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JURASSIC FAUNA OF KUTCH.

Vol. I.

The CEPHALOPODA, by WILLIAM WAAGEN, Ph. D.,
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INDEX.

	Page.	N	Page.		Page.
A				P	
AMALTHEUS pustulatus ...	40	NAUTILUS Calloviensis ...	18	PERISPHINCTES leiocymon ...	205
" Schaumburgi ...	41	" intumescens ...	20	" Martelli ...	190
AMMONITES Deshayesi ...	246	" Jumarensis ...	21	" mutans ...	151
" Martini ...	245	" Kamagunensis ...	19	" obliqueplicatus ...	187
ANCYLOCERAS calloviense ...	212	" Kutchensis ...	20	" obtusicauda ...	146
ASPIDOCERAS Babeanum ...	96	" Wandaensis ...	17	" occultefurcatus ...	195
" binodiferum ...	105			" omphalodes ...	150
" diversiforme ...	90	O		" Orion ...	161
" iphiceroideus ...	102	OPPELIA (Aptychus of Oppelia) ...	59	" pagri ...	181
" monacanthum ...	100	" bicostata ...	52	" paramorphus ...	163
" perarmatum ...	91	" cf. glabella ...	49	" perdagatus ...	158
" ponderosum ...	94	" cf. serrigera ...	57	" plicatilis ...	189
" sparsispinum ...	98	" fornix ...	50	" Pottingeri ...	183
" spec. indet. ...	101	" Kachbensis ...	55	" praecursor ...	178
" spec. indet. ...	106	" Nurrhaensis ...	51	" Pseudorion ...	160
" subdistractum ...	99	" orientalis ...	58	" Recuperio ...	172
" tenuispinatum ...	93	" plana ..	56	" Rehmanni ...	206
" Wynnei ...	103	" plicodiscus ...	56	" rota ...	186
B		" subcostaria ...	48	" sparsiplicatus ...	204
BELEMNITES calloviensis ...	14	" trachynota ...	54	" spirorbis ...	154
" claviger ...	6			" subcolubrinus ...	180
" cf. hastatus ...	11	P		" subevolutus ...	179
" fusticulus ...	9	PELTOCERAS agoceroideus .	78	" subtilis ...	170
" Gerardi ...	13	" Arduennense ...	79	" torquatus ...	191
" Jumarensis ...	12	" athleta ...	81	" virguloides ...	203
" Katrolensis ...	7	" bidens ...	85	PHYLLOCERAS Benacense ...	33
" Kuntkotensis ...	1	" propinquum ..	79	" cf. kunthi ...	25
" Oldhamianus ..	15	" semirugosum ...	83	" disputabile ...	31
" orientalis ...	5	PERISPHINCTES aberrans...	175	" Feddeni ...	27
" Sauvanausius ...	8	" alterneplicatus ...	199	" insulare ...	29
" spec. indet. ...	6	" altiplicatus ...	156	" jaraense ...	28
" Stoliczkanus ...	10	" anceps ...	207	" Lodaense ...	32
" subhastatus ...	14	" angygaster ...	148	" mediterraneum ..	34
C		" arcicosta ...	167	" ptychoicum ...	30
CRIOCERAS Australe ...	246	" arthriticus ...	210	" vicarium ...	26
H		" Balinensis ...	163	S	
HAPLOCERAS cf. tomeophorum ...	43	" bathyplocus ...	192	STEPHANOCERAS arenosum ...	121
" deplanatum ...	44	" Bleicheri... ..	194	" bullatum ...	129
" propinquum ..	45	" calvus ...	166	" chariense ...	126
HARPOCERAS crassefalcatum ...	70	" chloroolithicus ...	198	" chrysolithicum ...	127
" Dynastes ...	66	" cobra ...	174	" diadematum ...	130
" hecticum ...	61	" cf. funatus ...	155	" dimerum ...	132
" ignobile ...	69	" cf. suprajurensis ...	193	" elephantinum ...	124
" Kobelli ...	72	" congener ...	171	" eucyclum ...	142
" Lairensen ...	65	" curvicosta ...	169	" fissum ...	134
" lunula ...	63	" decorus ...	208	" Grantanum ...	123
" punctatum ...	62	" denseplicatus ...	201	" lamellosum ...	122
" Rauracium ...	68	" Dhosaensis ...	149	" macrocephalum ...	109
" trilineatum ...	71	" eudichotomus ...	197	" magnumbilicatum ..	133
L		" euplocus ...	182	" maya ...	113
LYTOCERAS Adeloides ...	37	" frequens r. ...	200	" Nepalense ,	136
" rex. ...	36	" Gudjinsiensis ...	176	" opis ...	140
		" hians ...	153	" Polyphemus ...	116
		" Indogermanus ...	185	" semilave ...	119
		" Jooraensis ...	211	" subcompressum ...	139
		" Katrolensis ...	184	" subtrapezinum ...	138
		" lateralis ...	165	" subtumidum ...	118
				" transiens ...	111
				" tumidum ...	115

PRELIMINARY NOTICE.

THE first part of the figures and descriptions of the Cephalopod fauna of the Jurassic rocks of Kutch, is published herewith, including all the known *Belemnitidæ* and *Nautilidæ*. We most deeply regret that the illness of the author Dr. Waagen, which has compelled his temporary return to Europe, will prevent the continuous issue of the succeeding fasciculi. The greater portion of the manuscript is complete, and a large number of plates have also been prepared. Of these plates the entire series will occupy nearly sixty, from which fact the value of the collection may be roughly estimated. But independently of the number and variety of the species met with, these will have a special interest from their geological relations, and there is little difficulty in anticipating that the present, when complete, will be one of the most important contributions to the Cephalopod palæontology of the Upper Jurassic formations (*Callovien* to *Tithonien*) ever issued.

I sincerely hope that a few months may restore Dr. Waagen to good health, and also enable him to complete this great work, which he has commenced with such zeal and power.

CALCUTTA ; }
March 1873. }

T. OLDHAM,
Supdt., Geol. Survey of India.

INTRODUCTION.

The general considerations resulting from the study of the Jurassic Cephalopoda of Kutch, (or Kach'h), and the important bearing which they have upon more generally interesting questions in Geology and Palæontology, will be treated of at the end of this Monograph. For our present purpose it will be sufficient to say a few words relating to certain stratigraphical terms used in the following pages.

The composition of the Jurassic formation of Kutch is by no means so uniform as, until very lately, it appeared to be; for Dr. Stoliczka, on his recent visit to Kutch, was able to distinguish several divisions or groups based as well upon the palæontological, as upon the physical and geological relations of the rocks. Those divisions, however, as was to be expected, do not exactly correspond in their stratigraphical relations with the groups distinguished in European-Jurassic countries, and I have, therefore, drawn up the following general table in order to show these general relations of the Kutch, with the corresponding divisions of the European-Jurassic series, and thus to lead to a right understanding of the meaning and value of the terms used. For further details I must refer to Dr. Stoliczka's detailed paper on the subject, which will shortly appear in the Memoirs of the Geological Survey of India.

KUTCH.		EUROPE.	
GROUPS.	BEDS.	ZONES.	GROUPS.
	Beds with <i>Ancyloceras</i> and <i>Ammonites</i> of the <i>Rhotomagensis</i> group.		CRETACEOUS.
OOMIA GROUP ...	Sandstones and shales, etc., with <i>Palæozamia</i> and other plants.	?	TITHON. GROUP.
	Sandstones and conglomerates with marine fossils. <i>Perisph. transitorius</i> , <i>frequens</i> ; <i>Trigonia</i> , etc.	Upper Tithon. Lower Tithon.	
KATROL GROUP ...	Sandstone and shales with <i>Phylloc. ptychoicum</i> , <i>Oppelia trachynota</i> , <i>Perisph. torquatus</i> , <i>Poittingeri</i> , etc.	Zone of <i>Perisph. mutabilis</i> . Zone of <i>Oppelia tenuilobata</i> .	KIMMERIDGE GROUP.
	Red ferruginous and yellow sandstones (Kuntkote Sandstone)* with <i>Steph. Maya</i> , <i>Pelt. perarmatum</i> , <i>Perisph. virguloides</i> , <i>leucymon</i> .	? Zone of <i>Pelt. bimammatum</i> . ? Zone of <i>Pelt. transversarium</i> .	
CHABER GROUP ...	Oolites (Dhosa Oolite) with <i>Steph. polyphemus</i> , <i>Perisph. Indo-germanus</i> , <i>Pelt. perarmatum</i> , <i>Arduennense</i> , <i>Babeanum</i> , etc.	Zone of <i>Amalth. cordatus</i> Zone of <i>Amalth. Lamberti</i> .	OXFORD GROUP.
	White limestones with <i>Pelt. athleta</i> , <i>Oppelia bicostata</i> , etc.	Zone of <i>Pelt. athleta</i> .	
	Shales with ferruginous nodules, with <i>Perisph. obtusicausta</i> , <i>anceps</i> , <i>Harp. lunula</i> , <i>punctatum</i> , etc.	Zone of <i>Perisph. anceps</i> .	KELLOWAY GROUP.
	Shales with calcareous banks and locally with golden (olite with <i>Steph. macrocephalum</i> , <i>tumidum</i> , <i>tullatum</i> , <i>Oppelia subcostaria</i> , <i>Perisph. funatus</i> , <i>patina</i> , etc.	Zone of <i>Stephanoc. macrocephalum</i> .	
PUTCHUM GROUP ...	Light grey limestones and marls with <i>Oppelia serrigera</i> , Corals and Brachio-pods, etc.		BATH GROUP.
	Yellow sandstones and limestones with <i>Trigonia</i> , <i>Corbula</i> , <i>Cucullea</i> , etc.		

* The position of this sandstone is not thoroughly ascertained, as it is apparently entirely wanting in western Kutch. From palæontological reasons I assigned to it the above place, because it has the following species in common with the Dhosa Oolite: *Steph. Maya*, *opsis*, *flavum*, *Peltoc. perarmatum*. The group of Kuntkote sandstones certainly includes the highest beds in which species of the genus *Stephanoceras* occur in Kutch.

were not yet known to occur also in Jurassic layers, I have been obliged to make several additions to it in arranging the Kutch Belemnites, and thus I propose for the latter the following divisions :

GASTROCÆLI.

Section I.—CANALICULATI.

(a.) Group of BELEMNITES CANALICULATUS, Schloth.

- (1.) Belemnites Kantkotensis, *Waagen*, n. sp.
- (2.) „ orientalis, *Waagen*, n. sp.

(b.) Group of BELEMNITES BLAINVILLEI, Orb.

- (1.) Belemnites, sp. indet.

Section II.—HASTATI.

(a.) Group of BEL. PISTILLIFORMIS, Blainv.

- (1.) Belemnites claviger, *Waagen*, n. sp.

(b.) Group of BEL. DUVALIANUS, Orb.

- (1.) Belemnites Katrolensis, *Waagen*, n. sp.
- (2.) „ Sauvanaus, *Orb.*

(c.) Group of BELEMNITES HASTATUS, Blainv.

- (1.) Belemnites fusticulus, *Waagen*, n. sp.
- (2.) „ Stoliczkanus, *Waagen*, n. sp.
- (3.) „ cf. hastatus, *Blainv.*
- (4.) „ Jumarensis, *Waagen*, n. sp.

(d.) Group of BELEMNITES FUSIFORMIS, Parkinson.

- (1.) Belemnites Gerardi, *Oppel.*
- (2.) „ Calloviensis, *Oppel.*
- (3.) „ subhastatus, *Ziet.*

NOTOCÆLI.

Section I.—CONOPHORI.

(a.) Group of BELEMNITES CONOPHORUS, Opp.

- 1. BELEMNITES OLDHAMIANUS, *Waagen*, n. sp.

We have, thus, from Kutch 14 species of Belemnites, most of which belong to the *GASTROCÆLI*, whilst the *NOTOCÆLI* are represented but by a single species. However, the occurrence of this is very remarkable, because in Europe the *NOTOCÆLI* are as yet known only from Tithonian and lower Cretaceous beds, while *Bel. Oldhamianus* is found in the upper Callovien, a little below *Pelt. athleta*;

an exception nevertheless, which is not so very uncommon in far distant geographical regions of one and the same geological period. The *GASTROCÆLI* have furnished 13 species, of which one is specifically undeterminable; the others are mostly new, but they do not exhibit anything very remarkable, except *Bel. claviger*, Waagen, which closely resembles certain well known cretaceous forms. Of greater interest are the species identical with European ones. They are—

Belemnites Sauvanausus, Orb.

„ cf. *hastatus*, Blainv.

„ *Calloviensis*, Opp.

„ *subhastatus*, Ziet.

The first of these occurs in Kutch in the society of *Pelt. perarmatum* in the uppermost beds of the Charee group; and this fact is of high importance, because it is exactly the position in which the species is also found in Europe. The second species occurs pretty closely on or about the same horizon both in Europe and in Kutch; and although I have not been able to satisfy myself thoroughly of the identity of the species, little doubt exists on that point.

Bel. Calloviensis, Opp., is found in Kutch in beds immediately overlying the Macrocephalus beds, and in Europe it has a similar bathological position. The same applies to *Bel. subhastatus*, Ziet., which is characteristic for the beds with *Steph. macrocephalum* both in Kutch and in Europe.

Thus the jurassic Belemnites of Kutch, generally, confirm the law of succession of different forms as known in the European jurassic strata of corresponding age.

GASTROCÆLI.

Section I.—CANALICULATI.

(a.) Group of *BEL. CANALICULATUS*, Schloth.

1. *BELEMNITES KUNKOTENSIS*, Waagen, n. sp., Plate I, Fig. 3, a—f.

This species is one of the most common Belemnites in the Kutch territory. Some excellent specimens were collected by Dr. Stoliczka at Kuntkote, and they principally serve as types for the description.

The shape of the guard is long, conical, or cylindrical, a little compressed from both sides in the upper or alveolar region. Lower down in the post-alveolar part this compression is not always well marked, and the transverse section of the guard here is more rounded or evenly depressed; but this latter case is very rare. The ventral side is provided with a long deep canal, which begins at the alveolar margin and reaches very nearly to the apex, here gradually becoming shallower and at last disappearing. The canal is deepest on the alveolar part of the guard; it is there narrow with rather sharp edges, as if

it were cut in with a knife. As soon as the canal reaches the post-alveolar part, it becomes shallower and broader, being broadest about the middle of this part. In this character the Belemnite somewhat resembles certain species of the Russian Jura. The sides of the guard are smooth without any impressions; the back is rounded, with a very slight groove-like elongated impression in the alveolar region, stretching down from the alveolar margin about as far as the phragmocone inside the guard.

The phragmocone is rather long, acute, forming an angle of 22 degrees. It begins at its lower end with a roundish embryonal bulb, and is divided into very numerous air-chambers, which are about one-sixth of the diameter distant from each other. The septa are not quite level, but very slightly depressed at the siphonal side and a little elevated at the back. The siphon is very narrow, quite marginal, and in its position corresponds with the canal outside the guard.

The axis is a little eccentric, lying a little more towards the ventral side.

Very young specimens are somewhat hastate in shape, being slightly reduced in thickness just below the alveolar region, but this shape is lost again already at an early stage of growth.

The measurements are—

The total length of the described specimen	...	...	...	...	112 mm.
The length of the axis	...	...	...	...	78 "
Diameter at apex of phragmocone from front to back				...	12 "
" " " from side to side				...	11 "

Remarks.—The examples which I have examined are very numerous, though only few entire specimens are among them; but even fragments are characteristic enough to be recognised as belonging to the present species. The localities at which the species occurs are:—Kuntkote, (about 20 specimens), out of a ferruginous sandy rock, together with *Steph. Maya* and other Ammonite-species of upper Oxfordian type; Gangta Bét, an island in the Run (about 15 specimens), out of a yellowish grey coarse sandstone, together with some of the same Ammonites as at Kuntkote; east of Lair, north base of Katrol range (5 specimens), out of the coarse iron-stained sandstone, with *Perisph. torquatus*, *Pottingeri*, and *Katrolensis*; village of Joorun (about 20 specimens), out of sandy concretionary layers at the base of the Katrol group; Lodai (2 specimens), out of yellowish sandstone of the same horizon; south of Bhooj (1 specimen), out of a coarse yellowish sandstone of the same horizon; south of Koora (about 10 specimens), out of shales, base of the Oomia group. Thus, the species ranges through the two upper divisions of the Kutch Jurassic formation, the Katrol and the Oomia groups, or, in other words, from the upper Oxford to about Lower Tithonian beds.

Belemn. Kuntkotensis has its nearest relation in *Bel. Aucklandicus*, Hauer.* The differences are slight, but sufficient to distinguish the species; they consist chiefly in *Bel. Aucklandicus*, being more cuneiform in its shape and having a broader

* Reise der österreich. Fregatte Novarra, Geolog. Theil, vol. I. Abth. 2, p. 99, pl. viii, figs. 2, 3.

and shorter canal, which does not extend so far down towards the apex, as it does in *Bel. Kuntkotensis*. Of other similar forms I may mention in the first place a Belemnite from Australia, of which Professor Phillips says: "It is not one of the Canaliculati, but more probably one of the Hastati," but which is figured on pl. XVI, fig. 7, as *Bel. canaliculatus* by Mr. Moore).^{*} This Belemnite resembles in many respects our species, but by the equal width and the sharpness of its canal, it is easily distinguished from the latter. That the Australian species is not *Bel. canaliculatus* is pretty certain. From Southern Africa, Tate† describes a Belemnite under the name of *Bel. Africanus* of the canaliculate group. It is, however, very easy to recognise the differences of this from our species; they consist in the thick and clumsy shape and in the broad and short canal. From *Bel. canaliculatus* and its nearer allies, *Bel. Kuntkotensis* is easily separable by the shape of its canal, which becomes flatter and wider on the post-alveolar region.

Bel. Kuntkotensis represents, together with the following species, the group of *Bel. sulcatus*, (Mill.), Phill., in the Kutch Jura; both of them, however, differ from the one mentioned by a more central axis.

2. BELEMNITES ORIENTALIS, *Waagen*, n. sp., Plate I, Fig. 4, *a—d*.

Though this species is represented in our Museum only by one specimen, I do not hesitate to describe it under a new name, as the form is very characteristic and its geological position is of interest.

The form of the guard is strongly conical with nearly straight sides and a long, sharp apex. The section is nearly round, somewhat squarish at the alveolar extremity. At the ventral side of the guard a not very broad, sharply cut-in, groove is visible, which begins at the alveolar region and reaches nearly to the apex; it is very much like the groove in *Bel. sulcatus*, but a little longer. Sides and back of the guard are smooth without impressions or grooves.

The phragmocone is not well preserved; it seems to be rather short, and has an angle of 28 degrees. The siphon is marginal, very thin, and corresponds in its position with the groove outside. The apex of the phragmocone and the axis of the guard are very nearly central; the latter entirely straight.

The dimensions of the described specimen are—

Length	...	...	...	...	...	...	62 mm.
Diameter at apex of the phragmocone from side to side	...	...	...	...	...	...	15 "
" " " from front to back	...	...	...	...	...	...	13 "
Length of the axis	...	...	...	...	...	...	55 "
From apex of phragmocone to the front...	...	...	...	...	...	...	6.5 "
" " to the back ...	...	...	...	...	...	...	6 "

Remarks.—The example, which has served for the above description, was found in a brownish Oolite at Wanda, where it occurs in the society of *Pelt. perarmatum* and several other lower Oxfordian species.

^{*} Quart. Journ. Geol. Soc., London, 1870, Vol. 26, p. 259

† *Ibid.* 1867, Vol. 23, p. 151, pl. VII, fig. 2.

Bel. orientalis is very nearly allied to *Bel. sulcatus*, Miller, as characterised by Professor Phillips; and the only important difference which induced me to separate the two forms, is the thoroughly central and straight axis in *Bel. orientalis*. All the other forms, belonging to the group of *Bel. canaliculatus*, are easily to be distinguished from our species by the shape of the canal or ventral groove.

If it were admissible to distinguish among the Belemnites similar developmental series, as among the Ammonites, the following species, *Bel. sulcatus*, *Bel. orientalis*, and *Bel. Kuntkotensis*, could constitute such a series, *Bel. sulcatus* being the oldest, or root-species.

(b.) *Group of* BEL. BLAINVILLEI, Orb.

1. BELEMNITES, sp. indet.

An apparently new species is indicated by a number of fragments consisting of upper and lower ends of the guard, pieces of the alveolar and post-alveolar region. The occurrence of these fragments in the same localities makes it very probable that all belong to one and the same species. The form of the guard appears to have been cylindrical, a little depressed from front to back. The ventral side is provided with a long canal, which begins as a very shallow and broad groove a short distance above the apex, becoming narrow already before it reaches the alveolar region, and disappearing again a little below the alveolar margin. Sides and back of the guard are smooth.

The phragmocone is tolerably long and pointed, enclosed in an angle of 15 degrees. The siphon is marginal, very narrow, and corresponding to the canal outside; the septa are one-fifth of the diameter distant from each other.

The species seems to become very large, as one specimen from Gangta Bét measures 25 mm. in diameter.

Remarks.—Fragments of the species are preserved in our Museum from three localities; Gangta Bét; east of Lair in the Katrol range; and south-east of Mankoa in the Charwar range: at the two last places occurring with certainty in the Katrol group.

The specimens show the nearest affinities to *Bel. Volgensis* or *absolutus* of the Russian Jura, but it seems impossible from the fragments to point out exactly the identity with, or the affinity to, those species.

Section II.—HASTATI.

(a.) *Group of* BEL. PISTILLIFORMIS, Blainv.

1. BELEMNITES CLAVIGER, *Waagen*, n. sp., Plate II, Fig. 2, a—f.

It seems very difficult to obtain perfect specimens of this species, a difficulty which is common to the whole group, for of *Bel. pistilliformis* itself specimens with the alveolar region preserved are also very rare. Thus, I cannot in the present

instance state whether in *Bel. claviger* the alveolar part of the guard possesses a canal or not.

As far as preserved, the guard is long, strongly pistilliform, with a rather short, slightly mucronate apex. Its section is roundish in the lower part of the post-alveolar region, and squarish in the thin upper end of it; the ventral side there is flattened with a slight longitudinal impression, the sides are also pressed in and a little excavated, the back is rounded. Farther down, very distinct vascular impressions extend along the sides of the guard.

The dimensions of the best preserved specimen are—

Length of the post-alveolar region	...	...	...	...	110 mm.
Diameter at upper end of it from front to back	...	...	...	...	6.5 "
" " from side to side	...	...	...	...	7 "
" of the rounded lower third of the post-alveolar region	...	...	...	...	16 "

Remarks.—Nowhere in Europe have any layers of the Jura formation as yet furnished Belemnites of the group of *Bel. pistilliformis*, and it is, therefore, very interesting to find forms of this group here in India associated with true and well known European Jurassic species. This clearly indicates how careful it is necessary to be when comparing rocks of distant countries from solitary, not identical, but only allied species. *Bel. claviger*, if found alone, would, from analogy, certainly be very easily taken as indicating cretaceous beds, whilst in reality it is of upper jurassic, (very likely Kimmeridgian,) age. Only a series of partly identical, partly analogous species can give an exact idea of the geological horizon of a given deposit.

Our species is very nearly allied to *Bel. pistilliformis*, Blainv., and the only important differences between the two consist in the upper end of the post-alveolar region, which is squarish in *Bel. claviger* and round in Blainville's species.

Specimens, mostly more or less extensive fragments, have been collected in the bed of the Bothor river, near Jurun, in a hard yellowish sandstone altered by the contact with basalt (one very good specimen); south of Lodai, in sandy shales above *Pelt. perarmatum*, (one nearly entire specimen and several large fragments); south of Jurun in soft sandy shales, at the village itself, in sandy concretionary beds, and east-south-east of this place again in soft shales; south of Boojoorie in dark red ferruginous sandstone; at all those localities it is found in the Katrol group.

At other places bad fragments were collected, which I can only doubtfully refer to this species. They come from south-west of Nurrha, out of a sandy bank of the Katrol group; from north-east of Goonari, out of yellow sandstone; and from north of Moondan, out of an oolitic layer: the two last localities are in the Oomia group.

(b.) *Group of* BEL. DUVALIANUS, Orb.

1. BELEMNITES KATROLENSIS, *Waagen*, n. sp., Plate II, Figs. 7, 8, 9.

The Belemnite to which I give this name is extremely characteristic for certain divisions of the Kutch Jura; and as its form is easily recognised, the species is of great value for the geology of Kutch.

The guard is rather short, cylindrical, perfectly round in section, or very slightly compressed from both sides, with nearly parallel sides, tapering gradually towards the apex. At the ventral side there is a short, rather narrow groove, or canal, which begins at the alveolar margin and terminates at the beginning of the post-alveolar region. On the sides of the guard are, in well preserved specimens, slight vascular impressions; the back is smooth.

The phragmocone is round, not quite straight, forming an angle of 19·5 degrees. It begins at its apex with a small embryonal bulb and has not very numerous septa, which are a little more than one-fifth of the diameter distant from each other. The siphon is marginal, very thin, and corresponding with the canal outside. The axis is straight and very nearly central, just perceptibly shifted towards the ventral side.

The dimensions of various specimens are—

	1.	2.	3.	
Total length of the guard	79	82	79	mm.
Diameter at the alveolar margin from back to front	14	13	12	"
" " " from side to side	14	12	11·5	"
Distance of end of the canal from apex	45	49	45	"

Remarks.—The localities are numerous at which *Bel. Katrolensis* has been met with:—Katrol range, east, west, and south of Lair, 12 well preserved specimens, in a greyish-yellow iron-stained coarse sandstone; at Lodai, in soft grey shales, 3 excellent specimens; at north of Dhosa, in a soft sandy calcareous bed, 1 specimen; from a soft sandy shale east of Rodur, 8 fragments; in a coarse sandstone south of Bhooj, many fragments; 2 well preserved specimens, in sandy calcareous beds north-west of Jikli. All these are out of the Katrol group; the species, however, seems to go yet higher, in the Oomia group; at least, I cannot distinguish some fragments which were collected by Dr. Stoliczka out of this group in the middle of the large hill next to Katrol hill.

The only species with which our species is somewhat closely allied is *Bel. Sauvanaus*, Orb. Both forms decidedly belong to the same developmental series. However, there are certain differences which lead me to consider both as different species. The form of *Bel. Katrolensis* is cylindrical, instead of hastate; the apex is gradually tapering to a point, and not mucronate; and the canal is shorter than in *Sauvanaus*.

The species is, speaking geologically, the youngest form as yet known of the group of *Bel. Duvalianus*.

2. BELEMNITES SAUVANAUSUS, Orb., Plate II, Fig. 6, *a-f*.

1843. *Bel. Sauvanaus*, Orbigny, Paléont. Franç. Terr. Jurass., I, p. 128, (pars) pl. 21, figs. 1—3 and 6—10.
 1863. " " " Ch. Mayer, Journ. de Conch., Avril, 1863.
 1866. " " " Oppel, Zone des *A. transversarius*, Benecke's Geognost. Palæontol. Beitr., II, p. 215.

The species, though described by D'Orbigny long ago, was comparatively rarely found and mentioned in European Jurassic beds, as it belongs there almost exclusively to the Mediterranean Province, which, until very lately, was but little studied.

The guard is short, hastate in shape, roundish in its section, with a slight ventral depression, and on the ventral side with a sharp, rather deep, but not very broad canal or groove, which occupies more than half of the length of the guard and begins at the alveolar margin. Down the sides run vascular impressions; the back is smooth, rounded. In the specimens from Kutch, the protracted mucronate apex is commonly worn off.

The phragmocone is long and rather acute, possessing an angle of 19 degrees, beginning at its lower end with a round embryonal bulb. The septa are not very numerous, being about one quarter of the diameter distant from each other. The siphon is marginal, very thin, and in its position corresponds with the canal outside the guard. The shell of the phragmocone shows very clearly the fine striation, differing from the general type in the asymptotes, which are two deeply impressed lines stretching along near the dorsal region, the arches there being very flat and depressed. The hyperbolar region is composed of fine straight lines, running up nearly vertical.

The axis is very nearly central, shifted, however, a little towards the back.

The dimensions of a specimen are—

Total length of guard	...	...	...	...	...	67	mm.
Diameter near apex of phragmocone from back to front	...	...	...	...	...	11	„
„ „ „ from side to side	...	...	...	...	...	12	„
„ at alveolar margin from back to front	...	...	...	...	...	10	„
„ „ „ from side to side	...	...	...	...	...	10.5	„
Distance of end of canal from apex	...	...	...	...	...	31	„

Remarks.—The species is not very rare in the Kutch Jura. It was found, south-west of Lodai, in sandy shale, (6 specimens, 2 of them entire, the others fragments); at Wanda, many fragments in soft shales; south of Samtra, some fragments in soft shales; north-west of Jumara, 3 specimens in a dark iron-oolite; from north-west of Kumagoona in shales (2 fragments). At all those localities, the species is found in thin shaly bands between and below the oolites with *Pelt. perarmatum* in the uppermost beds of the Charee group.

Bel. Sauvanus can easily be distinguished from *B. Katrolensis*, the nearest allied species, by its hastate shape, the longer canal, and the more finely pointed apex.

(c.) Group of *BEL. HASTATUS*, *Blainv.*

1. *BELEMNITES FUSTICULUS*, *Waagen*, n. sp., Plate I, Fig. 2, *a—e*.

Though only one specimen of this species is preserved in our Museum, it deserves to have a name given to it, as its form is very characteristic, and the resemblance to some not yet described species of the Alpine Jura of Europe very great.

The guard is very elongated, cylindrical, or very slightly hastate, the sides gradually tapering towards the slender and very elongated apex. On the former

part of the guard, a little behind the alveolar region, there is a short, not very broad or deep canal, which does not extend farther than the former third of the whole guard. It is doubtful if this canal is a ventral or a dorsal one, as on the single specimen I have for description the greater part of the alveolar region is wanting, and thus the position of the siphon is uncertain; I believe, however, from the relations of this species to others, that the canal is ventral. The sides of the guard show rather strong, straight, vascular impressions, the back is smooth and rounded. The transversal section is squarish in the former, rounded with a flattened ventral side in the middle part of the guard, and entirely rounded near the apex. The apical line or axis is central.

The alveolar region is broken away just at the beginning of the phragmocone.

The dimensions of the described specimen are the following:—

Length of the post-alveolar region	...	...	...	...	195 mm.
Diameter at beginning of it from back to front	...	...	...	...	9 "
" " " from side to side	...	...	...	...	9.5 "
" at upper third of post-alveolar region near end of canal from back to front	...	...	...	...	11 "
" " " " " from side to side	...	...	...	...	12 "
Distance of end of canal from the apex, about	...	...	...	...	130 "

Remarks.—The only specimen existing of this species is from the dark-red, sandy ferruginous rock of Kuntkote, together with *Ammonites* of middle Oxfordian types.

The species is apparently very nearly allied to *Bel. baculoides*, Ooster,* at least to the variety shown in his pl. 2, figs. 3, 4, which evidently represents a species different from that shown in figs. 1 and 2, but the shorter canal, the depression of the guard on the ventral side, and the strong vascular impressions on its sides, distinguish *Bel. fusticulus* from Ooster's species.

2. *BEL. STOLICZKANUS*, *Waagen*, n. sp., Plate I, Fig. 1, *a*—*f*.

This species represents in the Kutch Jura *Bel. unicanaliculatus*, Ziet., or *Bel. semisulcatus*, Münt.

The guard is very long, elongate, hastate, with a roundish section, a little depressed on the ventral side, principally in the middle of the post-alveolar region. Along the ventral side there is a deep and rather broad canal, which is, however, comparatively very short, because it does not reach quite so far down as the first third of the post-alveolar region, and vanishes here in a plain ventral depression of the guard.

The sides show very slight vascular impressions, and sometimes they are barely perceptibly flattened. The back is regularly rounded; apex very elongated; axis central.

* Ooster: Catalogue des Cephalopodes des Alpes Suisses, Neue Denkschr. der Schweiz. Naturf. Ges., Vol. 17, 1860.

The phragmocone is rather short, straight, not very acute, having an angle of 19 to 19·5 degrees. Its section is entirely rounded, the septa are not very numerous, about one quarter of the diameter distant from each other. The siphon is marginal, thin, and corresponding in position to the canal outside.

The dimensions of the described specimen are—

Total length of guard	...	...	...	...	...	168	mm.
Length of axis	...	...	...	...	...	160	"
Diameter at end of alveolar region from back to front	...	...	...	...	...	14	"
" " " " from side to side	...	...	...	...	...	12	"
" in the lower half of the post-alveolar region from back to front	...	...	...	...	...	15	"
" " " " " " from side to side	...	...	...	...	...	16·5	"
Distance of lower end of canal from apex, about	...	...	...	...	...	115	"

Remarks.—The specimens, which have served for description, are two nearly perfect ones, and several fragments collected by Dr. Stoliczka in the ferruginous sandy beds of Kuntkote in Wagur, together with the foregoing species and Ammonites of upper Oxfordian types. No specimens are known from other localities.

The species exhibits a very great resemblance to *Bel. unicanaliculatus*, Zieten, a European species of Oxfordian and Kimmeridgian age; but the general form of *Bel. Stoliczkanus* is more elongate, the canal shorter and less sharp. These characteristics are yet much more apparent when we compare our species with *Bel. hastatus*, Blainv. Another species which might be mistaken for the Kutch fossil is one figured by Ooster on pl. 2, figs. 1, 2 (non 3, 4), under the designation of *Bel. baculoides*, but this has the canal much longer and the apex quite different in shape from the Kutch form.

The relation to *Bel. unicanaliculatus*, Ziet., is of high interest, principally when we consider at the same time the Ammonite fauna, in which *Perisph. leiocymon*, Waag., corresponds with *Per. polyplocus*, Rein., and *Per. virguloides*, Waag., with *Per. virgulatus*, Quenst. As the number of species identical with those from the European Jura is very small in the Kuntkote beds, those analogies help much towards the determination of the age of those beds, and we thus come to the conclusion that the Kuntkote beds are very likely of upper Oxfordian age.

