

MEMOIRS  
OF  
THE GEOLOGICAL SURVEY OF INDIA.

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*Palæontologia Indica,*

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING THE  
PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF THE GOVERNMENT OF INDIA.

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Series XV.

Vol. VI, Memoir No. 2.

**THE FAUNA OF THE TRAUMATOCRINUS LIMESTONE  
OF PAINKHANDA.**

PLATES I TO V.

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CALCUTTA :

SOLD AT THE OFFICE OF THE GEOLOGICAL SURVEY, 27, CHOWRINGHEE ROAD.

LONDON : MESSRS. KEGAN PAUL, TRENCH, TRÜBNER & CO.

BERLIN : MESSRS. FRIEDLÄNDER, UND SOHN.

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1909

CALCUTTA  
SUPERINTENDENT GOVERNMENT PRINTING, INDIA  
8, HASTINGS STREET

# HIMALAYAN FOSSILS.

VOLUME VI, MEMOIR No. II.

## THE FAUNA OF THE TRAUMATOCRINUS LIMESTONE OF PAINKHANDA.

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

BY

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### INTRODUCTION.

As has been stated in my memoir on the Cephalopoda of the Himálayan Muschelkalk, in the classical section of the Shalshal cliff (Painkhanda) a dark grey limestone with *Traumatocrinus* follows above the upper Muschelkalk. This Traumatocrinus limestone, which lithologically is almost identical with the Ptychites beds of the upper Muschelkalk, is overlain by a bed of undoubtedly carnic age, containing *Dionella indica* Bittn., *Norella Kingi* Bittn., *Norella tibetica* Bittn., *Spirigera hunica* Bittn., *Aulacothyris nilangensis* Bittn.

The fauna of the Traumatocrinus limestone of the Shalshal cliff was described by E. v. Mojsisovics and A. Bittner in 1899. The examination of the scanty materials collected by the expedition in 1892 yielded the following species of *Brachiopoda* and *Ammonoidea* :—

*Myoconcha* sp. ind.  
*Rhynchonella rimkinensis* Bittn.  
*Joannites* cf. *cymbiformis* Wulf.  
*Trachyceras tibeticum* v. Mojs.  
*Arpadites rimkinensis* v. Mojs.  
*Rimkinites nitiensis* v. Mojs.  
*Discotropites* aff. *Plinii* v. Mojs.  
*Isculites* cf. *Heimi* v. Mojs.

This fauna was assigned to the zone of *Trachyceras Aonoïdes* (julic or middle carnic substage) by E. v. Mojsisovics, chiefly on the strength of the occurrence of *Joannites* cf. *cymbiformis* and of *Trachyceras tibeticum*, which was considered to be very closely allied to *Tr. austriacum* v. Mojs., one of the chief leading fossils of the *Aonoïdes* zone.

In 1900, A. v. Krafft discovered equivalents of the ladinic stage in the Shalshal cliff, intercalated between the upper Muschelkalk, with *Ptychites rugifer* Oppel, and the Traumatocrinus limestone. Upon the materials collected by him in the Traumatocrinus limestone, both of the Shalshal and Bambanag cliffs, in 1900, the following descriptions of the fauna of this horizon have been based.

A. v. Krafft in his preliminary report on the Mesozoic rocks of the Himalayas (General Report, Geological Survey of India, for 1899-1900, pp. 213, 214) did not accept the correlation of the Traumatocrinus limestone with the julic substage, as advocated by E. v. Mojsisovics. In my memoir on the ladinic, carnic, and noric faunæ of Spiti, I attempted to summarise the data then available for a correlation of the Traumatocrinus limestone of Painkhanda with the upper portion of the Halobia limestone of Spiti, but left its correlation with either the julic or cordevolic substage of the Alpine Trias an open question.

In my memoir quoted above A. v. Krafft's new collections from the Traumatocrinus limestone of the Bambanag and Shalshal cliffs were stated to be very poor in well-preserved fossils, but among them a good specimen of *Joannites Kossmati* Dien. could be identified. This statement was based on an inspection of the rough materials lying before me, but cannot be maintained any longer, since I have succeeded in chiselling out a considerable number of well-preserved fossils from the blocks of limestone, which had not been examined by A. v. Krafft.

### Description of species.

#### NAUTILOIDEA.

Genus : *CLYDONAUTILUS* v. Mojs.

Subgenus : *PROCLYDONAUTILUS* v. Mojs.

*PROCLYDONAUTILUS* cf. *BUDDHAICUS* Diener. Pl. I, fig. 1.

1903. *Proclydonautilus buddhaicus* Diener; Upper Triassic and Liassic faunæ of the exotic blocks of Malla Johar, Himál. Foss. l. c. Vol. I, Pt. 1, Pl. I, figs. 2, 3, 7.

A large and fairly well-preserved specimen of *Proclydonautilus*, consisting of air-chambers only, agrees so closely with *P. buddhaicus* from the red carnic limestone of the exotic block No. 2 in Malla Johar, that I should have ventured on a direct

identification, had not a difference in the width of the last volution prevented me from doing so. The measurements of the two specimens are as follow :—

	Specimen. Pl. I, fig. 1.	Specimen from exotic block No. 2.
Diameter of the shell . . . . .	107 mm.	117 mm.
„ „ umbilicus . . . . .	5.5 „	5 „
Height of the } above the umbilical suture . . . . .	63 „	75 „
last volution } „ „ preceding whorl . . . . .	45 „	52 „
Thickness of the last volution . . . . .	45 „	67 „

As is evident from a comparison of the above measurements, the whorls of the specimen from the Traumatocrinus limestone are compressed more strongly than those of the type-specimen of *Proclydonautilus buddhaicus*. Otherwise the two specimens agree almost entirely. At the beginning of the last volution the broad siphonal area is bordered by sharp marginal edges, which gradually turn into rounded shoulders and become less distinct in the vicinity of the aperture. In the meantime the width of the siphonal part decreases, the latter becoming narrowly rounded. The greatest transverse diameter is situated in the lower third of the height. Umbilical margin rounded, and separated from the umbilical suture by a high wall, which is slightly excavated along its base.

The sharp angular margins of the siphonal area persist up to a diameter of 45 mm. There are no tubercles present, as in *Cosmonautilus Dilleri* Hyatt and Smith (Triassic Cephalopod genera of America, U. S. Geol. Surv. Prof. Papers, No. 40, 1905, p. 207, Pl. LI, fig. 1, LII, fig. 1, LIII, figs. 1, 2, LIV, figs. 1-4, LV, figs. 1-11), which otherwise bears a great similarity to *Proclydonautilus buddhaicus*, as has been demonstrated in my memoir, quoted above.

Shell not preserved. The surface of the cast is perfectly smooth.

*Sutures*.—Septa very sinuous. External and lateral lobes deep. A small auxiliary lobe outside the umbilical suture. External lobe entire. External saddle divided by the marginal edge at the beginning of the last volution, but shifted gradually to the sides in later stages of growth.

The difference in the sinuosity of the septa in the present example and in the specimen from the exotic block No. 2 (Pl. I, fig. 7) is explained by the larger size of the air-chambers of the former.

*Locality. Number of specimens examined*.—Bambanag cliff, 1 mile W. of Martoli E. G.,<sup>1</sup> 1.

Genus : GRYPOCERAS Hyatt.

GRYPOCERAS RIMKINENSE nov. sp. Pl. II, fig. 4.

This species is nearly allied to *Grypoceras Guembeli* v. Mojsisovics (Cephalopoden der Hallstætter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 13, Taf. VII,

<sup>1</sup> E. G. = Encamping Ground.

fig. 2) from the julie Hallstatt limestone of the Roethelstein (Salzkammergut). In A. v. Krafft's collections it is represented by four specimens, one of them attaining moderately large dimensions, whereas the smallest nearly agrees in size with the Alpine type-specimen of *Grypoceras Guembeli*.

I have not succeeded in cleaning the inner volutions from the tough adhering matrix completely enough to observe the perforation of the umbilicus. Otherwise the characters of *Grypoceras* are very prominent, both in the shape and transverse section of the whorls and in the presence of an annular internal lobe.

Volutions of nearly equal height and width up to a diameter of 25 mm. In some specimens this proportion of height and thickness persists even in old age, as in the type-specimen illustrated. But even in those specimens, in which the height increases more rapidly in later stages of growth, the difference of these two dimensions is only very small.

Last volution overlapping the preceding one to less than one-third of its entire height. Transverse section rectangular, with distinct marginal shoulders, which are either rounded off or form obtuse edges. Siphonal area flatly curved, considerably broader than in *Grypoceras Guembeli*. Umbilical wall very high, vertical in the inner volutions, sloping very steeply near the aperture of the last whorl, and separated from the lateral parts by an acute edge.

The broad siphonal area and the sharp umbilical edge are good characters of distinction between the present species and *Grypoceras Guembeli*.

In the specimen illustrated the shelly test has been partly preserved. It shows the sharp and delicate transverse striæ of growth, which are turned posteriorly in the marginal region, crossed by a few indistinct spiral lines, which may be noticed especially in the vicinity of the marginal shoulders.

*Siphuncle*.—The position of the siphuncle is exactly the same as in *G. Guembeli*, namely, at the border of the middle and upper third of the height of the septum.

#### *Dimensions.*

Dia meter of the shell . . .	. . .	57.5 mm.
" " umbilicus . . .	. . .	12 "
Height } of the last volution . . .	. . .	{ 23 "
Thickness }	. . .	{ 28 "

*Sutures*.—Agreeing with those of *Grypoceras Guembeli*. Siphonal lobe flat, undivided, followed by a very low saddle and by a deep and broad lateral lobe. The apex of the lateral saddle corresponds with the umbilical edge. No umbilical lobe. Internal annular lobe present.

*Locality. Number of specimens examined*.—Shalshal cliff, 4.

#### GRYPOCERAS sp. ind. aff. RIMKINENSI Dien. Pl. II, fig. 5.

It is with some reserve that the present specimen is grouped with *Grypoceras*, on account of its general affinity with the preceding species. Its relationship

to the genus *Syringoceras* Hyatt may also be taken into consideration. The section of its penultimate volution is nearly circular, and its umbilicus is considerably perforated. Its whorls are more evolute than in typical species of *Grypoceras* or *Gryponautilus*, though less so than in typical *Syringonautilidæ*. In the last volution the transverse section becomes gradually rectangular, with its umbilical and siphonal margins rounded off regularly, but a similar modification in the transverse section of the body-chamber has also been noticed in *Syringoceras Zitteli* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, Supplem., p. 220, Taf. VI, figs. 3, 4).

My specimen is of strongly elliptical outlines. Its whorls are of nearly equal height and thickness. In its external characters it unites some features both of *Grypoceras rimkinense* and of *Syr. Zitteli*.

*Dimensions.*

Diameter of the shell	. . . . .	50	mm.
"    "    umbilicus	. . . . .	14	"
Diameter of the shell	} at the place of greatest expansion	{	32.5
"    "    umbilicus			
Height	} of the last volution	{	22.5
Thickness			

*Siphuncle.*—Unknown.

*Sutures.*—Not entirely known, but a broad and deep lateral saddle has been observed. This character is strongly in favour of grouping our species with *Grypoceras*, representatives of *Syringonautilidæ* being invariably provided with flat septa, which do not deviate considerably from a straight, radial direction.

*Locality.* Number of specimens examined.—Shalshal cliff, 1.

GRYPOCERAS STIRLINGII nov. sp. Pl. I, fig. 2.

This species, which is represented by a single fairly well-preserved specimen, recalls *Grypoceras haloricum* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, l. c. VI-1, p. 20, Taf. VII, fig. 4) in its size and general shape, but differs from it in its thicker volutions, which overlap one another more strongly, by its wider umbilicus, and in the presence of more distinctly marked umbilical and siphonal edges.

The transverse section is not rectangular but trapezoidal. The lateral parts are moderately curved and converge from the umbilical towards the siphonal margins. The greatest transverse diameter corresponds with the umbilical edge, which is acutely rounded. The whorls are thicker than high, especially so in the vicinity of the aperture. Umbilical wall high and very steep, nearly vertical. Siphonal area flat and bordered by distinct marginal edges, which are rounded off sharply.

The width of the siphonal area is less than one-half the width of the entire volution. The inner whorls are not accessible to observation.

The shell, which has been partly preserved in the vicinity of the aperture, is almost smooth, exhibiting only very delicate striæ of growth, which are directed forward on the steep umbilical wall.

*Dimensions.*

Diameter of the shell	. . . . .	87 mm.
„ „ umbilicus	. . . . .	20.5 „
Height	} of the last volution	. . . { 38 „
Thickness		

*Siphuncle.*—Not known.

*Sutures.*—Apparently agreeing with those of the preceding species, but not exactly known.

*Locality.* Number of specimens examined.—Shalshal cliff, 1.

AMMONOIDEA.

Genus: JOANNITES v. Mojsisovics.

JOANNITES CYMBIFORMIS Wulf. Pl. II, fig. 2, Pl. III, fig. 3, Pl. IV, fig. 1.

1793. *Nautilus cymbiformis* Wulfen, Ueber den Kämthnerischen, pfauenschweifigen Helmintolith, p. 121, Taf. XXIX, XXX.
1849. *Ammonites bicarinoïdes* Quenstedt, Cephalopoden, p. 243, Taf. XVIII, fig. 19.
1873. *Arcestes cymbiformis* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 85, Taf. LXI, figs. 1-5, LXII, fig. 1, LXIII, fig. 1, LXV.
1882. *Joannites cymbiformis* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 170.
1900. *Joannites cymbiformis* A. v. Kraft, General Report, Geol. Surv. of India for 1899-1900, p. 216.
1907. *Joannites cymbiformis* Frech: Die Hallstätter Kalke bei Epidaurus (Argolis) und ihre Cephalopoden, Neues Jahrb. f. Min. etc. Festband, p. 24, Taf. VI, fig. 2.
1908. *Joannites cymbiformis* Diener, Ladinic, carnic and noric faunæ of Spiti, Himâl. Foss., Pal. Ind. ser. XV, Vol. V, Pt. 3, Pl. XII, p. 72, figs. 5, 6.

As has been explained in my memoir on the middle and upper Triassic faunæ of Spiti, the specimen from the Traumatocrinus limestone of the Shalshal cliff, which has been identified with *Joannites cymbiformis* Wulf. by E. v. Mojsisovics (Himálayan Foss. Vol. III, Pt. 1, Pl. XX, figs. 3, 4), must be separated from the Alpine species, on account of some differences in the arrangement of its varices and of its sutural line. The examination of A. v. Kraft's materials from the same locality has, however, convinced me, that the true *Joannites cymbiformis* occurs together with this new species in the Traumatocrinus limestone of Painkhanda. There are several specimens of various dimensions before me, which agree with the Alpine type so closely, that they cannot be distinguished even as local varieties.

