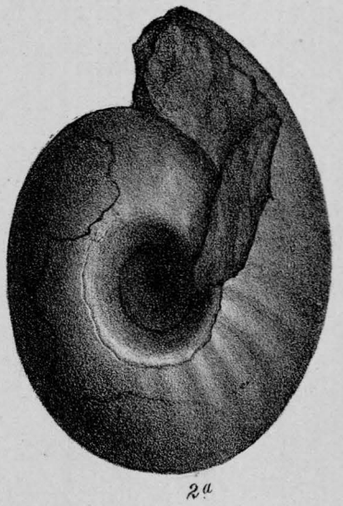
1a



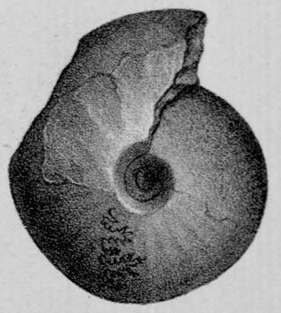
1c



2b



2a



3a

3b

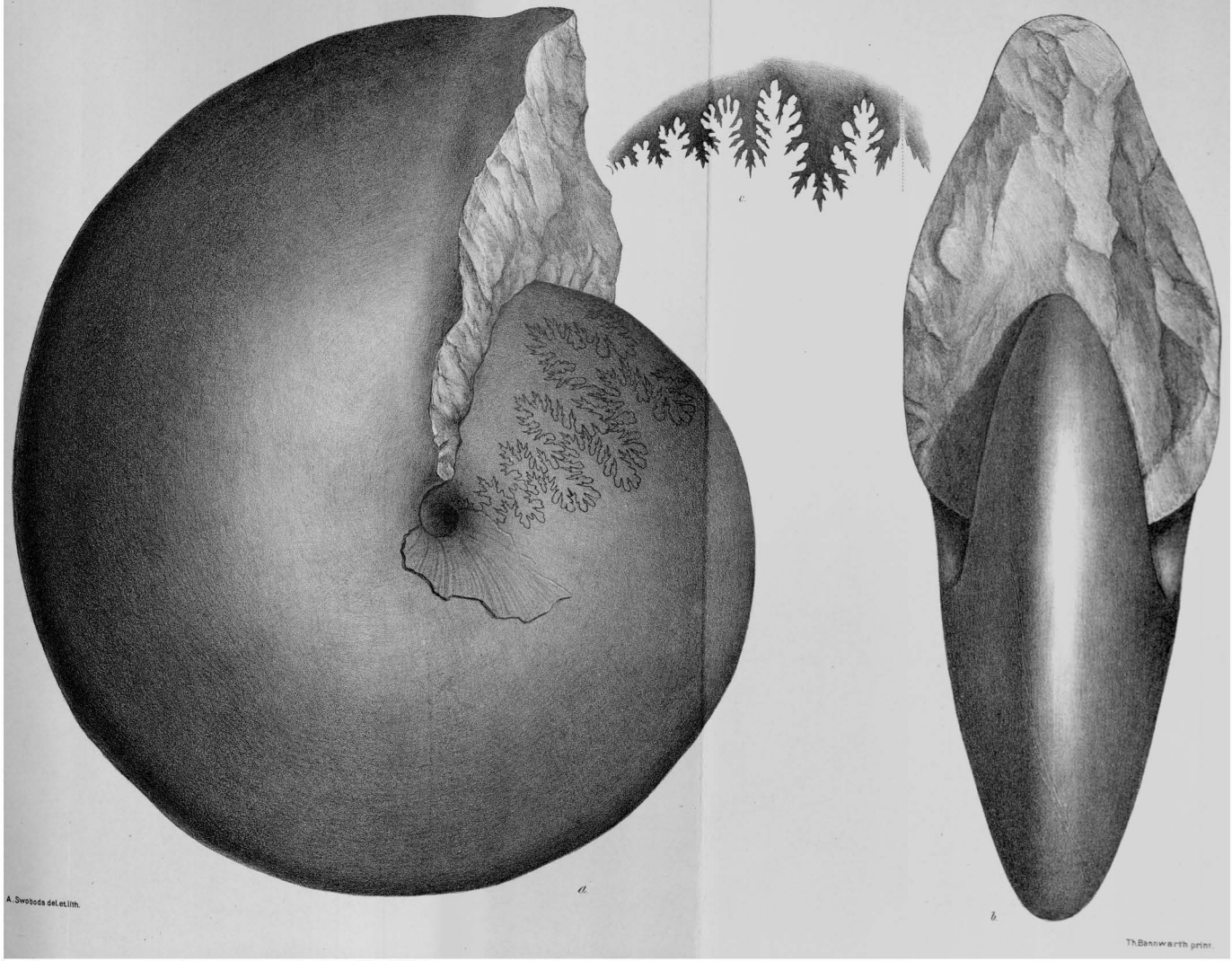
A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE XXVI.