3. BELEMNITES cf. HASTATUS, *Blainv.*

1827. *Belemnites hastatus*, Blainville, Belemn., p. 71, pl. 1, fig. 4, pl. 2, fig. 4, pl. 5, fig. 3.
 1842. " " (Blainv.), Orbigny, Pal. Franç. Terr. Jurass., Vol. I, p. 121 (pars), pl. 18.
 1848. " *semihastatus rotundus*, Quenstedt, Cephalop., p. 440, pl. 29, fig. 8.
 1857. " *hastatus*, (Blainv.) Oppel, Juraform., p. 546.

Out of a great many fragments I find only the upper and lower ends preserved, but they cannot be referred to any other species than *Bel. hastatus*. However, to prevent a possible mistake that might occur in the identification, I record these fragments merely under the name of *Bel. cf. hastatus*.

Among those fragments the lower ends of the guards are more or less cylindrical, rounded in section and smooth, with not very distinct vascular impressions

along the sides; the apex is somewhat mucronate. The upper ends are rather thin, also with a rounded section and a deep, not very broad canal along the ventral side. Some of the lower ends show yet the end of the canal.

The phragmocone is usually a little shorter than in *Bel. hastatus*, and possesses an angle of 20 to 21 degrees.

The dimensions of the species seem not to have exceeded the size of Quenstedt's figure.

Fragments of the species are preserved in our Museum from the following localities and layers:—North-east of Gudjinsir, out of black shales; east of Nurrha, out of gray shales; south of Keera hill, near Charee, out of yellowish-gray shales. At all these localities the species occurs together with *Pelt. athleta* or other Ammonites belonging to this horizon. At other places: Lodai, (Oolite); north-west of Jara, (in Oolite); south of Barasir (in shales); it is found somewhat higher in the society of *Pelt. perarmatum*.

At one locality, Wanda, Dr. Stoliczka collected the species in somewhat lower beds, below *Pelt. athleta* and with *Perisph. obtusicosta*.

The best specimens were found by Mr. Wynne in the Oolite at Lodai.

4. BELEMNITES JUMARENSIS, *Waagen*, n. sp., Plate II, Fig. 5, a—d.

A very nice little species of the hastate group.

The guard is beautifully fusiform in its shape, with very thin upper end and perfectly round section. The ventral side of the post-alveolar region is provided with a fine, narrow, not very deep groove, which occupies about half the length of it. The vascular impressions at the sides of the guard are very faint, barely perceptible; the back is smooth and rounded; the apex is not very pointed; axis straight and central.

The phragmocone is not preserved in the specimen I have for description.

The dimensions of the only preserved post-alveolar region of the species are—

Total length	...	...	...	...	...	...	68 mm.
Diameter at upper end of post-alveolar region from back to front	...	...	...	...	...	...	4.5 "
" " " " from side to side	...	...	...	...	...	...	4 "
" at the lower third of post-alveolar region from back to front...	...	...	...	...	...	...	8 "
" " " " from side to side	...	...	...	...	...	...	8.5 "
Distance of end of canal from the apex	...	...	...	...	...	...	36 "

Remarks.—The species is founded upon a single specimen, which was collected by Dr. Stoliczka together with *Bel. subhastatus* in the Macrocephalus beds at Jumara; other fragments from the Macrocephalus beds of north-west of Jara may possibly belong to the same species.

Bel. Jumarensis is very nearly allied to *Bel. hastatus*, Blainv., and is in fact the præcursorial form of this species. There are, however, certain marked differences between the two. In *Jumarensis*, the general shape is much less hastate, but rather fusiform. The section of the guard is thoroughly rounded, whilst in *Bel. hastatus*,

the section is always more or less depressed and a little squarish; the upper end is extremely thin, the canal fine and comparatively short, the vascular impressions at the sides of the guard are very faint, barely perceptible; in all these points, the contrary is the case in *Bel. hastatus*.

Thus, *Bel. Jumarensis* may fairly be considered as distinct, and it is the first and oldest representative of the true *HASTATI*, occurring in Kutch in typical *Macrocephalus* beds.

(d.) *Group of BELEMNITES FUSIFORMIS, Parkinson.*

1. *BELEMNITES GERARDI, Oppel, Plate II, Fig. 3.*

1865. *Belemnites Gerardi*, Oppel: *Palæontolog. Mittheil.*, p. 296, pl. 88, figs. 1—3.

The species is represented mostly by fragments in our Museum, but even those are so characteristic that it is easy to recognize the form.

The guard is short, cylindrical, or slightly hastate, rather broad, roundish in section near the alveolar margin, depressed in the greater part of the post-alveolar part. The ventral side is provided with a very deep and broad canal, which begins near the apex and reaches the alveolar margin; it is broadest in the middle part of the post-alveolar region. The back is flatly rounded, the sides nearly smooth, with extremely faint vascular impressions, gradually tapering towards the elongated apex.

The phragmocone is rather short, commonly a little compressed, straight, showing an angle of 24 to 28 degrees, its apex being central or very nearly so. The siphon is marginal, thin, and in its position corresponds to the canal outside the guard. The axis is central at its beginning, but becomes a little excentric at about the middle of the post-alveolar part; it is shifted towards the ventral side.

The dimensions are—

Total length of the guard, about	...	...	...	...	... 83 mm.
Diameter a little below alveolar margin from back to front	...	...	...	...	... 11·5 „
„ „ „ „ from side to side	...	...	...	...	... 12 „
„ at the beginning of post-alveolar region from back to front	...	...	...	...	... 11 „
„ „ „ „ from side to side	...	...	...	...	... 12 „

Remarks.—The localities at which *Belemnites Gerardi* occurs in Kutch are numerous. It has been found south of Samtra, in sandy shales; west side of Keera hill, in the highest beds of Oolite; at Wanda, in shales; south-west of Barasir, in black shales; south-east of Nurrha; south-east of Kagnora, in shales, the lowest beds exposed in Wagur; north-west of Kumaguna; in shales; from south-west of Lodai, in yellow sandy shales.

From this list it appears that the species has a rather extensive distribution, horizontal as well as vertical. It is entirely wanting in the true *Macrocephalus* beds, but begins immediately above it, and extends from here through the whole upper part of the Charee group; in other words, it is found in upper Callovian and lower Oxfordian beds.

Bel. Gerardi is very nearly allied to *Bel. Kuntkotensis*, but easily distinguishable by the faint vascular impressions along the sides of the guard, which determine the position of our species in the hastate group. From *Bel. subhastatus*, Ziet., it differs by the less hastate shape and the more roundish section of the guard; the same characteristics easily separate it from *Bel. Calloviensis*, Opp.

2. BELEMNITES CALLOVIENSIS, *Oppel*, Plate II, Fig. 4, *a—d*.

1848. *Belemnites semihastatus depressus*, Quenstedt, Cephalop., p. 440, pl. 29, figs. 12—19.

1857. *Belemnites Calloviensis*, Oppel, Juraform., p. 546.

The description and figure of this species by Quenstedt are excellent and need but few additions.

The guard is rather long and hastate in shape, strongly depressed, with a broad deep canal on the ventral side, which, however, becomes finer in the alveolar region, and reaches down until within a short distance of the apex. The vascular impressions along the sides of the guard are very faint, the back rounded.

The phragmocone is tolerably long, but not very acute, enclosing an angle of about 25°. The septa are very numerous, only about $\frac{1}{8}$ th of the diameter distant from each other. The siphon is thin, marginal, and corresponding to the canal outside the guard.

The dimensions are—

Total length of guard, about	...	...	...	...	...	90	mm.
Length of axis, about	...	...	...	...	...	73	"
Diameter at apex of phragmocone from back to front			...	...	...	6	"
" " " from side to side			...	...	...	7	"
" middle of post-alveolar region from back to front			...	...	...	7	"
" " " " from side to side			...	...	...	9	"

Remarks.—*Bel. Calloviensis* is not very common in the Kutch Jura. The species is found in thin-bedded Oolites or shaly limestones immediately above the true *Steph. macrocephalum*, and has in these beds been found north of Kumaguna and on the Keera hill near Charee.

3. BELEMNITES SUBHASTATUS, *Zieten*, Plate II, Fig. 1, *a—e*.

1832. *Belemnites subhastatus*, Zieten, Verst. Württemb., p. 27, pl. 21, fig. 2.

1840. " *canaliculatus*, Schloth., Sowerby, Trans. Geol. Soc., Lond., Vol. V, pl. xxiii, fig. 2, and expl.

1850. " *Grantanus*, Orbigny, Prodrome, I, p. 326.

1857. " *subhastatus* Ziet., Oppel, Juraform., p. 546.

Zieten's figure of this species is unfortunately so bad that it is very difficult to recognise the exact form which is generally understood under the name of *Bel. subhastatus*. A short remark by Oppel, who says in his Juraformation that the species is intermediate in its form between *Bel. canaliculatus*, Schloth., and *Bel. Calloviensis*, Opp., appears to be more reliable.

The guard is rather long, very little hastate, strongly depressed, with a moderately elongated apex. The ventral side is occupied by a strong, broad, somewhat flattened canal, which reaches nearly to the apex, and gets very little narrower in the alveolar region. The sides of the guard are narrowly rounded, and show only in very well preserved specimens vascular impressions. The back is broadly rounded, rather flat.

The phragmocone is not very long, straight, acute, exhibiting an angle of 20°, its apex is not central, but shifted towards the ventral side. The septa are numerous, about one-fifth of the diameter distant from each other, the siphon corresponding in its position with the canal outside.

The measurements of some specimens are :

		1.	2.	3.
Total length of guard	... ..	98 mm.	80 mm.	83 mm.
Length of axis	... ..	?	60 "	(?) "
Diameter at alveolar margin from front to back	... ..	12 "	11 "	8·5 "
" " " " from side to side	... ..	12 "	11·5 "	10 "
" " middle of postalveolar region from front to back	... ..	11 "	11 "	8 "
" " " " " from side to side	... ..	14·5 "	13·5 "	11 "

Remarks.—*Bel. subhastatus* is not very common in the Kutch Jura, and is apparently restricted to the beds with *Steph. macrocephalum*. The species was collected by Dr. Stoliczka in those beds north of Soorka in oolite; on the way between Kumaguna and Urira, also in oolite; north-west of Jumara, in flaggy oolitic limestone, and north of Deysulpoor, in calcareous shales. The locality at Keera hill near Charee has furnished only fragments, some of which seem to belong to this species.

Belemnites Grantanus, Orb., is to be considered a synonym of the European species, as Sowerby's figure, upon which the species is founded, represents nothing but a lower end of *Bel. subhastatus*.

Zieten's species is rather difficult to distinguish from *Bel. calloviensis*, Oppel, except by the greater thickness of the alveolar and of the beginning of the post-alveolar region, the result being expressed in the less hastate shape of the specimens. In Europe, *Bel. subhastatus* is also one of the most characteristic species of the *Macrocephalus* beds.

NOTOCÆLI.

Section I.—CONOPHORI.

(a.) Group of BELEMNITES CONOPHORUS, Oppel.

1. BELEMNITES OLDHAMIANUS, *Waagen*, n. sp., Plate I, figs. 5, 6.

Several specimens of a small canaliculate Belemnite, which at the first glance much resembled *Bel. Argovianus*, Ch. Mayer, were collected by Dr. Stoliczka in certain beds of the Kutch Jura, but on closer examination they proved to belong to the division of the *Notocæli* of Bronn.

The guard is very short, cylindrical, or slightly hastate, squarish, rounded in section, and on the back provided in the alveolar region with a short and narrow, but very deep canal, so much so that it nearly, as in *Belemnitella*, reaches the phragmocone. The apex is short and somewhat mucronate. The sides of the guard are slightly flattened, sometimes with indistinct vascular impressions; the ventral side is smooth, broad and flattened, broader than the back.

The phragmocone is rather long in comparison to the length of the guard, straight, showing an angle of 24° , its apex being thoroughly central. The siphon is marginal, not very thin, and in its position opposite to the canal outside the guard. The shell of the phragmocone exhibits in some specimens clearly the characteristic stripes, which in all *Belemnites* cover it; but as was first observed by Quenstedt* on *Bel. dilatatus*, the arched region, or back, corresponds with the canal of the guard, whilst the horizontal stripes with the siphon in the middle under the same lie opposite, corresponding with the smooth and flat ventral side of the guard.

The dimensions of the specimens are :

						1.	2.
Total length of guard	...	...	...	...	...	38 mm.	44 mm.
Length of axis	...	...	...	...	...	21	33 „
Diameter at end of alveolar region from back to front				...	...	10.5 „	12 „
„ „ „ „ from side to side				...	...	12 „	13.5 „

Remarks.—The species just described is of high geological interest, because it shows, that forms of the division of the NOTOCÆLI occur in much older beds than was believed only a short time ago.

Only three specimens have been found, proving that the species must be very scarce in Kutch. One of them is from a black shale south-east of Nurrha, from a bed a little below *Pelt. athleta*; the second specimen was found at Keera hill near Charí in the same geological position together with *Perisph. arthriticus*, in soft yellowish shales; the third specimen is from south of Samtra, also out of shales; it was collected there together with another thick short *Belemnite*, which is very likely a deformity of our species.

The nearest allied species is *Bel. conophorus*, Oppel, which is, however, distinguishable from *Bel. Oldhamianus* by its less deep canal and round section. In shape, *Bel. Argovianus* is also very much like our species, but it was placed by Ch. Mayer, who described it first, in the group of *Bel. Duvalianus*, and thus belongs to an entirely different division of *Belemnites*.

* Quenstedt, Cephalop. p. 449, pl. 30, fig. 8.

Family.—*NAUTILIDÆ*.*Genus.*—*NAUTILUS*.

The very remarkable constancy of form in the species belonging to this genus produces such a uniformity in the mesozoic Nautili, that only comparatively minute differences can be used to characterise single species. Nevertheless the number of carefully distinguished species is being added to daily, and it is of great interest to observe how the increasing knowledge of this group also serves to confirm the common law of the development in time of organic beings. Thus, there is, for instance, a very clear developmental connection between *Naut. lineatus*, Sow., *Naut. calloviensis*, Opp., and *Naut. Wandaensis*, Waagen, and no doubt many other forms will prove to stand in similar relation to each other, as soon as the intermediate forms of the series may be found. But Nautili are not very common in mesozoic formations, excepting a few species, and thus our knowledge regarding them increases but slowly.

On the other hand, we cannot expect to find in every bed a distinct species, and must treat the Nautili in this respect very much like the Belemnites, allowing for single species a rather extensive vertical occurrence. Here, as in the Belemnites, this may depend partly upon the simplicity of the form of the Nautilus shell, which does not admit of more minute distinctions, partly, however, it seems also to have its reason in the greater power of resistance in the animal against the influences of outer conditions.

Of all the six species of Nautili found in the Kutch Jura and described hereafter, only one is identical with a European form, *Nautilus calloviensis*, Oppel.

All the others are new species, one of them principally interesting on account of its ornamentation. *Naut. calloviensis* is in India found in beds having exactly the same relations as in Europe, viz., in the beds with *Steph. macrocephalum*.

*(a.) Group of NAUTILUS LINEATUS, Sow.*1. *NAUTILUS WANDAENSIS*, *Waagen*, n. sp., Plate IV, fig. 3, *a—b*.

A rather thick species, with obtusely angular whorls. Though the shell is preserved in the specimen from Wanda, it is so much worn that it cannot be seen whether it was concentrically striped or not.

The umbilicus is rather wide, being about one-eighth of the diameter, with perpendicular walls, which are even a little turned inside near the suture. The greatest thickness of the shell is on the umbilical margin; from here the sides slope down towards the external part, which is considerably flattened, with obtuse edges on both sides. The septa are simply curved, a little cut out at the external side. The position of the siphon is not visible.

The dimensions of the two preserved specimens are :

	I.	II.
Diameter of the shell	37 mm.	85 mm.
„ of the umbilicus	6 „	11 „
Thickness of the shell	23 „	60 „
Height of the last whorl from the umbilicus	19 „	45 „
„ „ „ „ from the preceding whorl	16 „	34 „

Remarks.—The description is founded on two specimens, of which one was found in dark oolite, north-west of Soorka, the other, also in oolite, near Wanda; at both localities they occurred in the society of *Pelt. peramatum*.

Naut. wandaensis is very nearly allied to *Naut. calloviensis*, Opp., but can be easily distinguished by its much larger umbilicus.

2. NAUTILUS CALLOVIENSIS, *Oppel*., Plate III, fig. 2, *a*,—*b*.

1840. *Nautilus hexagonus*? Sow. Transact. Geol. Soc., Lond., Vol. V, pl. 23, f. 4 and expl.

1842. *Nautilus hexagonus* (Sow.), Orbigny, Pal. Franç. Terr. Jurass., Vol. I, p. 161, pl. 35, figs. 1-2, (non Sow., Min. Conch).

1857. *Nautilus calloviensis*, *Oppel*, Juraform., p. 347.

This species seems rather common in Kutch; it is certainly the most common species of all the Nautili there.

The general form of the shell is smooth, not very thick, with a small umbilicus and somewhat angulate whorls. The umbilicus is only about one-thirteenth of the diameter deep, and with walls which are turned a little inside. The greatest thickness of the shell is at the umbilical margin; from there the flattened sides slope towards the external part, which also is flattened, and provided on each side with a very obtuse ridge. The shell itself is covered with two systems of fine striæ, of which the parallel ones, which follow the direction of the spiral, are limited to the external part of the shell. The others,—striæ of growth,—cover the whole shell, are somewhat falciform on the sides, but bend strongly backward on the external part. On very large specimens those lines become very strong, numerous, and look as if cut in with a knife; the other system of striæ then entirely disappears.

The septa are simply curved, a little cut out at the external part. The siphon is tolerably thick, and has its position in the outer third of the septum.

On the cast the normal line is often very strongly pronounced.

The dimensions of a specimen from north-west of Jumara are :

Diameter of the shell	65 mm.
„ of the umbilicus	4.5 „
Thickness of the shell	41.0 „
Height of the last whorl from the umbilicus	39.0 „
„ „ „ „ from the preceding whorl	25.0 „

Remarks.—The species is represented in our collection by five specimens, two of which were found in the golden oolite at Keera hill near Charí, one north-west of

Jumara in yellowish-gray limestone, and two north-west of Soorka in ferruginous concretions out of shales. The latter two are only body chambers, the one of which has, though compressed, a diameter from one side to the other of more than 90 mm. This shows how large the species did grow. All the specimens at the different localities were found in the society of *Steph. macrocephalum*.

Naut. calloviensis is very nearly allied to *Naut. lineatus*, Sow., but the differences have been already very well pointed out by Orbigny. From *Naut. wandaensis* the species is distinguishable by its smaller umbilicus. The differences from *Naut. hexagonus*, Sow., Min. Conch., were already well observed by Sowerby himself in his paper on the Kutch fossils; however, he united the Kutch-form, though with some doubt, with his former species.

(b.) Group of NAUTILUS HEXAGONUS, Sow.

1. NAUTILUS KUMAGUNENSIS, *Waagen*, n. sp., Plate III, fig. 1, *a—b*.

A rare species of the general form of *Naut. hexagonus*, Sow. The shell is narrowly umbilicated, rapidly increasing in height, and very likely becoming nearly as large as *Naut. giganteus*, Orb., which is a synonym of Sowerby's *Naut. hexagonus*.

The umbilicus is not very wide in this species, and not more than about one-tenth of the diameter. It is very deep, with perpendicular walls, a little turned in near the suture. The greatest thickness of the shell is at the umbilical margin; from there the flattened sides slope towards the external part. This latter is slightly excavated, with a somewhat prominent, rounded obtuse ridge on each side. The shell is nearly entirely smooth, only with extremely faint striæ of growth.

The septa are simply curved, but strongly cut out on the external side; the siphon is not preserved in the specimens I have for description.

The dimensions of the described specimen are:

Diameter of the shell	...	...	...	...	...	72	mm.
„ of the umbilicus	...	...	...	...	...	6.5	„
Thickness of the shell	...	...	...	...	...	48	„
Height of the last whorl from the umbilicus	...	...	...	...	...	40	„
„ „ „ „ from the preceding whorl	...	...	...	...	...	31	„

Remarks.—The only entire specimen is preserved in an iron nodule out of shales belonging to the beds of *Steph. macrocephalum*, north of Kumaguna. A fragment preserved in very fine brown oolite of Lodai seems to come out of the middle of the Charí group.

The species is nearly allied to *Naut. hexagonus*, Sow., but easily distinguishable from it by the smaller umbilicus and the less prominent ridges on the external angles.

(c.) *Group of NAUTILUS SUBINFLATUS, Orbigny.*1. *NAUTILUS INTUMESCENS, Waagen, n. sp., Plate III, fig. 3, a—b.*

A shell, of about the size of *Naut. pompilius*. It is of a thick inflated form, without umbilicus, if well preserved, as this part is then entirely covered by a thick shelly callosity, as in the living *Nautilus*. If the shell is destroyed, a tolerably wide umbilicus becomes visible.

The shell itself is very thick, and nearly entirely smooth, only on a few places extremely fine striæ of growth can be observed. The cast looks much more slender than when the specimen is covered with shell, and the appearance of an umbilicus gives to it quite a different aspect. The umbilicus is then a little less than one-eighth of the whole diameter of the cast, is very deep, and has perpendicular walls. The greatest transversal diameter lies a little above the umbilical margin; from there the sides slope slowly towards the perfectly rounded external part, in the middle of which the normal line is on casts sometimes slightly indicated.

The septa are simply curved, making a very shallow lobe on the external side. The siphon is not preserved.

The dimensions of a specimen from north-west of Jumara are :

Diameter of the shell	...	...	...	...	...	...	112 mm.
„ of the umbilicus	...	..	...	...	...	...	12 „
Thickness of the shell	...	...	...	...	...	...	85 „
Height of the last whorl from the umbilicus	...	...	...	...	...	...	68 „
„ „ „ „ from the preceding whorl	...	...	...	...	...	...	51 „

Remarks.—The specimen I have for description is out of a gray somewhat ferruginous limestone from north-west of Jumara, where it was found in the society of *Steph. macrocephalum*.

Of the species of *Nautilus* as yet described, only *Naut. subinflatus*, Orbigny, out of the Kimmeridge clay of Honfleur, etc., seems to show a certain relation to the Indian species, but it is unknown, if the former, when provided with shell, has its umbilicus closed with a callosity. Even *Naut. pompilius*, Linn., is much allied to *Naut. intumescens*; however, the former has more strongly curved septa. It is very strange to find in Kutch in jurassic beds a species which has its nearest relations among the living world. What may have been the reason that *Nautilus* was able to endure all the changes of so many geological periods without having been very sensibly affected by them?

(d.) *Group of NAUTILUS AGANITICUS, Schloth.*(1). *NAUTILUS KUTCHENSIS, Waagen, n. sp., Plate III, fig. 4, a—b.*

The species seems very rare in the Kutch Jura.

The form of the shell is rather thick, with flattened sides, angular externally, and with a small umbilicus. The latter is deep, with sloping walls, a consequence of

the umbilical edge being not very sharp; its diameter is one-eleventh of the diameter of the shell. The section of the whorls is somewhat rectangular, with flattened sides, flattened external part, and the greatest thickness near the umbilicus.

The septa are strongly curved with an obtuse saddle near the umbilicus, a not very deep rounded lobe on the sides of the shell, and also a rather strong excavation on the external part. The siphon pierces the septum in its outer fourth.

The shell itself is not preserved on the specimen I have for description.

The dimensions are :

Diameter of the shell	...	...	...	...	...	47 mm.
" of the umbilicus	...	...	...	...	...	5 "
Thickness of the shell	...	...	...	...	...	27 "
Height of the last whorl from the umbilicus	...	...	...	...	...	28 "
" " " from the preceding whorl	...	...	...	...	...	18 "

Remarks.—The species has been found in a brown iron-stained oolite, in the middle of the Charí group (beds with *Perisph. arthriticus*, Sow.) at Wanda, in only one specimen.

It is very nearly allied to *Naut. aganiticus*, Schloth., but has its siphon nearer to the external side. *Naut. biangulatus*, Orb., also resembles very much the Kutch species, but is distinguishable by the more angular shape of its aperture and by its excavated external side. All the other forms of the *aganitic* group, like *Naut. Franconicus*, Opp., or *Naut. Strambergensis*, Opp., have different sutures of the septa.

In Europe a very similar species occurs in the beds of *Perisph. anceps* of Württemberg, but it has as yet not been described under a separate name.

(?) Group of NAUTILUS MOJSISOVICSI, Neumayer.

(1). NAUTILUS JUMARENSIS, Waagen, n. sp., Plate IV, fig. 1, *a—b*, 2, *a—b*.

It is with great doubt that I unite the species from Jumara with *Naut. Mojsisovicsi*, Neum., in one group, as in the former the ornamentation is not so strong and is limited to the sides of the shell, but, at all events, Neumayer's species is more nearly allied to the Kutch form than any other as yet described.

Shell very thick, with flattened sides, flat external part and small umbilicus. The width of the umbilicus is, however, variable, and in one specimen its diameter is about one-ninth, in another about one-tenth of the diameter of the shell. The umbilicus is deep, with perpendicular walls; the umbilical edge, however, not sharp, but rather rounded. The sides are sloping towards the external part and a little excavated near it. The external part is flattened, with rather sharp edges on both sides. From the umbilical margin rise in adult specimens shallow obtuse folds, which extend, directed somewhat backward, to the external edge, and terminate here in a broad obtuse tubercle; no ornamentation of any kind passes the flat external part.

Young specimens are entirely smooth, the whorls more rounded in section. On the body chamber of very large specimens the ornamentation becomes less apparent, and the tubercles of the outer edge disappear entirely.

The septa are simply curved, a little cut out on the external part; the siphon is not preserved. On a cast of a young specimen, the normal line is well seen in the middle of the external side.

The dimensions are :

Diameter of the shell	...	...	...	...	...	...	112 mm.
„ of the umbilicus	...	...	...	...	...	...	12 „
Thickness of the shell	...	...	...	...	...	...	78 „
Height of the last whorl from the umbilicus	...	...	...	...	...	...	74 „
„ „ „ from the preceding whorl	...	...	...	...	...	...	61 „

Remarks.—*Naut. Jumarensis* is one of the rare forms, with decorated shell, which were only recently detected in Alpine jurassic strata. The species was found in three specimens in a yellowish-gray marly limestone directly below *Steph. macrocephalum* in the uppermost beds of the Putscham group, north-west of Jumara.

It is very remarkable how the species changes with age. Young specimens are barely distinguishable from *Naut. lineatus*, Sow., from the inferior oolite, whilst larger specimens are entirely different. The only species with which full grown shells can be compared is *Naut. Mojsisovicsi*, Neum., from the *Macrocephalus* beds of the Brielthal in the Sazkammergut. In the side-view, the ornamentation of both shells has a rather close resemblance, but in the Alpine species the umbilicus is larger, and the tubercles on the outer margin not developed, whilst in a front-view the smooth external part of *Naut. Jumarensis* immediately distinguishes both species. Besides that, in *Naut. Jumarensis* the ornamentation is chiefly restricted to the shell, and the cast shows very little of it,

CEPHALOPODA

OF THE

JURASSIC DEPOSITS OF KUTCH.

Order. TETRABRANCHIATA.

Family,—*AMMONITIDÆ*.

GENUS *PHYLLOCERAS*, SUESS.

This genus, though proposed in 1865 by Prof. Suess, was for a long time treated with great reserve by the scientific world, as the acceptance of it would have involved at the same time the acknowledgment of the principle on which it was founded, and that was precisely what it was thought desirable to avoid. If once the limits fixed by the common use of so many years were transgressed, one had to admit the consequences, and not only the genus *Phylloceras* must be accepted, but also the rest of the Ammonites must be subjected to further investigation and be dissolved into a number of genera, difficult to determine and difficult to circumscribe. But nevertheless the step had to be taken, not only because the number of Ammonite-species increased slowly to an excessive amount, but also, because discoveries were made regarding the shells of Ammonites which made it appear very improbable that all Ammonites could possibly belong to one and the same genus:

Prof. Zittel in 1868 was the first to accept the designation *Phylloceras*, as a generic name separate from Ammonites, and since that time, not only have Suess's genera come into common use, but also the greater portion of the other Ammonites have been divided into separate genera. How necessary and useful this was, soon appeared clearly from the other discoveries which were in the rear of this first step.

In his work on the Cephalopoda of Stramberg,* Zittel showed, that it was possible to arrange the species of *Phylloceras*, till then described, into certain rows

* Zittel: Die Cephalopoden der Stramberger Schichten, Palæontol. Mittheil., Vol. II, Abth. I.

or series, the species of which are for the most part nearly allied to each other, and in 1869 he published his discovery,* that the species of one and the same series differ principally in their lobes, which become more complicated, as the species are geologically younger. In the meantime I myself had made similar observations on other groups of Ammonites and had proposed to designate such relationships,† which no doubt had their origin in a genetic relation of the single species in time, by a certain formula, which I called the 'Genetic formula.'

Since that time several *Phylloceras* have been described, but no work was so important for the genus as the Memoir of Dr. Neumayr on the *Phyllocerates* of the Dogger and Malm only recently published in the Jahrbuch of the Austrian Geological Survey, and as it treats of species of the same geological periods as are developed in Kachh, it is of great value for determining and arranging the Kachh species.

Dr. Neumayr distinguishes the following groups:—

- I.—Group of *Phyll. heterophyllum*, Sow.
- II.—Group of *Phyll. tatricum*, Pusch.
- III.—Group of *Phyll. capitanei*, Catullo.
- IV.—Group of *Phyll. ultramontanum*, Zitt.

All these four groups are represented in different beds of the Kachh Jura, and though one or the other of them counts only one or two species here, whilst in Europe every zone has furnished a separate one, others are as rich (or even richer) in forms as they are in Europe.

The first of Neumayr's groups is represented only by a small specimen out of the beds with *Peltoceras athleta*, which I consider as belonging to *Phylloceras Kunthi*, Neum. The second group has furnished not less than five species, more than are known in the Jura of Europe. The oldest of them, *Phylloceras vicarium*, Waagen, n. sp., is found in the beds with *Steph. macrocephalum*, and there replaces the *Phylloc. flabellatum*, Neum., of Europe. Two other species, *Phyll. Feddeni*, W., and *Phyll. Jaraensis*, Waagen, n. sp., were found in the beds of *Asp. perarmatum*, the former allied to *Phyll. euphyllum*, Neum., but with somewhat simpler lobes, the other repeating the form of *Phyll. flabellatum* on a higher horizon, but with more complicated lobes. A fourth species, *Phyll. insulare*, Waagen, n. sp., comes from Gangta bét out of beds very likely of Upper Oxfordian age. It is allied to *Phyll. ptychoicum*, Quenst., but the tetraphyllism of the saddles is not well developed. The fifth species is *Phyll. ptychoicum*, Quenst., and occurs in the Ammonite beds of the Katrol group.

The group of *Phyll. capitanei*, Cat., is represented in Kachh by three species, of which one, *Phylloceras disputabile*, Zitt., is found in the *Macrocephalus* beds as a rather common fossil; another, *Phyll. Lodaiense*, Waagen, occurs also tolerably

* Zittel: Bem. über *Phyll. tatricum*, Jahrb. d. K. K. Geolog. Reichsanst., Vol. xix, p. 59.

† Waagen: Formenreihe des *Amm. subradiatus*, Benecke's Geognost. Palæont. Beitr., Vol. II.

common in the beds of *Asp. perarmatum*; the third, which I identify, though doubtfully, with *Phyll. Benacense*, Cat., is found very rarely in the Ammonite beds of the Katrol group, the probable equivalent of the Kimmeridge group of Europe.

The last group of *Phyll. ultramontanum*, Zitt., has furnished in Kachh only one species, *Phyll. mediterraneum*, Neum., which seems, however, here restricted to Upper Callovian beds.

Altogether the genus *Phylloceras* shows here in the ten species, by which it is represented, the same laws and succession of forms as in Europe, so that we can, merely by judging from the complication of the lobes, indicate with tolerable certainty the geological age of a species. It is remarkable that the same species as in Europe are not always found on the same horizons in Kachh, and that it thus appears that the groups, though following the same laws of development as in the European Ammonites, yet were travelling a different road, notwithstanding the specific agreement at certain stages. Nothing could show more clearly than this, that it is an inner law, which governs the changes of form in the animal life. This may be influenced by outer circumstances, the result of which are 'local' or 'replacing' species, but the tendency is here and in Europe the same, so much so that after long deviation at last the same form is produced. Thus in the group of *Phyll. tatricum* all the older forms, *Phyll. vicarium*, *Feddeni*, *Jaraense* and *insulare* are different from European species, but they result at last in the newest form of the group in a species which agrees in every point with the European *Phyll. pychoicum*. In the group of *Phyll. capitanei* the Indian series starts from a form identical with a European one, *Phyll. disputabile*, Zitt., and terminates also with a European one, *Phyll. Benacense*, Cat., but whilst in Europe the intermediate species are *Phyll. Manfredi* and *Puschi*, we have in India *Phyll. Lodaiense* as an intermediate form. Thus, it appears, the tendency is the same, but the ways are different.

(a.) Group of PHYLL. HETEROPHYLLUM, Sow.

1. PHYLLOCERAS cf. KUNTHI, Neum. Pl. V, Fig. 2a, b, c.

1868. *Phylloceras Kudernatschi*, (Hau.) Zittel: Jahrb. d. K. K. Geol. Reichsanst., Vol. xviii, p. 602.

1869. *Phylloceras Kudernatschi*, (Hau.) Zittel: *ibid*, Vol. xix, pl. 1, fig. 13.

1871. *Phylloceras Kunthi*, Neumayr: *ibid*, Vol. xxi, p. 312, fig. 6; pl. 13, fig. 1.

The species is only represented by a very small specimen, so that I cannot consider my determination beyond all doubt, but so much is certain, that the specimen belongs to the group of *Phyll. heterophyllum*, and is, if not identical, certainly very nearly allied to *Phyll. Kunthi*.

The specimen has only 18 mm. in diameter. The general form is flat, lenticular, with flattened sides, rounded siphonal part, and very small umbilicus. The

shell, though partly well preserved, seems smooth, without striation. The lobes are tolerably fine, the external and first lateral saddle finish in four phylla; there are six auxiliary lobes up to the umbilical suture.