In Pl. II, fig. 2, a medium-sized specimen has been illustrated, which may be compared especially with the Himálayan type from the "Grey beds" of Spiti illustrated on Pl. XII, fig. 6, of my memoir quoted above. It is provided with four varices on the circumference of the last volution. These varices are curved forward



on the flanks a little less strongly than in typical examples of the Alpine species, but agree in this respect with the types from the *Ellipticus* beds of the Roethelstein, which in the curvature of their varices take an intermediate position between *J. cymbiformis* and *J. Joannis Austriae* Klipst. In the marginal region they are turned backward for a short distance and are then curved forward again rather strongly, crossing the regularly rounded siphonal part in a flatly arched lappet, with its convexity turned anteriorly.

The specimen illustrated on Pl. II, fig. 4, is provided with its body-chamber, notwithstanding its small dimensions. It shows three varices only, agreeing in this respect with small examples of *Joannites cymbiformis* from the carnic Hallstatt limestone, which do not develop a fourth varix before a diameter of more than 70 mm. has been attained. In this specimen the curvature of the varices on the flanks is even flatter than in the medium-sized example described above.

Two specimens are of very large dimensions, rivalling in their size the Alpine type-specimen, illustrated by E. v. Mojsisovics on Pl. LXIII, fig. 1, of Cephalopoden der Hallstätter Kalke. One of these two specimens has been almost completely preserved, and its varices are curved rather strongly.

The second fragmentary specimen, which has been illustrated on Pl. IV, fig. 1, shows the umbilicus of the cast closed by a callosity, as it is usually found in full-grown individuals of this species.

*Dimensions.*

	I.	II.	III.
	(Pl. II, fig. 4.)	(Pl. II, fig. 2.)	Largest example.
Diameter of the shell . . .	32 mm.	69 mm.	cca. 270 mm.
" " " umbilicus . . .	2 "	5 "	16 "
Height } of the last volution .	{ 17 "	{ 37 "	157 "
Thickness }	{ 16.5 "	{ 33 "	96 "

*Sutures.*—Agreeing entirely with those of *Joannites cymbiformis*. Eight or nine saddles outside the umbilical suture.

*Locality. Number of specimens examined.*—Shalshal cliff, 4; Bambanag cliff, near Martoli E. G., 2.

*Remarks*—The presence of the genus *Joannites* in the marine Trias of Western America has been announced by Hyatt and J. P. Smith (Triassic Cephalopod genera of America, U. S. Geol. Surv. Prof. Paper No. 40, p. 76), but is still open to doubt. Neither *Arcestes Gabbi* Meek (Clar. King's Report of the U. S. Geol. Exploration of the 40th Parallel, Vol. IV, Pl. X, fig. 6 c.) nor *Joannites nevadanus* Hyatt and Smith (l. c. p. 76, Pl. XXIV, figs. 5-7) have dimeroid saddles. They cannot consequently be grouped with the genus *Joannites* if we rely on the diagnosis given by E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz p. 166), who explicitly states the presence of dimeroid saddles and of arcuate septa to be the two most important features of distinction in his new genus, established in 1879.

## JOANNITES KLIPSTEINI v. Mojsisovics. Pl. II, fig. 1.

1843. *Ammonites multilobatus* A. v. Klipstein, Beiträge zur Geol. Kenntnis der östlichen Alpen, p. 129, Taf. IX, fig. 1.
1869. *Arcestes cymbiformis* Laube (*ex parte*), Fauna der Schichten von St. Cassian, Denkschr. Kais. Akad. d. Wiss. XXX, Bd., p. 87, Taf. XLII, figs. a, c, d.
1875. *Arcestes Klipsteini* v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 84, Taf. LXI, figs. 2, 3, LXII, figs. 2, 3.
1882. *Joannites Klipsteini* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, p. 170.
1907. *Joannites Klipsteini* Frech, Die Hallstätter Kalke bei Epidauros (Argolis) und ihre Cephalopoden Neues Jahrb. f. Min. etc. Festsband p. 25, Taf. VI, fig. 3.
1908. *J. cf. Klipsteini* Diener, Ladinic, carnic and noric fauna of Spiti. Palæont. Ind., ser. XV, Himál. Foss., Vol. V, Pt. 3, p. 42, Pl. V, fig. 8.

According to the diagnosis given by E. v. Mojsisovics, *Joannites Klipsteini* is distinguished from *J. Joannis Austriæ* Klipst. by its strongly compressed shell and by the large number of varices, amounting to five or even six in full-grown specimens of large size. From *J. cymbiformis* Wulf. This species differs especially in the straightness of its varices, which scarcely show any curvature before reaching the siphonal margin.

One specimen, agreeing entirely in all its details with the Alpine type, has been found in A. v. Krafft's collection from the Traumatocrinus limestone of the Bambanag cliff. It is of medium size, holding an intermediate position in this respect between the two examples illustrated by E. v. Mojsisovics on Pl. LXI, fig. 2, and LXII, fig. 3. It is provided with six furrows, which are arranged at irregular distances. One of the varices corresponds to the boundary between the anterior and posterior portions of the last whorl. Three are situated in the anterior and two in the posterior half, but much nearer to the termination of the penultimate volution.

The varices are arranged symmetrically on both sides of the cast.

The shell is high-mouthed, compressed, with flattened lateral parts, converging gently towards the regularly rounded siphonal part.

*Dimensions.*

Diameter of the shell	. . . . .	63.5 mm.
" " umbilicus	. . . . .	4 "
Height	} of the last volution . . . . .	{ 33 "
Thickness		

The surface of the cast is perfectly smooth. No trace of the shelly test has been preserved.

*Sutures.*—Agreeing entirely with those of *Joannites Klipsteini* and *J. Joannis Austriæ* in their general arrangement. The details in the ornamentation of the saddles have been partly destroyed by weathering.

*Locality.* *Number of specimens examined.*—Shalshal cliff, 1; Bambanag cliff, near Martoli E. G., 1.

JOANNITES KOSSMATI Diener. Pl. II, fig. 3.

1908. *Joannites Kossmati* Diener, Ladinic, carnic and noric faunæ of Spiti, Palæont. Ind., ser. XV, Himál. Foss., Vol. V., Pt. 3, p. 40, Pl. V, fig. 7.

In the memoir quoted above a species of *Joannites* has been described, ranging from the topmost beds of the upper Muschelkalk of Spiti through the entire ladinic stage into the Daonella limestone, which, although nearly allied to *J. Joannis Austriæ* v. Klipst., differs from this species in the smaller number of its sutural elements.

Among my materials from the Traumatocrinus limestone also there are several specimens agreeing entirely with this new species from Spiti, for which the name of *Joannites Kossmati* has been proposed. The largest example, in which the body-chamber has been partly preserved, cannot be distinguished from the type-specimen of *J. Kossmati* as illustrated on Pl. V, fig. 7, in the memoir quoted above. It is of globose shape, inflated rather more strongly than individuals of *J. Joannis Austriæ* or *J. cymbiformis* of equal size, and shows two varices only in the circumference of the last volution. The varices are nearly radial and their direction is almost a straight line. Even in the siphonal region their curvature is very slight.

The body-chamber portion of the shell has been broken off, and has not been represented in the illustration, on account of its defective state of preservation.

*Dimensions.*

		(Chambered nucleus, without body-chamber).
Diameter of the shell	. . . . .	66 mm.
„ „ umbilicus	. . . . .	5 „
Height	} of the last volution . . . . .	{ 34 „
Thickness		

*Sutures.*—Agreeing exactly with those of the type-specimen of *Joannites Kossmati* from the ladinic stage. There are only six dimeroid saddles developed outside the umbilical margin. They are arranged along a very flat curve.

*Locality. Number of specimens examined.*—Shalshal cliff, 1, Bambanag cliff, near Martoli E. G., 1.

*Remarks.*—This species is perhaps very nearly allied to or even identical with *Joannites Stefanescui* Kittl (Beiträge zur Kenntnis der Triasbildungen der nordöstl. Dobrudscha, Denkschr. Kais. Akad. d. Wiss. Wien, Math. Nat. Kl., Bd. LXXXI, 1908, p. 58, Taf. III, fig. 3), from the ladinic or carnic limestone of Hagighiol. Kittl describes this species as being inflated more strongly than *J. cymbiformis* and provided with six saddles only, but his only type-specimen was too badly preserved to determine the presence or absence of varices.

JOANNITES MOJSVARI nov. sp. Pl. III, fig. 1.

1897. *Joannites cf. cymbiformis* E. v. Mojsisovics (*non* Wulfen), Beitræge zur Kenntnis der obertriadischen Cephalopoden faunen des Himálaja, Denkschr. Kais. Akad. d. Wissensch. Bd. LXIII, p. 656, Taf. XX, figs. 3, 4.

1899. *J. cf. cymbiformis* E. v. Mojsisovics, Himál. Foss. Vol. III, Pt. 1, p. 101, Pl. XX, figs. 3, 4

As has been stated by A. v. Krafft in his notes on the Mesozoic rocks of Spiti (General Report, Geol. Surv. of India, for 1899-1900, p. 213), a species of *Joannites* from the Traumatocrinus limestone of the Shalshal cliff, referred to *Joannites cymbiformis* Wulf. by E. v. Mojsisovics, must be separated from the Alpine type. It differs from the latter in the complete absence of varices in specimens exceeding a height of 35 mm. in the last volution. Of the two specimens from the Shalshal cliff, on which the description given by E. v. Mojsisovics was based, the smaller one has three varices on the cast in the circumference of the last whorl, corresponding to a diameter of 53 mm. The larger specimen, of which the sutures only were illustrated by E. v. Mojsisovics on Pl. XX, fig. 4, does not show any varices at all.

E. v. Mojsisovics, who noticed this character, did not venture to decide, on account of the small number of specimens suitable for examination, whether in this instance the Indian form indicates characteristic features or merely individual differences. He consequently abstained from introducing a new specific name for the Himalayan form. But this question may be considered as settled now, since a very large specimen of *Joannites* from the Traumatocrinus limestone is before me, which agrees in its sutures with the type illustrated by E. v. Mojsisovics, but has the surface entirely smooth and devoid of any varices. In this respect it shows a remarkable difference from *J. cymbiformis*, of which specimens of a corresponding size are invariably provided with deep and broad furrows (*vide* Pl. IV, fig. 1.)

That this specimen cannot be considered as a large example of *J. Kossmati*, in which the lateral varices have become obsolete in consequence of its advanced stage of growth, is evident from the fact that at least nine saddles can be counted in the last septum, which approximately corresponds to the middle line of the last volution.

I think that this species, which differs from *Joannites cymbiformis* in the absence of varices in later stages of growth, should be separated from the Alpine type and distinguished by a new specific name. As such I propose *J. Mojsvari* in honour of the learned author, who did not fail to recognize its characteristic features, although he was not convinced of their specific importance.

Inner volutions of this species, it is true, can scarcely be distinguished from *J. cymbiformis*, young specimens of which are also often provided with three varices only. A distinctive feature may perhaps be found in the nearly radial direction of the varices and in the more inflated shape of the shell. It is chiefly on the strength of these two characters that I have deemed it preferable to group the specimen from the Traumatocrinus limestone of the Shalshal cliff, illustrated on Pl. II, fig. 4, with *Joannites cymbiformis*, rather than with *J. Mojsvari*.

It may be urged that the differences, which are marked in full-grown specimens only, are not sufficient to justify a specific separation of *J. cymbiformis* and *J. Mojsvari*, and that these two should be included in a single species of somewhat wider range. But I think that this proceeding would be open to grave objections. By uniting *J. Mojsvari* with *J. cymbiformis* the range of the latter species would be a different one in Europe and India, comprising in the Indian

region forms with a smooth body-chamber devoid of varices, such as has never yet been noticed in European examples. The agreement in the range of variation consequently demands a narrower circumscription of the species and a separation of those types, which are beyond the range of variation of the typical shape of *J. cymbiformis* in the Mediterranean Province.

*Dimensions.*

Diameter of the shell . . . . .		178 mm.
„ „ umbilicus . . . . .		10 „
Height of the } above the umbilical suture . . . . .		97 „
last volution } „ „ preceding whorl . . . . .		29 „
Thickness of the last volution . . . . .		66 „

*Sutures.*—Agreeing very nearly with those of *Joannites Joannis Austriae* and of *J. cymbiformis*. As has been stated by E. v. Mojsisovics, the differences must be put to the account of individual variation, being scarcely more considerable than the variation noticed in European specimens of *J. cymbiformis*.

*Locality. Number of specimens examined.*—Shalshal cliff, 3. To this species numerous fragments of smooth shells which, on account of their inferior state of preservation, do not permit of a safe identification must probably be attributed.

*Remarks.*—The only European species of *Joannites*, in which varices are entirely absent has been described by E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, Supplementbd. p. 276), from the limestone of Wengen of ladinic age. But this species cannot be identified with *J. Mojsvari*, as it is provided with six saddles only, corresponding to a diameter of 78 mm. In the small number of saddles it agrees with *J. Kossmati* which is, however, provided with two varices on the circumference of one volution.

E. Kittl (Beiträge zur Kenntnis der Triasbildungen der nordöstlichen Dobrudscha, Denkschr. Kais. Akad. d. Wissensch. Math. nat. Kl. LXXXI., 1908, p. 59) describes a species of *Joannites* from Hagighiol without any varices, but its sutures are too badly preserved to allow a closer comparison with any congeneric form.

It may be urged that all these differences in the number of varices and sutural elements are only of varietal importance, and that all the types distinguished in the Traumatocrinus limestone should rather be united in one species. But I cannot agree with the advisability of introducing a species of such wide circumscription as would make it unfit to serve stratigraphical purposes.

Genus: ARCESTES Suess.

Subgenus: PROARCESTES v. Mojsisovics.

PROARCESTES cf. AUSSEANUS v. Hauer. Pl. III, fig. 2.

1847. *Arcestes Ausseanus* F. v. Hauer, Cephalopoden von Aussee, Haidingers Naturwissensch. Abhandl. I. p. 268, Taf. VIII, figs. 6-8.
1873. *Arcestes Ausseanus* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 99, Taf. LI, figs. 1-4, Taf. LIII, figs. 28, 31.
1902. *Proarcestes Ausseanus* E. v. Mojsisovics; ibidem, Supplementbd. p. 259.
1907. *P. Ausseanus*. Frech, Die Hallstätter Kalke bei Epidaurus (Argolis) und ihre Cephalopoden, Neues Jahrb. f. Miner. etc. Festbd. p. 20, Taf. IV, fig. 5.
1909. *P. cf. Ausseanus* Diener, Palæont. Indica, ser. XV, (Himál. Foss., Vol. 1, Pt. 1, Upper Triassic and Linnæic faunæ of the exotic blocks of Malla Johar, p. 18, Pl. III, fig. 6.

An inner nucleus of *Arcestes* agrees so closely with F. v. Hauer's species from the jolic Hallstatt limestone of the Salzkammergut, that I should not hesitate in venturing on a direct identification, with more complete materials at hand.

My specimen consists of air-chambers only. It is strongly inflated, with slowly increasing volutions, which are considerably broader than high. Three varices are faintly indicated on the cast. They run in a straight, radial direction across the siphonal area, but are very low and narrow.