Ptychites Sumitra, Diener; Shalshal Cliff near Rimkin Paiar, Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



a

c

b

A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE XXVII.

Fig. 1*a*, *b*, *c*. Ptychites Mangala, Diener; Spiti, Coll. Schlagintweit, Palæontological Museum in Munich.

Fig. 2*a*, *b*. Ptychites Sukra, Diener; Spiti, Coll. Schlagintweit, Palæontological Museum in Munich.

Fig. 3*a*, *b*. Isculites Hauerinus, Stoliczka; Lilang (Spiti), Coll. Geological Survey Museum, Calcutta (Stoliczka's type-specimen).

Fig. 3*c*. Isculites Hauerinus, Stoliczka; copy of the sutures of another specimen, after Stoliczka (compare Pl. XXXI., Fig. 11b).

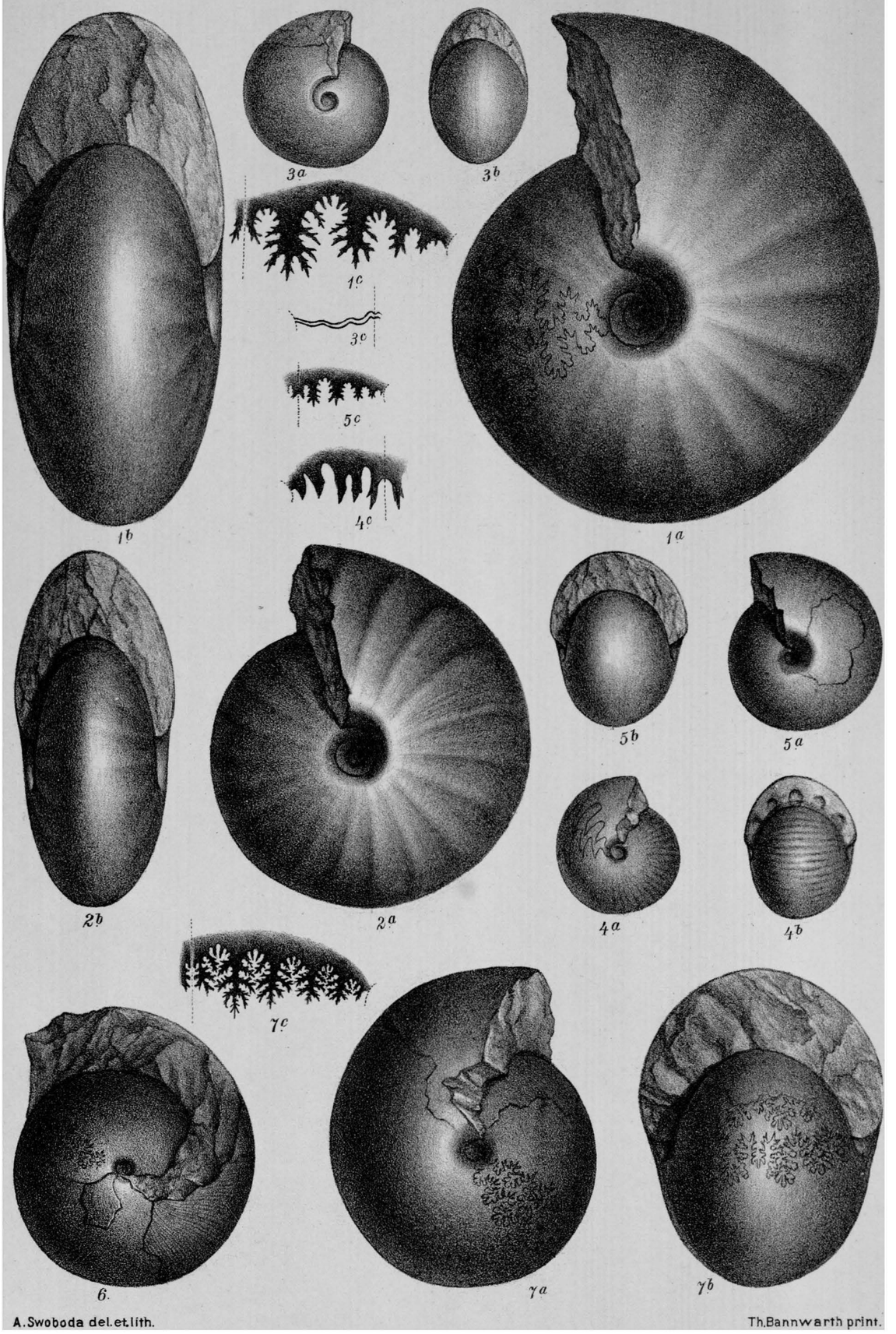
Fig. 4*a*, *b*, *c*. Lobites Oldhamianus, Stoliczka; Lilang (Spiti), Geological Survey Museum, Calcutta (Stoliczka's type-specimen).