The dimensions are—

Diameter	of the shell ...	...	...	...	...	...	18 mm.
"	of the umbilicus	...	...	...	...	...	1
Height	of the aperture from the umbilical suture	...	...	...	...	...	11
"	of the " from the preceding whorl	...	...	...	...	...	6
Thickness of the	" ...	...	...	...	...	...	7

Remarks.—The only specimen is from Leir, out of white limestone with *Peltoc. athleta*.

The form of the lobes of the specimen seems not quite identical with that of *Phyll. Kunthi*, but rather intermediate between that of this species and *Phyll. isotypum*, Ben., but the materials at my disposal are too limited to found a new species on them.

(b.) Group of PHYLLOC. TATRICUM, *Pusch.*

1. PHYLLOCERAS VICARIUM, *Waagen*. Pl. V, Fig. 4a, b, c.

The general form of the shell is inflated, the whorls rounded with broad siphonal side and deep depressed umbilicus, repeating with slight variations the general form of all the species of the group.

The greatest thickness of the whorls is near the siphonal part of the shell. From these the sides slope gradually towards the umbilicus, which is flat, nearly without vertical walls. The siphonal side of the whorls is provided with distant short rounded ribs, of which there seem to be about eight or ten on one whorl. The ribs are indistinct on the cast, and do not correspond with curved furrows round the umbilicus; the cast is here smooth.

The lobes resemble very much those of *Phylloceras flabellatum*, Neum. The siphonal lobe is nearly as long as the first lateral. The external saddle finishes in two phylla, but with some tendency to tetrephyllism; the first lateral saddle finishes diphyllic. There are six auxiliary lobes up to the umbilical suture, which are all only slightly ramified. The second lateral and first auxiliary saddles terminate in two phylla.

The dimensions are—

Diameter	of the shell ...	...	...	...	...	60 mm.
"	of the umbilicus	...	...	...	...	5
Height	of the aperture from the umbilical suture	...	...	...	...	33.5
"	of the " from the preceding whorl	...	...	...	...	22
Thickness of the	" ...	...	...	...	...	26

Remarks.—The only specimen existing of this species comes from north-west of Jumara out of a yellow limestone together with *Steph. macrocephalum*.

The affinities are manifold. The most nearly allied species seems to be *Phyll. flabellatum*, Neum. This is found in Europe in the upper region of the Bathonian group, and is characterised by the shape of the whorls and furrows round the umbilicus. In the former point, *Phyll. vicarium* agrees with the European species, but the furrows are wanting, and the lobes more complicated.

From *Phylloc. tatricum* our species is distinguishable by the larger umbilicus and the external saddle, which is nearly tetraphyllic. *Phyll. euphyllum*, Neum., resembles also very closely *Phyll. vicarium*, but the lobes of the former are much more complicated. Thus the Indian form represents an easily distinguishable species, which is characteristic for the beds with *Steph. macrocephalum*.

2. *PHYLLOCERAS FEDDENI*, Waagen. Pl. VII, Fig. 1a, b, c.

The general form of this species is very like *Phyll. flabellatum*, Neum. The whorls are thick and rounded, the umbilicus small and deeply depressed, the siphonal margin shows sharp short ribs, which go over the siphonal part of the shell and then disappear. The number of those ribs is, on the example which lies before me, eleven to twelve.

If we examine the shell more carefully, we find that there are some peculiarities which never occur in *Phyll. flabellatum* or any allied form. The shell itself is quite smooth, and not the slightest trace exists of furrows, which descend from the folds on the siphonal margin to the umbilicus, nor can one see any mark of the umbilical rosette as it is called by Zittel, though the shell there is so well preserved that every stria of growth is visible. The only ornamentations of the shell are those folds on the siphonal margin which are short, tolerably high, and numerous. The lobes agree in their general form with those of *Phyll. flabellatum*, only the external saddle shows a slight difference, consisting in an asymmetrical dentation of the outer leaf, a beginning of the bipartition of this leaf. As we know by Zittel's discovery, that in the genus *Phylloceras* the changes which the forms undergo in the course of time are expressed chiefly by a change in the dentation of the last leaves of the external and first lateral saddle, this character seems to be of some value. Besides this, we count on our example ten to eleven lobes on each side of the shell instead of seven as drawn by Orbigny for *Phyll. Hommairei*.

The dimensions of our example are—

Diameter	of the shell	...	...	...	...	...	107 mm.
"	of the umbilicus	...	...	...	...	...	11
Height	of the aperture from the umbilical suture	...	...	...	...	...	60
"	of the " from the preceding whorl	...	...	...	...	...	43
Thickness	of the " ...	...	...	...	...	...	24

Remarks.—The species seems to be very rare in the Indian Jura, and it is represented in our Museum only by a single example. This comes from the Joora hills on the road from Jooria to Dhosa. The rock which contains the fossil is very much like the rock of Lodai, in which *Phyll. Lodaiense* occurs. It is a

slightly sandy brown oolite with very small grains. The shells of the fossils are converted into very hard brown iron-ore, and it was therefore very difficult to get out the lobes of this species. The other Ammonites which are associated with *Phyll. Feddeni* are very numerous. They consist of forms which very likely indicate an Oxfordian age of the stratum. Among them we find *Peltoceras semirugosum* at Lodai associated with *Asp. perarmatum*. Therefore it is very probable that *Phyll. Feddeni* is an Oxfordian type, and it is of great interest to state that our species, both in its geological position and in its palæontological characters, establishes the junction between *Phyll. flabellatum* and *Phyll. ptychoicum*. It is more nearly allied to the former species than to the second, because its geological age is only a little younger than that of the first, but much older than that of the second one. *Phyll. euphyllum*, which also shows much resemblance to *Phyll. Feddeni*, has more complicated lobes; in *Phyll. vicarium* the first lateral saddle is diphyllic instead of triphyllic as in the species just described.

3. PHYLLOCERAS JARAENSE, *Waagen, n. sp.* Pl. V, Fig. 6a, b, c.

In general appearance this species strongly resembles *Phyll. semisulcatum* of the Neocomian.

The whorls are rounded, broadest near the siphonal part, the latter itself being smooth, without prominent ribs. The umbilicus is small, not very deep, surrounded by deep curved furrows, the so-called umbilical rosette, which are visible principally on the cast, but also on the shell a little fainter. The shell itself, as far as preserved, seems to be smooth.

The lobes are characteristic. The siphonal lobe is rather long, with two long, bifid terminating branches; the external saddle is unequal, tetraphyllic; the first lateral lobe only a little longer than the siphonal; the first lateral saddle also unequal, tetraphyllic, reaching high up. Second lateral lobes much shorter than the first. Second lateral and first auxiliary saddle diphyllic, the others monophyllic; six auxiliary lobes up to the umbilical suture.

The dimensions of the described specimen are—

Diameter of the shell ...	...	...	...	...	...	48 mm.
„ of the umbilicus ...	...	...	...	...	...	4
Height of the aperture from the umbilical suture ...	...	...	...	...	...	26
„ of the „ from the preceding whorl ...	...	...	...	...	...	18
Thickness of the „ ...	...	...	...	...	...	22

Remarks.—The only specimen existing of this species was found north-west of Jara in the Oolites with *Asp. perarmatum*.

The affinities of the species are not equally great with the different species which are next to it in their geological position. The most nearly allied, it seems, is *Phyll. Jaraense* to *Phyll. flabellatum*, Neum., and in fact I believe that the former represents the latter in India in a higher layer. Both are, however, distinguishable

by the wanting of folds on the siphonal side and the more complicated lobes in the Indian species. *Phyll. semisulcatum*, which in young specimens also very closely resembles *Phyll. Jaraense*, differs from this species by the smaller umbilicus, the more strongly curved furrows of the umbilical rosette, and the equal tetraphyllic termination of the external and first lateral saddle. Nearly in the same points it differs also from *Phyll. ptychoicum*, Quenst. *Phyll. Feddeni*, of the same bed as *Phyll. Jaraense*, has quite different lobes.

4. PHYLLOCERAS INSULARE, *Waagen, n. sp.* Pl. IX, Fig. 3a, b, c.

Small specimens of this species have not very much the look of a form belonging to the group of *Phyll. taticum*, as the whorls are smooth, rounded, without ribs on the siphonal side, or a rosette round the umbilicus. Only larger specimens have folds like *Phyll. ptychoicum*.

The greatest thickness of the whorls is near the siphonal part of the shell; from there the flatly rounded sides slope gradually towards the umbilicus, which is tolerably wide and rather deep. The shell seems entirely smooth, and neither the casts nor specimens with preserved shell show any ornamentation up to a diameter of 50 mm.

The lobes are very much like those in *Phyll. ptychoicum*. The siphonal lobe is as long as the first lateral, the external and first lateral saddles are very unequally tetraphyllic. Second lateral lobe shorter than the siphonal, second lateral saddle diphyllic; auxiliary lobes five up to the umbilical suture.

The dimensions of the described specimen are—

Diameter	of the shell	...	...	...	...	...	46 mm.
„	of the umbilicus	...	...	...	...	...	7
Height	of the aperture from the umbilical suture	...	...	...	...	...	25
„	of the „ from the preceding whorl	...	...	...	...	...	15
Thickness of the	„	...	...	...	...	...	20

Remarks.—The specimen from which I have described the species was found at Gangta Bét, an island in the Rann, in a sandstone, together with other Ammonites of very probably upper Oxfordian age.

All the characteristics of the shell show it to be most closely allied to *Phyll. ptychoicum*. Like this species in its typical form, *Phyll. insulare* gets the folds on the siphonal part only at an advanced stage of growth, being in early youth quite smooth. The lobes are distinguished by the small development of the inner two phylla in the external and first lateral saddle of the Indian species. All the other species, which could be compared with *Phyll. insulare*, are easily distinguishable by the ornamentations of the shells or casts, or by the differences of the lobes, which, although very minute, are always constant enough to characterise with certainty the species.

5. *PHYLLOCERAS PTYCHOICUM*, Quenst. Pl. VII, Fig. 2a, b, c.

1845. *Ammonites ptychoicus*, Quenstedt: in Leonh. and Bronn, Jahrb. für Mineral, p. 683, 1847 Cephalop., p. 219, pl. 17, fig. 12.
1866. *Ammonites ptychoicus*, (Quenst.) Benecke: Geognost. Pal. Beitr. I, p. 188.
1866. *Ammonites semisulcatus* (Orb.) Hébert: Bull. Soc. Géol. de Fr. 2ème, Sér. XXIII, p. 525.
1868. *Phylloceras ptychoicum*, (Quenst.) Zittel: Cephalop. d. Stramberg, Schichten, p. 59, pl. 4, figs. 3—9.
1869. *Phylloceras ptychoicum*, (Quenst.) Zittel: Jahrb. d. K. K. Geol. Reichsanst., XIX, p. 65.
1870. *Phylloceras ptychoicum*, (Quenst.) Zittel: Fauna d. ält. cephalopoden führend. Tithonbild., p. 35, pl. 1, figs. 11, 12, 13.
1871. *Phylloceras ptychoicum*, (Quenst.) Neumayr: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 326, pl. 16, fig. 10.

Phylloceras ptychoicum is one of the most interesting species of all those found in the Kutch Jura, not only for its palæontological characters, but still more for its geological value.

It was formerly a species very difficult to determine and certainly not easy to recognise. But since the excellent descriptions of Zittel, and his discovery of the law of the alteration of the lobes in *Phylloceras* have been published, nothing is easier than to determine this species with all desirable certainty.

The general form is thick, rounded, with inflated whorls and small umbilicus. On the broad, rounded siphonal side there are short, rather sharp ribs, which pass over it. Those ribs belong chiefly to the shell itself; on the casts they are almost invisible. The example which I have to describe bears them on the chambered part of the shell. Besides those ribs no ornamentation is visible.

The lobes are most characteristic, and on them the external and first lateral saddle are the most important parts. The external saddle is beautifully symmetrical, finishing in four phylla, of which the two corresponding ones are equal; the first lateral saddle is also divided into four terminating phylla, which are, however, not quite symmetrical. The whole lobe shows eight lateral lobes on each side of the shell.

The dimensions of the described specimen are—

Diameter of the shell	...	...	...	...	...	90 mm.
„ of the umbilicus	...	...	...	...	...	7 - (0,08)
Height of the aperture from the umbilical suture.	...	...	...	...	...	53 - (0,59)
„ of the „ from the preceding whorl	...	...	...	...	...	37
Thickness of the „	...	...	...	...	...	39 - (0,43)

Remarks.—The specimen described is from east of Lair, north base of Katrol range, out of a red sandy rock with very hard concretions of sandy limonite. It seems to occur there together with *Perisphinctes Pottingeri*, Sow. sp., *Oppelia trachynota* and *cutchensis*. In Central Italy *Opp. trachynota* is also found in its society, and it is remarkable that there the same variety occurs as is represented by the Cutch specimen with the ribs exclusively on the siphonal side of the chambered part of the shell. The position of the Italian fossils is very well determined by Zittel as of Tithonian age. Thus *Phylloceras ptychoicum*, wherever it

has yet been found in Germany, France, Spain or Italy, characterises with great certainty the same horizon, and is one of the chief representatives of the Tithonian Fauna.

As to its palæontological affinities to *Phyll. Feddeni*, before described, *Phyll. ptychoicum* has a much smaller umbilicus, flatter sides of the whorls, and tetraphyllic external and first lateral saddles, whilst *Phyll. Feddeni* has the external saddle diphyllic, with a little indication of triphyllism, and the first lateral saddle purely diphyllic. The differences from *Phyll. flabellatum* and the other forms of this group consist chiefly in the lobes, and to a much less extent in the ornamentation of the casts or shells, but the distinction of the species is never very difficult.

(c.) Group of PHYLLOCERAS CAPITANEI, *Catullo*.

1. PHYLLOCERAS DISPUTABILE, *Zittel*. Pl. VI, Figs. 1a, b, 2a, b, c, 3.

1852. *Ammonites tatricus* (Pusch.) Kudernatsch: Die Ammoniten von Swinitza, Abhandlungen d. K. K. Geologischen Reichsanstalt in Wien, Bd. I, p. 4; pl. I, figs. 4—6. (*non* Pusch).
 1869. *Phylloceras disputabile*, *Zittel*: Bemerkungen über einige Phylloceras Arten. Jahrb. d. K. K. Geolog. Reichsanst. in Wien, Vol. xix, p. 63.
 1871. *Phylloceras disputabile*, (*Zitt.*) Neumayr: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 332, pl. 14, fig. 7.

This species has been already very accurately described by Kudernatsch, and especially he has with great care noticed the changes which it undergoes from age, so that only little remains to be said regarding it.

The first stage of development I cannot observe with sufficient certainty, because there is only one example by which I could get out the inner whorls, but this specimen represents a variety, of which I am not quite sure, if it belongs to this species or represents a separate one; at all events it agrees so far with *Phyll. disputabile* that only the more inflated form of the whorls of this example would separate it from the mentioned species.

Exactly, as stated by Kudernatsch, we have here also the youngest states of growth smooth, and without those fine striæ which larger specimens show. The furrows on the cast are flat, and more rounded slight impressions than furrows. Beyond a diameter of 15 mm. the striæ become distinct, but only when of a diameter of 25 do the furrows become deeper and strongly defined. In the same degree as the furrows become distinct, the short rounded ribs on the outside of the shell become first distinguishable, then more and more high; they remain until a great age has been obtained by the shell, but it seems that these then begin again to become a little less distinct.

The number of the furrows on the cast, or rounded ribs on the shell, is in different individuals very variable; here in the Indian Jura, even more so than in the Jura of the Banat. The lowest number I can observe is five, the highest

nine. To show this variability I have figured, pl. vi, figs. 1, 2, and 3, three different individuals, one with five, one with six, and one with seven furrows or rounded ribs. Large examples of this species, if well preserved, look very much like the figure of *Phyll. Kochi*, Opp., as given by Zittel; only the granulations of the outer margin of the shell are wanting, but even in *Phyll. Kochi*, as Zittel states in one of his more recent publications, these are only accidental and depend upon the preservation.

The measurements of some examples are as follows:—

	I.	II.	III.
Diameter of the shell	67 mm.	130 mm.	195 mm.
„ of the umbilicus	5 - 0.03	6½ - 0.05	8
Height of the aperture from the umbilical suture	37 - 0.55	73 - 0.5	111
„ of the „ from the preceding whorl	21	39	58
Thickness of the „	26 - 0.38	42 - 0.32	57

Remarks.—The specimens I have for examination are eight in number, mostly from Keera hill near Charee, where they occur together with *Steph. macrocephalum*. One specimen is out of the same bed from north-west of Soorka. The proper layer in Europe for this species is the zone of *Amm. ferrugineus*, in the middle jurassic formation, and it is very remarkable to find here in India the same form, without showing the least differences, in the society of *Steph. macrocephalum*, etc., near Charee, (Kelloway) after the lapse of all the long period during which the Bath-Formation was deposited in Europe. Only after having settled here for some time, the influences of the different conditions, together with the separation from the other individuals of its own tribe, have effected a slight change in its general form and lobes, and have given rise to the following species. In Europe, in the meantime, the changes took place in another direction, so that there *Phyll. Puschii* is found in the place of *Phyll. Lodaiense*.

2. PHYLLOCERAS LODAIENSE, *Waagen*. Pl. V, Fig. 5a, b; Pl. VI, Fig. 4a, b, c.

The general aspect of this species is throughout like all of this group, and only the differences of the other species serve as characteristics of this one. It is therefore very difficult to give a regular diagnosis, because those fine differences require a longer description than it is possible to give in a brief diagnosis.

Like the preceding species, *Phyll. Lodaiense* has a finely striated shell, on which, however, the ribs, which characterise the other species of the group, are barely visible. The number of furrows beneath the shell is only five on all the examples which are in the possession of our Museum. The furrows are characteristic; they are not, as in *Phyll. disputabile*, equal in depth and breadth in their whole extension, but are very strong and deep near the umbilicus, and almost disappear near the siphonal part of the whorls. This gives our species a somewhat different aspect from the preceding species, and makes it easy to recognise it at first sight. The lobes of *Phyll. Lodaiense* agree in their general type throughout with

the lobes of *Phyll. disputabile*; only by careful examination one will find that there are differences of some importance. If we compare the first lateral saddle of the two species, we find that in *Phyll. disputabile* the three phylla terminating the saddle are unequal, the middle one being the longest, whilst in *Phyll. Lodaiense* all three are equal. All this seemed to me sufficient to justify our regarding this form as a separate member in the same developmental series.

The measurements of our larger example are—

Diameter	of the shell	...	...	...	...	88 mm.
"	of the umbilicus	...	...	...	...	6
Height	of the aperture from the umbilical suture	...	...	...	...	50
"	of the " from the preceding whorl	...	...	...	...	27
Thickness of the	"	...	...	...	...	29

Remarks.—There is some doubt if our species may not be identical with *Phyll. Manfredi*, Opp. I have here no example to compare the two species in nature; but as far as I can judge from the figures, it seems to me that *Phyll. Manfredi* differs from our species by thicker and more rounded whorls, by furrows, which are deepest on the siphonal margin, and by well developed folds on the siphonal side of the shell. *Phyll. Puschi*, Opp., is also nearly allied, but the great number of furrows and the much more complicated lobes allow of its being easily distinguished.

The examples I have to describe are four, all being found in the fine brown oolite with *Asp. perarmatum* at the following localities: Lodai (one specimen), north of Dhosa (two specimens), west of Jumara (one specimen).

3. PHYLLOCERAS BENACENSE, Catullo. Pl. V, Fig. 3a, b, c.

1847. *Ammonites Benacensis*, Catullo: Primo Appendice al Catalogo degli Ammoniti delle Alpi Venete, p. 9, pl. xii, fig. 1.

1871. *Phylloceras Benacense*, (Cat.), Neumayr: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 336, pl. xv, fig. 3.

It would have been impossible to recognise this species without the excellent drawings and descriptions in the Vienna Jahrbuch.

The specimens I have got for description are very defective, the one being more or less compressed, the other a fragment of a small specimen; but the smaller one exhibits so clearly lobes identical with those of *Phyll. Benacense* that there can be no doubt about the determination. The species is flat, compressed, with rounded siphonal side and a tolerably wide umbilicus. The whorls are provided, as it seems, with not more than five contractions on each circuit. The furrows produced by them on the cast are very slightly falciform and very shallow. The shell itself is not sufficiently preserved to notice whether there are on the outer side of it ribs on the siphonal part corresponding to the furrows on the cast.

The lobes are very characteristic. In their general form they agree very much with the lobes of *Phyll. disputabile*, Zitt., but the external saddle is decidedly

tetraphyllic, and the first lateral saddle pentaphyllic; of the five leaves, however, with which this saddle terminates, two are much smaller than the other three. Of auxiliary lobes there are five standing outside the umbilical suture; the saddles between them are diphyllic, except the last two.

The dimensions of a somewhat compressed specimen from the Katrol range, as far as I can observe them, are—

Diameter	of the shell	...	...	...	...	77 mm.
"	of the umbilicus	...	...	...	...	7
Height	of the aperture from the umbilical suture	...	...	...	...	44
"	of the "	from the preceding whorl	...	...	...	?27
Thickness of the	"	...	...	...	...	?

Remarks.—The two specimens of this species I have for description are from different localities, but both out of the Katrol group. One was found on the Katrol range itself in an iron-stained nodular sandstone, the other comes from east of Rodur out of sandy shales.

The most nearly allied species to *Phyll. Benacense* is *Phyll. Puschi*, Opp., but the first lateral saddle has in the latter species only four terminating phylla instead of five, and in all the Indian species like *Phyll. Lodaiense* or *disputabile*, the number of those phylla is reduced to three, so that *Phyll. Benacense* appears as a well characterised and easily distinguishable species.

(d.) Group of PHYLLOCERAS ULTRAMONTANUM, Zitt.

1. PHYLLOCERAS MEDITERRANEUM, Neum. Pl. V, Fig. 1a, b; Pl. VII, Fig. 3a, b, c.

1852. *Ammonites Zignodianus* (Orb.) Kudernatsch: Abhandl. d. K. K. Geolog. Reichsanst., I, pt. 2, p. 8.
 1854. *Ammonites Zignodianus* (Orb.) Hauer: Sitzungsber. d. K. K. Acad. d. Wissensch. in Wien, Vol. xii, pt. 5, p. 893.
 1859. *Ammonites Zignodianus* (Orb.) Villanova: Mem. de la real Acad. de Cienc. de Madrid, Vol. iv, pl. 1, fig. 7.
 1868. *Phylloceras Zignodianum* (Orb.) Zittel: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xviii, p. 603.
 1870. *Phylloceras Zignodianum* (Orb.) Zittel: Fauna d. ält. cephalopoden führenden Tithonbild., p. 40, pl. 1, fig. 15, pl. 2, fig. 1.
 1871. *Phylloceras Mediterraneum*, Neumayr: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 340, pl. 17, figs. 2—5.

In Europe this species has a very large vertical distribution, and ranges from the Bathonian up to the uppermost jurassic group; not so in Kachh, where it seems to be limited to upper Callovian beds.

The specimens I have for examination closely resemble in every respect the European form, only the umbilicus seems to be commonly a little larger.

The general form of the shell is flattened, with flatly rounded sides of the whorls, a rather broad siphonal part, and a tolerably wide open umbilicus. The shell itself is provided with seven or eight contractions on one circuit which are deeply cut in at the siphonal part, and then continue as slight, strongly falciform

curved furrows over the sides of the whorl; at the umbilical margins they are again a little more distinct. On the cast these contractions are marked by deep furrows, which are deeper near the umbilical margin and on the siphonal part, and are a little flattened in the middle of the sides of the whorl, where they make a strong bend towards the front. Between the contractions there are on the siphonal part of the shell fine filiform ribs which are worn off on the small specimens figured on pl. VII, fig. 3, but which are well visible on the larger example, pl. V, fig. 1. On the sides of the whorls those ribs change into the common striæ of growth. Different specimens are very variable in thickness, but the other characteristics remain the same.

The lobes are only visible on one small specimen from west of Soorka, but typically agree entirely with those figured by Zittel or Neumayr; the external saddle being diphylic, and the first lateral one triphylic. However, the lobes of our Indian specimen seem a little more finely divided on the whole than those in Neumayr's figure.

The body-chamber comprises one-half of the last whorl. The aperture is preserved in the specimens I have for examination, only in the part near the umbilical suture.

The dimensions of three different specimens are—

	I.	II.	III.
Diameter of the shell	70 mm.	110 mm.	165 mm.
„ of the umbilicus	10	19	27
Height of the aperture from the umbilical suture ...	34	53	75
„ of the „ from the preceding whorl ...	22	34	?
Thickness of the „	24	36	54

Remarks.—There are five specimens of *Phyll. mediterraneum*, known from Kachh, which all were found in beds a little above *Steph. macrocephalum* and below *Asp. perarmatum*. The localities are, west and north of Soorka, three specimens, found in gray shales with ferruginous concretions; north-west of Jara, in a yellowish white limestone together with *Pelt. athleta* (one specimen), and at Keera hill near Charee, in a hard yellow limestone (one specimen).

The observation of M. Neumayr, that *Phyll. zignodianum*, Orb., is a species of the Inferior Oolite and different from the species in the Mediterranean province, is of great value, as the differences which always existed between the specimens and Orbigny's figure are thus at once explained. *Phyll. mediterraneum* is now a well founded and easily recognisable species, which can scarcely be mistaken for any other.

GENUS *LYTOCERAS*, SUESS.

There is a beautiful specimen in our Museum coming from the jurassic layers of Kachh which belongs to this genus, and which is certainly one of the largest representatives of it existing. After careful examination, I cannot identify it with any described species, and I therefore shall describe it under the name of *Lyt. rex*. Another species, much less well preserved, but existing, however, in very characteristic fragments, is *Lytoceras Adeloides*, Kudernatsch.

As to the developmental series in this genus, I can from my material here add very little to the facts as yet known. I can only ascertain that the views of Zittel on this subject are quite right, and show that my examples in some points serve to prove the facts stated by him. The developmental series, to which the two species I am going to describe belong, may be called the

*Group of LYTOCERAS EUDESIANUM, Orb.*1. *LYTOCERAS REX, Waagen, n. sp.* Pl. VIII, Fig. 1a, b.

The only example lying before me has 600 mm. in diameter. The general aspect at first recalls *Lyt. Eudesianum*, or an allied form. The whorls are rounded, a little higher than broad, almost not touching each other; the increase of the whorls is, as in *Lyt. Adeloides*, 2.5. I count about seven whorls on this specimen. The inner ones, up to a diameter of 300 mm., are covered with fine, closely arranged undulated ribs, all of equal strength, as is shown on the figures of *Lyt. montanum* and *sutile*, Oppel. Exceeding a diameter of 300 mm. the ribs of the specimen become very slight and indistinct, only a few increase very much in strength and bear rather high, folded lamellæ; they are equidistant from each other, and I count about eighteen on the last whorl which belong for the greater part to the body-chamber. The lamellæ themselves are cut out or folded backwards as in all the *Lytoceras*, and of those folds there are fourteen to sixteen on one lamella round the whorl.

The existing example has nearly the whole body-chamber preserved, and the length of it is about one-half of a whorl. The rock in which the specimen is included is not adapted for getting out the drawings of the sutures, and I am therefore very sorry to be unable to describe exactly the lobes. On parts of the shell a little weather-worn, one can remark that there were, as in all *Lytoceras*, two very extended lateral lobes.

The dimensions of the only example are—

Diameter of the shell	...	...	...	...	...	600 mm.
" of the umbilicus	...	...	...	...	...	235
Height of the aperture	...	...	...	...	...	220
" of the preceding whorl	...	...	...	...	...	110
Thickness of the aperture	...	...	...	...	...	200

Remarks.—If we regard the species, setting aside the last whorl, we would find it difficult to distinguish the specimen from *Lyt. sutile*, Opp., to which our species certainly shows a great affinity. The undulations of the ribs of the inner whorls are not distinct enough to count them with certainty, but as soon as some few principal ribs are distinguishable, one remarks, that there are only seven on one side of the whorl instead of many as in *Lyt. sutile*. That brings this form nearer to *Lyt. Eudesianum*, where only six such undulations can be counted. In this latter species, however, from the very youngest stage of growth, already principal and secondary ribs are distinguishable, whilst, on the contrary, *Lyt. rex* shows them only on the last whorl. We have therefore here a species which is equally allied to *Lyt. sutile* as to *Lyt. Eudesianum*, but identical with neither of them.

There is therefore, I suppose, no doubt that *Lyt. rex* belongs to the developmental series of *Lytoceras Eudesianum*, but, if this be so, the laws of development, which Zittel pointed out for this series, are true only to a certain extent, but must be changed a little, if we are to unite all the allied forms under this group. There is no doubt that if we start, like Zittel, from *Lyt. cornucopiae*, Y. and B., we find that the changes of the mutations are in general expressed by diminishing the number of undulations of the ribs. But having arrived at a minimum in *Lyt. Adeloides*, Kudern., the number of undulations increases again gradually, but the principal ribs, which are very characteristic for the geologically older species, now disappear, and are only limited to the last whorl and body-chamber, or are entirely wanting.

The rock which contains the fossil is a grayish-yellow, partly soft, partly very hard sandstone, with veins of iron-ore in every direction: *Lyt. rex* is the only fossil out of this rock I know. According to Mr. Wynne's indication, the layer which contained the species is rather high above the golden oolite a little south of Keera hill near Charee; from a palæontological point of view, one should judge that *Lyt. rex* had a position lower than Tithonian and higher than Oxfordian layers.

2. *LYTOCERAS ADELOIDES*, *Kudernatsch*. Pl. VIII, Fig. 2.

1852. *Ammonites Adeloides*, Kudernatsch: Abhandl. d. K. K. Geolog. Reichsanst., Vol. I, Abth. 1, p. 9, pl. 2, figs. 14—16.

1868. *Lytoceras Adeloides*, (Kudern.) Zittel: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xviii, p. 603.

In general form, this species is very nearly allied to that just described, or also to *Lyt. Eudesianum*. The whorls are very loose, almost not touching each other, and therefore on the inner or dorsal side of the whorls almost not impressed. The section of the whorls is a little broader than high, but there is, it seems, a little variation in this, and this character is not quite constant. The whorls rapidly increase. The sculpture of the shell is, in all the fragments at my disposal, not very well preserved, but sufficiently to show the characteristics of the species. I

count on half a whorl about twelve prominent ribs, between which finer ribs are placed. The prominent ribs have on their top, when well preserved, shelly lamellæ, with three to four folds each. Those ribs begin already in a small diameter of the shell, and examples of about 150 mm. diameter show them very strongly. All this shows the identity of our specimens with *Lyt. Adeloides*, Kudern., as described by Kudernatsch, and even better fixed by Zittel. But the lobes also, which I have figured on plate VIII, fig. 2, are quite identical, of course setting aside the changes of age. The most characteristic fact seems to me to be, that the branches of the first lateral lobe quite envelope the siphonal tube. Kudernatsch states this in his description, and I also found it in the examples from Kachh. I have no unbroken specimen, and therefore I cannot give accurate measurements.

Remarks.—It was for a long time doubtful if this species should be separated from *Lyt. Eudesianum*, and Hauer, in his notes regarding this species, comes to the conclusion that there is no difference between them. Only Zittel, after having carefully examined large materials, has, influenced by the idea of developmental series, pointed out that there are some slight but very constant differences, sufficient to justify the acknowledgment of a separate mutation. This example shows more clearly than any other how the descendent theory, used in the right direction, instead of causing a superficial examination of natural objects, conducts, on the contrary, to the most conscientious comparison of the separate forms. The principal misconception entertained on this subject arises from the fact, that people will not allow the idea that there are no radical differences between single species. The distinction of species is in reality only a counting up of the accumulations of changes which all forms undergo in the course of time. Now, it is quite natural, that forms, separated by a long interval of time, or such as rise from a different root, show strong differences, whilst others very nearly connected in time and root appear similar to a high degree. But is it right to ignore, therefore, the latter and to notice only the first? Certainly not; if we have to write a history of life upon the earth, and this alone can be the problem of Palæontology, we must mark not only the stages, but also the footsteps of the development of forms, because only by following up footstep by footstep we will at last discover the secret of the creation.

As such a footstep now I consider *Lyt. Adeloides*; the stage and root at the same time is *Lyt. Eudesianum*; therefrom rises the whole developmental series. In one of my former papers I have proposed a certain way of writing to signify those relations between some Ammonites, and in this case I should write *Lyt. Adeloides*, Kud. (R. *Eudesianum*, Orb). The latter of the two names, I called the root, radix (= R), the former I called mutation, and the whole, the genetic or developmental formula. *Lyt. R. Eudesianum* alone, however, would signify the whole of the forms, which spring from this species, the whole developmental series or group as I called it formerly. In the special case now referred to, *Lytoceras Adeloides* is a mutation of the collective species *Lyt. Eudesianum*.

All the specimens I have here for examination came from Keera hill near Charee; they are fragments of four different individuals. The rock in which they are preserved is the fine, golden oolite, which contains *Steph. macrocephalum*. We find here, therefore, *Lyt. Adeloides* in the same position as in the Brielthal in the Austrian Alps.

GENUS *AMALTHEUS*, MONTF.

Of the many generic designations Montfort once proposed for the different forms of fossil cephalopoda but very few have remained in use up to this; and especially the divisions he made among the Ammonites were thought perfectly unacceptable, not without reason, because Montfort's genera were formed in quite an arbitrary way, without following any principle, and thus they were useless to science in by far the greater number of cases. Nevertheless, the names were given, and, in all cases, where their meaning could be found out with certainty, had to be used, if a generic name was thought desirable for the forms in question. Thus, in dissolving the old genus Ammonites into several smaller genera, Montfort's names had again to be taken into consideration, and Hyatt* was perfectly right in using the generic name of *Amaltheus* for the group of *Amalthei* of former authors, because the figure given by Montfort† cannot possibly be mistaken as representing anything but the form generally known as *Amm. margaritatus*, Montf.

It is differently with others of Montfort's names, such as *Pelagus*, *Planulites*, *Simplegades*, *Ellipsolithes*, etc.; none of the figures given to illustrate these genera is recognisable as a certain definite species, and even the group they possibly could belong to is very doubtful, and thus all these names cannot be used in science any more, but must become obsolete, and it was necessary to create new names for other divisions of Ammonites.