*Dimensions.*

Diameter of the shell . . . . .					31.5 mm.
„ „ umbilicus . . . . .					3 „
Height } of the last volution . . . . .					15 „
Thickness } . . . . .					cca. 29 „

*Sutures.*—The sutures show the characteristic features of the group of *Arcestes bicarinati*, especially the high and richly serrated median prominence of the siphonal lobe. Six saddles outside the umbilical suture. External branches of the siphonal saddle developed more strongly than the internal ones.

*Locality and number of specimens examined.*—Shalshal cliff, 1.

PROARCESTES sp. ind.

This species, which is only represented in A. v. Krafft's collections by a single fragmentary specimen from the Traumatocrius limestone of the Shalshal cliff, is perhaps nearly allied to *Proarcestes Marcoui* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 93, Pl. LXII, figs. 4, 5) from the jolic Hallstatt limestone of Aussee. It agrees with this species in the strongly compressed shape of its last volution. It is even more high-mouthed than any species of *Proarcestes* hitherto known. It differs, however, from *P. Marcoui* in the outlines of its transverse section, the lateral parts converging from the umbilical region towards the siphonal part, which is highly rounded, whereas they are flattened and nearly parallel in the Alpine species.

From the cast of the inner nucleus constrictions or varices are entirely absent. In the anterior portion of the body-chamber, which has been partly preserved, a broad and flat constriction is noticeable, running in a radial direction from the umbilicus to the external part, where it is slightly curved forward.

The umbilicus is narrower than in *P. Marcoui* and was probably closed by a callosity in the adult stage.

*Dimensions.*

		Inner nucleus.		Body-chamber.
Diameter of the shell . . . . .		38 mm.		?
„ „ umbilicus . . . . .		3 „		?
Height } of the last volution . . . . .		{ 18 „		35 mm.
Thickness } . . . . .		{ 19 „		25 „

*Sutures.*—The external shape of this specimen might suggest an identification with *Joannites*, but the sutures are those of *Arcestes*. The median prominence is rather high and serrated, reminding me of the group of *Arcestes*

*Barrandei* Lbe. The sutures agree very closely with those of *Proarcestes Marcovi*.

Genus : LOBITES v. Mojsisovics.

Subgenus : COROCERAS Hyatt.

COROCERAS cf. DELPHINOCEPHALUS v. Hauer. Pl. V, fig. 4.

- 1855. *Ammonites delphinocephalus* v. Hauer, Beiträge zur Kenntnis der Cephalopodenfauna der Hallstätter Schichten, Denkschr. Kais. Akad. d. Wissensch. Wien, Bd. IX, p. 157, Taf. V, figs. 1, 2, non 3-5.
- 1860. *Clydonites delphinocephalus* v. Hauer, Nachträge zur Cephalopodenfauna der Hallstätter Schichten, Sitzber. Kais. Akad. d. Wiss. XLI, p. 127. (non Tab. V, fig. 7).
- 1873. *Lobites delphinocephalus* v. Mojsisovics, Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 166, Taf. LXIX, figs. 14-18.
- 1902. *Coroceras delphinocephalus* E. v. Mojsisovics, ibidem, Supplementb., p. 291.

A single specimen of *Coroceras*, provided with a complete body-chamber whorl and apertural margin, agrees very closely with the Alpine type-specimen of *Coroceras delphinocephalus*, from which it is only distinguished by its smaller dimensions. In the jolic Hallstatt limestone of the Salzkammergut, examples of *Coroceras monile* Lbe. have been noticed by Mojsisovics, marking a transitional stage between that species and *C. delphinocephalus*. I should not hesitate in identifying my Himálayan specimen with such types, if I had not found it to agree with *C. delphinocephalus* in a subordinate detail, which induced E. v. Mojsisovics to keep the two species separate. The hood of the body-chamber is provided only with very low indistinct folds, not with sharp, delicate ribs, as in *Coroceras monile*. It is true that this difference in the ornamentation, as stated by E. v. Mojsisovics in his diagnosis of *Coroceras delphinocephalus*, is not evident from the illustrations on Pl. LXIX, figs. 14-17, but I have seen several specimens of this species, from the Hallstatt limestone of the Raschberg, in which the hood is nearly smooth, as in my Himálayan specimen. The contraction by which this hood is marked off from the preceding portion of the body-chamber is of annular shape, and of considerable width and depth.

*Dimensions.*

Diameter of the shell . . . . .		16.5 mm.
"    "    umbilicus . . . . .		1    "
Height } at the beginning of the last volution . . . . .	}	6.5    "
Thickness }		9    "
Height } of the hood . . . . .	}	8    "
Thickness }		10   "

*Sutures.*—Not known.

*Locality.* Number of specimens examined.—Shalshal cliff, 1.

COROCERAS VALDECUCULLATUM nov. sp. Pl. V, figs. 2, 3.

E. v. Mojsisovics, in his monograph of the Cephalopoda from the Hallstatt limestone, divided the species of *Coroceras* into two groups, both of them provided

with a paulostomatic hood corresponding with the commencement of the last volution. In the group of *C. Naso* this paulostomatic hood is short and consequently hidden beneath the peristomatic hood: in the group of *C. monile* it is of considerable length and not covered entirely by the peristomatic hood.

Now the present species is an extreme type of the group of *C. monile*, its paulostomatic hood being of excessive length and contrasting sharply with the short peristomatic hood. The paulostomatic hood is separated from the adjoining part of the last volution by a sharp rim and is entirely smooth, whereas the last whorl from this rim, up to the commencement of the peristomatic hood, is covered with numerous sharp ribs. The ribs are developed most strongly in the vicinity of the paulostomatic hood. In one of my specimens a broader rib is intercalated occasionally between the sharp ones, but this irregularity in the ornamentation has not been observed in the majority of my examples.

The peristomatic hood is very short, bordered by an annular furrow and elevated towards the apertural margin, as in *C. Suessii* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, l. c. VI-1, p. 167, Taf. LXIX, figs. 21-25) or in *C. Neumayri* v. Mojs. (ibidem, p. 168, Taf. LXX, figs. 1-4). The aperture is contracted very strongly.

#### *Dimensions.*

Diameter of the shell	. . . . .	12 mm.
„ „ umbilicus	. . . . .	1 „
Height	} of the peristomatic hood	. { 5.5 „
Thickness		

*Sutures.*—Agreeing in their shape and arrangement with the sutures in typical species of *Coroceras*. Lobes clydonitic, acute, saddles entire, somewhat laced at their bases. Median prominence broad and considerably lower than the adjoining siphonal saddle. Six saddles outside the umbilical suture. The second and fourth saddles are a little shorter than their neighbours, but the difference in size is rather insignificant. Last saddle broadly rounded and low, recalling the umbilical saddle in many *Goniatites* or in Triassic *Nautiloidea*.

*Length of the body-chamber.*—Exactly one entire volution.

*Locality. Number of specimens examined.*—Shalshal cliff, 4.

*Remarks.*—This species is easily distinguished from the congeneric forms in the Mediterranean region by its long paulostomatic hood and by its narrow aperture.

#### Genus: MONOPHYLLITES Mojs.

##### MONOPHYLLITES cf. SIMONYI v. Hauer. Pl. IV, fig. 3.

1847. *Ammonites Simonyi* F. v. Hauer, Cephalopoden von Aussee, Haidinger's Naturwiss. Abhandl. I, p. 270, Taf. IX, figs. 4-6.
1849. *Ammonites monophyllus* Quenstedt, Cephalopoden, p. 256, Taf. XIX, fig. 11.
1866. *Ammonites Simonyi* v. Dittmar, die Fauna der Hallstätter Kalke, Geognost. Palæont. Beiträge von Benecke, Schloenbach und Waagen, I, p. 360, Taf. XIII, figs. 22-24.
1873. *Lytoceras Simonyi* E. v. Mojsisovics, die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 32, Taf. XVII, figs. 1-6, Taf. XVIII.
1902. *Monophyllites Simonyi* E. v. Mojsisovics, ibidem, Supplementbd., p. 316.



A fragmentary specimen of a large-sized *Monophyllites*, which undoubtedly belongs to the group of *M. sphaerophyllus*, agrees so closely with *M. Simonyi* Hauer from the jolic Hallstatt limestone of Aussee that, with more complete materials at hand, a direct identification might be attempted.

My fragment is entirely chambered. Its transverse section is lanceolate, with its lateral parts converging in very flatly arched planes from the rounded umbilical margin to the siphonal part, which is narrowly rounded. The largest transverse diameter of 26 mm. corresponds to a height of 37 mm. The shape of the cross-section and the narrowness of the siphonal part especially afford good external characters of distinction between *M. Simonyi* and the congeneric species of the group of *M. sphaerophyllus*.

Fragments of the shelly test, which have been preserved along one side of my specimen—this is the side not figured in the illustration—show numerous transverse striæ, agreeing in their falciform direction and strength with the ornamentation of *Monophyllites Simonyi*.

*Dimensions*.—Not measurable.

*Sutures*.—Agreeing very closely with those of the large example of *M. Simonyi* from the Roethelstein illustrated by E. v. Mojsisovics on Pl. XVIII, fig. 6. Siphonal lobe very short, divided by a high median prominence, which is not serrated. Principal lateral lobe terminating in two symmetrical points, which are separated by a short median leaf, which is considerably smaller than in the illustration quoted above, recalling in this respect the illustration of a smaller specimen of *M. Simonyi* on Pl. XVIII, fig. 5. Second lateral lobe and following lobes tripartite. Two lateral and three auxiliary lobes are present.

*Locality. Number of specimens examined*.—Shalshal cliff, 1.

*Remarks*.—In my memoir on the ladinic, carnic and noric faunæ of Spiti (Palæont. Indica, Ser. XV, Vol. V, Pt. 3) a species of *Monophyllites* from the Grey beds of Thabo has been described and illustrated (Pl. XII, fig. 7), which is closely allied to the present one. A direct identification is, however, impossible, because the specimen from Thabo has been so strongly crushed that the original shape of its transverse section cannot be reconstructed.

### Subgenus : *MOJSVARITES*, Pompeckj.

#### *MOJSVARITES AGENOR* Muenst. Pl. IV, fig. 2.

1834. *Ceratites Agenor* Graf zu Muenster, Neues Jahrb. f. Miner. etc., von Leonhardt und Bronn, p. 15, Taf. II, fig. 9.
1841. *Ceratites Agenor* Graf zu Muenster, Beiträge zur Geognosie und Petrefaktenkunde, p. 135, Taf. XV, fig. 24.
1849. *Ammonites Morloti* F. v. Hauer, Neue Cephalopoden von Hallstatt und Aussee, Haidinger's Naturwissensch. Abhandl. III, p. 15, Taf. II, figs. 12-14.
1873. *Lytoceras Morloti* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 34, Taf. XVI, figs. 1, 2, XIX, figs. 11, 14, 15.
1882. *Monophyllites Agenor* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst. X, p. 205, Taf. LXXVIII, figs. 6-9.
1902. *Mojsvarites Agenor* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, l. c. Supplement, p. 316.

The group of *Monophyllites Suessii* Mojs., distinguished by its smooth shell, has been separated from the group of *M. sphærophyllus* Hauer (*Monophyllites s. s.*), as a proper subgenus, *Mojsvarites*, by Pompeckj; (Ammoniten des Rhaet, Neues Jahrb. f. Miner. 1895, II, p. 19). E. v. Mojsisovics (Himálayan Fossils, Vol. III, Pt. 1, p. 115) is inclined to regard *Mojsvarites* as the Triassic ancestor of the genus *Phylloceras*, considering *Lytoceras* as a descendant of *Monophyllites s. s.*

In the carnic Hallstatt limestone the subgenus *Mojsvarites* is represented by two species, *M. Agenor* Muenst. and *M. eugyrus* Mojs. *M. eugyrus*, which is also known from the Daonella beds of the Himálayas, has a flatter umbilicus, more slowly increasing and compressed whorls, and its sutures more richly serrated than *M. Agenor*.

To all appearance *M. Agenor* also occurs in the carnic stage of the Himálayas, but in a somewhat lower horizon than the Daonella beds (zone of *Halobia comata* Bittn.). In the Traumatocrinus limestone it is represented by a specimen of moderate dimensions, which in its shape and sutures agrees completely with the European specimens of Pozoritta and Aussee. The shell, which has been partly preserved, is either quite smooth or shows only slight indications of delicate falciform striæ, when viewed with the light falling obliquely on it.

The broadly vaulted siphonal part, the comparative thickness of the volutions, and the deep umbilicus, make a distinction from *M. eugyrus* an easy matter. My specimen consisting of air-chambers only, its size, when complete, cannot have been inferior to that of the large examples from the carnic Hallstatt limestone of the Salzkammergut.

#### *Dimensions.*

Diameter of the shell	. . . . .	42	mm.
" " umbilicus	. . . . .	13	"
Height	} of the last volution	17	"
Thickness		15.5	"

*Sutures.*—The sutures are, as our illustration indicates, in the closest agreement with those of F. v. Hauer's specimen from Aussee. The contrast in the shape of the terminal phylla in the siphonal and principal lateral saddles is very remarkable, the former being turned towards the external part, the latter towards the umbilical region. All the lobes are tripartite. The width of the principal lateral lobe deserves special mention, as it reminds me strongly of the same character in *Phylloceras persanense* Herbieh and in *Ph. Montgomeryi* Dien., from the lower Lias.

There appear to be two small auxiliary saddles outside the umbilical suture which are separated by a narrow lobe.

*Locality. Number of specimens examined.*—Shalshal cliff, 1.

Genus : *JUVAVITES* v. Mojsisovics.

Subgenus : *ANATOMITES* v. Mojs.

*ANATOMITES* sp. ind. Pl. I, fig. 3.

There is a fragment of a side of a species of *Anatomites* which probably belongs to the group of *A. scissi*. The fragment, which has been strongly crushed and injured by weathering, is, however, not sufficient to enable me to come to a tolerably certain decision about its specific position. A deep paulostomatic furrow, which is noticed at the beginning of the last volution, is bordered on either side by dichotomising ribs. The sculpture is rather simple. Undivided ribs appear to be entirely absent. Bifurcations of ribs occur both in the umbilical and marginal regions.

*Dimensions*.—Not measurable.

*Sutures*.—Not known.

*Locality*. *Number of specimens examined*.—Shalshal cliff, 1.

Genus : *ISCULITES* v. Mojsisovics.

*ISCULITES* cf. *HEIMI* v. Mojs. Pl. V, fig. 5.