Fig. 5*a*, *b*, *c*. Ptychites Asura, Diener; Lilang (Spiti), Geological Survey Museum, Calcutta.

Fig. 6. Proarcestes Balfouri, Oppel; Dras (Tibet), Coll. Schlagintweit, Palæontological Museum in Munich (Oppel's type-specimen).

Fig. 7*a*, *b*, *c*. Proarcestes Balfouri, Oppel; East slope of Tsang-Tsok-La (Tibet), Geological Survey Museum, Calcutta, Coll. Griesbach.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith. Th. Bannwarth print.

PLATE XXVIII.

Fig. 1*a*, *b*, *c*. Proarcestes bicinctus, E. v. Mojsisovics; Lilang (Spiti), Geological Survey Museum, Calcutta; Coll. Stoliczka.

Fig. 2*a*, *b*. Nov. genus ind. ex. fam. Arcestidarum sp. ind.; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 3. Nov. genus ind. ex fam. Arcestidarum sp. ind.; Sutures of a specimen from the same locality, Coll. Diener.

Fig. 4. Nautilus sp. ind. ex. aff. N. Griesbachi, Diener; Shalshal Cliff near Rimkin Paiar E. G., Coll. Diener.

Fig. 5. Nautilus Spitiensis, Stoliczka; Lilang (Spiti), Geological Survey Museum, Calcutta (Stoliczka's type-specimen).

Fig. 6*a*, *b*. Nautilus Griesbachi, Diener; N. of Kalapani, Kali River Valley (Byans), Coll. Griesbach, Geological Survey Museum, Calcutta.