The genus *Amaltheus* is one of the least known among the jurassic genera of Ammonites, and principally the species occurring in the 'Dogger' formation are generally so rare that it was for a long time doubtful if any true *Amaltheus* could be assigned to the middle jurassic beds.

So much more interesting is it therefore to find two species of this genus in the Kachh Jurassics, and one of them agreeing in every respect with a beautiful European species, *Amaltheus pustulatus*, Rein. The latter has been found by Dr. Stoliczka in nearly the same geological position as it occurs also in Europe, that is, together with *Pelt. athleta*.

The other is a new species, which I shall call *Amaltheus Schaumburgi* in honor of the artist under whose direction the plates have been executed. It occurs, like the other species, in the beds with *Pelt. athleta*.

* Hyatt, 1868. The fossil cephalopoda of the Museum of Comp. Zoology: Bull. of the Mus. of Comp. Zool. at Cambridge, Mass, p. 90.

† Montfort, 1808. Conchyliologie systematique, 1, p. 90.

1. *AMALTHEUS PUSTULATUS*, *Reinecke, sp.* Pl. IX, Fig. 2a, b, c.

1818. *Nautilus pustulatus*, Reinecke: *Maris protogaei Nautilus et Argonautas*, figs. 63, 64.
 1846. *Ammonites pustulatus*, (Rein.) Orbigny: *Paléont. Franç. Terr. Jurass.*, I, pl. 154.
 1846. „ *pustulatus Franconicus*, Quenstedt: *Cephalopoden*, page 134, pl. IX, fig. 22.
 1857. „ *pustulatus*, (Rein.) Oppel: *Jura formation*, page 560.
 1858. „ *pustulatus*, (Rein.) Quenstedt: *der Jura*, p. 525, (pars), pl. 69, figs. 32, 33.

Though only represented by a single specimen, this species being too characteristic to be mistaken, can be identified with tolerable certainty with the European one.

The specimen I have for description is a rather large one, but yet filled with air-chambers up to its end. The general form of the shell is inflated, the whorls being about as thick as high; the umbilicus is not very large, but deep, and surrounded by nearly perpendicular walls, which form a rounded edge with the sides of the whorls. The latter are flattened, covered with unequal strong ribs, which are for the greater part provided in the middle of the sides with strong spines, which, however, are generally broken off and then leave behind thick rounded tubercles. The ribs commence at the umbilical margin very low, increasing rapidly in height as they run in nearly a radial direction over the sides of the whorls; partly they divide into two, where they carry the tubercles; partly they remain unchanged, provided again with strong tubercles at the rounded edge, where the lateral and siphonal parts of the shell are touching. Thus there are two rows of tubercles running along the whorls, one in the middle of the sides, and one at the edge of the siphonal part of the shell. Some of the ribs are divided again at this second row of tubercles, most of them are not, but all are turned a little in front at the siphonal part. In the middle of the siphonal part of the whorls a keel exists, which is protracted into elongated tubercles where the ribs are touching it. These tubercles appear like a crest, when the shell is preserved, but generally the shell is partly broken off, and then the tubercles are rounded, low, and little distinct.

It was Quenstedt who first called attention to the peculiarities of the keel of this species. He proposes to form a new group of this and some allied species, for which he gives the name of "*Dorsocavati*." In preparing the specimen here described for description, I could well prove also for the Indian shell the same peculiarities, consisting in the keel being hollow and forming a separate tube, divided from the inner space of the whorl by a thin shelly layer, and nowhere communicating with the air-chambers, entire in itself, and admitting the entrance of the seawater all along the whole spiral of the shell.

The entire shell is covered with fine concentric striæ, as they are observable in most of the *Amalthei*.

The lobes are nowhere visible, as the whole specimen is covered with thick black shell.

The dimensions are—

Diameter	of the shell	...	...	...	...	...	90 mm.
"	of the umbilicus	...	...	...	...	...	19
Height	of the aperture	from the umbilical suture	...	...	...	...	44
"	of the "	from the preceding whorl	...	...	...	...	35
Thickness	of the "	...	...	...	...	...	40

Remarks.—The only specimen of this species from Kachh preserved in our Museum has been found by Dr. Stoliczka at a considerable distance north-east of Gudjinsir in a black shale, together with some fragments of *Pelt. athleta*, Phill.

Our Indian specimen agrees in general very well with the figures given by Quenstedt, less so with d'Orbigny's drawing. The ribs are more simple in our specimen than they are drawn there, and generally do not divide at the tubercles; then nearly every one of the ribs corresponds with a tubercle on the siphonal keel, contrary to d'Orbigny's figure, where three or four ribs unite in one tubercle. These differences, however, did not seem to me sufficient to distinguish a new species, as among the small pyritic specimens, found at Gammelshausen in Württemberg, a great variability in this respect is exhibited. Another difference between the Indian and the European specimens lies in the tubercles, of which in the Indian shell the outer row is the strongest, whilst in the other ones the inner tubercles are the more prominent. In consequence of this the transverse section of the whorl has a somewhat different appearance.

The geological position in which *Amalth. pustulatus* is found generally in Europe is not much different from that in which it occurs in India.

In Württemberg it is one of the most beautiful fossils of the "Brauner Jura, Z.," of Quenstedt, or of the "Ornatenthon" of Leopold von Buch. Nearly the same position of the species is indicated for the Indian specimen by its occurrence together with fragments of *Pelt. athleta*, which in Europe is also a species of the "Ornatenthon." The only difference is, that this latter fossil in Europe generally marks the upper region of these beds; *Amalth. pustulatus*, on the contrary, the lower region, and thus both species are generally not found together.

2. AMALTHEUS SCHAUMBURGI, *Waagen, n. sp.* Pl. IX, Fig. 1a, b, c.

This species in many respects resembles *Amalth. polygonius*, Zieten, sp., but nevertheless I think it necessary to create a new name for it on account of the different structure of its keel.

Only one specimen of this species is in our Museum which has been found in the same geological position as the foregoing species, but at another locality, by Dr. Stoliczka.

The general form of the shell is rather depressed, the whorls being much higher than broad. The umbilicus is not very large, flat, surrounded by low, not

strictly defined, walls. The largest transverse diameter of the whorls is nearly in the middle of the sides, and from that point the sides slope gradually and regularly towards the umbilicus as well as towards the siphonal part.

The shell is covered all over with strong radial ribs, which are, however, not very broad, leaving a broad smooth space between them. They start from the umbilicus as high narrow ridges, going nearly straight and radially to the middle of the sides, then turning a little towards the front divide into two or take a new and shorter rib between them; some remain entirely undivided. The ribs of both sides unite on the siphonal edge of the shell in high, sharp, crest-like tubercles, which form a strongly serrated keel. This keel is, as far as I can observe, not divided by a shelly layer from the inner space of the whorl, but is in its construction perfectly like the keel in the greater number of Ammonites. Thus this species does not belong to Quenstedt's group of the "Dorsocavati."

Though the shell is partly preserved in the specimen serving for description, yet the concentric striæ, which come out so strongly in the foregoing species, are very slightly marked in the present one, only causing a slight granulation on the top of the ribs, and not appearing at all in the broad flat spaces between them.

The lobes cannot be observed, as three quarters of the last whorl belong to the body-chamber, and the air-chambers, which follow them, are quite compressed.

The dimensions of the specimen are—

Diameter	of the shell, about	...	...	...	...	...	116 mm.
"	of the umbilicus	...	...	...	...	...	22
Height	of the aperture from the umbilical suture	...	...	...	...	...	53
"	of the " from the preceding whorl	...	...	...	...	...	35
Thickness	of the " ...	...	...	...	...	...	34.5

Remarks.—The specimen serving for description is preserved in sphærosiderite, is mostly a cast, and was found by Dr. Stoliczka at Gudjinsir in the beds with *Pelt. athleta*.

As I have already stated above, the species is very nearly allied to *Amalth. polygonius*, Ziet, and in its general appearance the affinity is striking, but on closer examination both species are easily distinguishable by the stronger and scarcer ribs, and the absence of spines in the middle of the sides of the whorls in the Indian Ammonite.

It is strange, however, to observe that in two shells so closely allied, as in *Amalth. polygonius* and *Amalth. Schaumburgi*, the one belongs to Quenstedt's *Dorsocavati*, whilst in the other the hollow keel is perfectly wanting. This difference may possibly show that the peculiarity in the keel is not of so great an importance as might be supposed.

Though the specimen here described has the greater part of the body-chamber yet preserved, no alteration can be remarked between the sculpture of the latter part and that of the air-chambers.

GENUS *HAPLOCERAS*, ZITTEL.

There have as yet been found only three specimens of this rare genus in the jurassic strata of Kachh, one of them not in a sufficient state of preservation to admit of an accurate determination, though it seems very probable that it belongs to *Haploceras tomephorum*, Zitt. The other is a new species, which I shall describe under the name of *Hapl. deplanatum*. Both are found in the ferruginous sandstones of the Katrol group. The third is of nearly Oxfordian age, and represents also a new species. Each of these species belongs to a different group of forms, and thus the genus, though it only furnished three species, is yet pretty well represented in the Kachh Jura.

Haploceras, characterized by smooth whorls, short body-chamber, eared mouth, and incisions on the siphonal side of the body-chamber, can, by a little care, be easily recognised even in small fragments by the smooth surface, the rounded siphonal side, and the strongly falciform striae of growth on the shell, which characters never occur together in other groups of Ammonites.

(a.) Group of *HAPLOCERAS* *RASILE*, *Opp.*1. *HAPLOCERAS* cf. *TOMEPHORUM*, *Zittel*. Pl. VII, Fig. 4a, b.

1865. *Ammonites incultus*, Oppel: Zeitschr. d. deutsch. Geolog. Ges., Vol. xvii, p. 552, (non *Amm. incultus*, Beyr).
 1870. *Haploceras tomephorum*, Zittel: Fauna der älteren cephalopoden führenden Tithonbildungen, p. 54, pl. 28, (4), fig. 9.

Though I suppose it to be nearly sure that our example from Kutch belongs to Zittel's species, I will not identify it without reserve, simply because the last part of the last chamber is wanting, and the siphonal lobe is not visible.

The example from Kutch lying before me is a rather small shell of 20 mm. diameter. The whorls are rounded, as broad as high, the umbilicus rather small and deep. There are three lateral lobes on each side, the first lateral lobe being the largest of them, all finishing in one point, the saddles with very little dentation. The siphonal lobe is too badly preserved to ascertain if it was longer or shorter than the first lateral, but it seems that the former was the case. The shell of the inner whorls is covered with fine striae of growth of strong falciform shape.

The dimensions are—

Whole diameter	...	...	...	...	...	20 mm.
Height of the last whorl	...	...	...	...	...	9
Thickness of the last whorl	...	...	...	...	...	9.5
Width of the umbilicus	...	...	...	...	...	5

Remarks.—The label attached to this specimen says: "From a gritty rag bed above the great thickness of clays and shales forming scarp of hills in 'Section S.' of Bhoojooree.—From the highest beds containing Ammonites in Katrol range at Juddoora, south of Bhooj."

The genus *Haploceras* begins in Europe in Inferior Oolite strata, and is there represented by three species; in the Bathonian there are two; in Kelloway strata one; the same in Oxfordian, one; in Kimmeridgian, one;* in the Tithonian formation, eleven; in the Neocomien again, two; it is therefore evident that the genus has its greatest development in the Tithonian age. If we look through all the species, we find that on account of the sutures and the section of the whorls, only two can be compared with our specimen; those are *Hapl. rasile*, Opp., var. *inflata*, Zitt., and *Hapl. tomephorum*, Zitt. After a most careful examination of all the valuable points, I come to the conclusion that most likely the example here existing belongs to the latter species. I regret very much that the bad state of preservation of this example does not allow me to state the determination with all certainty.

It is of great importance that this specimen comes "from the highest beds containing Ammonites;" and that it represents a Tithonian form. It would be too much to assign for this reason to the strata containing this fossil without doubt a Tithonian age, but it is certainly remarkable that the youngest beds, containing Ammonites in Kutch, have furnished a fossil of a type which in Europe also signifies the youngest jurassic fauna. But there is yet another specimen coming from the same locality and layer preserved in our Museum which represents another species, but also of a Tithonian type. I shall describe the species accurately on one of the next pages under the name of *Asp. Wynnei*.

The rock which contains the specimens is a red marly sandstone, with large grains of quartz.

(b.) Group of *HAPLOCERAS PSILODISCUS*, *Schloenbach*.

1. *HAPLOCERAS DEPLANATUM*, *Waagen*, n. sp. Pl. XI, Fig. 9a, b, c.

The species is very much allied in its general form to *Hapl. Erato*, Orb., but can be distinguished easily by its flatter shape.

The cast, which alone I have for description, is flat, disciform, with a tolerably wide umbilicus and rounded siphonal sides. The sides of the whorls, though flattened, are, however, not strictly level, but rounded in a very depressed arch. The umbilicus is shallow, surrounded by rather steep walls, which pass into the sides of the whorls without forming an umbilical edge. The siphonal side is narrow, but perfectly rounded.

The lobes are rather short and broad, but do not exceed the limits of variability as exhibited by the other species of the genus. Their general type somewhat recalls *Hapl. elimatum*, Opp., or *Stasczyi*, *Zeuschn*. The siphonal lobe is very short, with two small terminating branches, the external saddle low, with a

* Since this was written Dr. Neumayr has described several other Kimmeridgian species.

small secondary lobe in the middle. First lateral lobe the longest of all, nearly twice as long as the siphonal, with broad body and with one terminal and three lateral branches. First lateral saddle going high up, higher than all the others, with a secondary lobe in the middle. Second lateral lobe shorter than the first, unsymmetrical. Three auxiliary lobes as far as the umbilical suture.

The dimensions are the following :—

Diameter of the shell	...	...	...	...	...	27 mm.
" of the umbilicus	...	...	...	...	...	6
Height of the aperture from the umbilical suture	...	...	...	...	...	14
" of the " from the preceding whorl	...	...	...	...	...	11
Thickness of the " ...	...	...	...	...	...	8

Remarks.—The only specimen existing of this species was found on the road to the Charvar range, south of Bhooj, in the sandstones of the Katrol group. Though small and without body-chamber, it is a characteristic and well preserved specimen.

Hapl. deplanatum is at a first glance not easy to distinguish from the other smooth forms with complicated lobes, and principally *Hapl. psilodiscus*, Schloenb., and *Hapl. Erato*, Orb., are very nearly allied to the Kachh species. The former, however, can be distinguished by a somewhat smaller umbilicus and lobes, in which the first lateral saddle is without secondary lobes. *Haploceras Erato* has a larger umbilicus and thicker whorls. *Hapl. deplanatum* is in general next to *Hapl. psilodiscus* the flattest and thinnest species of the whole genus. From all the allied forms of the Tithonian formation, our species is also distinguishable by more simple lobes.

Hapl. deplanatum is in every respect the connecting link between *Hapl. Erato* and *Stasczyi*. Whilst in Europe the series seems rather broken,—as there, in Kimmeridgian beds, the genus is only represented by *Hapl. falcata* and *Wentzeli*, which do not well fit into the series,—the connection is completed by the Indian species, which keeps also a geological position between Oxfordian and Kimmeridgian formations.

(c.) Group of *HAPLOCERAS FIALAR*, *Oppel*.

1. *HAPLOCERAS PROPINQUUM*, *Waagen*, *n. sp.* Pl. XI, Fig. 4a, b.

This species is very nearly allied to *Haploceras Fialar*, *Opp.*, and possibly yet more to *Hapl. tenuifalcatum*, *Neum.*, but the latter species is very difficult to recognise from the brief description given in the *Verhandlungen* of the Vienna Geological Institute.

The general form of the shell is flat, discoid, with compressed, rounded whorls and a widely open umbilicus. The siphonal side shows a rounded edge, without keel or tubercles. The whorls are nearly entirely smooth up to a diameter of the

shell of about 30 to 35 mm., but in larger specimens the sides of the whorl are provided with thin, sharp, curved ribs, which begin near the siphonal margin and go down to the middle of the sides, where they meet a shallow canal, near which they terminate again. From the canal the shell gradually descends towards the umbilical suture, and, showing not a trace of any ribs, is only covered with faint striæ of growth, directed obliquely with a slight curve towards the mouth of the shell. The body-chamber, however, is not preserved.

The inner whorls, though apparently smooth, show also very fine and numerous curved ribs on the outer half of their sides, towards the siphonal part, visible if the specimen be held so that the light is reflected; but there never is any trace of a canal visible. The umbilicus in young specimens is a little deeper and surrounded by an obtuse umbilical edge.

The lobes are not very well seen, but one can observe that the siphonal lobe is very short, also the external saddle. The first lateral lobe is rather long, not very much ramified; the first lateral saddle goes up very high, and is unsymmetrical. The second lateral lobe is very small. There are four auxiliary lobes.

The dimensions are—

Diameter	of the shell	...	...	...	...	50 mm.
"	of the umbilicus	...	...	...	...	13
Height	of the aperture from the umbilical suture	...	...	...	...	22
"	of the "	from the preceding whorl	...	...	...	16
Thickness of the	"	...	...	...	...	11

Remarks.—The only full grown specimen of this species was collected by Dr. Stoliczka at the south side of Keera hill near Charee, in whitish shales with ferruginous nodules, with many quartz grains, immediately above the oolite, with *Aspidoc. perarmatum*.

The species is not difficult to distinguish from any other known. Among European species *Hapl. Fialar* is the most nearly allied to it, but is distinguishable by its more curved ribs and the tubercles on the siphonal side. Neumayr's *Hapl. tenuifalcatum* may even be identical with our species, yet as he distinctly states that there is no canal on the sides of the whorls, but does not give the diameter of the shell at which the canal is wanting, I cannot identify the Indian species with that from Transylvania.

Certain species of *Harpoceras* also resemble very much *Hapl. propinquum*, principally some varieties of *Harp. Brighti*, Pratt, but as this species has in young specimens already a pronounced sculpture and a rather deep canal, the Kachh form may be easily separated.

The two most nearly allied species of Europe above mentioned belong both to the zone of *Oppelia tenuilobata*. Very nearly the same seems to be the position of the Indian form at the base of the Katrol group, viz., Upper Oxfordian or Lower Kimmeridge.

GENUS *OPPELIA*, WAAGEN.

This genus, proposed by myself in 1869, is in Europe chiefly characteristic for the *Malm* formation. We should therefore expect its representation also in the Kachh Jurassic strata, and accordingly not less than ten species of the genus have been successively discovered.

They begin in Kachh below the beds with *Steph. macrocephalum*, are most numerous in species in the beds with *Perisph. arthriticus* and *Pelt. athleta*, and are yet represented by four species in the Katrol group. All, except one, belong to groups of forms which also occur in Europe, and several are identical with European species.

The origin and grouping of the species of the genus *Oppelia* I have discussed already at length in a former memoir, (Die Formenreihe des Amm. subradiatus, Benecke, Geogn. Pal. Beitr., Vol. II), and therefore I shall be brief here on this point.

There are four principal groups of forms represented among the Kachh species: the group of *Oppelia subradiata*, Sow., by *Opp. subcostaria*, Opp., *Opp. cf. glabella*, Leckenby, and a fourth species out of the bed with *Pelt. athleta*, which is, however, represented in our Museum only by two body-chambers in too bad a state of preservation to admit of accurate determination or description. There is a group of entirely Indian distribution, the group of *Oppelia fornix*, Sow. It forms a kind of transition from *Harpoc. hecticum* to *Oppelia*, and is represented in Kachh by *Opp. fornix*, Sow., and *Opp. Nurrhäensis*, Waagen, n. sp. The group of *Oppelia superba*, Waagen, represented by *Oppelia bicostata*, Stahl. The group of *Oppelia flector*, Waagen, with *Oppelia trachynota*, Opp., and *Opp. Kachhensis*, Waagen, n. sp. Group of *Oppelia subtililobata*, Waagen, by *Opp. plicodiscus*, Waagen, n. sp., in the Kachh Jura.

Two other groups deviate from the typical forms of *Oppelia* by a wider umbilicus and depressed whorls; they are the groups of *Oppelia lingulata*, Quenst., and of *Oppelia (Oecotraustes) genicularis*, Waagen, the first represented in Kachh by *Oppelia plana*, Waagen, n. sp., and the other by a compressed and not well preserved specimen, a species very likely identical with *Opp. (Oecotraustes) serrigera*, Waagen.

An isolated form of only Indian occurrence is *Oppelia orientalis*, Orb.

The species identical with European forms are, as in the other genera, distributed geologically quite in the same way as in Europe: *Opp. subcostaria* is associated with *Steph. macrocephalum*, *Opp. bicostata*, Stahl., with *Peltoc. athleta*, *Opp. trachynota* with *Aspidoc. iphiceroideus*. But not only do the identical species show the same geological distribution, there are also some analogous forms which represent European species in corresponding beds; thus *Opp. Kachhensis* replaces *Opp. compsa*, Opp., *Opp. plicodiscus* replaces *Opp. tenuilobata*, and *Opp. plana* replaces *Opp. modestiformis* of Europe in the Katrol group.

It is also of interest that the *Aptychus*, characteristic of the genus *Oppelia*, has also been found in Kachh. One specimen of rather considerable dimensions is

preserved in our Museum as coming from Kachh, but no exact locality is indicated. The specimen is preserved in a ferruginous sandy rock, and has been collected very likely in beds of the Katrol group.

(a.) *Group of OPPELIA SUBRADIATA, Sow., sp.*

1. *OPPELIA SUBCOSTARIA, Opp. sp.* Pl. X, Figs. 1, 1a, 2, 2a.

1857. *Ammonites flexuosus macrocephali*, Quenst.: Der Jura, p. 482, pl. 64, figs. 7, 8.

1862. „ *subcostarius*, Oppel: Paläontolog. Mittheilungen, I, p. 149, pl. 48, fig. 2a, b.

1869. *Oppelia subcostaria* (Opp.) Waagen: Geognost. Paläontolog. Beitr. v. Benecke, Schlönbach und Waagen, II, p. 219, pl. 19, figs. 2—5.

The description I have given in the paper quoted above is, I think, detailed enough to enable every one to recognise the species; thus I can be a little more brief here on this point and restrict myself to the Indian specimens.

In young examples one can distinguish, as in Europe, two varieties which seem at first view of two very distinct species; I myself was for a long time inclined to consider them as different. The Indian examples are, however, very well adapted to show that this is not the case. I have on pl. x, figs. 1 and 2, figured two examples, the first half of the last whorls of which show each one of the two varieties. In fig. 1 the younger states of growth are commonly very smooth; one remarks only a very little elevated spiral ridge on the middle of the sides. From there a few rather strong falciform ribs turning against the outer margin are visible, between which along the outer margin a greater number of very short fine ribs appear. Those latter, however, become slighter and slighter as the specimen grows large, and disappear entirely at a diameter of the shell of about 50 mm., so that only the stronger, falciform ribs still exist; and then the shell has attained its typical form. This is exactly the variety I have figured in pl. xix, fig. 3, of my former paper.

The other drawing, fig. 2, pl. x, shows the first half of the last whorl covered with rather strong, equal, falciform ribs, each of them terminating on the outer margin with a rounded prominent point. The points gradually disappear, the ribs become more distant, and at a diameter of about 55 mm. the specimen attains throughout the same typical form as the other variety. The Indian specimen is the first full grown example of this variety I have been able to examine; at the time I described this species in our Geognostisch paläontologischen Beitrægen I had only one young example from Balin at my disposal, and it was difficult to identify it with the other variety; the Kutch specimen now justifies my former views on this point.

The full grown form of *Oppelia subcostaria* is discoid, with a rather small umbilicus. The siphonal side is in casts always rounded; if the shell is preserved, a slight keel is visible. The sides of the specimens are more or less rounded and

bearing slight, distant falciform ribs, of which I count about fourteen on an example of 100 mm. in diameter.

The measurements are—

	I.	II.
Diameter of the shell	63 mm.	97 mm.
„ of the umbilicus	11	13
Height of the aperture from the umbilical suture ...	34	54
„ of the „ from the preceding whorl ...	24	36
Thickness of the „	17	27

Remarks.—The specimens now described are both from Keera hill near Charee, preserved in the same beautiful golden oolite in which also the *macrocephali* and the other species characteristic for this zone are preserved; another specimen had been found just at the base of the golden oolite, also at Keera hill. It is of great importance, and especially worthy of remark, that here *Oppelia subcostaria* occurs not only in the same form, but even in the same varieties as in Europe in the same layer. If one remembers how many extremely nearly allied forms exist, and what a little change would be sufficient to enable one to consider it as a different species, it is really astonishing that such changes cannot be pointed out. The ancestors of *Oppelia subcostaria* are all found in Europe, and I have formerly shown that the first roots of the species lie there in the inferior oolite in *Oppelia subradiata*. In India we have not yet found a single form like *Opp. subcostaria*, in older layers, and we must therefore presume that this species is of European origin.

2. OPPELIA cf. GLABELLA, *Leckenby, sp.* Pl. X, Figs. 7, 7a.

1859. *Ammonites glabellus*, Leckenby: Quart. Journ. Geol. Soc., Lond., XV, p. 12, pl. II, fig. 5a—c.

1866. *Ammonites glabellus*, (Leckenby) Oppel: Geognost. Palæontol. Beitr. von Benecke: Schlönbach u. Waagen, I, p. 215.

The example which represents the species is not very well preserved, and thus not well adapted for an exact determination, but the form deserves to be mentioned as occurring in the Indian Jura.

There are only the body-chamber and the last air-chamber preserved in the specimen I have for description.

The body-chamber occupies a little more than a half of the last whorl, is in its beginning still somewhat keeled, but soon loses the keel entirely and gets perfectly rounded on the siphonal side towards the mouth. The sides are flatly rounded with a shallow spiral furrow on the middle. The sides are thus divided into two parts, the inner of which is smooth; the outer is covered by arched ribs, some of which are stronger, principally near the furrow, the others are fainter and shorter, limited to the outer margin.

The lobes are short and very simple, nearly resembling those of *Opp. latilobata*, Waagen. The siphonal lobe is shorter than the first lateral; first lateral saddle divided by a secondary lobe, similar to the external saddle. Three auxiliary lobes.

The dimensions are—

Diameter of the shell	...	...	...	...	68 mm.
„ of the umbilicus	...	...	...	...	6
Height of the aperture from the umbilical suture	...	...	...	...	34
„ of the „ from the preceding whorl	...	...	...	...	22
Thickness of the „	...	...	...	...	20

Remarks.—The only specimen existing of this species was found at Keera hill near Charee, very likely in the bed of *Peltoc. athleta*, and is preserved in a gray marl nodule.

In Europe *Opp. glabella* is a species of Lower Oxfordian age, and thus the species would occupy a somewhat lower position in the Indian Jura.

There is yet another species belonging to the group of *Opp. subradiata*, preserved in our Museum, but the materials which exist—two body-chambers—are not sufficient to allow of an exact determination. The species reached a diameter of about 100 mm., and the specimens resemble in some respects the body-chambers of small specimens of *Opp. subcostaria*, but the umbilicus is much larger.

Both specimens are preserved in gray marl nodules, with the shell black in colour, and were found one in the zone of *Pelt. athleta*, north-east of Gudjinsir, the other in the same bed south-east of Nurrha.

(b.) Group of *OPPELIA FORNIX*, Sow.

1. (?) *OPPELIA FORNIX*, Sow. Pl. XIV, Figs. 7—7a.

1840. *Ammonites fornix*, J. de C. Sow.: Transact. Geol. Soc., Lond., Vol. v, pl. 61, fig. 13, and expl.

1871. *Harpoceras fornix*, (Sow.) Waagen: Records. Geol. Surv. of India, Vol. iv, p. 91.

This species seems to be one of the rarest in the Kachh Jura, as even in the very rich collections of fossils which have been at different times obtained by our Museum not a single specimen of this species is preserved. But I have been obliged to change the generic designation of *Amm. fornix* from *Harpoceras* into *Oppelia*, as the species shows great analogies to *Oppelia Narrhaensis*, which latter could be proved by new material to be an *Oppelia*.

To describe the species I can do nothing but repeat Sowerby's words. He says—"Discoid, depressed, (when young, keeled), undulated; inner whorls $\frac{1}{3}$ exposed, their exposed parts smooth; margin convex, smooth, with a row of minute tubercles on each side and a slender keel, which are lost in the external whorls; undulations bent back in the middle of the sides, divided towards the margin;

aperture sagittate elliptical. Diameter two inches, width of the aperture seven lines; its length one inch two lines."

Remarks.—The species is very peculiar in its shape, and has no representative whatever as yet in the European Jura. It is very nearly allied to the following species, and forms together with it a well characterised and easily distinguishable group.

2. *OPPELIA NURRHAENSIS*, *Waagen, n. sp.* Pl. XI, Fig. 2a, b; Pl. XIV, Figs. 3, 3a, 3b, 4, 5, 6, 6a.

1871. *Harpoceras Nurrhaense*, *Waagen*: Records, Geol. Surv. of India, Vol. iv, p. 91.

Very good materials of this species were brought back by Stoliczka from his geological tour in Kachh, among others, a full grown specimen with entirely preserved body-chamber, which causes me to transfer the species from the genus *Harpoceras* to *Oppelia*.

The shell in its general appearance and its variability most nearly resembles *Opp. fusca*, Quenst., among European species.

The outer form is discoid, compressed, with tolerably flat sides, a keeled siphonal side on the air-chambered part of the shell, a rounded one on the body-chamber, and a tolerably wide umbilicus. The sculpture is extremely variable, just as much and even more so than in *Oppelia fusca*. It is always composed of strongly curved, falciform ribs, which, however, are sometimes very numerous, sometimes scarce, sometimes provided with little tubercles on the outer margin, sometimes not.

The early stages of growth up to a diameter of 4 mm. are entirely smooth, with depressed rounded whorls without keel. The keel appears at about 7 mm. diameter, the ribs yet later, and often specimens of 15 mm. are still without them. When they appear, the outer part of them, going from the middle of the sides in a strong semicircular curve to the siphonal margin, is first visible; the inner part remains commonly very faint, is strongly directed towards the front, and corresponds with two or three of the outer ribs.

The permanent form of the shell appears only at a diameter of 35 to 40 mm. In specimens which were densely ribbed up to that size the ribs become thin, more distant at equal intervals, sharper and more regular; other varieties change their sculpture to about the same effect; but only the outer part of the ribs is well developed, the inner part is barely visible. On the body-chamber the ribs disappear entirely, and the shell is there densely covered with strong striæ of growth; the aperture is not well preserved, but it can be seen that it was slightly falciform with a rounded ventral prominence. There is, therefore, no doubt that the species belongs to the genus *Oppelia*. The umbilicus is about one-fifth of the diameter of the shell, and is surrounded by curved walls.

The lobes are very simple, and in adult specimens very characteristic. The siphonal lobe is broad, short, and divided into two short branches; external saddle tolerably broad, with a very small secondary lobe; first lateral lobe much longer than the siphonal, very little divided; first lateral saddle very broad, going very high up and divided into two unequal parts by a small secondary lobe; second lateral lobe very much like the first, but much shorter; second lateral saddle symmetrical, and somewhat shorter than the first; four auxiliary lobes up to the umbilical suture.

The dimensions of three specimens are—

				I.	II.	III.
Diameter	of the shell	...	...	...	22 mm.	39.5 mm.
"	of the umbilicus	...	...	...	7	9
Height	of the aperture from the umbilical suture	...	...	...	9	19
"	of the " from the preceding whorl	...	...	...	7	14
Thickness	of the " ...	...	...	...	6.5	11
						80 mm.
						14
						40
						27
						19

Remarks.—The species is commonly found in shales with nodules of Hæmatite, between the beds of *Steph. macrocephalum* and of *Pelt. athleta*, corresponding to the European zone of *Perisph. anceps*. In this position it has been collected east of Nurrha, north-west of Jumara, and at Keera hill near Charee. The species seems to have been a gregarious one, as commonly several specimens are obtained out of one and the same nodule.

Among the Indian forms, which are allied to *Opp. Nurrhaensis*, *Oppelia fornix*, Sow., can most easily be mistaken for it, but higher more compressed whorls, straighter ribs, and the absence of fine tubercles or spines near the siphonal margin in *Opp. Nurrhaensis* always enable us to distinguish both species.

Of European species only *Opp. fusca* seems really very much allied in its form to *Oppelia Nurrhaensis*, but our species has straighter ribs, a larger umbilicus, and quite different lobes.

(c.) Group of *OPPELIA SUPERBA*, *Waagen*.

1. *OPPELIA BICOSTATA*, *Stahl*. Pl. XI, Fig. 1a, b, c, d.

- 1824. *Ammonites bicostatus*, Stahl: Württemb. landwirthschaftl. corresp. Bl. for 1824, p. 49, fig. 9.
- 1831. *Ammonites bipartitus*, Zieten: Verst. Württemb., p. 18, pl. 13, fig. 6.
- 1831. *Ammonites calcar*, Zieten: l. c., p. 18, pl. 13, fig. 7.
- 1846. *Ammonites bipartitus*, (Ziet.) Quenstedt: Cephalop., p. 139, pl. 10, fig. 8.
- 1846. *Ammonites bipartitus* (Ziet.) Orbigny: Pal. Franç. Terr. Jurass., I, p. 443, pl. 158, figs. 1—4.
- 1857. *Ammonites bicostatus*, (Stahl.) Oppel: Jura form., p. 560.
- 1858. *Ammonites bipartitus* (Ziet.) Quenstedt: Jura, p. 530, pl. 70, fig. 11.
- 1869. *Ammonites bicostatus*, (Stahl.) Waagen: Benecke's Geognost. palæont. Beitr. II, pp. 192 and 222.

One of the most beautiful forms of the Upper Callovian beds. The general shape of the species is tolerably flattened, with flatly rounded sides, a rather shallow umbilicus, and a flat siphonal part, which is limited on each side by a dentated ridge

and provided in the middle with a sharp keel, which disappears, however, on the body-chamber, and is there replaced by a shallow groove.