1893. *Isculites Heimi* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 67, Taf. LXXXVII, figs. 8, 11, 12, 13.
1896. *Isculites cf. Heimi* E. v. Mojsisovics, Obertriadische Cephalopoden faunen des Himálaya, Denkschr. Kais. Akad. d. Wiss. Math. nat. Kl. LXIII, p. 608.
1899. *Isculites cf. Heimi* E. v. Mojsisovics, Himálayan Foss., Pal. Ind., ser. XV, Vol. III, Pt. 1, p. 41.
1903. *Isculites Heimi* (Mojs.)? Frech, Neue Cephalopoden aus den Buchensteiner und Wengener Schichten des südlichen Bakony. Aus dem Paläontologischen Anhang zum I. Teile des I. Bandes der Resultate den Wissenschaftl. Erforschg. des Balatonsees, p. 45.
1906. *Isculites Heimi* Diener, Fauna of the Tropites limestone of Byans, Palæont. Indica, ser. XV, Himálayan Foss. Vol. V, No. 1, p. 115, Pl. XV., fig. 1.

A small shell consisting of air-chambers only agrees very nearly with inner nuclei of the *forma typica* of *Isculites Heimi*, but the identification must be made with some reserve, the shape of its body-chamber being unknown to me. The egression of the umbilicus is but faintly marked, although one can see that the umbilical suture does not exactly follow the normal spiral.

Shell nearly smooth, with few, indistinct, striæ of growth only.

*Dimensions*.

Diameter of the shell	. . . . .	9.5 mm.
" " umbilicus	. . . . .	0.5 "
Height	} of the last volution	. {cca. 4.5 "
Thickness		

*Sutures*.—Agreeing in general with those of *Isculites Heimi*. The contrast between the entire external and the serrated internal margins of the siphonal saddle is clearly marked. At the base of the principal lateral lobe a comparatively large indentation is noticeable.

*Locality*. *Number of specimens examined*.—Shalshal cliff, 1.

## ISCULITES sp. ind. Pl. V, fig. 1.

There is a second specimen of *Isculites* in A. v. Krafft's collections. Its body-chamber has been partly preserved, but a considerable portion must have been broken off, the egression or opening out of the umbilicus being still rather small. The most important feature by which this specimen is distinguished from *Isculites Heimi*, is the remarkable decrease in the width of the last volution from its beginning towards the aperture. In this character it recalls *I. subdecrescens* v. Mojsisovics (Cephalopoden der Hallstätter Kalke l.c. VI-2, p. 68, Taf. LXXXVII, figs. 5, 6), but it is too fragmentary to warrant a complete identification.

The shell is entirely smooth.

*Dimensions.*

Diameter of the shell	. . . . .	. 17 mm.
" " umbilicus	. . . . .	. 2 "
Height } at the beginning of the last volution	. . . . .	{ 7 "
Thickness }		{ 10 "
Height } of the aperture	. . . . .	{ 9 "
Thickness }		{ 9 "

*Sutures.*—Unknown.

*Locality. Number of specimens examined.*—Shalshal cliff, 1.

## Genus: CELTITES v. Mojsisovics.

## CELTITES CONTRACTIFRONS nov. sp. Pl. V, figs. 6, 7.

Shells agreeing very closely with *Celtites trigonalis* Diener (Ladinic, carnic and noric faunæ of Spiti, Himálayan Foss., Vol. V, Pt. 3, p. 29, Pl. VI, fig. 11) from the Daonella limestone of Lilang, have been discovered among A. v. Krafft's materials from the Traumatocrinus limestone of the Shalshal cliff. They exhibit the same blunt geniculation of the spire, imparting to the shell a nearly triangular outline, with bluntly rounded angles.

The only external difference between the type-specimen from the Daonella beds of Spiti and our examples from the Traumatocrinus limestone of Painkhanda consists in the presence of constrictions, accompanying the geniculations in the latter. In my type-specimen the ornamentation is very delicate and restricted to the vicinity of the aperture. It consists of parabolic ears, which are connected by ribs crossing the siphonal area. In the specimens before me narrow constrictions are added to this pattern of ornamentation, which run across the entire tube in a direction considerably turned forward, and form a broadly curved lappet on the siphonal area. Neither these constrictions nor the geniculations are arranged at regular intervals.

The constrictions following the geniculations of the tube probably correspond to paulostomatic furrows. The geniculations resemble the phylogerontic contractions in the body-chamber of *Lobites* v. Mojs. or *Coroceras* Hyatt.

*Dimensions.*

	Fig. 6.	Fig. 7.
Diameter of the shell . . . . .	16.5 mm.	13 mm.
„ „ umbilicus . . . . .	8 „	6.5 „
Height } of the last volution . . . . .	{ 4 „	3 „
Thickness }	{ 6.5 „	4.5 „

*Sutures.*—Standing widely apart, goniatitic, but distinguished from those of *Celtites trigonalis* by the very deep position of the siphonal lobe and by the development of sharply pointed wings on either side of the short median prominence. Lateral saddle higher than the external one. A small umbilical lobe outside the umbilical suture.

*Locality. Number of specimens examined.*—Shalshal cliff, 3.

Genus: DISCOTROPITES Hyatt et Smith.

DISCOTROPITES sp. ind. (group of *D. punctati*.)

A species of *Discotropites* closely allied to *D. Plinii* E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 289, Taf. CXXX, figs. 4-6), from the Traumatocrinus limestone of the Shalshal cliff, has been described by E. v. Mojsisovics (Himálayan Foss., Vol. III, Pt. 1, p. 48). In A. v. Krafft's collection the genus *Discotropites* is represented by a single fragment only, which is too small to permit any closer comparison with the Alpine species. But it is certainly not identical with the form described by E. v. Mojsisovics, its ornamentation pointing decidedly to the group of *D. punctati*.

*Locality. Number of specimens examined.*—Bambanag cliff, near Martoli E. G., 1.

Genus: CARNITES Mojs.

CARNITES cf. FLORIDUS WULF. Pl. IV, fig. 5.

For a list of synonyms *vide*: C. Diener, The fauna of the Tropites limestone of Byans, Himálayan Foss. Palæont. Ind., ser. XV, Vol. V, Pt. 1., p. 169.

To this list the following quotations should be added:—

1900. *Hauerites* sp. ind. A. v. Krafft. General Report, Geol. Surv. of India, for 1899-1900, pp. 215, 216.

1905. *Carnites floridus* Frech, Nachträge zu den Cephalopoden and Zweischalern der Bakonyer Trias Palæontologischer Anhang zu Bd. I Th. 1 der Resultate der Wissenschaftl. Erforschg. des Balatonsees, Nachtrag. p. 18, figs. 23-25.

1908. *Carnites floridus* Diener, Ladinic, carnic and noric faunæ of Spiti, Himálayan Foss., Vol. V., Pt. 3, p. 70, Pl. XII, fig. 2.

Indian representatives of this remarkable Alpine species have been described from the Tropites limestone of Byans and from the Grey beds of Spiti. Its presence in the Traumatocrinus limestone is also very probable, but cannot, unfortunately,

be proved in a satisfactory manner, my materials at hand being too scanty. There is only a single fragment of the last volution available, showing four lobes and three saddles of the four last septa. It is strongly compressed, and provided with a narrow siphonal area, which is bordered by two sharp keels. Between these two marginal keels the external area is not deeply excavated, but slightly elevated in the middle, although no median keel is developed.

To judge from the proportions of the sutural elements, the specimen must have been of large size and may have attained a diameter of about 120 mm., corresponding to the last septum.

The surface of the cast is entirely smooth.

*Sutures*.—Agreeing exactly, as far as known, with those of the typical form of *Carnites floridus* from Deutsch Bleiberg.

*Locality*. *Number of specimens examined*.—Shalshal cliff, 1.

#### Genus: PLACITES v. Mojsisovics.

##### PLACITES cf. POLYDACTYLUS VAR. OLDHAMI v. Mojs. Pl. IV, fig. 4.

1896. *Placites Oldhami* E. v. Mojsisovics, Beitræge zur obertriadischen Cephalopodenfauna des Himálaya, Denkschr. Kais. Akad. d. Wissensch, LXIII, p. 664, Taf. XIX, fig. 2.  
 1899. *Placites Oldhami* E. v. Mojsisovics, Himálayan Foss. l. c., Vol. III, Pt. 1, p. 111, Pl. XIX, fig. 2.  
 1906. *Placites polydactylus* var. *Oldhami* Diener, Fauna of the Tropites limestone of Byans, ibidem. Vol. V, Pt. 1, p. 165, Pl. XIV, figs. 7, 8, 9.

The chambered cast illustrated belongs to a species of *Placites*, which is probably identical with *Pl. polydactylus* var. *Oldhami* from the Daonella beds of Lauka, and from the Tropites limestone of Byans. In its external shape, proportions and sutures, it agrees very closely with this species, but its state of preservation does not permit of a direct identification.

*Sutures*.—As far as known agreeing with those of *Pl. polydactylus*, especially so in the development of two adventitious lobes.

*Locality*. *Number of specimens examined*.—Shalshal cliff, 1.

#### Genus: RIMKINITES Mojsisovics.

##### RIMKINITES NITIENSIS v. Mojsisovics. Pl. IV, fig. 4.

1897. *Hungarites nitiensis* E. v. Mojsisovics, Beitræge zur Kenntnis der obertriadischen Cephalopodenfaunen des Himálaya, Denkschr. Kais. Akad. d. Wissensch. LXIII, p. 669, fig. 1, non 2, 3.  
 1899. *Hungarites nitiensis* E. v. Mojsisovics, Himálayan Foss., Vol. III, Pt. 1, p. 118, fig. I, non 2, 3.  
 1908. *Rimkinites nitiensis* Diener, Ladinic, carnic and noric faunæ of Spiti, Palæont. Indica, ser. XV, Himálayan Foss., Vol. V, Pt. 3, p. 32, Pl. IV, figs. 8, 9, 10.

As has been explained in my memoir quoted above, two different species have been united in *Rimkinites nitiensis* by E. v. Mojsisovics. The name must be restricted to the ammonite from the Traumatocrinus limestone of the Shalshal cliff, which seems to have a rather wide vertical distribution in the Trias of the

Himálayas, ranging from the topmost beds of the Muschelkalk in Spiti through the entire Daonella shales and the Daonella limestone.

In A. v. Krafft's collections from the Traumatocrinus limestone of the Shalshal cliff a single fragment only of this species has been found, showing the delicate falciform striæ on the lateral parts, and recalling the ornamentation in *Harpoceras* even more distinctly than the specimen illustrated on Pl. IV, fig. 8, of my memoir quoted above.

#### RIMKINITES EDMONDII Diener.

1865. *Ammonites floridus* Salter, Palæontology of Niti, p. 61, Pl. VIII, fig. 1, non 2, 3, non Pl. VI, fig. 1.  
 1897. *Hungarites nitiensis* E. v. Mojsisovics, *ex parte*, Denkschr. Kais. Akad. d. Wissensch. LXIII, p. 669, figs. 2, 3, non 1.  
 1899. *Hungarites nitiensis* E. v. Mojsisovics, *ex parte*, Himálayan Foss. Vol. III, Pt. I, p. 118, figs. 2, 3, non 1.  
 1908. *Rimkinites Edmondii* Diener, *Ibidem*, Vol. V, Pt. III. Ladinic, carnic and noric faunæ of Spiti, p. 34, Pl. VI, figs. 2, 3.

This species, which corresponds to the circumplicate type of *Rimkinites nitiensis*, in the original interpretation of E. v. Mojsisovics, is represented in A. v. Krafft's collection by a single specimen of small size, which is but indifferently preserved.

I have nothing to add to my description of this species quoted above.

#### Genus: ARPADITES v. Mojsisovics.

#### ARPADITES RIMKINENSIS v. Mojsisovics.

1897. *Arpadites rimkinensis* E. v. Mojsisovics, Beiträge zur Kenntnis der obertriadischen Cephalopodenfaunen des Himálaya, Denkschr. Kais. Akad. d. Wissensch. Wien, LXIII, p. 50, Taf. XIV, fig. 6.  
 1899. *A. rimkinensis* E. v. Mojsisovics, Palæont. Indica, ser. XV, Vol. III, Pt. 1, p. 59, Pl. XIV, fig. 6.  
 1908. *A. rimkinensis* Diener, *Ibidem*, Vol. V, Pt. 3, Ladinic, carnic and noric faunæ of Spiti, Pl. IV, p. 16, figs. 3-6.

This species, of which seven specimens were known to E. v. Mojsisovics from my own collections in the Traumatocrinus limestone of the Shalshal cliff in 1892, is represented by a single fragment only in A. v. Krafft's collections, from the same locality. In its dimensions and sculpture it agrees so closely with the type-specimen figured by E. v. Mojsisovics that an illustration is hardly necessary. Nor have I anything to add to my descriptions quoted above.

In Spiti *Arpadites rimkinensis* is a common species in the topmost beds of the Muschelkalk.

#### Subgenus: DITTMARITES v. Mojsisovics.

#### DITTMARITES cf. CIRCUMSCISSUS v. Mojsisovics. Pl. V, fig. 13.

1893. *Arpadites (Dittmarites) circumscissus* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke Abhandl. K. K. Geol. Reichsanst., VI-2, p. 457, Taf. CLIV, figs. 2-5.

A single fragmentary specimen from the Tropites limestone of the Shalshal cliff reminds me very strongly of this species of the group of *Arpadites rimosi*. It resembles most closely the specimen illustrated on fig. 4 by E. v. Mojsisovics, both in its proportions and sculpture. But the flattened ribs are arranged at equal distances along the entire half-volution, which is satisfactorily preserved and are as narrow as in the body-chamber of the Alpine example quoted above. This character is, however, subject to considerable variation in *Dittmarites circumscissus*, the ribs being broader and more widely separated at the aperture, in the specimen illustrated on Pl. CLIV, fig. 3, than at the commencement of the last volution, corresponding to a smaller diameter in the specimen fig. 4. This difference is consequently not of specific importance.

The regularity in the arrangement of ribs in our Himalayan specimen might lead us to suppose, that its last volution belongs to the body-chamber, as far as it is sculptured. This suggestion is supported by the presence of several dichotomising or intercalated ribs, which do not originate at the umbilical margin, but terminate in sharp points before reaching it.

In the regularity of its ornamentation our specimen recalls *D. Ferdinandi* v. Mojsisovics (l. c. p. 459, Taf. CLIII, figs. 15, 17, CLIV, fig. 1) but is distinguished from the latter species both by the absence of any incisions in its smooth external keels, and by its wider umbilicus.

*Dimensions.*

Diameter of the shell	. . . . .	28	mm.
"    "    umbilicus	. . . . .	8	"
Height	} of the last volution	12.5	"
Thickness			

*Sutures.*—Not known.

*Locality.* *Number of specimens examined.*—Shalshal cliff, 1.

DITTMARITES sp. ind. aff. LADON v. Dittm. Pl. I, figs. 4, 5.

The larger of the two specimens illustrated is provided with its body-chamber. The smaller specimen is an inner nucleus consisting of air-chambers only. The small specimen very closely resembles examples of equal size of *Arpadites* (*Dittmarites*) *Ladon* v. Dittmar (*Zur Fauna der Hallstätter Kalke*, Geognost. Palæont. Beiträge von Benecke, Schloenbach und Waagen, I, p. 382, Taf. XVIII, figs. 1, 2), especially the inner volutions of the type-specimen from the jalic beds of the Feuerkogel, which has been illustrated by E. v. Mojsisovics on Pl. CLIII, fig. 6 of his monograph of the Cephalopoda of the Hallstatt limestone (*Abhandl. K. K. Geol. Reichsanst.*, VI-2, p. 461). The whorls increase slowly, and are higher than broad, enveloping one another along the siphonal area and covered with broad, falciform ribs, which are separated by very narrow intercostal valleys. In the posterior portion of the last volution some ribs in the umbilical region are elevated somewhat above the general convexity of the shell. All the ribs are undivided.