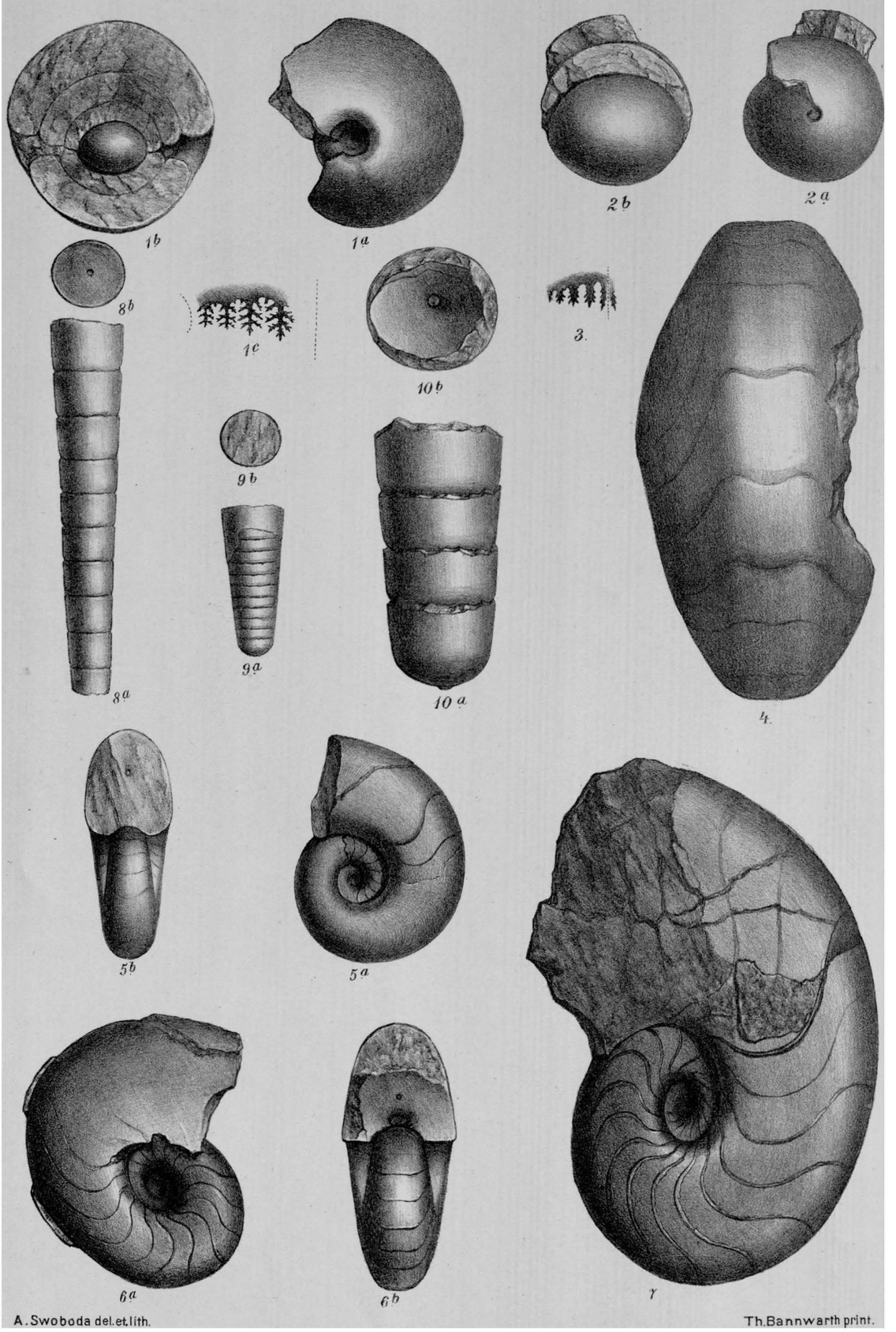
Fig. 7. Nautilus Griesbachi, Diener; a large specimen from the same locality, Coll. Griesbach.

Fig. 8*a*, *b*. Orthoceras cf. campanile, v. Mojsisovics; Utadhura Pass (Johár), Coll. Diener.

Fig. 9*a*, *b*. Atractites sp. ind.; Spiti, Coll. Geological Survey Museum, Calcutta.

Fig. 10*a*, *b*. Orthoceras sp. ind. ex. aff. O. campanile; Spiti, Geological Survey Museum, Calcutta.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith. Th. Bannwarth print.

PLATE XXIX.

Fig. 1*a*, *b*, *c*. Danubites Kansa, Diener.

Fig. 2*a*, *b*, *c*. Danubites Ambika, Diener.