The sides of the whorls are covered with faint falciform ribs, which are flattened on the outer curved part, and sometimes even provided with a longitudinal groove on the top, and terminate in a dentation of the ridge along the siphonal part of the shell. Along the middle of the sides there is a faint canal accompanied on the side towards the umbilicus by a low rounded ridge. The inner part of the falciform ribs lies between this and the umbilical margin, but is mostly so faint that it is visible only on comparatively large specimens. The dentations on both sides of the siphonal part consist of fine flat compressed tubercles, but those on one side do not correspond with those on the other, but alternate with each other. At the beginning of the body-chamber this alternation is, however, no more so constant or distinct.

Young specimens up to a diameter of about 14 or 15 mm. are entirely smooth, except the dentations along the siphonal part and the keel, which are very prominent. At a diameter of about 20 mm., the ribs on the sides of the whorl become distinct and remain visible until the end of the body-chamber; the dentations, however, disappear at the beginning of this last part of the shell. The length of the body-chamber is about one-half of the last turn. The aperture is not preserved.

The lobes are simple. The siphonal lobe very short, external saddle also rather short, unsymmetrically divided into two parts by a small secondary lobe; first lateral lobe long with slightly ramified partitions; first lateral saddle broad, going high up, with two very small secondary lobes; second lateral lobe very small and short; there are yet three auxiliary lobes separated from each other by rather broad saddles.

The dimensions are—

Diameter of the shell	...	...	58 mm.
„ of the umbilicus	...	...	13
Height of the aperture from the umbilical suture			27
„ of the „ from the preceding whorl	...	...	19
Thickness of the „	...	...	18

Remarks.—The only specimen of this species was found south-west of Barasore on the south side of Charvar range in the bed with *Peltoc. athleta*, and is preserved in a gray, very hard marl nodule.

Oppelia bicostata is one of the most characteristic fossils of the zone of *Peltoc. athleta* in Europe, and its occurrence of exactly the same form and in the same position here in India is of the highest scientific interest. It shows clearly how the faunæ of even minute geological horizons are spread over half the world, and how species observed as associated in one place maintain this association even in the remotest districts.

(d.) Group of *OPPELIA FLECTOR*, *Waagen*.1. *OPPELIA TRACHYNOTA*, *Opp.* Plate X, Figs. 6, 6a.1863. *Ammonites trachynotus*, Oppel: Palæontolog. Mittheilungen, I, p. 214, pl. 56, fig. 4a, b.1870. *Oppelia trachynota*, (Opp.) Zittel: Fauna d. ält. Cephalop. führend. Tithonbild., p. 70, pl. 5, fig. 3.

This species is very difficult to recognise in a stage of growth younger than are the examples which lie before me. If the body-chamber, which in the *Flexuosi* always gives the best points to recognise the species, is wanting, only with great care is it possible to attribute the inner whorls to one or the other species.

Zittel (*l. c.*) has figured a good and sufficiently characteristic specimen of the species, and a comparison of our figure with his drawing will show more easily than any description that the Kachh specimen belongs to the species. The young examples of *Opp. trachynota* show a rather small umbilicus. The sides of the whorls are more or less rounded and fall with a sharp edge, a little bending inside, towards the umbilical suture. They are covered with not very numerous flexuose ribs, which terminate on the outer margin with strong prominent tubercles, of which I count about twenty-one on one whorl. The siphonal side is rounded, and bears in the middle a row of small and numerous tubercles, which are very easily destroyed by the action of the weather. The sutures very much resemble the usual lobes of the *Flexuosi* in their general form. We count five lateral lobes, the first one being by far the largest. The siphonal lobe is very short, divided into two short branches. The external saddle is also short, and divided by a small secondary lobe; the first lateral saddle very long, longer than all the others.

The dimensions of one of my examples are—

Diameter of the shell	...	...	66 mm.
„ of the umbilicus	...	...	10
Height of the aperture from the umbilical suture	...	...	34
„ of the „ from the preceding whorl	...	...	23
Thickness of the „	...	...	21

Remarks.—One of the examples now before me is from Kutur (Joora hills), collected by Mr. Blanford; the other from the ‘Ammonite-bed (*i. e.*, in which Ammonites are plentiful)’ in the section east of Lair, on the north base and scarp of Katrol range. It is true Ammonites must be very common here, because there are a great number of those fossils from the same locality and layer preserved in the Museum. They all belong to the genus *Perisphinctes*, and resemble very much forms which in Europe mark layers of higher Oxfordian or Kimmeridgian age. The species of the group of *Macrocephali*, the *Perisphinctes* of middle oolitic types, the *Harpoceras* and *Haploceras* are wanting throughout, so that it is very probable that we have here a layer quite different both in the quality of rock and in age from the golden oolite of Cheree. *Oppelia trachynota* is in Europe very characteristic for the higher part of the Upper Jura, *i. e.*, from the Kimmeridge

group upwards, and the society in which the species is found at Lair does not oppose the supposition that it may be here of similar age.

The rock in which are preserved both examples of *Oppelia trachynota* in the Joora hills, as in the Katrol range, seems to be a reddish marly layer with many grains of quartz and very hard concretions, containing mostly the fossils.

Oppelia trachynota is distinguishable from the allied forms by its not very high whorls and the very strong and prominent ornamentation.

2. OPPELIA KACHHENSIS, *Waagen*. Plate X, Figs. 4, 4a, 4b.

I doubted for a long time whether I should separate this species from *Oppelia compsa*, to which it is extremely nearly allied; but considering that identifications between Indian and European species are of great scientific consequence, and that one must therefore be doubly careful in identifying the fossils, I preferred to describe the specimens under a new name, instead of putting them together with a well known European form without sufficient certainty.

The description of the species is very difficult. The young stage is covered with distinct flexuous ribs, of which every second one bears on its termination on the siphonal margin a rather strongly rounded tubercle. After having attained a diameter of 55 mm. the shell becomes successively smooth, by the disappearing of the ribs, the tubercles become scarce, and take exactly double the distance from each other than the tubercles in *Oppelia compsa* do; whether the body-chamber is differently ornamented from the other whorls I cannot state, as the largest example I have at my disposal, having a diameter of 105 mm., shows sutures to the end. The siphonal side of the shell is rounded, and in the younger stages of growth ornamented in the middle with small, closely arranged, rounded tubercles, which disappear absolutely in larger examples. The sutures are not very finely dentated, but are of the form usual in the *Flexuosi*.

The dimensions are—

Diameter of the shell	...	...	...	...	...	84 mm.
„ of the umbilicus	...	...	...	...	...	12
Height of the aperture from the umbilical suture	...	...	...	...	...	46
„ of the „ from the preceding whorl	...	...	...	...	...	35
Thickness of the „	...	...	...	...	...	26

Remarks.—I have here four specimens of *Opp. Kachhensis* for examination. All are from east of Lair on the north base of Katrol range, from the same bed as the preceding species—the ‘Ammonite-bed’ of the section there.

The type represented by the species is quite of Kimmeridgian aspect, and if such a form were found in European strata, one would without doubt attribute the layers containing it to the Kimmeridge group of the upper Jura.

(e.) Group of *OPPELIA SUBTILLOBATA*, *Waagen*.1. *OPPELIA PLICODISCUS*, *Waagen*. Plate X, Figs. 5, 5a.

The only example of this species existing is a young one, not exceeding a diameter of 30 mm., but nevertheless it represents without doubt a species different from all as yet described, but certainly nearly allied to *Opp. tenuilobata*.

The specimen has for an *Oppelia*, and principally for a form of the group of *Opp. subtililobata*, rather thick rounded whorls. On the middle of the sides is a flat spiral furrow, often somewhat interrupted by irregular falciform ribs, which partly pass through it and partly are interrupted. The outer part of these radial ribs is a little thickened and more like a flat elongated tubercle.

The siphonal side is rounded, and on the cast is without visible keel. On both sides on the siphonal margin there are a great many very fine short ribs which are so characteristic for the whole group of *Opp. subtililobata*. The sutures are, notwithstanding the small dimensions of the specimen, very finely dentated. The siphonal lobe is very short; the first lateral is the longest of all, terminating in three branches; the second lateral is very much like the first, but much shorter; there are yet six or seven auxiliary lobes visible. The external saddle is, like the first lateral, divided into two parts by a small secondary lobe; the first lateral saddle does not go much farther up than all the other saddles.

The dimensions are—

Diameter of the shell	...	...	...	...	31 mm.
„ of the umbilicus	...	...	...	...	4
Height of the aperture from the umbilical suture	...	...	...	...	17
„ of the „ from the preceding whorl	...	...	...	...	10
Thickness of the „	...	...	...	...	9

Remarks.—The example I have for description is from south of Madapoor; it is preserved in a yellowish gray marly concretion very much like some *Perisphinctes* of upper jurassic type. I thought it of some interest to describe the species, though only one example is preserved, because this type in Europe is very significant for upper jurassic layers. The developmental series to which the species belongs begins in the uppermost layers of the Callovien and finishes in the Tithonian group.

(f.) Group of *OPPELIA LINGULATA*, *Quenst.*1. *OPPELIA PLANA*, *Waagen*, *n. sp.* Pl. XI, Fig. 3a, b.

Like all the species of the whole group, *Opp. plana* also has a very simple form.

The general shape is flat, discoid, with compressed whorls, wide umbilicus, and rounded siphonal side. The sides of the whorls are smooth without any ribs, but on their middle a rather broad strong canal runs along as in *Oppelia modestiformis*. The widely open umbilicus is surrounded by perpendicular walls, which pass without forming an umbilical edge into the sides of the whorl.

The lobes are very simple and barely ramified; the siphonal lobe has two very short branches, and is short and broad; the external saddle is also very short; a secondary lobe in it very little developed; first lateral lobe a good deal longer than the siphonal, terminating in three short branches; first lateral saddle going a little higher up than the external, second lateral lobe, comparatively very small: two auxiliary lobes as far as the umbilical suture.

The dimensions are—

Diameter of the shell	...	...	...	...	...	26 mm.
" of the umbilicus	...	...	...	...	...	8
Height of the aperture from the umbilical suture	...	...	...	...	...	10
" of the " from the preceding whorl	...	...	...	...	...	8
Thickness of the " ...	...	...	...	...	...	6

Remarks.—There is only one specimen of this species preserved in our Museum which was collected in the sandstones of the Katrol group south-west of Nurrha.

Though the specimen is somewhat broken, yet I thought it advisable to describe it under a new name, as its form is characteristic, and the occurrence of a species allied to *Opp. modestiformis* in the Katrol group is of importance.

Opp. plana is, as already remarked, most nearly allied to *Oppelia modestiformis*, *Opp.* It can, however, easily be distinguished from this species by its much wider umbilicus and a little less compressed whorls. *Opp. lingulata* which also could be mistaken for our species, has much thicker and rounder whorls.

(g.) Group of OPPELIA (OECOTRAUSTES) GENICULARIS, *Waagen*.

1. OPPELIA (OECOTRAUSTES) cf. SERRIGERA, *Waagen*. Pl. X, Fig. 3.

1869. *Ammonites (Oecotraustes) serrigerus*, *Waagen*: *Geogn. Palæont. Beitr. von Benecke, Schlönbach u. Waagen*, Vol. ii, p. 230, pl. 20, figs. 7 and 8.

In order to give an exact idea of the real composition of the extinct cephalopodous fauna of a certain country, it is necessary to mention even bad specimens so long as it is possible to indicate the position they may obtain among the other already described species. This was already the case in a certain degree with *Opp. glabella* before described, and it is yet much more the case with the species now mentioned.

The examples lying before me are three; all three on one slip of a gray, very hard sandy shaly rock from the south of Nurrha. They are quite compressed, and the best preserved of them which is figured on pl. X, fig. 3, is only a flat impression of the shell in the rock. But even in this state of preservation no one will doubt, even in looking at the figure, that it belongs to the section *Oecotraustes* I have formerly described; the want of the tubercles on the inner whorls and on the last part of the last whorl, as well as the deviation of the regular spiral, are evidence to

this position. The species, however, is doubtful. As far as one can observe, it shows mixed characters of three species, *Opp. subfusca*, *serrigera*, and *conjungens*, but the general form seems to me most nearly allied with the Bathonian species, *Opp. serrigera* and *subfusca*. The diameter of the largest example is 44 mm.

ISOLATED FORM.

OPPELIA ORIENTALIS, *Orbigny*. Pl. XI, Figs. 5*a*, *b*, *c*, 6 ; Pl. XII, Figs. 8, 8*a*, 8*b*.

1840. *Ammonites corrugatus*, J. de C. Sow. : Transact. Geolog. Soc., Lond., Vol. v, pl. 23, f. 12, and expl. (non Sow. 1824, M. C., pl. 451, fig. 3).

1850. *Ammonites orientalis*, *Orbigny* : Prodrôme, I, p. 331, Et. 12, Nr. 58.

1871. *Harpoceras orientale*, (Orb.) *Waagen* : Records, Geol. Surv. of India, Vol. iv, p. 91.

After I had published in the Records of our Survey the sketch of the *Ammonites* of Kachh, Dr. Stoliczka brought back, among other extensive materials, also an entire specimen of this species from his tour in Kachh, and having found from this that the body-chamber of it is like that of an *Oppelia*, I am obliged to change the name from *Harpoceras* into *Oppelia orientalis*.

The appearance of the full-grown form is entirely different from that of the small specimen I had formerly to examine, but yet it is pretty certain that both belong to the same species.

The inner whorls up to a diameter of about 8 or 10 mm. are entirely smooth, rounded in section, with a barely perceptible keel on the siphonal side. After that rather straight, falciform ribs appear, every one of which is divided into two branches a short distance from the umbilical edge. The branches are a little flattened on their top, have a direction somewhat backward, are very slightly curved, and terminate at the siphonal part of the shell in compressed sharp tubercles, which are placed in a continuous row on both sides of the keel. This form remains until the shell becomes about 20 mm. in diameter. In yet larger specimens the ribs become less numerous and thicker, and at the beginning of the body-chamber, at about 35 to 40 mm. diameter, the keel on the siphonal side disappears, the tubercles on the ribs become indistinct, and the ribs much more strongly curved. The siphonal side of the body-chamber is smooth, only slightly undulated, as in some *Aegoceras*. The aperture is falciform, apparently without ears, and with a rounded ventral process.

The umbilicus is in all stages of growth rather wide, a little less than one-third of the diameter of the shell. It is surrounded by perpendicular walls, which pass, however, into the sides of the whorls without forming a distinct umbilical edge.

The lobes are in neither of the specimens well preserved, but the smaller of both exhibits them to a certain extent at least, so that one can observe that the siphonal lobe is short and broad, also the external saddle; the first lateral lobe is not much longer than the siphonal; the first lateral saddle goes a little higher up

than the external; the second lateral lobe is about as long as the siphonal; there are two auxiliary lobes.

The dimensions of the two specimens are—

						I.	II.
Diameter	of the shell	...	...	...	...	19 mm.	52 mm.
"	of the umbilicus	...	...	...	...	6	15
Height	of the aperture from the umbilical suture	...	...	...	...	8	22
"	of the " from the preceding whorl	...	...	...	...	6.5	?18
Thickness	of the " ...	...	...	...	...	6	17

Remarks.—The specimens I have for description are two; the smaller of them was found at Charee in a yellowish-gray sandy oolite of unknown age; the larger one has been collected by Dr. Stoliczka north-west of Jara in a yellowish-gray, sandy oolite just below the bed with *Peltoceras athleta*, and above the *Macrocephalus* layers. The specimen which has been figured by Sowerby is also from Keera hill near Charee.

Sowerby's figure, given in the Transactions of the Geological Society of London, (Vol. V, pl. 23, Fig. 12,) upon which Orbigny's species is founded, is very bad, and barely to be recognised. The principal features, however, in which also the specimens just described agree with the figure, seem to be that the ribs are divided already near the umbilical margin into two branches, of which, if the specimen is not very much weather-worn, each is provided with a small compressed tubercle, and that there is on the siphonal side of the shell a distinct keel between the two rows of tubercles in young specimens, as one is represented by the drawing of Sowerby.

The species seems barely allied to any European species, except possibly to *Harpoceras hecticum*, with which it has the tubercles along the siphonal side in common. However, in this species the ribs are much more curved, and never divided near the umbilical margin; besides that the body-chamber is quite different.

APTYPCHUS. Pl. XI, Fig. 8a, b, c.

Already in my introductory notes to the genus, I have mentioned that an *Aptychus* belonging to the genus *Oppelia* has been found in ferruginous sandy beds in Kachh.

The specimen, though not preserved entirely, has very considerable dimensions; it is 58 mm. long and 33 mm. broad, and must have belonged to a very large individual of *Oppelia*. The outer side is covered by broad, deep folds, comparatively very few in number, which are not quite straight, but a little undulating; the outermost are the broadest. The furrows between the folds are narrow on the upper, and increase in breadth as they approach the lower, part of the shell. On the inner or concave surface, densely arranged plications, running parallel with the outer or curved margin, are visible, which disappear, however, towards the inner

edge, leaving a smooth space, upon which three or four extremely faint descending folds are visible radiating from the upper and inner corner of the shell.

No *Oppelia* of so considerable a size as would agree with the size of this *Aptychus*, has as yet been found in Kachh. We may, therefore, expect yet the discovery of another species of *Oppelia* in the Katrol group.

GENUS *HARPOCERAS*, WAAGEN.

I proposed this name in 1869 for all the Ammonites with falciform ornamentation on the shell, distinguishing in the meantime some subgenera, of which one (*Oppelia*) subsequently proved to be of generic value, and as such was entirely separated from the old genus by Zittel and by myself.* But even in this new, limited sense, the genus still comprised a very great number of species, by far the largest proportion of which belong to the Liassic period, whilst only comparatively few forms go up to the middle and upper Jurassic. Of the latter one group is principally represented in the Kachh beds,—the group of *Harpoceras hecticum*,—which has furnished not less than seven species, all out of beds from the zone of *Steph. macrocephalum* up to that of *Aspid. perarmatum* inclusive.

Another group is of entirely Indian distribution, as there is no European species of it known. It is the group of *Harpoceras ignobile* with three species, all three found in beds a little older than the zone of *Peltoc. athleta*. *Harp. ignobile* itself is characteristic for this horizon in the Kachh Jura.

There is yet another species, which does not seem to have any relation with any species, as yet published, and which I must consider, therefore, as an isolated form; it is *Harp. Kobelli*, Opp.

The seven species belonging to the first group are—*Harpoceras hecticum*, Rein. sp., *H. punctatum*, Stahl., *H. lunula*, Ziet., *H. vicinum*, Waagen, n. sp., *H. Laireuse*, Waagen, n. sp., *H. dynastes*, Waagen, n. sp., and *H. Rauracum*, Mayer. Of these four occur also in the European Jura. *H. hecticum* is found there in the zone of *St. macrocephalum*; *H. lunula* and *punctatum* in the zone of *Perisph. anceps*; *H. Rauracum* in the zone of *Amalth. cordatus*. In Kachh the first of these species occurs also in the society of *St. macrocephalum*; the two next were collected in the beds between that of *St. macrocephalum* and the bed with *Pelt. athleta*, corresponding to the European zone of *Perisph. anceps*: and the last was found in oolite together with *Aspidoc. perarmatum*. Thus the geological position of the identical species is exactly the same here in India as it is in the European strata.

The second group comprises *Harp. ignobile*, Sow., *H. crassefalcatum*, Waagen, n. sp., and *H. trilineatum*, Waagen, n. sp., but no European species.

* Zittel: Fauna d. ält. Cephalop. führenden Tithonbildungen, 1870, p. 57.

Waagen: über die Ansatzstelle der Haftumskeln beim Nautilus und den Ammoniden, Palæontographica, 1870.

(a.) Group of *HARPOCERAS* *HECTICUM*, *Rein. sp.*1. *HARPOCERAS* *HECTICUM*, *Reinecke, sp.* Pl. XII, Figs. 3, 3a, 3b, 4, 4a, 4b, 5.1818. *Nautilus hecticus*, Reinecke: *Maris protogaei Nautilus et Argonautas*, fig. 34.1846. *Ammonites hecticus*, (Hartm.) Orbigny: *Pal. Franç. Terr. Jurass.*, I, p. 432, pl. 152.1857. *Ammonites hecticus*, (Rein.) Oppel: *Jura formation*, p. 552.

There are two specimens preserved in our Museum, which may be attributed to Reinecke's species, the one, perfectly agreeing with d'Orbigny's figures 1 and 2, pl. 152, but only lately discovered in the body-chamber of the specimen of *St. macrocephalum* figured on pl. XXV of this volume, and the other one figured on pl. XII and described hereafter. The latter specimen is a fragment of a very large individual, which had barely the aspect of the true *Harp. hecticum*, but having taken out with much labour the inner whorls, I found that it belonged to Reinecke's species.

The inner whorls up to a diameter of the shell of about 40 mm. are a little rounded, squarish, somewhat higher than broad. The sides are covered with rather strong falciform mostly bipartite ribs, which have on the siphonal margin strong elongated tubercles. The siphonal side is strongly keeled, with a very weak, nearly invisible ridge on both sides of the keel; the keel a little granulated.

At larger stages of growth, all the ornamentations of the shell get gradually weaker. At a diameter of the shell of about 80 to 90 mm. flat, falciform ribs are still well visible, but the tubercles at the siphonal margin have already nearly disappeared; they are converted more or less into a weak longitudinal interrupted ridge. The keel of the siphonal side is yet strongly visible, but the grains upon it have become very small and numerous contrary to Orbigny's figure. The ridges on both sides of the keel are still existing; they are covered with fine closely arranged, nearly invisible ribbings in correspondence with the granulations of the keel.

The whole example, of which a fragment is lying before me, had about 180 mm. in diameter. The last whorl is 75 mm. high. The ribs still exist, but they are very flat and indistinct, only the outer part visible. On the cast, the keel of the siphonal side has disappeared, the shell shows yet traces of it. The whorl is covered with lobes up to the end.

The sutures show very characteristically the form which commonly marks the species of the genus *Harpoceras*. The siphonal lobe is very short, broad, and divided into two tolerably long branches. The first lateral lobe is not very long, with broad undivided stem, and terminating in five nearly symmetrical branches. The second lateral lobe is very unsymmetrical. From this up to the umbilical suture there are three auxiliary lobes, and beneath the suture up to the antisiphonal lobe yet two more. The antisiphonal lobe is symmetrical, finishing in one symmetrical finger. Of the saddles, the external saddle has a large secondary lobe, and the first lateral is the longest of all.

Of the dimensions I cannot give more than the height and thickness of every whorl—

Height	of the first whorl	from the umbilical suture	...	...	75 mm.
"	of the "	from the siphonal side of the preceding whorl	...	...	59
Thickness of the	"	...	...	...	36
Height	of the second whorl	from the umbilical suture	...	...	37
"	of the "	from the siphonal side of the preceding whorl	...	...	29
Thickness of the	"	...	...	...	25
Height	of the third whorl	from the umbilical suture	...	...	14
"	of the "	from the siphonal side of the preceding whorl	...	...	11
Thickness of the	"	...	...	...	11

Remarks.—The example described is from the golden oolite at Keera hill near Charee, and occurs here in the society of *Steph. macrocephalum* and the allied species.

It is undeniable that there are some slight differences between our specimen and the figures given by Orbigny and others, consisting in the slight granulations of the keel and the short radial ribs on both sides of it. I may say that it is possible that those differences may indicate a different species, but when one has seen a great many examples of *Harp. hecticum* from numerous European localities, and remarked the great variety of form among them, I prefer to call the Indian form simply *Harp. hecticum*, not asserting, however, that by a careful examination of the European specimens in comparison with the Indian ones, we should not be able to distinguish several species. As our knowledge of those forms now stands, and not having at my disposal very extensive materials, I can do nothing else but abide by the collective name.

Harpoceras hecticum and all the allied forms, with tubercles on the siphonal margin, are in Europe very characteristic for the lower region of the Kelloway group. The society of *Steph. macrocephalum*, in which the species is found in India, seems to indicate for it here also a similar age.

2. HARPOCERAS PUNCTATUM, *Stahl*. Pl. XIII, Figs. 9a, b, 10.

- 1824. *Ammonites punctatus*, *Stahl*.: Württemb. landwirthschaftl. Corresp. Bl., Vol. vi, p. 48, fig. 8.
- 1830. *Ammonites punctatus*, (*Stahl*.) *Zieten*: Verst. Württemb., p. 13, pl. 10, fig. 4.
- 1846. *Ammonites lunula* (*Ziet.*) *Orbigny*: Pal. Franç. Terr. Jurass., Vol. i, p. 439 (pars), pl. 157, figs. 1—4.
- 1846. *Ammonites hecticus* (*Rein.*) *Quenstedt*: Cephalop., p. 117, pl. 8, fig. 1.
- 1857. *Ammonites punctatus*, (*Stahl*.) *Oppel*: Jura form., p. 553.
- 1858. *Ammonites hecticus lunula*, *Quenstedt*: Jura, p. 545, pl. 72, fig. 7. (Variety) (non *A. punctatus* (*Stahl*.) *Quenst.*: l. c. p. 544, pl. 71, fig. 21).

The species, though characteristic and not very difficult to recognise, has yet very often been mistaken, and even in *Quenstedt's* Jura it is entirely misrepresented. *Zieten's* figure is excellent, and the species can easily be recognised from it with certainty.

The first stages of growth are flat, with a wide umbilicus, rounded, depressed whorls, a faint keel on the siphonal part of the shell, and more or less smooth sides of the whorls. In specimens exceeding a diameter of 8 or 10 mm. the ornamentation, consisting of strongly bent prominent falciform ribs, is for the most part well developed. The ribs are mostly dichotome, some simple, begin at the umbilical suture with a strong bend towards the front, are highest in the middle of the sides, where they are divided, turn over the back, and reach the siphonal side again with a slight curve towards the mouth of the shell.

The siphonal part of the shell is always provided with a distinct keel even in large specimens. The umbilicus is shallow and wide, the whorls very little embracing.

The lobes cannot be observed on any of the specimens.

The dimensions of two specimens are—

					I.	II.
Diameter	of the shell	...	...	...	22 mm.	33 mm.
"	of the umbilicus	...	...	...	8	12
Height	of the aperture from the umbilical suture	...	...	...	9	13
"	of the " from the preceding whorl	...	...	...	7.5	11
Thickness	of the " " " " " "	...	...	...	7	12

Remarks.—The species is represented by two specimens in our Museum, one of which is from Vanda, out of a fine brown oolitic rock immediately above the bed with *Steph. macrocephalum*; the other was found loose on the ground near Barasore, and is preserved also in a fine ferruginous oolite.

The species is very variable, a variation chiefly expressed in the ribs, which are sometimes scarce, sometimes very numerous, sometimes very strong and sometimes much less so; the specimens figured, however, very closely represent the typical form. This variability accounts also for the number of mistakes which have been made in identifying the species. Both Orbigny and Quenstedt have misrepresented the species, Orbigny confounding it with *Harp. lunula*, Ziet., Quenstedt mistaking it entirely, as he identified a variety of *Harp. Brighti* with Stahl's species, and united the true *Harp. punctatum* with *Harp. lunula*.

3. HARPOCERAS LUNULA, Ziet. Pl. XIII, Fig. 1a, b.

1830. *Ammonites lunula*, Zieten: Verst. Württem., p. 14, pl. 10, fig. 11, (Reinecke?).
 1841. *Ammonites Lonsdali*, Pratt: Ann. and Mag. of Nat. Hist., ser. I, Vol. viii, p. 164, pl. 5, fig. 2.
 1846. *Ammonites hecticus compressus*, Quenst.: Cephalop., p. 119, pl. 8, fig. 3.
 1857. *Ammonites lunula* (Ziet.) Oppel: Jura form., p. 553.
 1858. *Ammonites hecticus compressus*, Quenstedt: Jura, p. 546, pl. 72, fig. 8.
 1871. *Harpoceras lunula* (Ziet.) Neumayr: Abh. d. K. K. Geol. Reichsanst., Vol. v, p. 28, pl. ix, fig. 7.

The general form of this species is very much like that of the preceding one, but the whorls are more compressed, the umbilicus smaller, and the whole shell more disciform. Young specimens, however, are difficult to distinguish from specimens of an equal size of *H. punctatum* or any other allied species.

The first stages of growth are entirely smooth, with wide umbilicus and depressed whorls, with a barely visible keel on the siphonal side. But already at a

diameter of 5 to 8 mm. the whorls become more compressed and the umbilicus comparatively smaller. On specimens a little larger one can in most cases already distinguish faint ribs on the sides of the whorls, which begin at the siphonal margin, and go in a slight curve to the middle of the sides, where they disappear again. Only in specimens attaining 30 mm. in diameter, the inner part of the falciform ribs lying round the umbilicus becomes visible; this is never very strong, but distinct. One can now distinguish that the ribs begin simple at the umbilical margin, from there are directed towards the front, become very flat on the middle of the sides, and are there divided into two branches.

The umbilicus becomes comparatively smaller as the specimens grow larger, and is, principally in large specimens, surrounded by well defined vertical walls. The siphonal side of the shell is always provided with a distinct keel; however, in casts of very large specimens the keel is lost, or at least not visible.

The lobes are very difficult to observe in the examples I have for examination; however, the principal features can be made out. The siphonal lobe is tolerably broad and short, with two small branches; external saddle very broad, with a small eccentric secondary lobe; first lateral lobe somewhat longer than the siphonal, tolerably broad, little branched, first lateral saddle going a little higher up than the external, rather narrow, with no distinct secondary lobes; second lateral lobe much smaller than the first: there are yet two small auxiliary lobes.

The dimensions of two specimens are—

	I.	II.
Diameter of the shell ...	42 mm.	55 mm.
„ of the umbilicus ...	12·5	15
Height of the aperture from the umbilical suture	17	24
“ „ of the „ from the preceding whorl	?12	18
Thickness of the „	12	14

Remarks.—There are two specimens of *Harp. lunula* in our Museum; both have been found at Vanda in layers between beds with *Steph. macrocephalum* and those with *Pelloc. athleta*; the one of them is preserved in a light coloured oolite, exactly like that of Clucy in the Dép. Jura, which also contains *Harp. lunula* in large quantities; the other came out of a yellow hard marl nodule.

The species characteristic for the European zone of *Perisph. anceps* is tolerably easy to recognise and to distinguish from other allied species. The ornamentation is variable as in *Harp. punctatum*, but the variations are limited to the number and strength of the ribs. The characteristics of the species, which never change, are—a tolerably small umbilicus, ribs, which are strongly curved, and are flattest on the middle of the sides; and a permanent keel. By the small umbilicus *Harp. lunula* is distinguishable from most of the other *Harpoceras* of the middle and upper Jura, and by the want of three keels along the siphonal side, it is distinct from *Harp. Henrici*, *mendax*, *Delmontanum*, or others of lower or middle Oxfordian strata.

4. HARPOCERAS LAIRENSE, *Waagen, n. sp.* Pl. XIII, Figs. 3a, b, 4a, b.

This species has in general much resemblance to *H. hecticum*, Rein. It can, however, easily be distinguished by several characteristic features.

The general form of the adult specimen is flat, with compressed whorls, a tolerably wide umbilicus and keeled siphonal side. I have no specimen to examine the first stages of growth, but as it seems from the inner whorls of larger examples, they are smooth up to a diameter of four or five millimetres; then strong, slightly falciform ribs appear, which, however, are not continuous over the whole side of the whorl, but begin at the umbilicus and reach from there a little turned towards the front, until the middle of the side, where they finish in a somewhat elongated obtuse tubercle. There every one of them is replaced by two rather straight short ribs, which go from the middle of the side, a little turned backwards, to the siphonal part of the shell, where they terminate also in low tubercles.

This sculpture changes a little in larger specimens. There single, slightly falciform ribs go from the umbilical margins to near the siphonal side, swollen to an obtuse tubercle on the middle of the lateral part of the shell, but undivided. They terminate at the siphonal margin also with a low obtuse tubercle. Between those simple ribs are short straight ribs intercalated at the siphonal margin; they begin there with an obtuse tubercle and do not quite reach the middle of the side of the shell.

The umbilicus is always tolerably wide, about one-third or one-fourth of the diameter of the shell, and is surrounded in adult specimens by well defined perpendicular walls, which, however, do not exist in young specimens.

The siphonal side is, though not very sharp or rather obtuse, always distinctly keeled, on the air-chambers as well as on the body-chamber.

The lobes are very difficult to observe in the specimens I have got for examination, but are remarkable on account of the little development of the lobes in comparison with the enormous broad saddles. The siphonal lobe is very short and broad, with very short branches, very little dentated; external saddle also very broad and short, with a very small, nearly central secondary lobe; first lateral lobe very narrow, with few dentations and three narrow terminating branches; first lateral saddle broad, going a little higher up than the external, with a secondary lobe; second lateral lobe very narrow and small; there are one or two auxiliary lobes.

The dimensions of two specimens are—

				I.	II.
Diameter of the shell	...	...	...	38 mm.	37 mm.
„ of the umbilicus	...	...	...	11	10.5
Height of the aperture from the umbilical suture...	...	...	...	17	16
„ of the „ from the preceding whorl...	...	...	...	12.5	12
Thickness of the „ on the tubercles	...	...	...	10.5	9.5
„ of the „ between the tubercles	...	...	...	9	?

In both specimens the last half turn is body-chamber, but the mouth of the shell is preserved in neither of them.

Remarks.—There are four specimens of this species among the materials I have for examination. Two of them were collected at Lair in light yellow marls with concretions, containing also *Pelt. athleta*. Another specimen comes also out of the *Athleta* bed north-east of Gudjinsir, and is preserved in a very hard gray marl nodule; the last specimen has been found north-west of Jikli in a hard yellow calcareous rock, very likely a little older than the *Athleta* bed. On the whole, we can therefore say that the species is of upper Callovian age.

Harp. Laireuse is characteristic enough to distinguish it easily from the allied species. It unites the characters of *H. hecticum* and *punctatum* in one, having a row of tubercles in the middle of the sides and along the siphonal margins. At the same time it exhibits much straighter ribs than the species mentioned, and has much more compressed whorls than *H. punctatum*. Besides the peculiar arrangement of the ribs, which are not divided on the middle of the sides, but replaced there by two short ones, or the undivided ribs of larger specimens, between which short ones are intercalated on the outer margin, is a feature which never is again repeated in any other species of *Harpoceras*. By this character alone, besides the tubercles existing on the whorls, the species can be distinguished from *Harp. lunula*, *Rauracum*, or any other.