A deep median furrow is noticeable in the siphonal area, at the commencement of the last volution, corresponding to a diameter of the shell of 10 mm. But distinct siphonal keels are not developed before a diameter of 13 mm. has been reached. Those keels originate in the shape of comparatively broad ledges and become acute only in later stages of growth.

Whereas in *D. Ladon* the sculpture changes to a certain extent in later stages of development, it remains nearly unchanged in our Himálayan species. The body-chamber fragment figured shows simple broad ribs, separated by deep intercostal furrows, and sharp siphonal keels, which are entirely smooth, not crenulated, as in *D. Ladon*.

Both in its lateral sculpture and in the persistence of smooth siphonal keels this species reminds me even more strongly of *Arpadites (Dittmarites) circumscissus* v. Mojsisovics, than of *D. Ladon*, but it differs from it in its lower whorls and wider umbilicus.

My materials are not sufficient for justifying the introduction of a new specific denomination.

*Dimensions.*

		Fig. 4.	Fig. 5.
Diameter of the shell . . . . .		9 mm.	19.5 mm.
" " umbilicus . . . . .	cca. 12	"	4 "
Height } of the last volution . . . . .	{	14.5 "	9 "
Thickness		13 "	7.5 "

*Sutures.*—Agreeing in general with those of *Dittmarites Ladon* and *D. Dorceus* v. Dittm. Lobes and saddles serrated. Marginal walls of the lateral lobes converging towards their bases. Siphonal lobe very short and bicuspidate. Principal lateral lobe terminating in a large acute point. Second lateral saddle divided by the umbilical suture.

*Locality. Number of specimens examined.*—Shalshal cliff, 2.

Genus : CLIONITES v. Mojsisovics.

CLIONITES sp. ind. ex aff. DORÆ v. Mojsisovics. Pl. V, fig. 12.

Although the only specimen available for examination is fairly well preserved, I do not consider it as sufficient to justify the introduction of a new specific name.

The specimen is closely related to *Clionites Doræ* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 474, Taf. CXLIII, fig. 4), from the jolic Hallstatt limestone of Aussee, in reference to its shape and in the arrangement of its sculpture. The volutions are strongly compressed, embracing one another but very little and increasing slowly from the umbilical margin, which is rounded off obtusely, while the lateral parts are very flatly curved towards the narrow siphonal part, which is provided with a deep median furrow.



“The specimen illustrated, *viz.*, a cast, with the beginning of the body-chamber, agrees in its general features with *Trachyceras austriacum* from the Feuerkogel near Aussee in such a remarkable way, that I should not have hesitated to identify it with this characteristic species, but for the fact that the more simple structure of the suture line requires the isolation of the Indian form. I regard the latter therefore as a representative of *Trach. austriacum* and designate it *Trach. tibeticum*. Should the differentiation of the species not be considered justified—which in this, as in so many other cases, is only a matter of individual conception or personal judgment—the varietal name *tibetica* should be added to the Indian form of *T. austriacum*.”

The learned author did not fail to remark a difference in the character of the sculpture of his Indian form and of the Alpine types of *Trach. austriacum*. Instead of the external double row of tubercles occurring in the latter, only knob-like extremities of the ribs are to be seen in *T. tibeticum*. But this difference is explained correctly by E. v. Mojsisovics by the different mode of preservation of the Indian and Alpine types. The Himálayan specimen is a cast devoid of its shelly substance, and consequently does not show the double row of external tubercles, but their presence in examples provided with their test is suggested, according to E. v. Mojsisovics, by the specially strong development of the projection of the extremities of the ribs.

This suggestion has been proved to be correct by the examination of new materials collected in the Traumatocrinus limestone of the Shalshal cliff by A. v. Krafft. There is one fragment especially of a body-chamber, provided with its shelly test, which shows the double row of external spiral tubercles as distinctly as any of the Alpine examples of *T. austriacum* from the Hallstatt limestone of the Salzkammergut. Another specimen is a cast, agreeing in its dimensions very closely with the type specimen of *T. tibeticum*, which has a small fragment of the original shell preserved along the siphonal part. On this fragment two small tubercles are noticed rising from a common base in the external spiral row, whereas the cast exhibits only the stout, knob-shaped extremities of the ribs, as illustrated in the type-specimen of *T. tibeticum* by E. v. Mojsisovics.

Thus there is a complete agreement in the sculpture of *Trach. austriacum* and *Trach. tibeticum*, and the only difference between the two species is the more simple structure of the sutures in the Asiatic type. But even in this respect some of the specimens collected by A. v. Krafft do not agree with the description and figures as given by E. v. Mojsisovics, but correspond exactly with the European form. As is seen from my illustration, the stems of the saddles are provided with deep denticulations, and the principal lateral lobe is wide and tripartite, not terminating in a single, narrow point, as in *Trach. tibeticum*.

From this it is evident that *Trach. austriacum* is represented in the Himálayas by specimens agreeing completely with the European form, and that types with more simple sutures, as for instance that illustrated by E. v. Mojsisovics, can only be considered as varieties, to which the name *var. tibetica* may be assigned.

*Dimensions.*

Diameter of the shell	. . . . .	46	mm.
" " umbilicus	. . . . .	9.5	"
Height	} of the last volution	22.51	"
Thickness			

*Locality.* Number of specimens examined.—Shalshal cliff, 6.

Subgenus: *PROTRACHYCERAS* v. Mojs.

*PROTRACHYCERAS* sp. ind. aff. *ARION* v. Mojs. Pl. V, fig. 10.

The only specimen available for examination has been greatly injured. Its state of preservation is, however, sufficient to establish its relationship to the group of *Protrachyceras Attila*. Its sculpture is characterised by the presence of numerous, very closely set, and narrow ribs, and of a large number of spiral rows of tubercles (eleven or twelve), which are rather delicate.

The lateral ornamentation is remarkable for the change which the direction of the ribs undergoes, during different stages of growth. At the beginning of the last volution the ribs are falciform, with a strong bend, turned forward, in the marginal regions, as is common in the overwhelming majority of carnic *Trachycerata*. In the middle portion of the last volution the ribs are directed backward in the marginal region, and their falciform shape has been replaced by a flat curve, with its convexity turned forward. A large portion of the shell having been broken off, the place where the two patterns of ornamentation must have met is, unfortunately, not accessible to observation. In the anterior half of this volution the direction of the ribs is nearly radial, and they cross the siphonal area in straight lines, exactly as in the subgenus *Analcites*, with the exception only of a narrow space in the middle of the shell, which remains smooth. This space which corresponds to the median furrow in typical species of *Trachyceras* is not depressed, but marked only by an interruption of the lateral sculpture. In this character our species agrees closely with *Protrachyceras Arion* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 634, Taf. CLXX, figs. 3, 4), from the jülic Hallstatt limestone of Aussee, but the smooth median zone is still narrower, and the external tubercles are more delicate in the Indian form. The lateral ribs correspond exactly on either side of the shell.

In its general shape also our specimen recalls *Protrach. Arion*. In the width of its umbilicus it holds an intermediate position between the two specimens from Aussee, which have been illustrated by E. v. Mojsisovics.

*Dimensions.*

Diameter of the shell	. . . . .	50	mm.
" " umbilicus	. . . . .	cca. 11	"
Height	} of the last volution	24	"
Thickness			

*Sutures*.—Not known.

*Locality*. *Number of specimens examined*.—Bambanag cliff, 1.

PROTRACHYCERAS sp. ind. (Group of *P. FURCOSA*). Pl. V, fig. 14.

Two fragmentary specimens of small dimensions are representatives of a species of *Protrachyceras* belonging to the group of *Protrach. furcosa*, and is perhaps a descendant from *Protr. furcatum* Muenst. It has high-mouthed volutions, which increase slowly and are very strongly compressed, and a comparatively wide umbilicus. In the narrow siphonal part a deep median furrow is excavated, which is bordered by ear-shaped, spirally elongated tubercles. Between this external row of tubercles and the following one there is a complete interruption of sculpture, exactly as in *Protr. subfurcatum* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 624, Pl. CLXVI, fig. 6).

The lateral parts are nearly flat, and covered with stout and broad falciform ribs, which bifurcate at irregular intervals. These ribs are the most prominent elements of ornamentation. There is a remarkable contrast between the strong development of the lateral ribs and the feebly developed spiral tubercles, of which there are altogether four rows. The lateral tubercles are spirally elongated, as in *P. furcatum* and its allies.

The chief difference between the present species and the Alpine descendants of *Protr. furcatum* in the julic Hallstatt Limestone (*P. subfurcatum* v. Mojs., *P. Hadwigæ* v. Mojs.), consists in the strong development of the ribs in my Indian form, whereas these ribs are but faintly marked in the European types.

*Dimensions.*

Diameter of the shell	. . . . .	25	mm.
„ „ umbilicus	. . . . .	6.5	„
Height	} of the last volution .	12	}
Thickness			

*Sutures*.—Agreeing very nearly with those of *Protr. furcatum* Muenst, as illustrated by E. v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, Abhandl. K. K. Geol. Reichsanst., X, Taf. XXII, fig. 3). Saddles brachyphyllic, with margins converging from a broad base towards the tops, which are narrowly rounded. Lateral lobes terminating in long digitations. A small auxiliary saddle standing outside the umbilical suture.

*Locality*. *Number of specimens examined*.—Shalshal cliff, 2.

Genus: SIRENITES v. Mojsisovics.

SIRENITES COOKEI nov. sp. Pl. V, fig. 11.

This species is represented in A. v. Krafft's collection by the type-specimen illustrated, which, although somewhat fragmentary, has been preserved sufficiently

well to justify the introduction of a new specific name, and by two more examples of larger dimensions, which have, however, been greatly injured, especially so in the external region. It is not a typical representative of the genus *Sirenites*, but one of the numerous transitional shapes between *Protrachyceras* and *Sirenites*, in which the number of external tubercles is less than twice as great as the number of lateral ribs, and in which plaited external keels are consequently absent. We are therefore obliged to class this species with the group of *Sirenites senticosi* v. Mojs.

My type specimen is high-mouthed, strongly compressed, and provided with a comparatively narrow umbilicus. The greatest transverse diameter corresponds to the umbilical margin, which is acute and separated from the umbilical suture by a low and vertical wall. In these sutures, and also in the general character of its sculpture, it recalls *Sir. Hortensia* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., IV-2, p. 739, Taf. CLXII, fig. 24).

The lateral parts are covered with broad and stout ribs, which occasionally bifurcate at irregular distances from the umbilical margin. The number of bifurcations is not very considerable. There are altogether nine or ten rows of spiral tubercles present. The tubercles in the umbilical region are more delicate, spirally elongated, and set very close to each other. Two rows consist of tubercles of especially large dimensions, the marginal one and the row following next to it.

The external tubercles are arranged into keels, which are not distinctly individualised, the ear-shaped tubercles being separated by deep furrows, which run diagonally towards the median depression in the narrow siphonal area.

*Dimensions.*

Diameter of the shell . . . . .	.	.	.	42 mm.
" " umbilicus . . . . .	.	.	.	9 "
Height } of the last volution . . . . .	.	.	.	23 "
Thickness }	.	.	.	

*Sutures.*—As far as known, richly serrated, with dolichophyllic saddles. The inner margin of the second lateral saddle corresponds to the umbilical edge.

*Locality. Number of specimens examined.*—Bambanag cliff, 1; Shalshal cliff, 2.

Genus: GIRTHICERAS nov. gen.

GIRTHICERAS PERNODOSUM nov. sp. Pl. I, fig. 6.

My materials for the introduction of this new genus are rather scanty, consisting of a single specimen of small dimensions, whose body-chamber has not been entirely preserved, but as it cannot be united with any of the genera of Triassic ammonites hitherto described and as its characters of importance are

clearly marked, I consider myself justified in proposing a new generic name. The leading features of the new genus are obvious from the following description of the species, which should be considered as its prototype.

In its general shape this species recalls some Alpine representatives of *Gryponautilidæ*, especially *Grypoceras* (*Gryponautilus*) *Suessii* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 26, Taf. VI, fig. 11, Taf. XIII, fig. 2). The volutions, which increase very slowly, are broader than high, and provided with a broad and flattened siphonal area, which is marked off from the lateral parts by distinct, obtusely rounded edges. The greatest transverse diameter corresponds to the umbilical margin. From this place the lateral parts converge towards the siphonal area as nearly flat planes. The umbilicus is very deep, moderately wide, and surrounded by a vertical wall. Umbilical margin forming an obtuse edge.

The principal elements of sculpture are stout umbilical tubercles, which, in their strong development recall the pattern of sculpture in *Stephanites* Waag., or in *Acrochordiceras* Hyatt. From these tubercles radial ribs originate, which become broadened out and at the same time gradually obliterated towards the siphonal area. In the last of these ribs, which occurs on the body-chamber of my type-specimen, its margins are elevated into narrow secondary costæ. The places where the vanishing ribs meet with the siphonal edges are marked by faint swellings of the latter.

#### Dimensions.

Diameter of the shell . . . . .	.	.	25	mm.
„ „ umbilicus . . . . .	.	.	5	„
Height } of the last volution	.	.	12.5	„
Thickness }	.	.	15	„

*Sutures*.—The dolichophyllic suture-line in general bears the character of some genera of *Haloritinæ* and *Juvavitinæ*. The number of sutural elements is rather small, there being not more than two lateral lobes and saddles present. The development of the auxiliary lobes could not be ascertained.

Siphonal lobe standing on an equal level with the principal lateral lobe and divided by a low median prominence, with entire margins and a rounded apex. Lateral lobes with deep digitations. Saddles richly serrated, with indistinct individualization of several phylla.

*Locality. Number of specimens examined*.—Bambanag cliff, 1.

*Remarks*.—The diagnosis of the genus *Girthiceras* runs as follows :—

Globose shells, with a flattened siphonal area and a strong umbilical sculpture. Sutures dolichophyllic.

It is more difficult to assign to this genus its proper systematic position. The small number of sutural elements exclude it from being grouped with *Arcestoidea* and *Pinacoceratoidea*. But there is no Alpine or American genus among the *Tropitoidea*, to which it could be more closely compared. There are perhaps, it is true, some affinities with the genus *Miltites* v. Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 334), which

resembles *Girthicerus* in the development of strong umbilical tubercles and in the arrangement of the sutural line, but in the character of the siphonal part the difference is too remarkable to permit the suggestion of a direct phylogenetic connection.