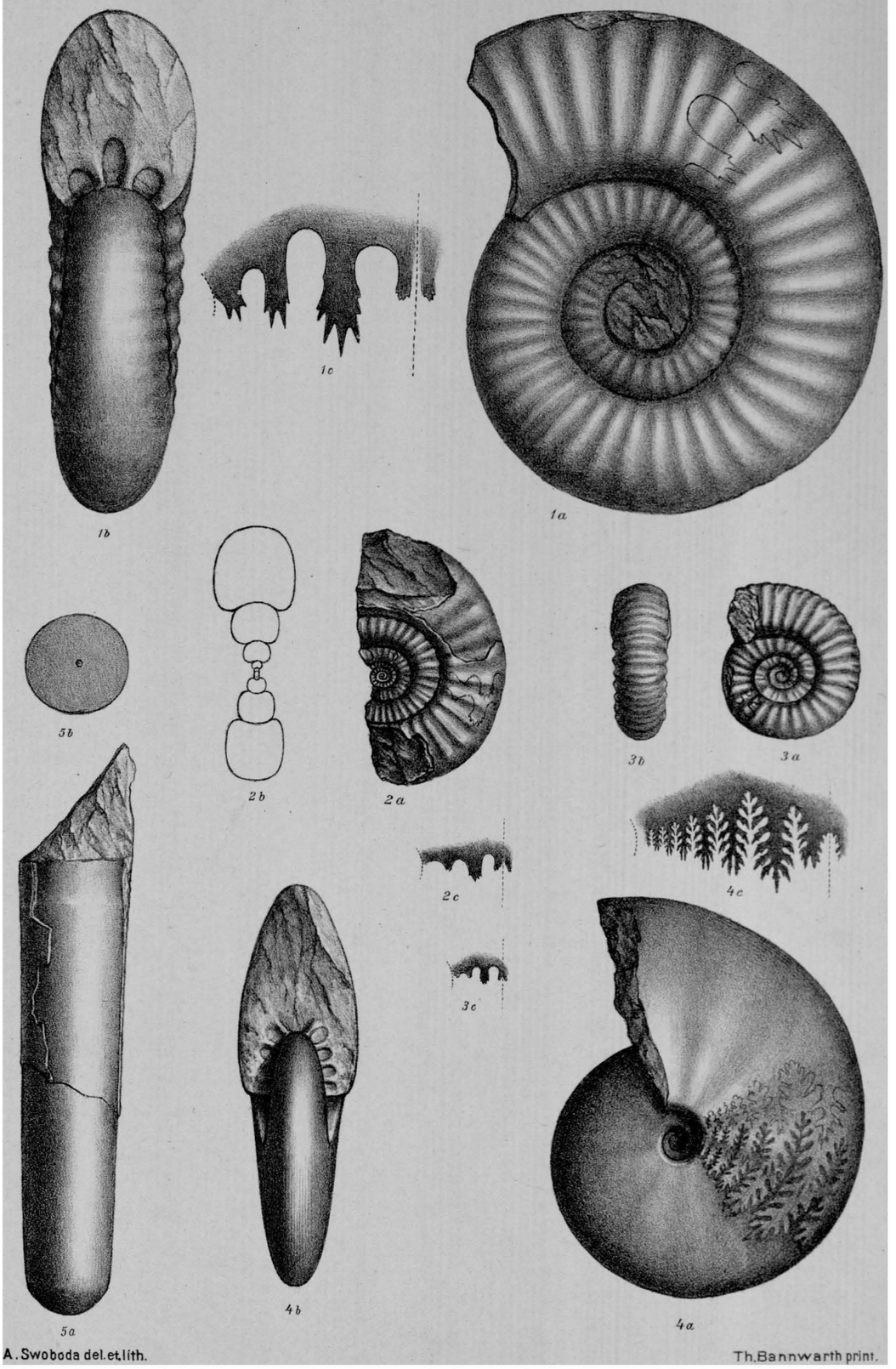
Fig. 3*a*, *b*, *c*. Sibirites Pandya, Diener; 3*c*. Sutures incorrectly drawn, two lateral lobes only and no auxiliary lobe.

Fig. 4*a*, *b*, *c*. Sturia mongolica, Diener.

Fig. 5*a*, *b*. Orthoceras sp. ind.

All specimens from the triassic limestones of Chitichun (Tibet), Coll. Diener.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith. Th. Bannwarth print.

PLATE XXX.

Fig. 1*a*, *b*.
Fig. 2*a*, *b*. } Procladiscites Yasoda, Diener.
Fig. 3*a*, *b*, *c*.

Fig. 4. Xenodiscus, nov. sp. ind.

Fig. 5*a*, *b*, *c*. Gymnites Ugra, Diener.

Fig. 6*a*, *b*, *c*. Xenodiscus Middlemissi, Diener.

Fig. 7*a*, *b*, *c*. Monophyllites Confucii, Diener.

All specimens from the triassic limestones of Chitichun (Tibet), Coll. Diener.