5. HARPOCERAS DYNASTES, *Waagen, n. sp.* Pl. XIII, Figs. 6a, b, 7a, b, 8a, b.

The dimensions of this species are very considerable in comparison with the other forms as yet described, and thus it is very conspicuous.

Young specimens resemble very much *H. lunula*, Ziet., but have a larger umbilicus and straighter ribs. The first stages of growth are, as in all the allied species, quite smooth, with depressed whorls and a slight, barely visible keel on the siphonal side. At a diameter of 10 mm. the ribs become visible. They are scarce, slightly falciform, divided into two branches on the middle of the sides. In a little larger specimen they are provided with small tubercles at their termination on the siphonal margin; but these soon disappear again, the section of the whorls becomes a little higher, the umbilicus a little smaller, and the sides of the shell are covered with slightly falciform ribs, which are yet present in very large specimens as broad not very prominent folds.

The umbilicus is wide in small specimens, gets a little narrower in specimens of middle size, and gets again wider in very large examples. It is surrounded by vertical walls, which, however, are rarely well defined. The siphonal side is always provided with an obtuse not very prominent keel, which becomes a little less distinct in very large specimens, and is there limited to the shell, not a trace being observable on the cast.

The lobes are short, not very complicated. The siphonal lobe is short, but not very broad, with a ramified branch on each side; external saddle not very broad, with a well developed secondary lobe nearly in the middle; first lateral lobe broad, a good deal longer than the siphonal, with many short thick branches, the latter little ramified; first lateral saddle narrow, going a little higher up than the external, much indentated; second lateral lobe narrow, shorter than the first, well ramified; second lateral saddle very narrow, going not quite so high up as the first. There are yet three well developed auxiliary lobes with narrow saddles between them.

The dimensions of two small specimens are—

	I.	II.
Diameter of the shell ...	27 mm.	41 mm.
„ of the umbilicus ...	8	10
Height of the aperture from the umbilical suture	11	19
„ of the „ from the preceding whorl ...	9.5	16
Thickness of the „ ...	8	11

The largest fragment preserved in our Museum has for the last three measurements the following dimensions :—

Height of the aperture from the umbilical suture	62 mm.
„ of the „ from the preceding whorl ...	45
Thickness of the „ ...	30

The whole fragment is composed of air-chambers.

Remarks.—Several specimens of *Harp. dynastes* have been collected in different localities. The largest and most characteristic specimens, mostly fragments, come from the *Athleta* bed, south-east of Nurrha, and are preserved in gray marl nodules, the shell itself being black calcspar; other specimens were found at Lair, also in the *Athleta* bed, and are preserved in a hard yellow calcareous marl. The third locality where the species occurs is the south-west side of Keera hill near Charee, in a dark shale, the fossils consisting of pyrites; the shales are just below the oolite bank with *Aspidoc. perarmatum*. From north of Gudjinsir come three fragments, which also belong to this species, but occupied there a situation a little below *Pelloc. athleta*; they are also turned into iron pyrites. Two small pyritic casts from Vanda I unite, though with some doubt, with this species.

The species is, I think, most nearly allied to *H. lunula*, Ziet., and the resemblance is striking, principally in large specimens. Yet one can always distinguish *H. dynastes* from Zieten's species by the much straighter ribs, which character is apparent in young as well as in adult specimens; besides that there are in young specimens little tubercles at the end of each rib along the siphonal margin which are wanting in *H. lunula*. *Harp. hecticum* is distinguished from our species also by much more curved ribs, whilst *H. Lairensense* has rather straight ribs; they are, however, arranged quite differently.

6. HARPOCERAS RAURACUM, *C. Mayer*. Pl. XIII, Fig. 5*a, b, c*.

1837. *Ammonites Murchisoni*, (Sow.) Pusch: Polens Palæontologie, pl. 13, fig. 5, (non fig. 4, non Sow.).
 1864. *Ammonites Rauracus*, Mayer: Journ. de Conch., Vol. xii, p. 376; Vol. xiii, pl. 7, fig. 4.
 1866. *Ammonites Rauracus*, (Mayer) Oppel: Zone des Amm. transvers.; Bencke's geognost. pal. Beitr., II, p. 215.

The description given by Ch. Mayer is good, and the species can be easily identified from it. He says:—"Shell compressed, keeled, composed of six whorls, for two-thirds enveloping each other, rapidly increasing, compressed. Ribs thick, flexuose, rarely bifurcate; interrupted in the middle of the sides by a kind of canal strongly directed towards the front in the part lying between this canal and the umbilical suture, turned backwards in the outer part, and becoming broader towards the siphonal side, where they gradually disappear. The lateral lobes are rather long and are four in number."

Young specimens are smooth, as in all the other allied species, but in this instance they have whorls not so strongly depressed as is common, but are rather compressed with peculiarly flattened sides. At a diameter of the shell of about 10-15 mm. faint, not very numerous, curved ribs appear near the siphonal side, which soon begin to correspond with little folds at the umbilical margin. The perfect sculpture, as it is described by Mayer, is mostly developed only at a diameter of about 30 to 35 mm., and the shell is then highly characteristic in its appearance.

The width of the umbilicus is somewhat variable; it is sometimes a little less, sometimes a little more, than one-third of the diameter of the shell. In small specimens the umbilicus is surrounded by perpendicular walls, which are well defined from the sides of the whorl, forming an umbilical edge; this latter, however, becomes often more or less obsolete in larger specimens. The siphonal side is always provided with a well marked obtuse keel, on each side of which a fainter ridge goes along; thus the siphonal side appears trimarginate.

The lobes are not sufficiently preserved to admit of an accurate description.

The dimensions of the only specimen I have for examination are—

Diameter of the shell	...	...	...	...	...	...	33 mm.
" of the umbilicus	...	...	...	...	...	...	12
Height of the aperture from the umbilical suture	...	...	...	...	...	...	13.5
" of the " from the preceding whorl	...	...	...	...	...	...	11.5
Thickness of the " "	...	...	...	...	...	...	10

Remarks.—The only specimen of this species has been collected in the oolites with *Asp. perarmatum* north-west of Soorka.

Ch. Mayer, very reasonably, compares his species with *H. Delmontanum*, Opp., which is in fact the nearest allied species, but is distinguishable by narrower siphonal side, stronger ribs, and smaller umbilicus. Other species, which also resemble *H. rauracum*, like *H. lunula* or *H. dynastes*, differ from Mayer's species by the want of three ridges along the siphonal side and the different ornamentation of the sides of the shell.

(b.) *Group of HARPOCERAS IGNOBILE, Sow.*1. HARPOCERAS IGNOBILE: *J. de C. Sow.* Pl. XII, Figs. 1, 1a, 2, 2a, 2b.1840. *Ammonites ignobilis*, J. de C., Sow.: Transact. Geol. Soc., Lond., II Ser., Vol. v, pl. 23, fig. 11 and expl.1850. *Ammonites lunula* (Ziet.) Orbigny: (pars): Prodrome, I, p. 329, No. 22. (Cited from Kachh).

It was a very good and highly characteristic species, which Sowerby designated under the above mentioned name, and the figures and descriptions which I am going to give will confirm this opinion.

I have no example to observe the first stage of growth of this species; the smallest specimen I have has 28 mm. in diameter. At that age, the shell has a tolerably narrow umbilicus, the sides of the whorls are flat, and covered with readily distinguishable falciform ribs, which bear on the siphonal margin a fine rounded tubercle. The siphonal side shows a strong keel, and the whole shell has a great resemblance to certain varieties of *Harp. hecticum*. As the species grows larger the remarkable straightness of the outer part of the ribs, which Sowerby's figure so well represents, appears more defined. This sculpture remains till a diameter of 50 mm. Exceeding this, the sculpture becomes gradually weaker, the points on the siphonal margin disappear, also the inner part of the ribs, and at the same time the sides of the whorls become more rounded. This is the sculpture of the body-chamber, which is about half a whorl in length. The siphonal side is there more rounded, but a trace of the keel remains up to the mouth. The mouth itself is not preserved on any of the examples. The umbilicus is rather narrow, surrounded by perpendicular walls, which form a distinct edge in joining the sides of the whorls.

The sutures are very much like those described before on *Harp. hecticum*, but they appear in their general form a little longer and more slender. The second lateral lobe is asymmetrical as in the species just mentioned.

The dimensions are—

					I.	II.
Diameter of the shell	...	...	...	...	50 mm.	88 mm.
„ of the umbilicus	...	...	...	...	10	20
Height of the last whorl from the umbilical suture	...	...	...	...	26	37
„ of the „ from the siphonal side of the preceding whorl	...	...	...	...	20	29
Thickness of the „	...	...	...	...	15	23

Remarks.—The specimens belonging to this species, lying before me, are nine, five of them coming from Keera hill near Charee. None of them shows traces of golden oolite; all are preserved in a yellowish gray, very hard marly rock, out of which no true *Steph. macrocephalum* is preserved in the Museum. They belong to a layer, representing the Upper Kalluvian of Europe, more especially to the equivalents of the zone of *Perisph. anceps*, or a little lower. Another specimen has been collected on north-west of Jara in the same horizon, preserved in an iron nodule; two are from Vanda, coming also out of the same horizon, preserved in grayish-yellow marl nodules; the last specimen has been found north-west of Jikli, loose on the ground. It also is preserved in a yellow marl nodule.

Harpoceras ignobile shows rather strong alliances to *Harp. hecticum*, but much less to *H. lunula*, with which Orbigny wishes to identify this species. From both species the Indian form is easily distinguished by the straightness of the ribs, which gives these shells a very strange aspect. Besides this the differences from *Harp. hecticum* lie in a smaller umbilicus: from *Harp. lunula* in stronger and pointed ribs, much less in number.

2. HARPOCERAS CRASSEFALCATUM, *Waagen, n. sp.* Pl. XII, Figs. 6, 6a, 7.

Under this name I will describe a beautiful species of Ammonite. The common aspect is very much like *Harp. hecticum*, but a little careful examination will easily distinguish both species. I have no example to observe the youngest stages of growth. At a diameter of the shell of 15 mm. the whorls are about as broad as high, the ribs are very thick and rounded, only a little curved, and mostly on the outer part of the whorl divided into two branches; they finish on the siphonal margin in high rounded tubercles. When the individual grows larger, the height of the whorls by far exceeds the breadth, but the ornamentation undergoes only slight changes. The siphonal side is obtuse, with a distinct, but not very high keel. At a diameter of 50 mm. I count on the outer margin twenty ribs and tubercles, on the inner margin eleven ribs. At the place where the ribs divide themselves into two, they are a little thickened, forming a kind of tubercle. The largest example I know has 66 mm. in diameter, but the form is in all points the same as in the smaller specimens. The umbilicus is rather narrow, surrounded by perpendicular walls, which do not form a very distinct umbilical edge in joining the sides of the whorls.

The lobes are very like those of *Harp. ignobile*, Sow., but not sufficiently preserved to draw them.

The dimensions of the two examples existing are—

					I.	II.
Diameter of the shell	...	...	...	...	50 mm.	66 mm.
" of the umbilicus	...	...	...	...	11	15
Height of the last whorl from the umbilical suture	...	...	...	...	25	30
" of the " from the siphonal side of the preceding whorl	...	...	...	...	18	24
Thickness of the last whorl	...	...	...	...	19	22

Remarks.—Though *Harp. crassefalcatum* shows great affinity to the species before described, I thought it proper to give it a separate name, because the form of the shell is in certain characteristic points constantly different.

Harp. crassefalcatum is always much thicker and much more strongly ornamented than *Harp. ignobile*, and instead of losing its ornamentation in larger stages of growth, on the contrary, this increases in strength. From *Harp. hecticum* my species differs by the much stronger, straighter, and less numerous, ribs and tubercles.

Both examples I have for description are out of the same yellowish-gray hard marl rock, which contained the specimens of *Harp. ignobile*. From Europe this form is not yet known.

3. HARPOCERAS TRILINEATUM, *Waagen, n. sp.* Pl. XIII, Fig. 2a, b.

This species exhibits very distinctly the character of the group,—the very peculiar straightness of the ribs. It is, however, not difficult to distinguish from both species before described.

The shell is not very flat, disciform, with a wide umbilicus and an obtuse, keeled siphonal side. Young specimens up to a diameter of 5 mm. are entirely smooth, with broad depressed whorls, then thick slightly falciform ribs appear gradually, and give to the shell somewhat the appearance of *H. punctatum*, Stahl., but the ribs are always much straighter. The ribs begin at the umbilical suture as thick rounded prominences, and are divided into two branches, forming an elongated tubercle at the point of division, already in the lower third of the height of the whorl. The secondary ribs start from the point of division in a straight direction to the siphonal margin and terminate there without forming a distinct tubercle. The whole rib shows only one bend at the spot where the bifurcation takes place, where a flat angle directed with its apex towards the front is formed.

The umbilicus is flat in not quite adult specimens, and not surrounded by proper walls; in larger specimens, however, an umbilical wall is formed, which is not limited by an umbilical edge. A peculiarity is, that the points of partition of the ribs are yet visible in the umbilicus, which gives the whorl a remarkable appearance.

The siphonal side is rather broadly obtuse with a low broad keel in the middle, and two lower, narrow ridges on both sides of it. Both keel and ridges are visible also on casts.

The lobes are not very well preserved in the specimens I have for examination. The siphonal lobe is short and not very broad, the external saddle very broad and short, with a small secondary lobe not quite in the middle; the first lateral lobe is a good deal longer than the siphonal terminating with three nearly symmetrical branches; first lateral saddle going rather high up, tolerably broad, with two small secondary lobes; second lateral lobes very narrow, much shorter than the first; one larger and one very small auxiliary lobe.

The dimensions of two specimens of this species are—

	I.	II.
Diameter of the shell	44 mm.	49 mm.
„ of the umbilicus	14.5	16
Height of the aperture from the umbilical suture ...	19	22
„ of the „ from the preceding whorl ...	14	16.5
Thickness of the „	14	17

Remarks.—Two specimens of this species were collected in Kachh, one in a yellow marl rock together with the two preceding species of the same group at the south-west side of Keera hill near Charee; the other also in a yellow marl rock together with *Harpoceras lunula* at Vanda.

H. trilineatum is principally nearly allied to *H. crassefalcatum*, W., but is distinguishable easily from it by much finer and much more numerous ribs, which do not terminate on the siphonal margin with a developed tubercle. From *H. ignobile* our species differs by more depressed whorls, stronger ribs, and wider umbilicus. The trimarginate siphonal side is also a feature of *H. trilineatum*, not repeated in the two species just alluded to. Other trimarginate species of the genus *Harpoceras*, like *H. rauracum*, *scabridum*, or others, have all much more curved ribs, and are easily distinguishable from the species here described.

(c.) ISOLATED SPECIES.

HARPOCERAS KOBELLI, *Oppel*. Pl. XIII, Figs. 11a, b, 12a, b, 13a, b.

1863. *Ammonites Kobelli*, *Oppel*: *Palæontolog. Mittheilung.*, p. 273, pl. 76, fig. 1a—c, fig. 2a, b.

The specimens of this species are, perhaps, the most interesting among the whole series collected in Cutch, as they not only tend largely towards a right understanding and classification of other jurassic rocks in India in which *Harp. Kobelli* occurs, but will also partly be able to solve the controversy which arose about the Liassic Ammonites which were said to have been found in Indian strata.

The species is very variable as far as ornamentation is concerned, smooth, or with scarce thick falciform ribs. Young specimens up to a diameter of about 20 to 25 mm. are always entirely smooth, if the shell is preserved; casts, however, exhibit a shallow spiral canal running along the middle of the sides of the whorls. The shell itself is very much worn in the specimens, I have for description, so that one cannot observe the fine striæ of growth which are drawn in *Oppel's* figures. The umbilicus is wide, the whorls compressed, but with rounded sides, the siphonal part of the shell rounded without a trace of a keel. The keel appears only at 25 mm. diameter, when at the same time for the most part the ornamentation of the shell also appears, but in specimens which never are provided with any ribs, a keel is formed at about 30 mm. diameter.

In examples larger than those as yet described here, the sides of specimens provided with the shell bear a deep canal below their middle towards the umbilicus, which is fenced at the umbilical side by a rather sharp narrow ridge. On the part of the shell between the canal and the siphonal side strong broad rounded ribs are visible, which begin gradually as the specimens grow larger than 25 mm. in diameter, and increase in strength in larger specimens. They rise near the canal as thin ribs, directed nearly horizontally backwards, turn then in a strong curve, gaining much in strength towards the siphonal side, and disappear again before

reaching the latter part of the shell with a curve towards the front. That division of the sides of the whorls which lies between the canal and the umbilicus is entirely smooth, and slopes gradually towards the umbilical suture; only in larger specimens an obtuse umbilical ridge is observable. The line along which the umbilical suture joins the preceding whorl runs always along and a little outside the canal of the latter.

The variability I alluded to is not only, however, apparent in specimens of different age, but specimens of equal dimensions are often entirely different in aspect, as will be seen from the figures given in Pl. XIII. The ribs described before frequently never appear, the shell remains entirely smooth, only provided with the canal on the lateral part of the shell. Ribbed examples differ from each other by the number and sharpness of the ribs, which often appear exactly as in the specimens figured by Oppel, but often are also more scarce and broadly rounded, or more numerous.

The lobes in the specimens I have for examination are commonly not so long as drawn by Oppel. The siphonal lobe is rather short and broad, little ramified, only with two short branches; external saddle short and broad, with a small secondary lobe in the middle; first lateral lobe much longer than the siphonal, but rather broad, with three short branches at the end; first lateral saddle going much higher up than the external, not very broad, with two indistinct secondary lobes; second lateral lobe about the shape of the first one, but much shorter; there are two auxiliary lobes above the umbilical suture.

The dimensions of three specimens are the following—

				I.	II.	III.
Diameter	of the shell	...	...	42 mm.	41 mm.	36 mm.
"	of the umbilicus	...	...	15	12	12
Height	of the aperture from the umbilical suture	...	...	16	17	13
"	of the "	from the preceding whorl	...	14	15	11
Thickness	of the "	...	...	10	9.5	8

There have been found in Kachh no such large specimens as those figured by Oppel from Niti.

Remarks.—The species is represented by a fair number of specimens in our Museum, all collected by Dr. Stoliczka. By far the largest part of them has been found south-west of Nurrha, in a nodular sandy limestone with many fragments of plants and mica in the middle region of the Katrol group. Another specimen comes from north-east of Gudjinsir out of the same beds, but preserved in a red ferruginous sandstone nodule.

There is, I think, no doubt that the Kachh specimens are identical with the species described by Oppel, and, though large specimens are wanting among the materials from Kachh, a comparison of Oppel's smaller figure and the figures given on Pl. XIII will show easily that they all belong to one and the same species. Also Oppel's specimen has on the inner whorls the canal or furrow only visible on

the cast, and the keel seems to appear just before the end of the last whorl. Only the lobes show a certain slight difference, as they appear to be not quite so long and narrow in the Kachh specimens as in those from Niti. The differences of *H. Kobelli* from *H. bifrons* are easy to recognize if once stated. They consist in the want of furrows on both sides of the keel on the siphonal part of the shell, and in the narrow ridge by which the furrows on the sides of the whorls is limited towards the umbilicus. No other species excepting *H. bifrons* can be compared with the Indian form.

It is one of the anomalies experienced in the investigation of formations in very distant countries that often certain types of form which one is accustomed to find only in certain limited beds in one country, in another appear on quite different horizons, thus rendering it often extremely difficult to identify those beds as of the age to which they in reality belong. Such an instance we have in *H. Kobelli*, whose extreme resemblance to *H. bifrons* of the Lias of Europe led the scientific world to believe that it must have its position also in Liassic beds. That this is not the case the specimens from Kachh show, which were found on a horizon corresponding to about the middle of the Kimmeridge group.

This occurrence of the species in the Kachh jurassic beds is of importance, as it serves to furnish at last the decisive proof against one of the grossest accusations ever pronounced against a man of so high a scientific standing as Oppel had attained. The news of the controversy about the origin of the specimens which served as originals for the drawings of the Rev. Mr. Everest, which had arisen in Calcutta, had just reached Europe, as the second part of Oppel's "Mittheilungen" was published. Some undefined talk about it must have been related also to Mons. Amie Boué, who was not at all connected with the scientific questions then raised, in fact was an entire stranger to the description and distinction of Jurassic Ammonite species, as well as to the questions about their geological horizons or their geographical distribution, but who was yet induced to make in public at the session of the Imperial Academy of Sciences of Vienna some very serious remarks about Oppel's Himalayan Ammonites. After having stated that those are very much in the wrong who despise Palæontology, or believe it to be an entirely distinct science from Geology, he proceeds: "That not every man has got the taste, talents or means for palæontological enquiries is natural, but then not every one is permitted to give his opinion about such points. An unnecessary and even ridiculous increase of the number of species can happen such as that brought forward by Oppel, caused by the change of boxes from and for Calcutta." It is clear from these words that Mr. Boué never can have read either the memoirs in the Journal of the Asiatic Society of Bengal or Oppel's book, or else he would not have styled the latter "Beitraege" whilst the title is "Mittheilungen." That no such thing existed as a change of boxes was already stated by Benecke, who also pointed out that Boué could not have given the declaration quoted above of his own accord. Some benevolent friend, who had not courage to come forward himself, and who

did not hesitate to concoct a little story from half digested rumours, must have instructed Mons. Boué, who took for granted all that he was told. The sad part of the whole, however, is, that the intense excitement, caused by Boué's article, seemed to accelerate in Oppel the outbreak of a nervous fever, of which a few days before his youngest child had died, and which had cast already its forebodings on Oppel's youthful life.

It is a debt due to Oppel's memory by the scientific world to unravel every thing connected with Oppel's Himalayan Ammonites, and I feel happy that it has fallen to my lot to be able to redescribe for the first time that species from the Indian deposits, which was likely to raise the greatest suspicion, and so to dispel any doubts which might still have existed about the Indian origin of Oppel's specimens.

GENUS *PELTOCERAS*, WAAGEN.

A short diagnosis of this genus I have given already in the Records of our Survey, 1871, p. 91, but the exact reasons which caused me to separate the forms placed under the genus *Peltoceras* from *Aspidoceras*, Zittel, I have yet to explain.

The genus *Aspidoceras* was proposed in 1868 by Zittel in his "Cephalopoden der Stramberger Schichten," but only in 1870 he gave a strict description of it and defined it to a certain number of species, which ought to correspond nearly with the group of the *Armati* as it is accepted by Quenstedt in his "Cephalopoden," but not with the *Armati* of v. Buch, which is something quite different. There is no doubt that the *Armati* of Quenstedt form a well-defined and well-characterised group, but Quenstedt includes therein some species which are distinctly excluded by Zittel from his genus; those are "*Ammonites athleta*, *Arduennensis*, *annularis*, etc."

It is very difficult to decide on the position of those species just mentioned, though their relation to the other groups of Ammonites is very clear. There is no doubt that they are very nearly allied to the *Planulati* or the genus *Perisphinctes*, though they are even in their young stages of growth easily distinguishable by their general appearance. But not less are they allied with the genus *Aspidoceras*, even so much that larger examples, (I have figured one of an allied species on pl. 15, fig. 1), show almost no differences from forms really belonging to the genus just quoted; Quenstedt had therefore good reason to unite those species with his *Armati*, and I should rather prefer to adopt his views on this point than the views of Prof. Zittel, who puts them in the genus *Perisphinctes*. Certainly he had some very good reasons for doing so, such as are the existence of contractions of the shell, though they are only very rarely to be observed, and the eared mouth of most of the species in younger stages of growth, but, on the other hand, the sutures are quite different from those commonly existing in the *Perisphinctes*,

and nearly all the species, except a few of the group of *P. annulare*, arrive, after having attained a certain size, at the general form of a certain group of *Aspidoceras*. Therefore, I think, if one would not create a separate genus for those forms, it would be more convenient to take them under the designation of *Aspidoceras*.

But the genus *Aspidoceras* thus defined would have to be divided into two large sections, each of them having about the importance of a genus, and it seems to me better to make the division permanent, and to create a new generic designation for the species which Zittel distinctly excluded from his genus and the allied forms, than to extend the limits of the genus *Aspidoceras*, so far that the species cannot be easily comprised under one simple diagnosis. I proposed, therefore, for the species allied to *Amm. annularis*, *Constanti*, and some others a new generic designation, *Peltoceras*.

The species belonging to this genus are mostly patelliform, with very large umbilicus, whorls with strong straight ribs, which are mostly provided with two or three rows of spines in adult specimens; siphonal side more or less flattened or even excavated, the ribs passing over it or disappearing before they reach it; sutures with very much enlarged predominant first lateral lobe, very broad external saddle, and second lateral lobe very little developed, or entirely wanting. Most essential for the generic determination of the shells I place under the name of *Peltoceras* is the form of the earlier stages of growth, which is characteristic to a high degree, and varies but very little in most of the species. The strong, sharp, mostly dichotome, but sometimes also undivided, ribs which cover the inner whorls of those Ammonites cannot be easily mistaken, and serve well to recognise the genus, even in specimens where other characteristics are not observable. The whorls are always very little embracing, and the transversal section of the latter somewhat rectangular.

The general typical form of the shell is modified in different species in several directions, such as that the spines are entirely wanting, or the ribs nearly entirely replaced by corresponding spines, but the general type of the genus can nevertheless even in such forms, be easily recognised.

There is no doubt that, if we follow up the different developmental series of the genus to their root, we are carried to some form of *Perisphinctes* wherefrom the genus takes its origin, but to indicate the species which forms the connecting link between the two genera is absolutely impossible. The near affinity between *Peltoceras* and *Perisphinctes* is not only shown by the general appearance of the young specimens of species of the former genus, but also by the occurrence of faint contractions of the shell in one or the other of the *Peltoceras*. There are, however, yet other genera which take their rise from *Perisphinctes*, as *Aspidoceras* and *Simoceras*, and which are very nearly allied to our genus; in fact, so much so that I formerly thought it necessary to unite a part of the forms generally comprised under the name of *Aspidoceras*, the group of *Asp. perarmatum* and allied species, with *Peltoceras*.

That I had been wrong in doing so was proved by Dr. Neumayr,* who had more extensive materials of *Aspidoceras* at his disposal than I had here; however, I should not have given up my opinion so easily had I not found among the fossils brought from Kachh by Dr. Stoliczka a specimen of a new species, *Asp. diversiforme*, which showed clearly that the relations of the '*Perarmati*' were different from those of *Peltoceras*.

Thus there can be no doubt, from the characters exhibited by the younger stages of growth of species of both genera, *Aspidoceras* and *Peltoceras*, that the one originates from the group of *Perisphinctes convolutus* or *Martiusi*, to which the larger number of middle jurassic *Perisphinctes* belong; the other, on the contrary, takes its origin from a group of *Perisphinctes*, as yet apparently entirely unknown in the European or any other jurassic strata, and perfectly distinct from the "*convolutus* group."

The genus *Simoceras* is less allied to our genus than *Aspidoceras*, and can easily be distinguished by the strong, deep contractions of the shell, which are characteristic for it.

The number of species which I unite under the name of *Peltoceras* is thus not very large, as only the species allied to *Pelt. annulare*, *athleta*, and *Arduennense*, belong to it. Thus limited, the genus begins in the upper part of the Kelloway group, and has its last representative in about middle or upper Oxfordian beds. There can be distinguished a series of developmental groups, some of which have been already pointed out by Dr. Neumayr.† He mentions three groups, all starting from the single species of *Pelt. annulare*, and then proceeding through the mutations of *P. chauvinianum*, Orb., and *P. Eugeni*, Orb., to *P. bimammatum*, Quenst., in one instance; through *P. torosum*, Opp., *P. spissum*, Opp., *P. Arduennense*, Orb., and *P. transversarium*, Quenst., to *P. reversum*, Leckenb., in another instance, and at last through *P. athleta*, Phill., to *P. constanti*, Orb. Though the species are well picked out and arranged, yet I cannot entirely agree with these statements. First of all I do not think that *P. chauvinianum*, Orb., fits well into the series, but is rather to be considered as an isolated form. Then it seems to me that it is not likely that *P. athleta* can have been derived from *P. annulare* itself. I rather feel inclined to suppose that some as yet undescribed species from older beds has given rise to both of the species, so that *P. athleta* is not subordinate to *P. annulare*, but co-ordinate. Thus my arrangement of the species must necessarily become different, and in consequence of that I distinguish—(1) group of *P. annulare* with the mutations *P. torosum*, Opp., *P. spissum*, Opp., *P. Arduennense*, Orb., *P. reversum*, Leckenb., *P. transversarium*, Quenst.; (2) group of *P. Eugeni*, Orb., to which only doubtfully can *P. bimammatum*, Quenst., be connected; (3) group of *P. athleta*, Phill., with the mutations *P. constanti*, Orb., *Murrayanum*, Simps.,

* Neumayr: Abhandl. d. k. k. Geolog. Reichsanst., Vol. V, p. 188.

† Neumayr: Jahrb. d. k. k. Geolog. Reichsanst., Vol. XXI, p. 369.

and some species of Phillips, too imperfectly described, to enable one to recognise whether they may belong here or not.

All these groups are represented in the Kachh Jura by one or the other species, two of which agree specially with European forms. The first group has furnished two species, *P. aegoceroides*, Waagen, n. sp., and *P. Arduennense*, Orb.; the second only one species, *P. propinquum*, Waagen, n. sp.; the third is represented by three species, *P. athleta*, Phill., *P. bidens*, Waagen, n. sp., and *semirugosum*, Waagen, n. sp.

Of these *P. athleta*, Phill., and *P. Arduennense*, Orb., were observed to occupy in Kachh the same relative geological position which they do in Europe.

(a.) Group of PELTOCERAS ANNULARE, Rein., sp.

1. PELTOCERAS AEGOCEROIDES, Waagen. Pl. XVI, Fig. 3a, b.

A very small species, with nearly the whole last chamber preserved, and yet not measuring more than 15 mm. in diameter. From the first stages of growth, the shell is covered with fine, undivided ribs, bent a little backwards, which become strong on the last whorl. I count on the last whorl exactly forty ribs, which are highest on the siphonal side; they are not all equidistant, but some of them are a little closer, and the space between two of those approximated ribs looks like a contraction of the shell, the furrow between them being rather deep. It is apparent that those contractions of the shell, though also indicating margins of the aperture in former stages of growth as in *Perisphinctes*, are different from the sulci occurring in this genus, because here the direction of the sulci is often not the same as the direction of the ribs, and the sulci cut the ribs in more or less oblique an angle, but there they are included between two parallel ribs, indicating thus a more simple apertural margin.

The whorls of the species I am describing are almost not touching each other, so that the siphonal side of the preceding whorl produces nearly no impression at all on the antisiphonal side of the following one. The whorls are rounded, depressed, and very numerous.

The lobes are not distinctly visible on any part of the shell, and I am therefore not able to describe or to draw them.

The measurements are—

Diameter of the shell	...	...	...	15 mm.
„ of the umbilicus	...	...	...	7
Height of the last whorl	...	...	...	4.25
Thickness of the „	...	...	...	4.5

Remarks.—The only specimen of this species I have for description is from Joorra out of a brown fine oolite, which contains at the same time *Aspid. perarmatum*. The species is very nearly allied to young specimens of *P. Arduennense*,

torosum, and *spissum*, but is distinguishable by its single ribs, which never occur in so small examples of the species just mentioned, and by the depressed form of the whorls. *Pelt. aegocerooides* is a member of a lower Oxfordian fauna of the beds with *Asp. perarmatum*.

2. PELTOCERAS ARDUENNENSE, *Orb. sp.* Pl. XVI, Fig. 2a, b.

1847. *Ammonites Arduennensis*, Orbigny: Pal. Franç. Terr. Jurass., I, p. 500, pl. 187, figs. 4-7.

I have figured on pl. 16, fig. 2, a small example of an Ammonite, which I believe to be the young stage of *Pelt. Arduennense*. The whorls are finely ribbed, the ribs are dichotome, sometimes trichotome, just as is figured by Orbigny on the inner whorls of his *Amm. Arduennensis*, and are most prominent on the siphonal side of the whorl. The shell is very slightly involute, the transverse section of the whorls is a little compressed, somewhat rectangular. The lobes are not visible.

Remarks.—The determination of this specimen is not quite certain, because the young examples of a large group of forms allied to *Pelt. Arduennense* are so similar in their whole appearance that it is difficult to attribute them to the one or the other species. I can state only with certainty that the figured example does not belong to any of the other Indian species. But as the specimen showed great resemblance to the Oxfordian form, I put it under this name with the purpose of showing that there is in India a species which I cannot distinguish at that stage of growth from *Pelt. Arduennense*.

The locality which has furnished the specimen is the Joora hills, where it occurs in the Dhosa oolite.

(b.) Group of PELTOCERAS EUGENI, *Raspail*.

1. PELTOCERAS PROPINQUUM, *Waagen, n. sp.* Pl. XVI, Fig. 1a, b.

Though only one specimen of this species is in the possession of our Museum, I thought it yet advisable to describe it under the above name, as it seems to furnish a certain connecting link between *Pelt. Eugeni* and *bimammatum*.

Young specimens are in this species, more than in any other except *P. athleta*, like *P. annulare*, Rein. Up to a diameter of about 40 mm. the shell changes very little in its general appearance. The whorls are rounded in their transversal section, rather depressed, only very little higher than broad. They are covered with not very fine sharp ribs, which are for the greater part dichotome, sometimes single, very rarely one of the secondary branches is yet again divided into two. The point of division of the ribs is not near the umbilical margin, but about in the middle of the sides. Contractions of the shell do exist, but are very rare. In somewhat

larger specimens, up to a diameter of about 90 to 100 mm., the ribs are simple, first numerous, and not very high, then more and more increasing in distance and strength, but yet without any tubercles. As in younger specimens, they cross as high simple ridges over the siphonal side, but bear here, not as in former stages of growth, a little depression, like young specimens of *P. bidens*, W.