## LAMELLIBRANCHIATA.

### DAONELLA INDICA Bittner.

1899. *Daonella indica* Bittner, Himálayan Foss., Palæont. Indica., ser. XV, Vol. III, Pt. 2, p. 39, Pl. VII, figs. 4-11.  
 1908. *Daonella indica* Diener, ibidem, Vol. V, Pt. 3, Ladinic, carnic and noric faunæ of Spiti, p. 11, Pl. III, figs. 6, 7, 10.

The occurrence of this species at the top of the Traumatocrinus limestone from the Shalshal cliff has been established by A. Bittner. There are also two specimens before me which according to A. v. Krafft's labels, were collected in the Traumatocrinus limestone of the Bamnanag cliff, N.-W. of Martoli E. G.

### DAONELLA sp. ind. aff. OBLIQUA v. Mojs. Pl. V, fig. 15.

A right valve of a *Daonella* of strongly elongated shape reminds me very much of *Daon. obliqua* v. Mojsisovics (Ueber die triadischen Pelecypodengattungen Halobia und Daonella, Abhandl. K. K. Geol. Reichsanst., VII, p. 21, Taf. II, figs. 5, 6) in the very remarkable difference in the length of its anterior and posterior region. The apex is shifted anteriorly. Its excentric position imparts to the valve a curvature, which is directed obliquely downwards, but the curvature is marked less strongly than in *D. obliqua*.

The apex is not perfectly smooth, as in the Alpine form, but covered with very delicate and numerous ribs, which are intersected by coarse laminæ of growth. The ribs increase in strength towards the pallial margin, but the concentric wrinkles are restricted chiefly to the central and anterior portions of the valve. The majority of the ribs are dichotomous, but there is no distinctly marked arrangement into fasciculi.

*Locality.* *Number of specimens examined.*—Shalshal cliff, 1.

### AVICULA sp. ind. cf. SEISIANA Broili. Pl. V, fig. 17.

A fragmentary cast of a right valve reminds me very strongly of *Avicula seisiana* Broili (Die Fauna der Pachycardientuffe der Seiseralpe, Palæontographica, L, p. 166, Taf. XVIII, fig. 27). It especially resembles the specimen illustrated by L. Waagen on Pl. XXXIV, fig. 5 of his Lamellibranchiaten der Pachycardientuffe der Seiser Alpe" (Abhandl. K. K. Geol. Reichsanst., XVII, Heft 2), very closely, in its acutely oval outlines, its very small and rudimentary anterior ear, and in its large posterior wing, which is not marked off in any way from the visceral portion of the shell.



The apex is very low, directed forward, and does not project beyond the hinge line. The surface of the cast is entirely smooth. Notwithstanding the close agreement between our specimen and *Avicula seisiana* a direct identification is impossible, on account of its fragmentary condition. There are some Triassic species of *Gervilleia* (*G. musculosa* Stopp.) and *Edentula* (*E. planata* Broili, *E. lateplanata* Waag.), with which the present cast might also be compared. Its relationship to the genus *Avicula*, although the most probable, cannot be ascertained, since the characters of its hinge line are unknown.

*Locality. Number of specimens examined.*—Shalshal cliff, 1.

PECTEN nov. sp. ind. aff. SUBALTERNANS d'Orb. Pl. V, fig. 16.

A single left valve of a small *Pecten* deserves a special description, as it is the first Indian representative of a group of *Pectines* with alternating ribs, which plays such an important part in the fauna of Lamellibranchiata from St. Cassian.

It is of circular outline, of equal length and height, and very flatly curved. The anterior wing is considerably larger than the posterior one. The sculpture consists of two systems of radial ribs of very different strength. The stronger primary ribs originate in the vicinity of the apex, the weaker secondary ones make their appearance considerably later. There are twelve primary ribs counted in the circumference of the pallial margin. Primary and secondary ribs alternate quite regularly. The wings are also covered with close-set ribs, but the incrustation of matrix does not exhibit their ornamentation in its details. The radial ribs are intersected by numerous and very delicate concentric lines of growth but only a very small minority of these concentric lines is sufficiently strong to make the points of intersection rise into small elevations. Consequently, no distinct reticulation of the shell is developed.

It is the group of *Pecten alternans* Muenst. (Goldfuss, *Petrefacta Germaniæ*, p. 42, Taf. 88, fig. 11), to which our Himálayan species undoubtedly belongs, but it cannot be identified directly with any of the Alpine forms of this group.

In its circular outlines it agrees best with *Pecten moniliferus* Bittner (Lamellibranchiaten der alpinen Trias, Abhandl. K. K. Geol. Reichsanst., XVII, I. Abt., Revision der Lamellibranchiaten von St. Cassian, p. 157, Taf. XVIII, figs. 29, 30), but this Alpine species is easily distinguished by its smaller number of primary ribs (nine) and by their crenulated crests. All the other Alpine species are higher than long; nor does any one among them agree completely with our Himálayan type in its ornamentation. In *Pecten Andraeei* Bittner (l. c. p. 156, Taf. XXIV, fig. 16) the ribs do not alternate regularly. In *P. Sandbergeri* Klipst. (Bittner, l. c. p. 157, Taf. XVIII, figs. 31, 32) there are only six primary ribs; in *P. subæquicostatus* Bittner (l. c. p. 156, Taf. XVIII, figs. 27, 28) both the primary (12 to 14) and secondary ribs originate together in the apical region. In *P. asperulatus* Bittner (l. c. p. 156, Taf. XVIII, fig. 26), the contrast between the two systems of ribs is less sharply marked, and the surface of the shell has a distinctly

reticulate appearance. This reticulate character, which is produced by the regular development of tubercles at the places where the ribs are intersected by concentric lines of growth, distinguishes also *P. subalternans* d'Orbigny (Prodrome I, p. 202, Bittner, l. c. p. 154, Taf. XVIII, fig. 25) from our Himálayan form; another feature of difference is its elongated, not circular shape. Nor can our species be identified with the fragmentary *Pecten* from the Seiser Alpe, which has been described and illustrated by Broili (Fauna der Pachycardientuffe, Palæontographica, L, p. 174, Taf. XIX, fig. 25).

Although our species is certainly new, and several species of the group of *Pecten subalternans* d'Orb. have been based on single valves, I prefer to abstain from the introduction of a new specific denomination.

#### ASTARTOPIS (?) sp. ind.

Two fragmentary specimens of moderately large size from the Traumatocrinus limestone of the Shalshal cliff are too badly preserved to permit of a specific identification. The two valves being firmly attached to each other in both specimens, the hinge apparatus is not known to me. In their general shape and dimensions, in their prominent concentric sculpture and in the absence of a distinct posterior keel they remind me of *Trigonodus* Sandb., but the development of a deep cordiform lunula and the strongly prosogyrate character of the beaks peremptorily forbid a grouping with this genus.

The Triassic genus to which my specimens, as far as it is possible to judge from their inferior state of preservation, appear to be most closely allied, is *Astartopis* v. Woehrmann (Die Fauna der sogenannten Cardita und Raibler Schichten, Jahrb. K. K. Geol. Reichsanst., XXXIX, 1889, p. 222). The prototype of this genus, *Astartopis Richthofeni* Stur, differs considerably, however, from the Indian form. In the latter the apex is shifted far more forward, and the entire shell is longer than high, as in *Trigonodus*. From *Myophoriopsis* our species is distinguished by the absence of a distinct keel; and from *Pachycardia* by the straight direction of its posterior margin, and by the steep slope of the posterior area in both valves. None of my specimens is fit for illustration.

#### HEMINAJAS sp. ind. (cf. WOEHRMANNI Waag.) ?

A fragmentary cast of the apical portion of a left valve from the Shalshal cliff reminds me very strongly in its external characters of the group of *Myophoria fissidentata* Woehrm. (*Heminajas* Neumayr). From the apex, which is strongly incurved, a distinct keel-shaped elevation runs towards the posterior margin. The triangular areola between this elevation and the upper region of the posterior margin is comparatively broad, as in *Heminajas Woehrmanni* var. *Neumayri* L. Waagen (Die Lamellibranchiaten der Pachycardientuffe der Seiser Alpe, Abhandl. K. K. Geol. Reichsanst., XVIII, Heft 2, p. 44, Taf. XXIX, figs. 1, 14, XXX, fig. 5, XXVIII, fig. 13.)

L. Waagen, on the strength of a personal examination of my specimen, has confirmed its identification with the genus *Heminajas*.

## BRACHIOPODA.

### SPIRIGERA HUNICA Bittner. Pl. V, fig. 18.

1899. *Spirigera hunica* Bittner, Himálayan Fossils, Palæont. Indica, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 31, Pl. VI, figs. 8-13.  
 1900. *Spirigera hunica* A. v. Krafft, General Report, Geol. Surv. of India for 1899-1900, p. 210.  
 1908. *Spirigera hunica* Diener, Ladinic, carnic and noric faunæ of Spiti, Himálayan Foss., l. c., Vol. V, Pt. 3, p. 7, Pl. II, figs. 9, 10.

This species, which has been described from the horizon of *Daonella indica* in the Shalshal cliff by Bittner, and from the ladinic beds of Spiti by A. v. Krafft, is very largely represented in A. v. Krafft's collections from the Traumatocrinus limestone of the Shalshal cliff. One of the largest specimens, belonging to the typical form, has been illustrated.

Although, according to Bittner, the *Spirigera* nature of the species is proved incontestably by its external features, I have not succeeded in developing the spiral cones in the dorsal valve, the internal structure of the shells having been completely destroyed in all the specimens I was able to examine. I have consequently nothing to add to the exhaustive descriptions of the species given by Bittner.

### RETZIA sp. ind. aff. LADINA Bittner. Pl. V, fig. 21.

A single specimen the beak of which has been broken off, has the external characters of Triassic representatives of *Retzia*, but it is of course questionable whether any of them should be classed with this Palæozoic genus.

Indistinct traces of an area are only indicated in my specimen, on account of the fragmentary state of its apical region. The shell, so far as I am able to judge from the few remains of the shelly test adhering to the cast, was probably punctate.

Our Himálayan example belongs to those species of *Retzia* with numerous ribs, which originate in the Alpine Muschelkalk with *R. Mojsisovicsi* Boeckh and *R. speciosa* Bittn. and have their last representative in *R. modesta* Bittn. from the Dachsteinkalk. It especially resembles *R. ladina* Bittner (Brachiopoden der alpinen Trias, Abhandl. K. K. Geol. Reichsanst., XIV, p. 92, Taf. III, fig. 1) from St. Cassian very closely, although one of its most characteristic features, the small size of the beak, could not be ascertained. Its outlines are regularly rounded, and nearly circular. The two valves are equally vaulted. The hinge line of the dorsal valve is provided with very small ears which are not separated distinctly from the rest of the surface of the shell. The median rib of the dorsal valve is marked distinctly by being somewhat more

elevated than the lateral ribs, of which eight occur on either side. The frontal line is perfectly level.

The measurements of this specimen are as follow :—

Entire length of the shell	. . . . .	15 mm.
Length of the dorsal valve	. . . . .	13 „
Breadth of the shell	. . . . .	13 „
Thickness of both valves	. . . . .	8.5 „

As is obvious from the above measurements, our Himálayan specimen is of larger size than any of the congeneric species from the beds of St. Cassian.

*Locality. Number of specimens examined.*—Shalshal cliff, 1.

#### AULACOTHYRIS NILANGENSIS Bittner.

1899. *Aulacothyris nilangensis* Bittner, Himálayan Foss., Palæont. Indica, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 30, Pl. VI, figs. 3-7.

This species was described by A. Bittner from the bed with *Daonella indica* overlying the Traumatocrinus limestone in the section of the Shalshal cliff. A single specimen was also found in the Traumatocrinus limestone itself by A. v. Krafft. It is a little larger than the specimens from the bed with *Daonella indica* illustrated by Bittner. Its front line is not quite level but bent down very slightly.

#### RHYNCHONELLA RIMKINENSIS Bittner. Pl. V, fig. 2.

1899. *Rhynchonella rimkinensis*, Bittner, Himálayan Foss., l. c., Vol. III, Pt. 2, p. 33, Pl. VI, fig. 19.

1908. *Rh. cf. rimkinensis* Diener, ibidem, Vol. V, Pt. 3, Ladinic, carnic and noric faunæ of Spiti, p. 8, Pl. II, fig. 11.

This is the only species of Brachiopod from the Traumatocrinus limestone of the Shalshal cliff *s. s.*, which was known to Bittner. It is represented by three specimens from the same locality in A. v. Krafft's collection. One specimen, which has been figured in this memoir, is of unusually large size, and its frontal lobe is protracted considerably beyond the high, vertically flattened, lateral margins.

The measurements of this specimen are as follow :—

Entire length of the shell	. . . . .	16 mm.
„ breadth „ „	. . . . .	12 „
Length of the dorsal valve	. . . . .	14 „
Thickness of both valves	. . . . .	8.5 „

Bittner compares this species with *Rhynchonella intercurrens* Bittn. (Brachiopoden der Alpenen Trias, Abhandl. K. K. Geol. Reichsanst., XIV, p. 222, Pl. XII, figs. 10-12) from the Hallstatt limestone of Styria, but I do not think that there exists any close affinity between the two forms, the flattening of the lateral margins, the distinctly produced frontal lobe, and the presence of strong folds imparting a very characteristic shape to *Rhynchonella rimkinensis*. I should

rather prefer to assign it to the group of *Rh. trinodosi* Bittn., especially to a relationship with *Rh. subacuta* Muenst. from the beds of St. Cassian.

RHYNCHONELLA (AUSTRIELLA) sp. ind. ex aff. MIDDLEMISSII Bittn.

Pl. V, fig. 22.

This species, of a nearly smooth *Rhynchonella*, with a rather broad shape and slightly vaulted front margins, reminds me very strongly of *Rh. Middlemissii* Bittner (Himálayan Foss., l. c., Vol. III, Pt. 2, p. 68, Pl. VI, fig. 21). There are several fragmentary valves of large size before me, but only one complete specimen, consisting of both valves. Although the smallest among all of them, it is nearly twice as large as the type-specimen of *Rh. Middlemissii*, from the red crinoid limestone (lower Muschelkalk) of the Middlemiss crag near Chitichun No. I.

The chief difference between the two species consists in the more equivalve character of the present form, the ventral and dorsal valves being almost equally inflated. The frontal tongue is wide, but very short, and not plicated. A comparatively strong bend or plication marks the line of junction between this frontal tongue and the adjoining lateral regions. To these regions belong two or three very small and short folds. The rest of the shell is smooth and unornamented. The beak of the ventral valve has, unfortunately, not been completely preserved in any of my specimens, but so far as we may judge from the fragments, it agrees with the beak of *Rhynchonella*.

The shelly test is coarsely fibrous, not punctate. The umbonal region of the dorsal valve is divided by a short median septum.

The dorsal valve does not show the presence of distinctly developed ears on both sides of the apex, as has been observed in *Rhynch. Middlemissii* by Bittner. Nevertheless traces of such minute ears are indicated along the line of junction, in which the umbonal parts of the two valves meet. There are several species of the subgenus *Austriella* (group of *Rhynchonella dilatata* Suess) known to me, in which these ears are not more conspicuously developed.