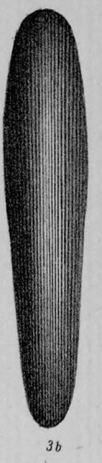
MUSCHELKALK, HIMALAYA (CEPHALOPODA)

1a

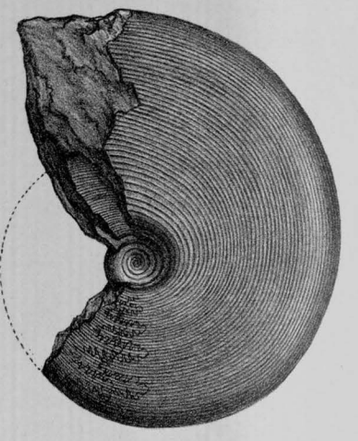
1b

2b

2a

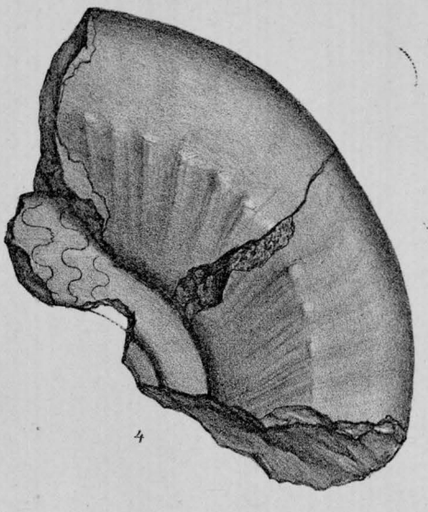


3b

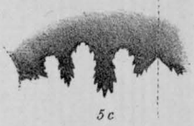


3a

3c

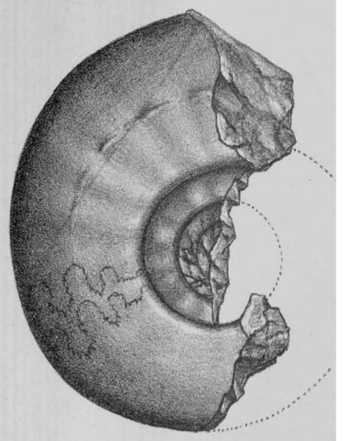


4



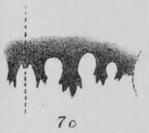
5c

5b



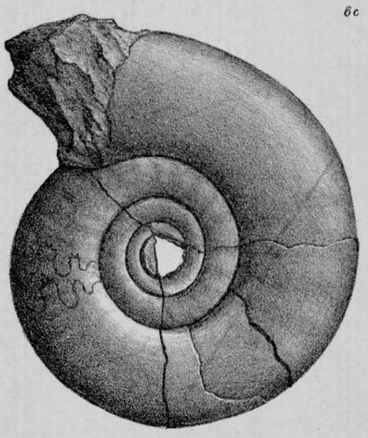
5a

6c

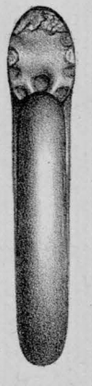


7c

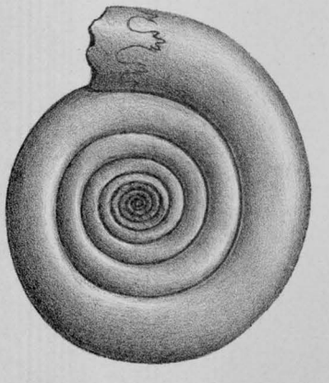
6b



6a



7b



7a

A. Swoboda del. et. lith.

Th. Bannwarth print.

PLATE XXXI.

Fig. 1*a*, *b*, *c*.
Fig. 2*a*, *b*. } Monophyllites Confucii, Diener.

Fig. 3*a*, *b*, *c*.
Fig. 4*a*, *b*. } Monophyllites Pradyumna, Diener.

Fig. 5*a*, *b*. Monophyllites Pitamaha, Diener ; young specimen.

Fig. 6*a*, *b*. Monophyllites, nov. sp. ind.

Fig. 7*a*, *b*, *c*.
Fig. 8*a*, *b*. } Monophyllites Pitamaha, Diener.