When the shell attains a diameter of about 100 mm. tubercles appear rather suddenly on the ribs, one compressed and pointed near the umbilical margin, and one thick and rounded on the margin of the siphonal side. The ribs pass yet on over the siphonal part of the shell, but in the middle of it they are interrupted by a deep, not very broad furrow, which passes along there, but they do not bear any tubercles on each side of the furrow. In very large specimens, it seems the tubercle, which is situated at the margin of the siphonal side of the whorl, more and more approaches the furrow, whilst the tubercles on the umbilical margin become smaller and less distinct, and thus the last part of the shell of *P. propinquum* resembles more or less a gigantic specimen of *P. bimammatum*.

In this full grown state the general shape of the shell is patelliform, with very wide umbilicus and whorls, squarish in their transversal section, with flattened siphonal part, intersected by the thick swollen ribs which pass over it, and provided with a longitudinal furrow. The umbilicus is never surrounded by a distinct vertical wall, and such an umbilical edge is never developed.

The form of the lobes I can only gather from different bits being exposed on different parts of the shell. The siphonal lobe is tolerably long and narrow with a long straight branch on either side; external saddle very broad, with a short but well developed secondary lobe not quite in the middle of it, but a little shifted towards the first lateral lobe; the latter very long, a good deal longer than the siphonal, with a long medial terminating branch; first lateral saddle very broad, with a well developed eccentric secondary lobe, limited towards the umbilicus by a small little developed sutural lobe, second lateral and every auxiliary lobe thus wanting.

The measurements of the described specimen are—

Diameter	of the shell	...	123 mm.
„	of the umbilicus	... ..	63
Height	of the aperture from the umbilical suture	...	39
„	of the „ from the preceding whorl	...	38
Thickness	of the „	...	36

There are yet fragments of a much larger outer whorl of the same specimen.

Remarks.—The specimen just described was found by Dr. Stoliczka north-west of Kumagoona in a yellow sandy calcareous rock, belonging very likely to the region of *Asp. perarmatum*, but possibly also a little higher.

The species is nearly allied to several others, principally to *P. Eugeni*, Orb., *P. bidens* and *semirugosum*, W. The full grown stage of *P. propinquum* is always

easy to distinguish from the forms mentioned: from the first by the want of tubercles on either side of the furrow on the siphonal part of the shell; from the second and third by the ribs which cross over the siphonal side, whilst this part of the shell is entirely flat in *P. bidens* and *semirugosum*. Young specimens of the four mentioned species are not so easily distinguishable; however, on closer examination, constant differences can be discovered.

In the inner whorls of *P. Eugeni* the ribs are less numerous and more distant, and never bidichotomous as is often the case in *P. propinquum*. In *P. semirugosum* the ribs are much coarser and divided near the umbilical margin, not on the middle of the sides; in *P. bidens* they are mostly simple, undivided, and in *P. Arduennense*, which must be also compared, they are much finer than in all the others. In this way *P. propinquum* in all its stages of growth can be distinguished from the allied forms.

(c.) Group of PELTOCERAS ATHLETA, *Phill.*

1. PELTOCERAS ATHLETA, *Phillips, sp.* Pl. XVII, Figs. 2a, b, 3a, b, c.

1829. *Ammonites athleta*, Phillips: Geol. of Yorkshire, ii, pl. 6, fig. 19.

1847. *Ammonites athleta*, (Phill.), Orbigny: Pal. Franç. Terr. Jurass., Vol. i, p. 457, pl. 163 & 164.

1848. *Ammonites athleta*, (Phill.), Quenstedt: Die Cephalopoden, p. 189, pl. 16, figs. 1—3.

1857. *Ammonites athleta*, (Phill.), Oppel: Jura formation, p. 558.

1858. *Ammonites athleta*, (Phill.), Quenstedt: Der. Jura., p. 538, pl. 71, figs. 1—3.

Though fragments of the species are rather common in Kachh, an entire specimen has not been found as yet, and principally the inner whorls, so characteristic for the species, are never preserved.

The shape of the young form I can only guess from the impressions it left on the antisiphonal side of the outer whorls of larger examples, and I see there that its siphonal side was provided with fine sharp ribs, as in European specimens of *P. athleta*.

The Indian specimens seem to have got their spines at a rather early state of growth, but not earlier than some of the specimens found in Württemberg, of which one is figured in Quenstedt's "Cephalopoden," which had got the outer row of spines at 25 mm. diameter, and had already with 45 mm. diameter an entirely smooth siphonal side. This seems about the variety which resembles most closely the Indian form. In specimens whose diameter I estimate at about 50 mm. both rows of spines are already well developed, the outer a good deal stronger than the inner, the siphonal side is nearly entirely smooth, and only faint traces of the ribs, which go over it from one spine to the other opposite, are visible. The transversal section of the whorls is rectangular, a little higher than broad. This shape remains apparently till the specimens grow very big; at least fragments, which are derived from specimens of at least 180 to 200 mm. diameter, show yet

the same form, only the spines are comparatively a little weaker. The corresponding spines of the different rows on either side of the whorls are connected by low ribs, which have sometimes a longitudinal depression on their top.

The lobes do not agree entirely with those figured by Orbigny in his 'Paléontologie Française,' but differ in several points. The siphonal lobe is tolerably broad, well divided, with two principal branches, external saddle very broad with two secondary lobes, one larger near the siphonal and one smaller near the first lateral lobe; first lateral lobe not much longer than the siphonal, rather narrow, well branched; first lateral saddle about as long as the external, not very broad, with a small central secondary lobe; after that there are yet two smaller lobes, placed under a certain angle towards the first lateral; the first of them not very large, unsymmetrical, the second a little larger, forming a kind of second lateral lobe, but already half concealed in the umbilical suture.

The measurements of two of the fragments are—

				Larger fragment.	Smaller fragment.
Height	of the aperture	...	...	... 63 mm.	25 mm.
Thickness of the	„	between the ribs	...	... 51	24
„	of the	„	on the ribs between the tubercles	... 85	27

Remarks.—The fragments of this species preserved in our Museum were collected at the following localities: north and north-east of Gudjinsir, in whitish, marly limestone, the shell of the fossils being converted into black calcspar,—fragments of four specimens; north-west of Jikli—a fragment in yellowish marly limestone; Vanda—a fragment out of a rock of the same description; north-west of Soorka hill—two fragments out of light grayish limestone, the shell of the fossils converted into black calcspar; north-west of Nurrha—a fragment exactly preserved like those of Gudjinsir or Soorka hill; south-west side of Keera hill near Charee—a fragment also preserved in the same way.

It will be easily seen from the drawings given on pl. 17 that the general form of the Indian specimens agrees well with that of the European *P. athleta*. However, they show not quite the typical shape, but rather resemble certain varieties which also occur in Europe, but are there not so common as the typical form. The most prominent difference lies in the siphonal side, where the three ribs which start from every spine on one side and are again united in the spine of the other side disappear at a comparatively early state of growth in the Indian specimens, whilst in the European ones they commonly remain much longer; this difference, however, is certainly not sufficient to separate both forms as different species.

Peltoceras athleta is in Europe most characteristic for upper Kallovien beds.

2. PELTOCERAS SEMIRUGOSUM, *Waagen, n. sp.* Pl. XIV, Figs. 1, 1a, 1b, 2, 2a.

The species described under this name is very remarkable. The changes which the species undergoes from its first youth to its full grown stage are so large that I have to describe them as if there were at least four different species. The general form of the shell is always patelliform, with very wide umbilicus, and rather compressed whorls.

From the first beginning of the shell, up to a diameter of about 15 mm., the whorls are rounded, and covered with sharp, fine, dichotome ribs, which pass over the rounded siphonal side; only the embryonal chamber and the first whorl are smooth, without any ornamentation. Growing larger, the whorls become more and more high, and at the same time the transverse section of them becomes more angular, the siphonal side being now rather flat; the ribs, which were on the former whorls divided in two on the middle of the sides, have now their dichotomism near the umbilical margin. This state remains up to a diameter of about 80-90 mm. The shell at that time resembles *Pelt. Arduennense* extremely, so that I for a long time was in doubt if I should not join the Indian form with Orbigny's species. But after a careful examination I found that even at that stage of growth there are some differences between the two species which make it possible to separate them, though, only knowing this stage, I would not have considered them sufficient for specific distinction. The ribs in *Pelt. semirugosum* are straighter, and more distinctly dichotome, so that I have never observed trichotome ribs as is often the case in *Pelt. Arduennense*.

Exceeding a diameter of 90 mm. the aspect of the shell becomes quite different, and one would certainly determine a fragment from this stage, as *Pelt. constanti*, Orb. The transverse section of the whorls is high, and nearly rectangular; the ribs are very regularly dichotome, and every one bears a strong tubercle on the outer margin; from there low ribs pass over the flat siphonal side, which, however, disappear nearly entirely at a diameter of the shell of about 110 mm. At this size the points near the umbilical margin, where the ribs are divided into two, become successively higher and thicker, and two of the ribs unite now commonly into one outer marginal tubercle. So the shell gets very soon two rows of tubercles, one near the umbilical and one near the outer margin, and then only has it arrived at its permanent state.

The species grows astonishingly large. I believe it is one of the largest forms existing among the *Aspidoceras*-like types. There is here preserved a fragment of the outer whorl of such a gigantic example, of which the aperture is about 120 mm. high and 95 mm. broad, though the preceding whorl at the same radius has only 70 mm. in height and 55 mm. in breadth. This shows clearly the rapid increase of the whorls in this species. In the inner whorls of course the increase seems a little slower, but there is only a slight difference.

The lobes are of the characteristic form of the whole group. The siphonal lobe is not very broad, a little shorter than the first lateral one; the external saddle is extremely broad, with a secondary lobe, which is not quite preserved in the figured example.

The lateral lobe is very long and terminates in a long narrow branch; the lateral saddle is much smaller than the external, provided, however, with a secondary lobe, but not going higher up than the latter; the second lateral lobe is very indistinct, and nearly of the same shape as the auxiliary lobe. The second lateral saddle is very small, but distinct and bearing a small secondary lobe. Beginning from the first lateral saddle all the lobes and saddles hang down, forming thus a large sutural lobe.

The dimensions of the figured example are—

Diameter of the shell	...	...	...	...	...	158 mm.
" of the umbilicus	...	...	...	...	...	66
Height of the last whorl from the umbilical suture	...	...	...	...	...	55
" of the " from the preceding whorl	...	...	...	...	...	52
Thickness of the " ...	...	...	...	...	...	41
Height of the preceding whorl from the umbilical suture	...	...	...	...	...	28
Thickness of the " " ...	...	...	...	...	...	22

Remarks.—The examples I have to examine are several, all coming from Lodai and Joora, out of a brownish, fine oolite, which very often passes into a hard, calcareous crinoidean breccia. The fossils are mostly covered with a ferruginous crust. The shell is commonly preserved and converted into iron ore or into a white kalkspathic matter.

As I have already mentioned before, *Pelt. semirugosum* shows great affinities to several already described species, so that it is difficult to distinguish it at certain stages of growth. The first species which comes into consideration here is *Pelt. Arduennense*, but one can compare both species only up to a diameter of 80-90 mm.—exceeding this, no one would think them both identical. That also the younger specimens are distinguishable by straighter and regularly dichotomous ribs I mentioned before. The example figured by Orbigny is not large enough to state with all necessary certainty if the species, on growing larger, could not have got also, like our species, two rows of thorns on both sides of the whorl, and such could not be identical with the form here described; but firstly Orbigny states it as characteristic for his species, that it never gets thorns, and then, on the other hand, Quenstedt in his 'Jura' mentions fragments of the body-chamber of *Pelt. Arduennense* from the "Vaches noires" of about 40 mm. high and 26 mm. broad—dimensions in which our species has already for a long time had its spines. That there is at the "Vaches noires" also a species which gets spines in the larger stages of growth there is no doubt, because I found once there a fragment of an Ammonite which on the inner whorl resembled very much *Pelt. Arduennense*,

whilst the outer whorl had two rows of spines, but I do not remember it exactly enough to determine if it be identical with one of the Indian species or not.

Before *Pelt. semirugosum* gets its two rows of tubercles, there is a short space of the shell which very much resembles *Pelt. constanti*, having only on the outer side of the whorl one row of spines.

That for ~~this~~ reason our species is not to be united with *Pelt. constanti* is natural, because *P. constanti* has its characteristic form for several whorls, without getting a second row of spines, but our species, on the contrary, has this form only for not quite half of a whorl, then already putting on the umbilical row of spines.

Full grown examples are not easy to distinguish from larger specimens of *Asp. perarmatum*; both have two rows of tubercles, the outer one being stronger than the inner, but on *Pelt. semirugosum* the inner whorls are so entirely different from those of *Asp. perarmatum* that nobody would think of uniting both species into one.

There seems little doubt that the species is of Oxfordian age. It seems to come from the same layer as *Pelt. Arduennense* and *Asp. perarmatum*, which both indicate in Europe Oxfordian strata, and are there found exclusively in the lowest region of that division.

3. PELTOCERAS BIDENS, *Waagen, n. sp.* Pl. XV.

Like the species just described, this also is subject to great changes according to age, but the changes are a little different from those occurring in the other.

The first stages of growth, up to a diameter of about 25 mm., have a large umbilicus and rounded whorls with strong not very fine ribs; about half the number of them is single, the other half divided into two. The siphonal side is rounded, and the ribs pass over it in the same shape as they are developed on the sides of the whorl. When the shell attains a diameter of more than 40 mm., the transverse section of the whorls becomes oval, much higher than broad, the ribs are strong, and all undivided, and on the now somewhat flat siphonal region they are swollen on both sides, forming in a way two rows of obtuse tubercles. At this stage the species has the most characteristic form; growing larger it attains again an appearance very much like *Pelt. semirugosum*, but notwithstanding that, there are yet always some distinguishing points. In specimens exceeding a diameter of 90 mm. on the outer side of the whorls, following the margin where the flat siphonal side joins with the sides of the whorls, tubercles appear which soon correspond with smaller ones on the umbilical margin, so that the whole form very much resembles *Aspidoceras perarmatum*.

Of the species here in question I have not yet seen such large fragments as of *Pelt. semirugosum*. The largest example known to me has 340 mm. in diameter, and is figured on pl. XV, fig. 1, $\frac{2}{3}$ of its natural size.

The sutures are very much like those in other allied species, the siphonal lobe not very long, finely dentated, the external saddle extremely broad, with a large secondary lobe next to the siphonal lobe, and a small one next to the first lateral lobe. First lateral lobe much longer than the siphonal, with rather broad and elongated body, terminating in one narrow long branch. The first lateral saddle is much smaller than the external, provided with a secondary lobe; second lateral lobe of the same shape as this secondary one, yet less distinct than in the preceding species; second lateral saddle not distinguishable, those last two hanging down to a large sutural lobe.

The dimensions of the large specimen are—

Diameter of the shell	...	...	340 mm.
„ of the umbilicus	...	...	170
Height of the aperture	...	...	90
Thickness of the „ about	...	...	75

Remarks.—*Peltoceras bidens* is very nearly allied to a whole group of Ammonites which are not easy to be distinguished, and it seems therefore desirable to go through all the single forms, and to state the specific value of every one of them.

On reviewing the species, which come here into consideration, it is easy to find that there are two groups of forms, those which never bear points or spines, and those which in full grown age are covered with them. Though the first group seems not to come into comparison with the species here described, it is yet necessary to mention those also, because the young stage of our species is very nearly allied to them. We have to consider here only the species with squarish or angular aperture, and I begin them with—

Pelt. Arduennense, Orb. The ribs are fine, dichotome or trichotome, and, at a diameter of about 300 mm., the shell is not yet provided with thorns. Zone of *Am. Lamberti* and that of *Am. cordatus*.

Pelt. spissum, Opp. The ribs fine, mostly single, a little bent backwards; no examples with spines or thorns known. Zone of *Am. Lamberti*.

Pelt. torosum, Opp. Aperture more rounded, ribs in the beginning mostly dichotome, on the last whorl thick, single, and strongly bent backwards; no specimen with spines known. Zone of *A. Lamberti*.

Pelt. reversum, Leckenby. Depressed, rather roughly ribbed; ribs dichotomous to the end, strongly bent backwards. Near the mouth apparently traces of spines on the umbilical margin. A very characteristic species, but its layer not exactly known (Kelloway rock of Yorkshire).

Pelt. transversarium, Quenst., (identical with *Pelt. Toucasianum*, Orb.) Ribs very strong and little numerous, single or dichotome near the umbilical margin, strongly bent backwards; no spines. Middle Oxfordian.

Pelt. Eugeni, Orb. Whorls rather rounded, ribs mostly dichotome, becoming simple at a diameter of about 50 mm., forwarded with two rows of spines on the

sides of the whorls, and two on the siphonal side. Very rare species of the zone of *Am. cordatus*.

Pelt. propinquum, Waagen, n. sp. Whorls rather rounded, ribs distant, often bidichotome; at a diameter of about 100 mm. two rows of spines on the sides of the whorls, and a depression on the siphonal side.

Pelt. Constanti, Orb. Whorls rectangular, ribs dichotome near the umbilical margin, getting spines on the outer margin at a diameter of about 50 mm., spines near the umbilicus wanting. Zone of *Am. cordatus*.

Pelt. Murrayanum, Simpson. Whorls very compressed, twice as high as broad, in adult examples provided with two rows of tubercles (diameter about 300 mm.) (Kelloway rock of Yorkshire).

Pelt. semirugosum, Waagen. Young stage up to 90 mm. very much like *P. Arduennense*, but the ribs straighter and strongly dichotome. Full-grown, (from a diameter of about 110 mm.) with two rows of tubercles on the sides of the whorls. Aperture a little higher than broad.

Pelt. bidens, Waagen. Young stage with strong single ribs; on the siphonal side two rows of not very distinct tubercles. Full-grown, two rows of thorns on the sides of the whorls; thorns less numerous than in the preceding species; whorls much higher than broad. Dhosa oolite of Cutch.

?? *Pelt. armiger*, Sow. A very doubtful species, which I cannot make out either from the description or from the figure. The description given by Sowerby is: "Discoid, inner volutions exposed, inner whorls radiated and furnished with a row of tubercles on their sides; outer whorls with a row of tubercles near the inner edge, and a row of spines near the outer edge; on each side the tubercles and spines connected by thick ribs; margin flat, aperture oblong, squarish, diameter 7 inches." I have never seen a species with tubercles on the inner whorls as this is described and figured by Sowerby, and it is certain that among the materials in the possession of our Museum not a single specimen like it is preserved.

Other doubtful species, the meaning of which only can be settled by examining the originals, which served for description, are *Pelt. Williamsoni*, Phill., resembling *Pelt. bidens*, but with depression of the ribs on the siphonal side nearly absent and a more squarish aperture, *Pelt. ? instabile*, Phill., and *Pelt. Vernoni*, Phill., possibly, if a *Peltoceras*, identical with *Pelt. Arduennense*, Orb.

These are the forms allied to my species. It is easy to be seen, that even with a few short sentences one is able to signify the distinctive points between the several species. I only wish to make a few additional remarks regarding the lobes of *Pelt. semirugosum* and *bidens*, considering that in the first species the second lateral saddle is distinct, provided with a secondary lobe, whilst in the second one the same saddle is quite indistinct, not different from any auxiliary saddle.

The examples for description are several, coming from the same brown oolite as the preceding species, partly from Joora, partly from Lodai, and, as far as I can judge from other species, being a member of a fauna of lower Oxfordian age.

GENUS *ASPIDOCERAS*, ZITTEL.

Though the name of *Aspidoceras* was used by Zittel already in 1868, it was not before the year 1870 that he gave a diagnosis of the genus. Since then many excellent observations about the genus have been published by Dr. M. Neumayr, and many of the difficult and often obscure relations of it to other generic forms have been cleared up. But it was not without difficulty that these results had been obtained, and thus even Dr. Neumayr in his newest publication had to change the opinions he had expressed in 1871 in the Jahrbuch of the "Geologische Reichsanstalt" of Vienna. This shows clearly what intricate questions he had to deal with, and how only the most extensive materials, like those which Dr. Neumayr had at his disposal for his last memoir, could lead towards a definitive solution.

Also I was myself misled by the affinities of certain species of *Aspidoceras* to transfer them into my new genus *Peltoceras*, which has been shown, as well by the remarks of Dr. Neumayr as by my own observations, to be erroneous.

As the question now stands, one can say with tolerable certainty that the genus *Aspidoceras* takes its origin from certain forms of the genus *Perisphinctes*, and that the first species, in which the peculiarities of the genus are well developed, and which, therefore, must be considered as truly deserving the name, are *Asp. perarmatum*, or rather *Asp. diversiforme*, Waagen, n. sp., which I am going to describe in the following pages.

Thus defined, the genus commences in the beds with *Pelt. athleta*, and continues up to the lower cretaceous formation, having its greatest development in the Kimmeridge and lower Tithonian group.

It is easy to distinguish three principal sections in the genus: the '*Perarmati*,' the '*Cycloti*,' and the '*Hybonoti*.' The two first of these are in every respect very nearly allied to each other, though in fact the only really connecting link between them is *Asp. perarmatum*; the third section, connected with the *Perarmati* through *Asp. pressulum*, Neum., deviates, however, so far from the original type of the *Aspidoceras* that it will be necessary to create a new generic designation for them, principally as the sculpture on most of the species strongly bent on the siphonal side of the shell towards the aperture indicates an apertural margin somewhat different from that usual in the genus *Aspidoceras*. The materials at my disposal are, however, not sufficient to establish a new genus, and thus I can only call attention to the existing differences.

The developmental series in the different sections of the genus have been pointed out already with great care by Dr. Neumayr, with whose views about most of the species I agree perfectly. In the section of the '*Perarmati*' I can distinguish: (a), group of *Asp. perarmatum*, Sow., with the mutations *Asp. Oegir*, Opp., *Asp. eucyphum*, Opp., *Asp. hypselum*, Opp., *Asp. clambum*, Opp., etc.; (b), group of *Asp. biarmatum*, Ziet., or better of *Asp. ponderosum*, Waagen, a new species of the *Athleta*-beds of Kachh, with the mutations *Asp. biarmatum*, Ziet.,

and *Asp. Babeanum*, Orb.; (c), group of *Asp. distractum*, Quenst., with the mutations *Asp. Edwardsianum*, Orb., *Asp. Meriani*, Opp., *Asp. corona*, Quenst., and *Asp. Rupellense*, Orb.

The section of the 'Hybonoti' comprises only one developmental series, the group of *Asp. pressulum*, Neum., with the mutations *Asp. Knopi*, Neum., *Asp. harpephorum*, Neum., *Asp. Beckeri*, Neum., and *Asp. hybonotum*, Opp.

The section of the 'Cycloti' offers great difficulties in arranging the species into developmental rows, and it is mostly in this section that I cannot quite agree with Dr. Neumayr's views. In my opinion the *Cycloti* can be divided into about five different groups, which are the following: (a), group of *Asp. Haynaldi*, Neum., with the mutations *Asp. microplum*, Opp., and *Asp. Wolfi*, Neum.; (b), group of *Asp. longispinum*, Sow., with the mutations *Asp. acanthicum*, Opp., *Asp. bispinosum*, Ziet., etc.; (c), group of *Asp. atavum*, Opp., with the mutation *Asp. binodum*, Opp.; (d), group of *Asp. liparum*, Opp., with the mutations *Asp. circumspinosum*, Opp., *Asp. Altenense*, Orb., *Asp. Lallierianum*, Orb., etc.; (e), group of *Asp. Neoburgense*, Opp., with the mutations *Asp. cyclotum*, Opp., and *simplum*, Orb.

Thus we can altogether distinguish in the genus *Aspidoceras* not less than nine different groups.

Every one of these groups is, however, not represented in the Kachh Jura. We have here—

I—in the section of the *Perarmati*: (a), group of *Asp. perarmatum*, Sow., represented by *Asp. perarmatum*, Sow., and *Asp. tenuispinatum*, Waagen, n. sp.; (b), group of *Asp. ponderosum*, Waagen, represented by *Asp. ponderosum*, W., *Asp. Babeanum*, Orb., and *Asp. sparsispinum*, Waagen, n. sp.; (c), group of *Asp. distractum*, Quenst., represented by *Asp. sub-distractum*, Waagen, n. sp.

II—in the section of the 'Hybonoti': group of *Asp. pressulum*, Neum., represented by *Asp. monacanthus*, Waagen, n. sp., and another not well determined species.

III—in the section of the *Cycloti*: (a), group of *Asp. longispinum*, Sow., represented by *Asp. iphiceroide*s, Waagen, n. sp., and *Asp. Wynnei*, Waagen, n. sp.; (b), group of *Asp. atavum*, Opp., represented by *Asp. binodiferum*, Waagen, n. sp., and another undeterminable species.

There has also been found in the Kachh Jura, together with *Pelt. athleta*, an isolated species, which could not be attributed to any of the groups just mentioned, and from which possibly two genera, *Aspidoceras* and *Simoceras*, could be derived; I call this species *Aspidoceras diversiforme*, Waagen, n. sp.

Of all the species mentioned only two are common to the Kachh and the European Jura; they are *Asp. perarmatum*, Sow., and *Asp. Babeanum*, Orb. Both are found in Kachh, absolutely as in Europe, just above the beds with *Pelt. athleta*.

Section I.—PERARMATI.

(a.) ISOLATED SPECIES.

1. ASPIDOCERAS DIVERSIFORME, *Waagen, n. sp.* Pl. XVII, Fig. 1a, b, c, d.

It is only a fragment, not very excellently preserved, which leads me to the foundation of this species, but the development of the shell as exhibited by this fragment, and the conclusions which may be deduced from it, seemed to me sufficiently interesting to justify the distinction of a new species.

The fragment indicates a specimen of about 170 to 180 mm. diameter. The general shape of the entire specimen was patelliform, with a very wide umbilicus and compressed whorls. The inner circuits are not preserved, but from the impression they left on the antisiphonal side of the outer whorls one can observe that, at a diameter of the shell of about 50 mm., they were covered with fine ribs, which were, however, less in number on the sides of the whorls; on the siphonal side they are directed slightly towards the front, and vanish in the middle, where they give space to a broad, smooth, but not excavated band, which occupies the middle of the siphonal side. This latter part is not depressed, but equally rounded. At a diameter which may have been about 80 mm., the sides of the whorl bear fine low, but distant ribs, which are nearly entirely straight, and are strongest near the umbilical margin. On the outer margin each of them is dissolved in three or four smaller ones, which are rounded and rather strong, but very short, not reaching the middle of the siphonal side, where the smooth band yet continues. At that size, the siphonal side is rather depressed, from which the whorl gets a somewhat rectangular section.

The last whorl has an entirely different shape from the foregoing ones, though it is not body-chamber, but filled with air-chambers. It is strongly rectangular, with flat siphonal, and straight lateral parts. The latter are covered with rather strong rounded ribs, every one of which bears two tubercles, one a short distance above the umbilical, and another on the outer, margin. The siphonal side is smooth, without any ribs.

The involution is very small, and all the whorls envelope each other very little.

The lobes are characteristic of the general typical shape prevailing in the genus. The siphonal lobe is not very broad and moderately long, with two long terminal and two side branches; external saddle broad, with a well developed median secondary lobe; first lateral lobe very broad, longer than the siphonal, with five unsymmetrical end-branches, of which the middle one is very long; lateral saddle narrow, with a small secondary lobe, going a very little higher up than the external; second lateral lobe very small, little branched; sutural lobe sending two branches above the umbilical suture, looking like two auxiliary lobes. On the antisiphonal side the well branched sutural lobe is limited by a narrow, very long saddle, which goes up as high as the lateral saddle. The antisiphonal lobe is extremely long and slender, as long as the first lateral, with many short branches on either side.

Remarks.—The fragment upon which this species is founded has been collected in the *Athleta*-bed a long distance north-east of Gudjinsir by Dr. Stoliczka.

Asp. diversiforme is in reality a thoroughly intermediate species between several genera of *Ammonites*, and thus it may be well adapted to throw some light upon the developmental connections of these genera. There is certainly no doubt that the former stages of development in *Asp. diversiforme* are so nearly allied to certain forms of *Perisphinctes*, principally of the group of *P. convolutus*, that, if the outer whorls of the shell had not been known, it would have been described as *Perisphinctes*. The only difference from the *convoluti* is the flat band on the siphonal side, which is something exceptional, though not astonishing, in the group of *Perisphinctes* just mentioned.

Somewhat larger specimens, showing a diameter of about 80 mm., bear yet great resemblance to the genus *Perisphinctes*; however, this resemblance is no longer as striking as in somewhat smaller individuals. The now flattened, smooth siphonal side on the contrary makes it doubtful if the species had not been better considered as belonging to Zittel's genus *Simoceras*, which, from Dr. Neumayr's discoveries, is also very nearly allied to *Perisphinctes*. The reasons why I did not consider the species as belonging to *Simoceras* are: the higher whorls and smaller umbilicus, the scarce and faint contractions of the shell, and, above all, the lobes which are so completely of the type generally observed in the *Perarmati* that it seems not possible to make a distinction.

Full sized specimens must be related already by their general appearance either to the genus *Peltoceras* or *Aspidoceras*. It cannot be referred to the former on account of its different inner whorls, which agree much better with the inner whorls of *Asp. perarmatum* than with any other, and as the lobes equally tend to show the relations of the species to the *Perarmati*, I thought it best to unite it with the genus *Aspidoceras*.

On the whole, *Asp. diversiforme* shows so many affinities to *Aspidoceras*, as well as to *Simoceras*, that I am inclined to consider it as the *root species* of the two genera.

(b.) Group of *ASPIDOCERAS PERARMATUM*, Sow.

1. *ASPIDOCERAS PERARMATUM*, Sow. Pl. XVI, Figs. 4a, b, 5a, b, 6, 7.

1822. *Ammonites perarmatus*, Sowerby: Min. Conch., IV, p. 72, pl. 352.

1847. *Ammonites perarmatus*, (Sow.) Orbigny: Pal. Franç. Terr. Jurass., I, p. 498, pl. 184, 185, figs. 1-3.

1866. *Ammonites perarmatus*, (Sow.) Opperl: Zone des Amm. transversarius, p. 13.

1871. *Aspidoceras perarmatum*, (Sow.) Neumayr: Jahrb. d. k. k. Geolog. Reichsanst., Vol. xxi, p. 371, pl. 20, fig. 1.

A series of several excellent specimens of this well known European species has been collected at Vanda, the Joora hills and Lodai, allowing of a rather accurate description and determination.

The younger stages of growth are represented in two varieties, which are rather different in their general aspect. The smaller specimen has 22 mm. in diameter. The whorls are much higher than broad, rounded squarish, embracing each other very little, umbilicus tolerably wide. The sides of the whorls are covered with fine, not very prominent ribs, of which commonly the third one is thicker and stronger; at the rounded outer margin, the thinner ones are divided each into two or three finer ribs, which pass, a little bent towards the front, over the siphonal part of the shell; the thicker ones terminate on the same margin in a kind of tubercle, produced by a strange curvature of the rib as in *Perisphinctes curvicosta*, Opp. Starting from the tubercle two distinct ribs go over the siphonal side, one forming a half circle towards the front, the other rather straight.

On a specimen of 30 mm. diameter I am able to observe what changes in form the species undergoes on growing a little larger. In this specimen the shape is in every detail identical with that formerly described up to a diameter of 20 mm. Then the tubercles at the outer margin are already rather prominent and pointed, the ribs on the sides of the whorls connected with them are very strong and distinct, whilst between them only one weaker rib is visible, but yet the siphonal side is not smooth, but the ribs cross over it. At a diameter of 27 mm. the first little spine near the umbilical margin appears, and only now is the typical form of the species established, but with the difference, that at this size only the principal ribs bear an outer and an inner tubercle, whilst the intercalated lower ribs are provided only with an outer tubercle. Sometimes one or the other of the principal ribs is divided into two at the inner tubercle, and then two outer tubercles correspond to one inner one. The general form of the shell now changes only very little; large as the specimens may grow, only the ribs which connect the corresponding tubercles of the two rows become weaker and weaker, and the siphonal side gets more and more smooth. The transversal section of the whorls is then obtuse rectangular, a little narrower at the outer than at the umbilical margin. The umbilicus is wide open, the whorls barely touching each other.

The tubercles are commonly not very numerous in large specimens, but one of the specimens from Vanda is conspicuous by the great number of spines which it bears on the last whorls.

The lobes are commonly slightly different from what Neumayr describes in the European specimens; they are mostly narrower and comparatively longer, but not much more ramified. The siphonal lobe is very long and comparatively narrow, with four principal branches; external saddle extremely broad with two secondary lobes, one smaller near the siphonal and one larger near the first lateral lobe; first lateral lobe not quite as long as the siphonal, very slender, terminating with two principal branches; first lateral saddle a little variable in its breadth according to the interference of the hollow spines at the umbilical margin, with a

small secondary lobe; second lateral lobe (if one can call this lobe such) very small; sutural lobe yet entirely above the umbilical suture.

The measurements of three specimens, two from Vanda, one from Lodai, are the following:—

				I.	II.	III.
Diameter	of the shell	...	...	31 mm.	100 mm.	200 mm.
"	of the umbilicus	...	...	12	42	91
Height	of the aperture from the umbilical suture	...	...	12	38	63
"	of the " from the preceding whorl	...	...	10.5	36	61
Thickness	of the " ...	...	...	12	42	62

Remarks.—The best specimens of this species have been found at Vanda in a strongly ferruginous oolite just above the white limestone with *Peltoc. athleta*. The other specimens, which were collected at Lodai in a sandy oolite, at the Joora hills in brown ferruginous oolite, at Kumaguna north of Warar hill in whitish oolite, north of Jumara in a brown sandy oolite, and on the south-west side of Keera hill near Charee also in yellowish sandy oolite occupied the same position. A very badly preserved fragment from the red ferruginous sandstone of Kuntkote can only with doubt be considered as belonging to this species.

Neumayr has with great skill pointed out the differences between *A. perarmatum* and the other allied species, and I have nothing to add to what he says. From *P. bidens* and *semirugosum* Sowerby's species can easily be distinguished by the shape of the inner whorls and of the tubercles, which are much finer and more pointed.

Asp. perarmatum is one of the most characteristic and most common species of the European Jurassic districts, and occupies there the same bathrological position as in Kachh, immediately above *P. athleta*.