#### Dimensions.

Entire length of the shell	. . . . .	cca.	18 mm.
„ breadth „ „	. . . . .		19 „
Length of the dorsal valve	. . . . .		17 „
Thickness of both valves	. . . . .		9.5 „

In one of my largest fragments, of a ventral valve, a length of 28 mm. corresponds to a width of 32 mm.

*Locality.* Number of specimens examined.—Shalshal cliff, 1 complete specimen and four fragmentary valves.

*Remarks.*—The presence of *Austriella*, one of the most characteristic groups of *Rhynchonella* from the Alpine Hallstatt limestone, in the Traumatocrinus

limestone of Painkhanda agrees with the rich development of *Arcestidae* in this rock group. Whereas *Arcestes*, *Joannites*, and *Lobites* are comparatively rare in the ladinic and carnic beds of Spiti, they are represented here by numerous specimens and individuals. This is another instance of the striking dependence of the distribution of the species of *Austriella* upon the facies of the deposits enclosing them.

RHYNCHONELLA (NORELLA) KINGI VAR. TIBETICA Bittner. Pl. V, fig. 19.

1899. *Rhynchonella (Norella) tibetica* Bittner, Himálayan Foss., Palæont. Indic, ser. XV, Vol. III, Pt. 2, p. 32, Pl. VI, figs. 2, 17, 18.

As Bittner himself has stated, *Rhynchonella tibetica* is only a smooth variety of *Rh. Kingi* Bittner (l. c. p. 32, Pl. VI, figs. 14-16), and does not deserve the rank of a proper species. The only specimen by which the species is represented in A. v. Krafft's collection, differs by its large dimensions from Bittner's types, from the horizon of *Daonella indica* at the upper boundary of the Traumatocrinus limestone. Its measurements are as follow:—

Entire length of the shell	. . . . .	21 mm.
„ breadth „ „	. . . . .	25 „
Length of the dorsal valve	. . . . .	20 „
Thickness of both valves	. . . . .	11 „

The small and sharp beak, with its lateral margins slightly hollowed out, and the deep median depression of the dorsal valve, characterises the species as a typical representative of the group of the subgenus *Norella*. The frontal region is perfectly smooth, not plicated.

*Locality. Number of specimens examined.*—Shalshal cliff, 1.

## CRINOIDEA.

### TRAUMATOCRINUS sp. ind.

Several fragments of stems were collected by A. v. Krafft, both from the Shalshal and Bambanag cliffs, agreeing closely with the types illustrated by K. v. Dittmar (Geognost. palæont. Beiträge von Benecke, Urban und Schloenbach I, Taf. XX, figs. 1, 2) and S. v. Woehrmann (Die Fauna der sogenannten Cardita und Raibler Schichten, Jahrb. K. K. Geol. Reichsanst., XXXIX, 1889, p. 190, Taf. V, fig. 7), but none of them is preserved more satisfactorily than the specimen from the *Daonella* limestone of Kágá (Spiti), illustrated on Pl. II, fig. 13, of my memoir on the ladinic, carnic and noric faunæ of Spiti (Himálayan Foss., Vol. V, Pt. 3).

## SUMMARY.

The fauna of the Traumatocrinus limestone of Painkhanda, which succeeds the ladinic stage in the sections of the Bambanag and Shalshal cliffs, consists of the following forms:—

## CEPHALOPODA.

1. *Proclydonautibus* cf. *buddhaicus* Dien.
2. *Grypoceras rimkinense* nov. sp.
3. „ sp. ind. aff. *rimkinensi*.
4. „ *Stirlingii* nov. sp.
5. *Joannites cymbiformis* Wulf.
6. „ *Klipsteini* v. Mojs.
7. „ *Kossmati* Dien.
8. „ *Mojsvári* nov. sp.
9. *Proarcestes* cf. *Ausseanus* v. Hauer.
10. „ sp. ind.
11. *Lobites* (*Coroceras*) cf. *delphinocephalus* v. Hauer.
12. „ „ *valdecucullatus* nov. sp.
13. *Monophyllites* cf. *Simonyi* v. Hauer.
14. „ (*Mojsvarites*) *Agenor* Muenst.
15. *Juvavites* (*Anatomites*) sp. ind.
16. *Isulites* cf. *Heimi* v. Mojs.
17. „ sp. ind.
18. *Celtites contractifrons* nov. sp.
19. *Carnites* cf. *floridus* Wulf.
20. *Placites* cf. *polyductylus* var. *Oldhami* v. Mojs.
21. *Rimkinites nitiensis* v. Mojs.
22. „ *Edmondii* Dien.
23. *Arpadites rimkinensis* v. Mojs.
24. „ (*Dittmarites*) cf. *circumscissus* v. Mojs.
25. „ „ sp. ind. aff. *Ladon* v. Dittm.
26. *Clionites* nov. sp. ind. aff. *Doræ* v. Mojs.
27. *Trachyceras austriacum* v. Mojs.
28. *Protrachyceras* sp. ind. aff. *Arion* v. Mojs.
29. „ sp. ind. (group of *furcosa*).
30. *Sirenites Cookei* nov. sp.
31. *Girthiceras* nov. gen. *pernodosum* nov. sp.

## LAMELLIBRANCHIATA.

32. *Daonella indica* Bittn.
33. „ sp. ind. aff. *obliqua* v. Mojs.
34. *Avicula* sp. ind. (?) cf. *Seisiana* Broili.
35. *Pecten* nov. sp. aff. *subalternans* d'Orb.
36. *Astartopis* sp. ind. (?)
37. *Heminajas* sp. ind. (cf. *Woehrmanni* Waag.?)

## BRACHIOPODA.

38. *Spirigera lunica* Bittn.  
 39. *Retzia* sp. ind. aff. *ladina* Bittn.  
 40. *Aulacothyris nilangensis* Bittn.  
 41. *Rhynchonella rimkincensis* Bittn.  
 42. „ (*Austriella*) sp. ind. aff. *Middlemissii* Bittn.  
 43. „ (*Norella*) *Kingi* var. *tibetica* Bittn.

## CRINOIDEA.

44. *Traumatocrinus* sp. ind.

In 1897 only six species of Cephalopoda were known to E. v. Mojsisovics,<sup>1</sup> who assigned to the fauna of the *Traumatocrinus* limestone a carnic age, correlating it with the zone of *Trachyceras Aonoides* (julic substage).

There was good reason for A. v. Krafft in 1900 to consider these faunal guides as not sufficient for a more exact determination of the age, but the rich fauna described in the present memoir shows the typical carnic habit so indubitably and strikingly, that it seems to me almost superfluous to discuss further its homotaxis with the carnic stage and, more especially, with the julic substage. This homotaxis is not obscured even by local peculiarities of the fauna, the number of ammonites identical with, or very closely allied to, European species being comparatively large.

As such species the following may be mentioned :—

- Joannites cymbiformis* Wulf.  
 „ *Klipsteini* v. Mojs.  
*Proarcestes* cf. *Ausseanus* v. Hauer.  
*Lobites* (*Coroceras*) cf. *delphinocephalus* v. Hauer.  
*Monophyllites* cf. *Simonyi* v. Hauer.  
 „ (*Mojsvarites*) *Agenor* Muenst.  
*Isulites* cf. *Heimi* v. Mojs.  
*Carnites* cf. *floridus* Wulf.  
*Placites* cf. *polydactylus* var. *Oldhami* v. Mojs.  
*Arpadites* (*Dittmarites*) cf. *circumscissus* v. Mojs.  
*Trachyceras Austriacum* v. Mojs.

This assemblage of species is characteristic of the julic substage (zone of *Trachyceras Aonoides*), although some of them are common to the cordevolic and julic substages and one (*Mojsvarites Agenor*) ranges throughout the entire carnic stage, from the zone of *Trachyceras Aon* into the zone of *Tropites subbul-*

<sup>1</sup> The specimens from the dark grey limestone of the Ralphu glacier, designated as the horizon of *Ammonites Aon* by Griesbach, have not been kept separate from the fauna of the *Traumatocrinus* limestone by E. v. Mojsisovics.



*latus*. The presence of *Clionites* nov. sp. ind. aff. *Doræ*, of *Anatomites* sp. ind., and of *Sirenites Cookei*, are also arguments in favour of a Julic age of this fauna, neither *Clionites*, *Anatomites*, nor *Sirenites* making their appearance in the Mediterranean region before the commencement of the Julic epoch.

On the other hand the Traumatocrinus limestone is wanting in such faunistic elements as according to our present knowledge, are confined to the cordevolic substage and of which they are characteristic. There are a few species which have their habitat in the Ladinic beds of the Himálayas (*Joannites Kossmati*, *Arpadites rimkinensis*, *Rimkinites nitiensis*, *R. Edmondii*), but they are of no stratigraphical importance in comparison with the large number of identical species speaking in favour of a Julic age. Their wide vertical distribution makes them unfit for a separation of stratigraphical horizons which are narrowly limited.

The European affinities are very strongly marked in the Cephalopod fauna of the Traumatocrinus limestone. Among the elements, imparting to this fauna its Indian stamp, the two genera *Rimkinites* and *Girthisceras* only are worthy of mention. The Lamellibranchiata also are nearly allied to Alpine forms, especially to such species as are found in the Pachycardia beds of the Seiser Alpe, occupying an intermediate position between the cordevolic and Julic substages.<sup>1</sup>

The reasons which have induced me to correlate the Traumatocrinus limestone provisionally with the upper division of the Daonella limestone of Spiti are no longer valid. The fauna of the Grey beds, occurring from 100 to 150 feet above the Daonella limestone, is a true equivalent, both of the fauna of the Traumatocrinus limestone, and of the zone of *Halobia comata* in Painkhanda.

Thus the stratigraphical distribution of *Daonella indica* Bittn. is still wider than had been anticipated, this species ranging throughout the entire Ladinic into the middle Carnic stage.

<sup>1</sup> In his memoir "Geologische Beiträge aus Suedtirol" (Neues Jahrb. f. Min. etc. 1903, II, p. 12) E. Koken strongly insists on a direct correlation of the Pachycardia and Raibl beds.

## EXPLANATION OF PLATES.

### PLATE I.

Fig.	1 <i>a, b</i>	PROCLYDONAUTILUS CF. BUDDHAICUS Dien. ; Bambanag Cliff.
„	2 <i>a, b</i>	GRYOCERAS STIRLINGI Dien. ; Shalshal Cliff.
„	3	ANATOMITES SP. IND. ; Shalshal Cliff.
„	4 <i>a, b</i>	} ARPADITES SP. IND. (DITTMARITES) AFF. LADON Mojs. ; Shalshal Cliff.
„	5 <i>a, b, c</i>	
„	6 <i>a, b, c, d</i>	GIRTHICERAS <i>nov. gen.</i> PERNODOSUM Dien. ; Bambanag Cliff.

Fauna of the Traumatocrinus limestone.

Geol. Surv. of India.

Pl. I.

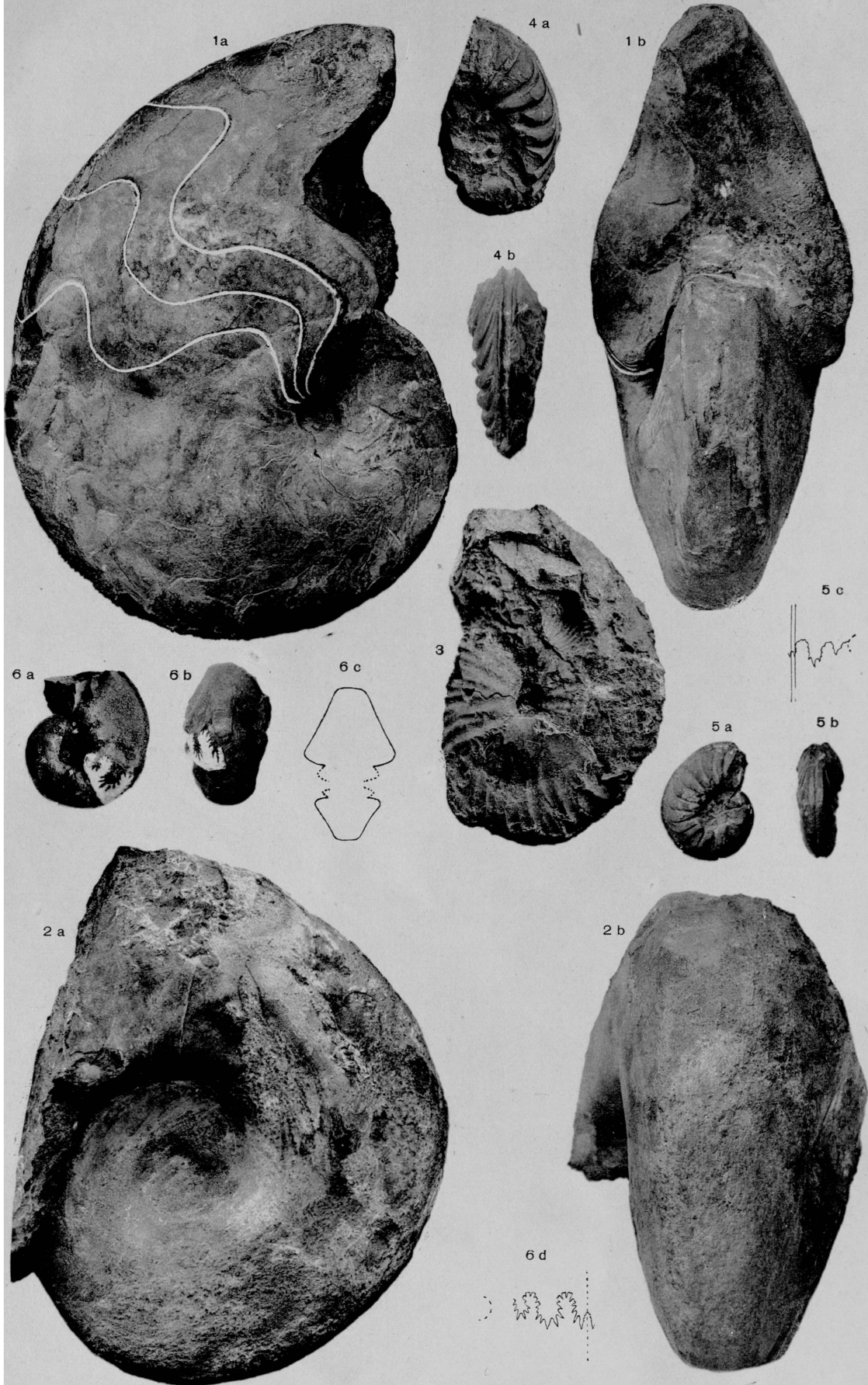


PLATE II.