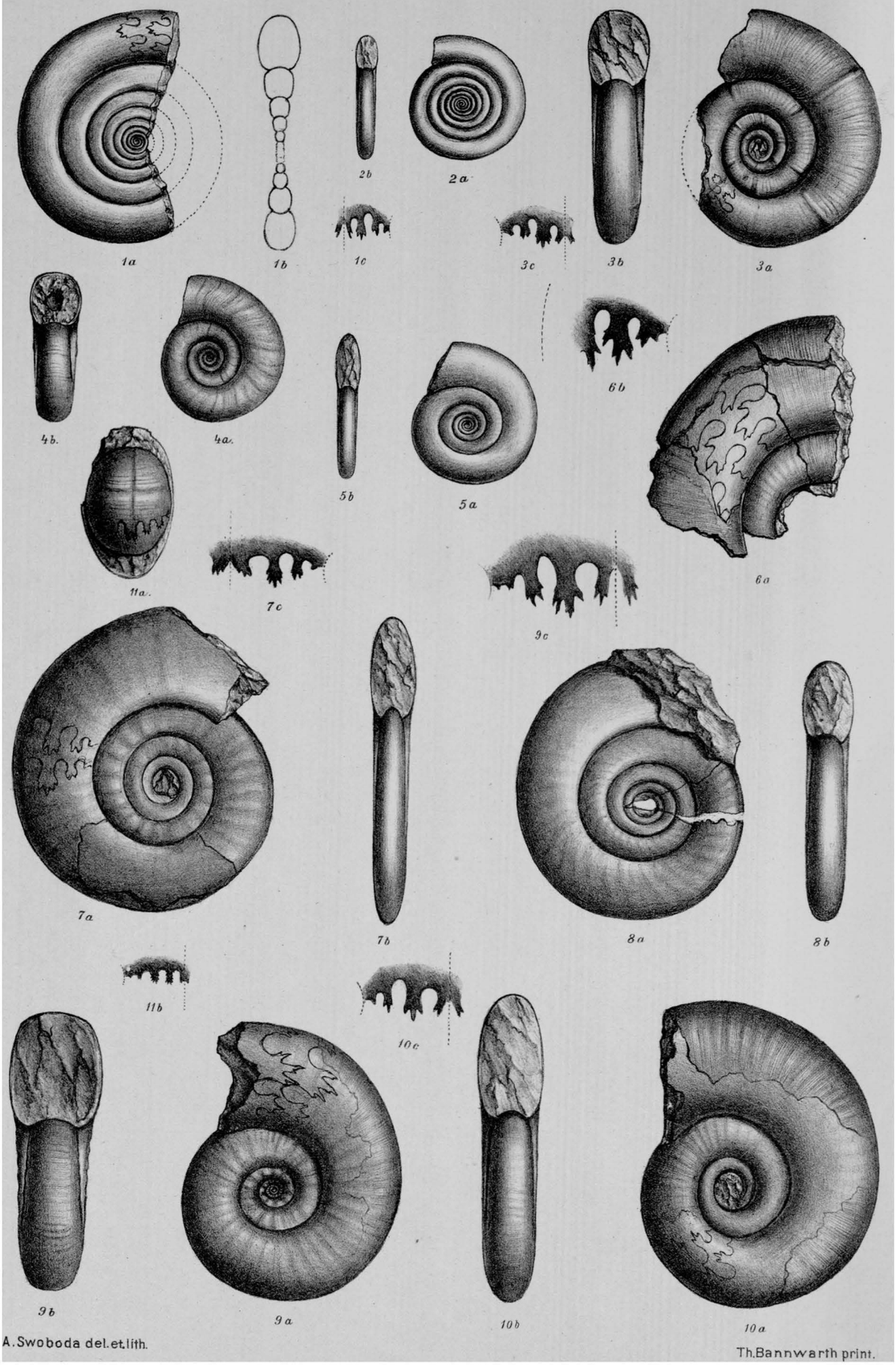
Fig. 9*a*, *b*, *c*. Monophyllites Hara, Diener.

Fig. 10*a*, *b*. *c*. Monophyllites Kingi, Diener.

All specimens from the triassic limestone of Chitichun (Tibet), Coll. Diener.

Fig. 11*a*, *b*. Isculites Hauerinus, Stoliczka ; Lilang (Spiti), Geological Survey Museum, Calcutta, Stoliczka's type-specimen. Side-view of the inner volutions and sutures, the last whorl (body-chamber) having been taken off.

MUSCHELKALK, HIMALAYA (CEPHALOPODA)



A. Swoboda del. et lith.

Th. Bannwarth print.