- |      |               |   |
|------|---------------|---|
| Fig. | 1 <i>a, b</i> | JOANNITES KLIPSTEINI Mojs. ; Bambanag Cliff.                |
| „    | 2 <i>a b</i>  | JOANNITES CYMBIFORMIS Wulf. ; Shalshal Cliff.               |
| „    | 3 <i>a, b</i> | JOANNITES KOSSMATI Dien. ; Shalshal Cliff.                  |
| „    | 4 <i>a, b</i> | GRYPOCERAS RIMKINENSE Dien. ; Shalshal Cliff.               |
| „    | 5 <i>a, b</i> | GRYPOCERAS SP. IND. AFF. RIMKINENSI Dien. ; Shalshal Cliff. |

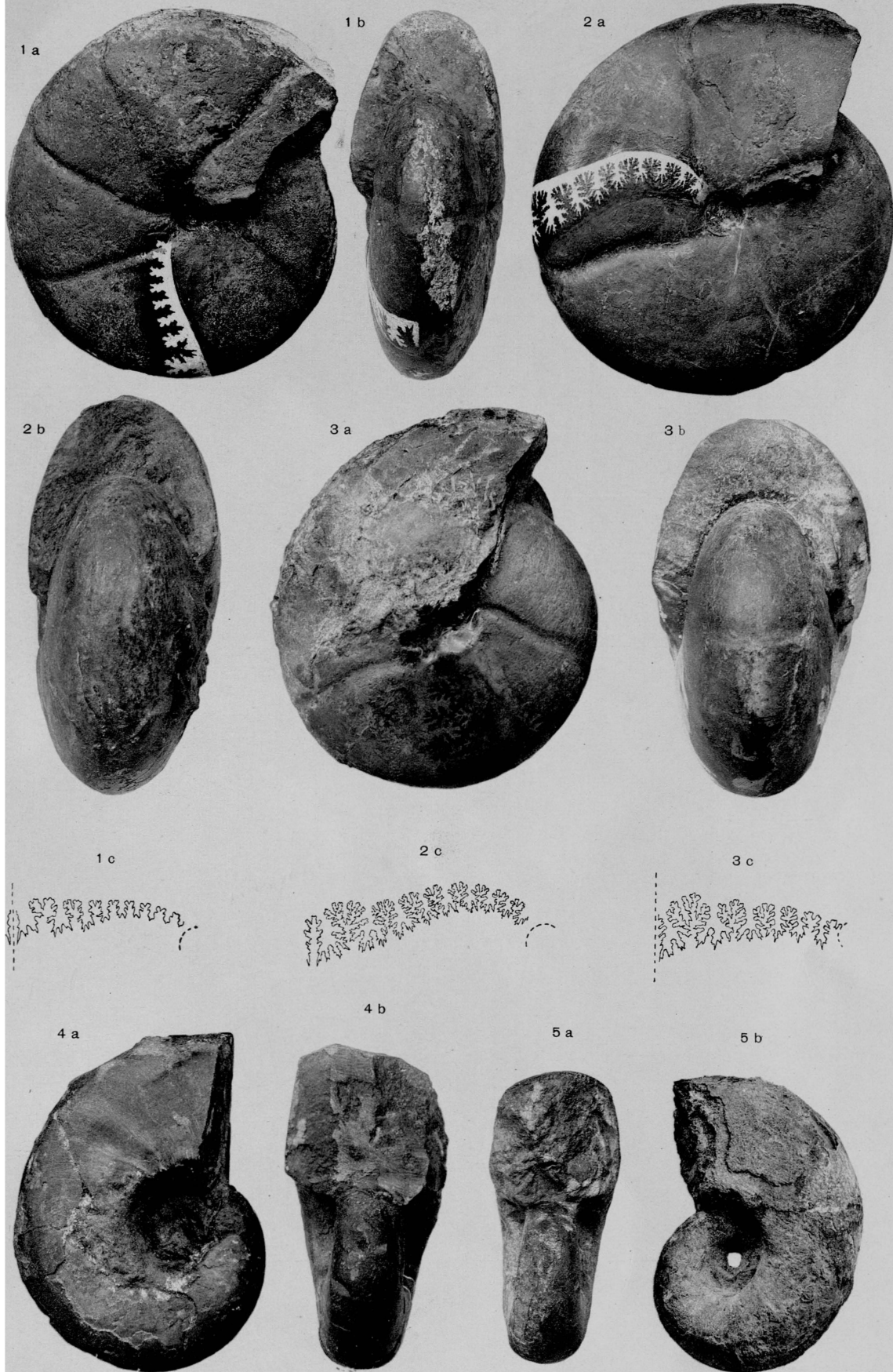


PLATE III.

- |      |                  |   |
|------|------------------|---|
| Fig. | 1 <i>a, b, c</i> | JOANNITES MOJSVARI Dien. ; Shalshal Cliff.        |
| „    | 2 <i>a, b</i>    | PROARCESTES CF. AUSSEANUS Hauer ; Shalshal Cliff. |
| „    | 3 <i>a, b</i>    | JOANNITES CYMBIFORMIS Wulf. ; Shalshal Cliff.     |

Fauna of the Traumatocrinus limestone.

Geol. Surv. of India.

Pl. III.

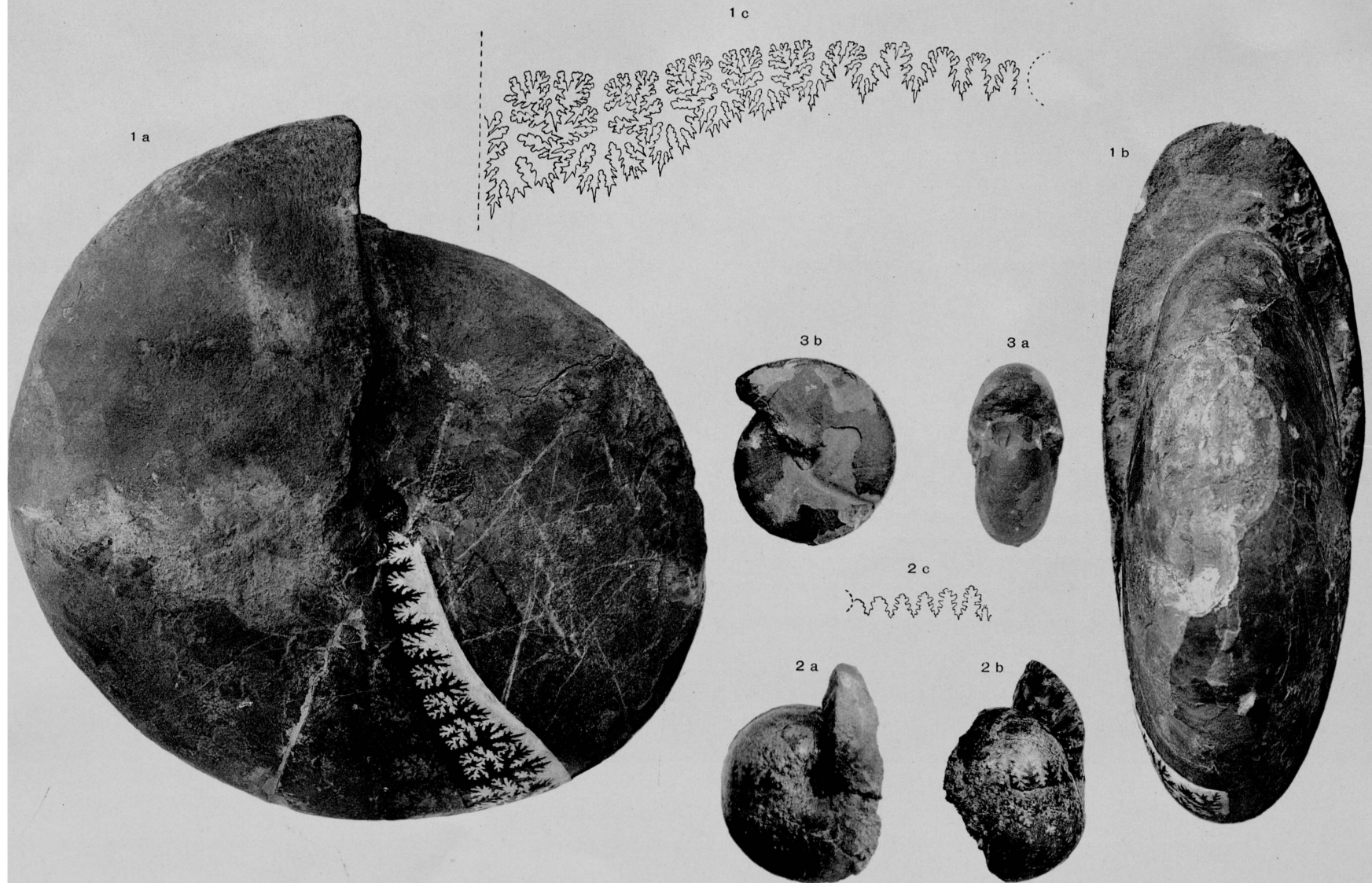


PLATE IV.

Fig. 1	JOANNITES CYMBIFORMIS Wulf.
„ 2a, b, c	MONOPHYLLITES (MOJSVARITES) AGENOR Muenst.
„ 3a, b, c	MONOPHYLLITES CF. SIMONYI Hauer.
„ 4a, b	PLACITES CF. POLYDACTYLUS VAR. OLEHAMI Mojs.
„ 5	CARNITES CF. FLORIDUS Wulf.



Fauna of the Traumatocrinus limestone.

Geol. Surv. of India.

Pl. IV.

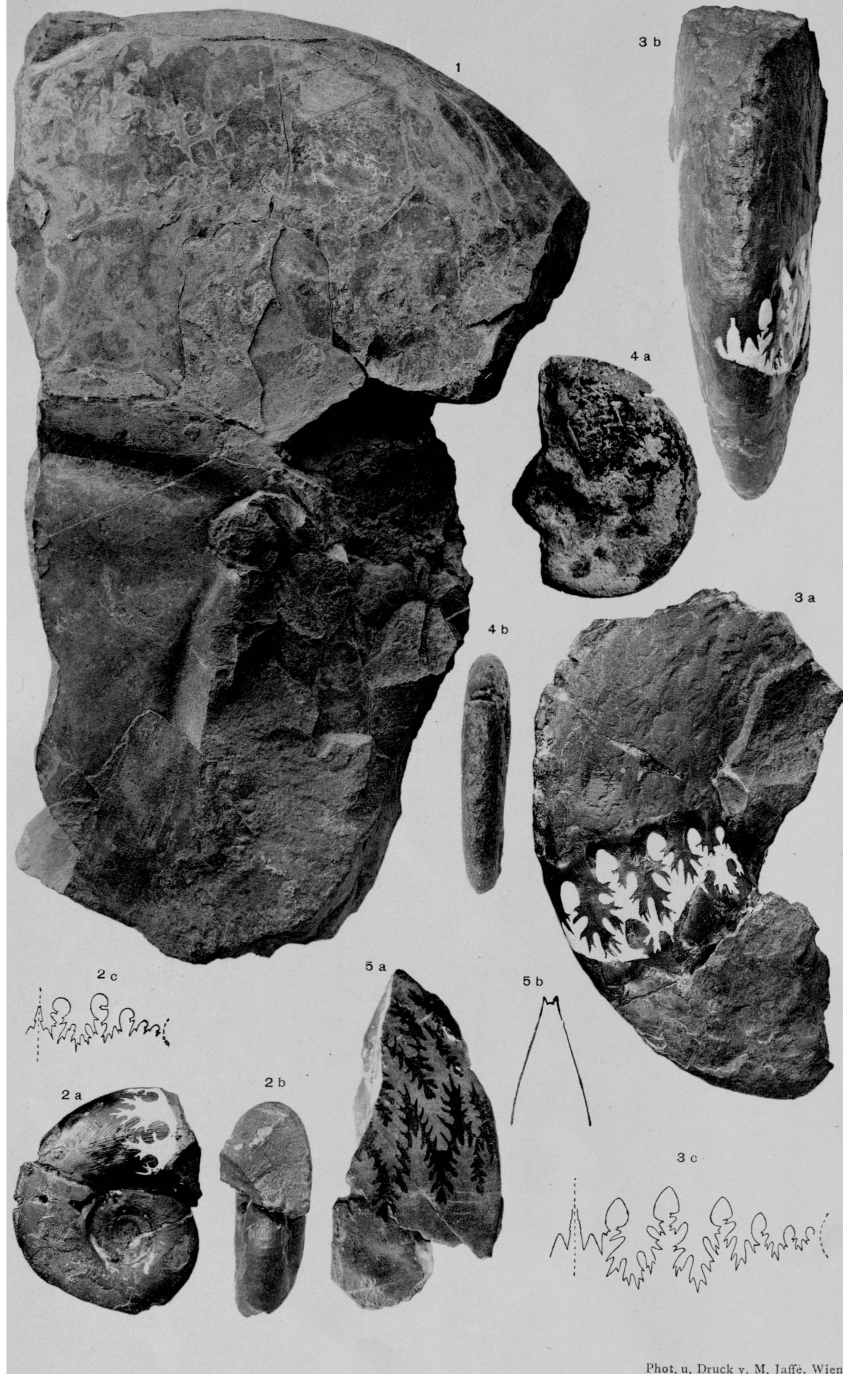


PLATE V.

Fig. 1a, b	ISCULITES SP. IND.
„ 2a, b	} COROCERAS VALDECUCULLATUM Dien.
„ 3	
„ 4a, b	COROCERAS CF. DELPHINOCEPHALUS Hauer.
„ 5a, b, c	ISCULITES CF. HEIMI Mojs.
„ 6a, b	} CELTITES CONTRACTIFRONS Dien.
„ 7a, b, c	
„ 8a, b, c	} TRACHY CERAS AUSTRIACUM Mojs.
„ 9a, b	
„ 10a, b	PROTRACHY CERAS SP. IND. AFF. ARION Mojs.
„ 11a, b	SIRENITES COOKEI Dien.
„ 12a, b	SIRENITES SP. IND. EX. AFF. DORAE Mojs.
„ 13a, b	ARADITES (DITTMARITES) CF. CIRCUMSCISSUS Mojs.
„ 14a, b, c	PROTRACHY CERAS SP. IND. (group of FURCOSA).
„ 15	DAONELLA SP. IND. AFF. OBLIQUA Mojs.
„ 16	PECTEN SP. IND. AFF. SUBALTERNANS d'Orb.
„ 17	AVICULA SP. IND. CF. SEISIANA Broili.
„ 18a, b, c, d	SPIRIGERA HUNICA Bittn.
„ 19a, b, c, d	RHYNCHONELLA (NOBELLA) TIBETICA Bittn.
„ 20a, b, c, d	RHYNCHONELLA RIMKINENSIS Bittn.
„ 21a, b, c, d	RETZIA SP. IND. AFF. LADINA Bittn.
„ 22a, b, c, d	RHYNCHONELLA (AUSTRIELLA) SP. IND. AFF. MIDDLEMISSII Bittn.

The specimen illustrated in fig. 10 from the Bambanag Cliff. All the rest from the Shalshal Cliff.

Fauna of the Traumatocrinus limestone.

Geol. Surv. of India.

Pl. V.