2. ASPIDOCERAS TENUISPINATUM, *Waagen, n. sp.* Pl. XVII, Fig. 4a, b.

The species stands about in the middle between *A. perarmatum*, Sow., and *A. Edwardsianum*, Orb., and is about equally different from both of them.

The inner whorls of the only specimen of this species I have for description, up to a diameter of about 20 mm., are covered with equidistant rather strong ribs, which bear a kind of elongated tubercle at a little distance from the umbilical margin. The ribs are rather strongly directed towards the front from the umbilical suture to the middle of the sides of the whorls, but then turn back again a little. Between the principal ribs there are, when the shell of the fossil is preserved, yet finer ribs, which, however, might rather be called strong striæ of growth. In specimens exceeding a diameter of 20 mm. thin spines are formed by the principal ribs on the outer margin, where the lateral joins the siphonal part of the shell. This outer row of spines increases very quickly in size, whilst the inner ones always remain

very small, and on the cast barely perceptible. As the shell grows larger the outer tubercles, which are then very strong and prominent, become more distant and less numerous.

The transversal section of the whorls is decidedly squarish, very little broader than high. The umbilicus is very wide, the whorls barely touching, only attached to each other by the flat siphonal side of the foregoing whorl.

The lobes are not visible, as nearly the whole specimen is covered with its shell. The measurements are—

Diameter of the shell, about	75 mm.
„ of the umbilicus	... 35
Height of the aperture	... 24
Thickness of the „	... 25

Remarks.—The only specimen of this species has been collected in the brown ferruginous oolite of the horizon of *Asp. perarmatum* north-west of Jara.

The nearest allied species is, it seems, *Asp. Tietzei*, Neum., which in a young stage of growth has also the inner row of spines earlier and better developed than the outer one, but those spines stand nearer to the umbilical margin and remain yet predominant in larger specimens when they have already nearly disappeared in *Asp. tenuispinatum*. Larger specimens cannot be mistaken one for the other, as the species from Kachh has then thick strong tubercles on the outer margin. From *Asp. perarmatum* our species differs by the weakness of the inner tubercles, which appear, however, already at a much earlier stage of growth.

Lastly, the differences from *Asp. Edwardsianum* lie in the much smaller number of spines on the outer margin, and in the much narrower siphonal side of *Asp. tenuispinatum*.

(c). Group of ASPIDOCERAS PONDEROSUM, *Waagen*.

1. ASPIDOCERAS PONDEROSUM, *Waagen*, n. sp. Pl. XX; Pl. XXI, Fig. 2.

As of nearly all the other species in the bed of *Pelt. athleta*, so also of this species only fragments have been found, but sufficiently preserved to admit of an exact description and determination.

The general form of the species is coronate, with enormous tubercles on either side of the whorls, and an extremely deep infundibuliform umbilicus. The youngest stage of growth is preserved in none of the specimens at my disposal; the smallest size I can observe is about 15 mm. diameter, when the sides of the whorls are covered with distant, simple, rather strong ribs, which bear a small tubercle on the outer end. At about 25 mm. diameter a second row of tubercles near the umbilical margin is added, and in this stage the shell has very much resemblance to young specimens of *A. Babeaum*, Orb., but its siphonal side is more depressed and less

ribbed. The form changes now very little till a diameter of 70 to 80 mm. is attained; the whorls are very depressed, nearly twice as broad as high, with two rows of very strong tubercles or rounded spines, which are situated very near each other, as the lateral part of the whorl is very narrow, but which amount to barely more than twelve pairs on one circuit. The outer row of tubercles is not adpressed to the ascending wall of the following whorl, but stands free. Specimens exceeding a diameter of 100 mm. bear again a different aspect. The outer row of tubercles, though in smaller specimens appearing before the inner one, and till now being stronger than the latter, rapidly disappears in specimens of the size mentioned, whilst the inner tubercles increase to an enormous extent. The whorl has no more any distinguishable lateral part, but is entirely composed of an extremely broad siphonal part and the umbilical walls. Then only has the species attained its adult shape which is not changed again.

The lobes are throughout of the common *Aspidoceras* type. The siphonal lobe is long, rather narrow, with short ramifications; the external saddle is extremely broad, occupying nearly one-half of the whole extent between the siphonal and the sutural lobe, with a very small secondary lobe about the middle of it; first lateral lobe very narrow, and very little ramified, about as long as, or a little shorter than, the siphonal lobe, terminating in three unequal branches, situated as in many other *Aspidoceras* between the two rows of tubercles; first lateral saddle rather broad, a little shorter than the external, without any distinct secondary lobe; second lateral lobe very small and short, separated by a tolerably broad saddle from a small auxiliary lobe; sutural lobe yet entirely above the umbilical suture, narrow, rather long, terminating in three nearly symmetrical branches.

The dimensions of the largest tolerably complete specimen are the following:—

Diameter	of the shell	...	...	150 mm.
"	of the umbilicus	...	...	65
Height	of the aperture from the umbilical suture			59
"	of the "	from the preceding whorl		54
Thickness	of the "	between the tubercles		85
"	of the "	on the tubercles	...	103

The specimen is composed entirely of air-chambers.

Remarks.—This beautiful species seems to be not very rare in the Kachh Jura, and Dr. Stoliczka tells me that fragments of it are nearly everywhere to be found, where the *Athleta* bed is exposed. In our Museum it is represented from the following localities: north-west of Jara, north of Soorka hill, the figured specimen, in a grayish-white marly limestone, the shell converted into black kalkspar, in some places, however, in the innermost layers iridescent like mother-of-pearl. Another tolerable specimen has been found on the south-west side of Keera hill near Charee; a compressed, but tolerably complete small specimen comes from west of Barasir, and is preserved in a sandy marl nodule; a small fragment of an outer whorl has been collected in the *athleta*-bed at Vanda.

The general appearance of *Asp. ponderosum* is so characteristic that the species is not likely to be mistaken; however, some remarks about its relations to other forms may be useful. Small specimens have a certain resemblance to *P. athleta*, only the innermost whorls have not those sharp ribs which are characteristic for young specimens of this species; but also the outer whorls are much broader, the two rows of spines nearer together, and the spines themselves stronger and more prominent. Adult specimens of both species, however, are so different that they do not allow of any comparison. From *Asp. Babe anum*, Orb., our species can be distinguished by the more depressed whorls, stronger tubercles, and smooth siphonal part of the shell in a young stage of growth; by the extremely broad transversal section of the whorls and enormous development of the inner tubercles in adult specimens.

2. ASPIDOCERAS BABE ANUM, Orbigny. Pl. XIX.

1847. *Ammonites Babe anus*, Orbigny: Paléont. Franç. Terr. Jurass., Vol. i, p. 491, pl. 181.

Two excellent large specimens represent this species in our Museum, and give a fair idea of its shape and development.

The general form of the species is thick, patelliform, with a wide and deep umbilicus, depressed whorls, and a more or less flattened siphonal side. The sides of the whorls are provided with two rows of spines, of which the outer one is obliterated on the last circuit.

I cannot examine the first stages of growth of the species, as the innermost whorls in the specimens at my disposal are not preserved. At a diameter of 25 mm. two rows of spines on either side of the whorls are already well developed, though the spines themselves are not very prominent. The corresponding spines of the different rows are connected together with high ribs, nearly as high as the spines. At this size the outer row of spines seems a little stronger than the inner, but soon the inner spines increase considerably in strength and become predominant over the outer ones. The greatest transversal diameter of the whorls, therefore, lies on and between the inner spines; from there the lateral parts of the whorl slope towards the siphonal part, with which it unites in an obtuse ridge on which the outer tubercles are placed. The siphonal part of the shell is in all stages of growth rather flat, and not so strongly prominent as in Orbigny's side-view, which is greatly exaggerated. The front-view, however, seems tolerably correct, as the transversal section of the whorl is there squarish, oblong, with depressed siphonal part, which is in accordance with nature. At a diameter of about 100 mm. the outer tubercles are already very small and weak, the lateral part of the whorls becomes gradually more sloping and less distinct from the siphonal part, and at 160 mm. diameter nearly the last trace of the outer tubercles has gone. The inner tubercles, on the contrary, increase in size at the same rate as the outer ones disappear, and one of

the largest of them has 22 mm. in diameter at its base. The spines are all hollow, and as well pointed, if in the state of casts, as if provided with shell; their number is somewhat variable, but rarely less than seventeen pairs on one circuit.

The form of the lobes in the Indian specimens is pretty nearly identical with that drawn by Orbigny, especially if one considers that there are variations of their shape in one and the same individual according to the different arrangement of the spines in different parts of the shell. The siphonal lobe is tolerably broad and very long, terminating with four principal branches; external saddle extremely broad, divided into two unequal parts by a large secondary lobe; the outer part is narrower, without distinct secondary lobe; inner part broader, with a small secondary lobe; first lateral lobe a little shorter than the siphonal, very narrow, and terminating in four unsymmetrical branches; lateral saddle rather broad, with a very small secondary lobe; on the whole, about in the same line with the external saddle; second lateral lobe rather long, but extremely narrow and reduced; this is followed by a rather broad and well developed auxiliary lobe, which makes in its direction an angle with the foregoing; the well developed sutural lobe stands yet entirely above the umbilical suture.

The dimensions of two specimens are the following :—

					I.	II.
Diameter	of the shell ...	...	...	...	180 mm.	218 mm.
"	of the umbilicus	...	...	...	80	95
Height	of the aperture from the umbilical suture	...	...	...	64	76
"	of the " from the preceding whorl	...	...	...	59	70
Thickness	of the " between the spines	...	...	...	85	(P)98
"	of the " on the spines	...	...	...	(P)120	P

Both specimens are composed of air-chambers to the end.

Remarks.—The locality at which both examples of this species have been collected is Vanda. They occur there in a very hard brown oolite, the same bed, in which also excellent specimens of *Asp. perarmatum* have been found.

The position of the species in Europe is quite the same as here; it lies in lower Oxfordian strata. I myself collected it once at the "Vaches noires" in a dark brownish-gray oolite together with many specimens of *Pelt. Arduennense* and *Constanti*, just above the shales with *Pelt. athleta*.

The species is easily distinguishable from the allied forms, as *A. perarmatum* or such species; it however, resembles more closely *A. ponderosum*, W., just now described by myself. From this species, *Asp. Babeaum* can be distinguished by the predominance of the inner row of spines already in tolerably young specimens, the sloping of the lateral parts of the shell towards the siphonal side, and less depressed whorls. In other species, which could be compared, like *A. eucyphum*, etc., not only the disappearance of the outer row of tubercles in full grown specimens is not yet fixed, but further the spines are not hollow as in Orbigny's species, and in consequence of this are on the casts only represented by rounded tubercles.

The name I have chosen for the species requires yet some remarks. In 1830 Zieten described a little Ammonite under the name of *A. biarmatus* as coming from the "Lias Schiefer" of Boll, which was found, however, without any doubt to belong to the zone of *A. Lamberti* in the neighbourhood, and has been identified by Oppel partly with *Amm. Babeanus*, Orbigny, but this author never stated if he thought the specimens figured by Orbigny were identical with Zieten's species or only other specimens mentioned in the text. It is impossible to decide the question about the identity of both species without examination of Zieten's original specimen, as his figure is too imperfect to allow of a close comparison. As the matter stands thus, I was obliged to abstain from any attempt to settle the question, and used Orbigny's name, as his figures represent exactly the form which the Indian species exhibits.

3. ASPIDOCERAS SPARSISPINUM, *Waagen, n. sp.* Pl. XVIII.

In its general form this species keeps about midway between *A. perarmatum* and *A. Babeanum*; it is, however, more nearly allied to the latter one, on account of its losing the outer row of spines in full-grown specimens.

The species is, like the foregoing one, thick, patelliform, with deep umbilicus and depressed whorls, which are covered on either side with two rows of spines. I cannot state what appearance young specimens may have had, as the inner whorls of the specimen I have for examination are destroyed. In large specimens the spines of the different rows are about equal in strength, the lateral part of the shell not sloping towards the siphonal side, and the single pairs of spines very distant from each other, so much so that only twelve pairs can be counted on one circuit. The transversal section of the whorls is squarish, oblong, a little broader than high; the siphonal side smooth, and tolerably flat.

The lobes are not visible.

The dimensions of the specimen from Vanda are—

Diameter	of the shell ...	...	...	...	...	170 mm.
"	of the umbilicus	...	...	...	...	80
Height	of the aperture from the umbilical suture	...	...	...	...	61
"	of the " from the preceding whorl	...	...	...	...	56
Thickness	of the " between the spines	...	...	...	...	63
"	of the " on the spines, about...	...	...	...	...	83

The species lost its outer row of spines only very late in its growth, as in the specimen of which I just have given the measurements, this row is only just beginning to become weaker.

Remarks.—The only specimen of this species has been found in the oolites with *Asp. perarmatum* at Vanda.

Asp. sparsispinum is closely allied to two formerly described species, that is, to *A. Babeanum* and *A. perarmatum*. From the former our species is distinguishable by more squarish whorls, the lateral parts of which do not slope towards

the siphonal side, and less numerous spines, which count only twelve pairs in our species, whilst there are seventeen to eighteen in *A. Babeanum*. From *A. perarmatum* the species differs by its much broader whorls and spines, of which the outer row gets slowly weaker, and the inner one increases in size, whilst in Sowerby's species the contrary is the case. *Asp. sparsispinum* must be placed in the group of *Asp. ponderosum* on account of the disappearance of the outer tubercles in larger specimens, but in many other respects it shows great analogies to the group of *A. perarmatum*, and furnishes thus in reality a connecting link between the two groups.

(d.) Group of *ASPIDOCERAS EDWARDSIANUM*, Orb.

1. *ASPIDOCERAS SUBDISTRACTUM*, Waagen, n. sp. Pl. XXI, Fig. 1a, b.

I was for a long time inclined to describe the specimen, which I consider now to represent a new species, as *Asp. Rupellense*, Orb., but after having exposed, with great labour, the inner whorls and the long spines which cover them, I came to the conclusion that it forms a species intermediate between that of Orbigny and *Asp. distractum*, Quenst.

The innermost whorls are destroyed by weather action, and only at a diameter of about 15 mm. the shape of the shell begins to become clearly visible. The last whorl is, at this diameter, about 5 mm. high, with flat lateral and flat siphonal parts, rather compressed, with a row of thin, very acute, straight spines along the umbilical margin, and another row of spines on the outer margin, which latter, however, are very long, slightly curved and turned backwards. The sides of the whorls are nearly perfectly smooth, only with slight traces of flattened ribs connecting the corresponding tubercles of the different rows. The form of the shell just described remains up to a diameter of about 40 to 50 mm. Then a change is effected by the inner row of tubercles becoming more and more distant from the umbilical margin. The whorls get more compressed as the species grows larger, and are at last a good deal higher than broad.

The siphonal side is narrow, flatly rounded, and assumes somewhat the appearance of being excavated by the outer spines, forming an angle of about 45° with the siphonal part of the shell.

The spines themselves, as well those of the inner as those of the outer row, are all hollow, but separated from the inner space of the tube by a layer of shell, shutting them up at their base. Thus the fossil, if the shell is lost, appears without any spines, but with thick rounded tubercles on the outer margin, and very small, barely prominent, ones near the umbilicus.

The umbilicus is always wide open, with tolerably perpendicular walls in small specimens, but with very oblique ones in adult examples. The umbilical suture runs always strictly along the outer row of tubercles of the preceding whorl, and the corresponding spines are for the greater part of their length firmly adpressed to the umbilical wall.

The lobes are very badly preserved and only partly visible, but one can observe, that there is a long and rather narrow siphonal lobe, a very broad external saddle, and a narrow first lateral lobe, not as long as the siphonal, and situated between the two rows of spines; whether a second lateral lobe exists or not is not visible.

The measurements are the following :—

Diameter	of the shell	...	...	...	...	88 mm.
"	of the umbilicus	...	...	...	...	37
Height	of the aperture from the umbilical suture	...	...	...	...	32.5
"	of the " from the preceding whorl	...	...	...	...	32
Thickness of the	"	...	...	...	...	25

Remarks.—The only specimen of this species has been collected at Gangta Bét, an island in the Runn, in a greyish-yellow, very hard sandstone, of very likely middle or upper Oxfordian age.

Asp. subdistractum is of a certain interest, as it furnishes the connecting link between two species, of which the one occurs in Europe in lower Oxfordian, the other in Kimmeridgian beds, whilst in the intermediate strata no transitional species was known. This is represented by our species, which is equally allied to *Asp. distractum* as to *Asp. Rupellense*, without agreeing entirely with either of them.

From the former species *Asp. subdistractum* is distinguishable by the existence of an inner row of spines, and by the structure of all the spines, which are, though being hollow, shut off at their base by a layer of shell, separating them from the remainder of the tube, which is not the case in Quenstedt's species, which has got simple hollow spines. From *Asp. Rupellense* the Indian species differs also by the existence of an inner row of spines already in a young stage of growth, by the outer spines being thin, slightly curved and turned backwards, and by much more compressed whorls.

From other species of the group, like *Asp. Edwardsianum*, *Meriani*, or *corona*, the Indian form is always easily to be distinguished, at least so far as up to this moment the knowledge of these species extends. When we once know the adult form of *Asp. Meriani* or *corona* the relations between these species and *Asp. subdistractum* will possibly be found closer than they appear now.

Section II.—HYBONOTI.

(a.) Group of ASPIDOCERAS PRESSULUM, Neum.

1. ASPIDOCERAS MONACANTHUM, Waagen, n. sp. Pl. XXI, Fig. 3a, b.

It is with great doubt that I propose this new name for a species which in our Museum is only represented by a small and not very brilliantly preserved fragment. However, the occurrence of a species of the section *Hybonoti* in the Kachh Jura, and its geological position there on about the same horizon as the *Hybonoti* generally are found to occupy in Europe, is of so high an interest that a name seemed to be necessary for the Indian form.

The fragment I have for description is a piece of the body-chamber of an individual of about 130 to 140 mm. in diameter. The whorl is compressed, the aperture nearly twice as high as broad, the largest transversal diameter being near the umbilical margin, where thick equidistant tubercles are situated, from which very indistinct ribs go towards the outer margin. The ribs are broad, low, somewhat falciform, and bent strongly towards the front a little above the middle of the sides. Besides the ribs, which start from the tubercles, there are yet other fainter ones intercalated, which are, however, only visible near the outer margin.

The siphonal side is flatly excavated, bearing on each side of the excavation a low broadly rounded ridge, each of which is provided on its top with a very indistinct crenulation corresponding with the ribs which come up from the sides of the whorl. This crenulation is stronger and more distinct on the inner than on the outer whorl. Except the tubercles the whole sculpture is extremely weak in the specimen I have for description, but that may partly depend upon the preservation of the fragment.

Remarks.—The only fragment of this species has been found by Mr. Fedden in a yellowish-gray conglomeratic sandstone of the Katrol group west of Katrol range.

Of the species of the *Hybonoti* as yet described there is one very nearly allied to the Kachh form, that is, *Asp. harpephorum*, Neum. This species is, however, easily distinguishable by a different arrangement and stronger prominence of the ribs. But another species figured by Dr. Neumayr on the same plate, but not named, could be considered identical with *Asp. monacanthum*, as it differs apparently only by somewhat stronger ribs. This was found in the beds with *Asp. acanthicum* at Gylkos-kö in Transylvania.

2. ASPIDOCERAS, *species indeterminata*. Pl. XXI, Fig. 4a, b.

There is yet another fragment which indicates a species related to *Asp. hybonotum*, Opp., and which has been found south of Booj on the road to the Charvar range in the lowest beds of the Katrol group, a brownish ferruginous sandstone. It is very likely the oldest species, geologically, of the group, possibly of upper Oxfordian age, and in so far interesting, as it is yet very nearly allied to *A. perarmatum*.

The fragment consists only of a part of the body-chamber of a rather large specimen. The transversal section of it is somewhat rectangular, higher than broad, with its greatest breadth on the umbilical margin. The sides of the whorl are flat, with two rows of fine spines or tubercles, one on the umbilical and another near the outer margin; the spines of the inner row are considerably stronger than those of the outer one; the corresponding spines of the different rows are connected together by very slight, flattened, ribs, which go yet from the inner tubercle down to the umbilical suture. The flat siphonal part bears a broad, very slight excavation, which is not provided with any granulation on either side.

The fragment is too imperfect to allow of giving a name, but I thought it not uninteresting to mention it, as it furnishes possibly some reason for tracing the descent of *Asp. hybonotum* from *Asp. perarmatum*.

Section III.—CYCLOTI.

(a.) Group of ASPIDOCERAS LONGISPINUM, Sow.

1. ASPIDOCERAS IPHICEROIDES, Waagen, n. sp. Pl. XXIII.

1871. *Aspidoceras iphicerum*, (Opp.) Waagen : Records, Geol. Surv. of India, Vol. iv, p. 92.

In the short extract of the results of the examination of the collection of Kachh Ammonites at that time in the possession of our Museum, I noticed a specimen coming from north of Dhosa as *Asp. iphicerum*, Opp. Since then some other specimens have been obtained, which enabled me to determine the species more exactly and led me to distinguish it from Oppel's species under the above name.

Asp. iphiceroides is no very large species, attaining scarcely more than 150 mm. in diameter; the whorls are inflated, the umbilicus deep, the siphonal side prominent, broad, rounded.

The form of the species is rather variable according to size. Very small specimens up to a diameter of about 15 to 20 mm. are nearly entirely smooth and increase very slowly in size. If the shell is preserved, very fine isolated spines are here and there observable on the umbilical margin, the first of them being about at a diameter of 10 mm. Yet scarcer are spines of a similar description which indicate an outer row, but appear sometimes a little earlier, sometimes later, than the inner ones. At a diameter of about 20 mm. the spines of the two rows begin strictly to correspond with each other, and I observe on a specimen of 40 mm. diameter seven pairs of spines on one circuit. In the single pairs the spines are not connected by a rib, but stand isolated, though rather closely together, which causes the siphonal part of the shell to appear far projecting. The spines are long, very thin, and the tubercles, which replace them on the cast, are as yet barely perceptible. In very young specimens, the casts, therefore, appear entirely smooth, but in examples exceeding a diameter of 50 mm., the cast also bears rather strong rounded tubercles. The shell shows a few slight folds between the tubercles, which extend to the siphonal part of the shell and cause there some slight undulations. In full grown specimens even on the cast such undulations can sometimes be observed.

The correspondence of the tubercles is not constant during the whole lifetime of the species, but sometimes two outer tubercles correspond to one inner one, sometimes two inner to one outer one, and principally on the body-chamber they become rather irregular.

The species does not seem to become very large, specimens of 150 to 180 mm. diameter are apparently already full grown. The body-chamber occupies a little more than half a circuit, and differs in its sculpture by its rather prominent undulations on its lateral and siphonal parts, and by the irregularity of the tubercles. The apertural margin of the shell is not preserved.

The lobes are of the common shape, as in other *Aspidoceras*, differing only in smaller details. The siphonal lobe is rather broad, not very long, with four short branches on either side; external saddle not very broad, with a small eccentric secondary lobe, shifted towards the first lateral; first lateral lobes very broad, fan-shaped, with five nearly symmetrical terminating branches, not quite as long as the siphonal; first external saddle tolerably narrow with a somewhat eccentric, small secondary lobe, shifted towards the first lateral; second lateral lobe much shorter than the first, terminating in four somewhat unsymmetrical branches, situated between the two rows of tubercles; second lateral saddle broad, with a broad but short secondary lobe; two rather large auxiliary lobes above the umbilical suture.

The measurements of three specimens are—

				I.	II.	III.
Diameter	of the shell	...	...	41 mm.	82 mm.	142 mm.
"	of the umbilicus	...	...	10	23	42
Height	of the aperture from the umbilical suture	...	...	18	37	66
"	of the " from the preceding whorl	...	...	14	27	51
Thickness	of the " ...	...	...	22.5	47	73

Remarks.—*Asp. iphiceroides* is represented by three specimens in our Museum, two of them coming from north of *Dhosa* out of a soft sandstone with iron nodules, the third from the *Charvar range*, south of *Bhooj*, out of a bed of similar mineralogical character, all those lying immediately above the oolites with *Asp. perarmatum*.

The species resembles several of the *Aspidoceras* previously known, and principally *Asp. iphicerum*, Opp. From all the *European* forms, however, which could be compared (except *Asp. atavum*), the Indian species is distinguishable by a less flattened and more prominent siphonal side, by tubercles much less numerous, of which the two rows, however, are much closer together. From *Asp. atavum* our species differs by the want of ribs between the corresponding tubercles of the different rows, the more rounded whorls, and the greater number of spines.

The general shape of this species would, if found in *European* territories, indicate beds of *Kimmeridgian* age. It is probable that it does the same here in India.

2. ASPIDOCERAS WYNNEI, *Waagen, n. sp.* Pl. XXI, Fig. 5a, b; Pl. XXII.

In my short extract published in the Records of our Survey, I compared this species with *Asp. Appenninicum*, Zittel, but I find now from two small specimens collected subsequently by Dr. Stoliczka that the affinity to *Asp. longispinum*, Sow., is much greater; only the full-grown stage of *Asp. Wynnei* shows, like *Asp. Appenninicum*, the outer row of spines placed on the outer margin.

Of the first stages of growth, up to a diameter of 30 mm., only casts are at my disposal, and they appear nearly entirely smooth with scarcely any indication

of tubercles, a tolerably wide umbilicus, surrounded by perpendicular walls, and rounded whorls. At the indicated diameter, however, rather strong spines, which are also well distinguishable as tubercles on the cast, are formed, and arranged in two rows, one on the umbilical, and another not far from the outer, margin. The rows are more distant from each other than in the preceding species.

In tolerably large specimens there are nine to ten pairs of spines observable on one circuit. The pairs, however, are not quite equidistant, and often there are on the outer row one or two spines more than on the inner.

A short distance before the body-chamber begins, the spines of both rows increase rapidly in size, and the outer one of them approaches more and more the outer margin, in consequence of which the siphonal part of the shell becomes flatter and less prominent. In a specimen with preserved shell of about 160 mm. diameter from each of the excessively long and thick spines of the outer row of the last circuit start several flat folds, which unite with the corresponding tubercle of the inner row, if one is present, and then disappear again. On the siphonal side there are also a number of very faint flat folds or undulations visible, which start irregularly from the tubercles on either side.

If the shell is very perfectly preserved one can observe on the siphonal part three different layers of which it is composed. The innermost is 2 mm. thick and converted into transparent kalkspar, and has certainly formed formerly the nacreous part of the ammonite shell. It is slightly undulated, but not striped. Above this comes a layer, thin like paper, untransparent, and covered with numerous transversal, sharp and slightly prominent lines. The last layer is again very thin, not transparent, but entirely smooth.

The lobes are very roughly dentated. The siphonal lobe is rather long and not very broad, not quite symmetrical; external saddle rather narrow, divided by a secondary lobe into two unequal parts, of which the inner one is much shorter than the outer; first lateral lobe much shorter than the siphonal, but hanging so far down that the ends of both come nearly in the same line, narrow at its base, with a somewhat broader, rosette-shaped end; first lateral saddle much shorter than the external, with a very small, median secondary lobe; second lateral lobe shorter than the first, otherwise about of the same shape as the latter, only more unsymmetrical; second lateral saddle like the first; two very small auxiliary lobes above the umbilical suture.

The measurements are not easy to take, as the specimens are all more or less altered by compression. As far as one can make them out, they are in two specimens the following:—

		I.	II.
Diameter of the shell	... ..	95 mm.	165 mm.
„ of the umbilicus	... ..	29	62
Height of the aperture from the umbilical suture	... ..	40	63
„ of the „ from the preceding whorl	... ..	32	54
Thickness of the „	... ..	47	62

Remarks.—All the specimens of this species which exist in our Museum have been collected at Jadoora in the Katrol range in a ferruginous band just above the Oomia conglomerate, the lowest part of the Oomia group.

The affinities of *Asp. Wynnei* to *Asp. longispinum* (= *Asp. iphicerum*) are striking in half grown specimens, the distance of the two rows of spines, the prominence of the siphonal side, the inflated whorls, being equal in both species, but the former stages of growth as well as full-sized specimens show sufficient differences for the distinction of the European and the Indian form. Small examples differ from *Asp. iphicerum* by the thin scanty spines, if the shell is preserved, and by the want of even tubercles on the cast, whilst full grown specimens are distinguishable by the irregularity of their enormous spines, the folds, which run from one spine to the other, and the more depressed siphonal side, by which latter peculiarity it approaches more nearly to the shape of *Asp. Appenninicum*, Zitt.

From the before described species *Asp. Wynnei* is also distinguishable by the stronger spines, the two rows of which are more distant from each other, and by the more depressed siphonal side. Other species of *Aspidoceras*, which could be compared, such as *Asp. acanthicum*, etc., are not easily mistaken for our species.

(b.) Group of ASPIDOCERAS ATAVUM, Opp.

1. ASPIDOCERAS BINODIFERUM, Waagen, n.sp. Pl. XXIV.

This species grows to a very considerable size, and is the most conspicuous among the Indian *Aspidoceras*. In its general form it is thick, inflated, with a tolerably wide umbilicus, and two rows of tubercles on either side.

I cannot examine the very first stages of growth, as the innermost whorls of the specimens I have for description are destroyed by weather-action; but at a diameter of about 20 mm., already a row of very strong tubercles, prominent even on the cast, is visible a short distance from the umbilical margin, whilst on the margin itself only weak traces of tubercles can be detected. Only when exceeding the mentioned diameter the shell becomes provided with a distinct inner row of tubercles, which then remains constant up to the end of the body-chamber. The two rows of tubercles are very close together, and the corresponding tubercles of the different rows are mostly connected together by broad low ridges. The number of tubercles is rather large, but not equal in both rows, as the outer row counts many more than the inner, and thus very often two outer tubercles correspond to one inner one. The siphonal side is high, rounded, strongly prominent, more so in the outer whorls than in the inner. The umbilicus is tolerably wide, deep, surrounded by perpendicular walls, which do not form, however, an umbilical edge as in *Asp. binodum*, Opp.

The lobes are characteristic, but badly preserved. The siphonal lobe is broad and not very long, with four short branches on either side; external saddle

rather broad, divided by a not very large secondary lobe into two unequal parts, of which the outer one is much longer than the inner; first lateral lobe broad, fan-shaped, terminating in five short branches, shorter than the siphonal, but hanging down so far that the ends of both are in the same line; first lateral saddle tolerably broad with a well developed secondary lobe; second lateral lobe long, little shorter than the first, narrow; second lateral saddle very broad with two small secondary lobes; two well developed auxiliary lobes above the umbilical suture.

The dimensions of a specimen with nearly entire body-chamber are as follows:—

Diameter of the shell ...	...	...	...	210 mm.
„ of the umbilicus	...	...	...	69
Height of the aperture from the umbilical suture	...	...	...	87
„ of the „ from the preceding whorl	...	...	...	66
Thickness of the „	...	...	...	96

The length of the body-chamber occupies a little more than half a whorl.

Remarks.—The only specimen of this species has been found in the lower beds of the Katrol group in a sandstone with iron nodules north of *Dhosa*, together with *Asp. iphiceroides*.

Asp. binodiferum is very closely allied to *Asp. binodum*, Quenst., and I was for a long time doubtful, if I should not unite both species, but at last the more depressed shape of the whorls and the presence of an umbilical edge in Quenstedt's species led me to distinguish the Indian form. From *Asp. iphiceroides* the present species is distinguishable by stronger and more numerous tubercles, which begin already at an early age, by the much more considerable size the species attains, and by the lobes, in which the different shape of the external saddle is most conspicuous. Whilst in *Asp. binodiferum* this part agrees with the shape shown in the lobes of *Asp. Wynnei*, it is much more symmetrical in *Asp. iphiceroides*. From *Asp. atavum* the present species differs by much more numerous tubercles, from *Asp. longispinum* and allied forms by the narrow lateral sides of the shell, and the strongly prominent siphonal part.

2. ASPIDOCERAS, *species indeterminata*.

A fragment, coming from the sandstones with iron nodules of the Katrol range, (middle region of the Katrol group) shows great affinities to *Asp. binodum*, Quenst., exhibiting a tolerably depressed siphonal and very narrow lateral parts, which are limited below by an indistinct umbilical edge; the lobes, however, seem to be more complicated than in Quenstedt's species.

I mention this fragment because the locality is interesting, and also because it certainly indicates yet another species of the group of *Asp. atavum* besides the one described above.

GENUS STEPHANOCERAS, WAAGEN.

The longest known and most celebrated species of the Kachh Jura belong to this genus; I mean the different forms of the "*Macrocephali*" which were figured and named by Sowerby in 1840. Since that time they have been mentioned and discussed in nearly every general work, but no one was enabled to state any particulars about the conditions under which the fossils were found on the spot, or about the species which accompany the *Macrocephali* in the same layer. It will be found, on reading the following pages, that besides the forms already figured by Sowerby, there are yet a number of allied shells which deserve specific designation, and though it is probable that many of them are found also in European localities, I have had to describe and figure them, as no previous specific description existed. The reason which forced me to distinguish the species was this: I found that in Kutch the group of the *Macrocephali* is not restricted to the layer in which in Europe *Macrocephali* are found, but that they occur there in strata, which are as high as the upper region of the Oxford group, and I was therefore obliged to describe very carefully the forms belonging to the proper "*Macrocephalus* layer," in order to be able to compare this fauna with that of the higher beds.

Of all the many divisions which can be distinguished in the genus *Stephanoceras*, only the *Macrocephali* are represented in the Kachh Jura, and just this group it is whose position in the genus has been doubted, on account of the existence of some forms which in their full grown state resemble very much the true *Macrocephali*, but must be considered on account of their inner whorls to belong to the genus *Cosmoceras*. From the descriptions of the Indian species, which will follow hereafter, it will, however, clearly be seen that the *Macrocephali* here in India form such a well characterised and well defined group of forms, which fits so entirely into the genus *Stephanoceras*, that they are very likely of much older than Callovian origin, and that it will be better to consider the small family of the *Callovienses*, to which the above-mentioned species belong, as forming part of another genus, only accidentally agreeing in their full grown state with the *Macrocephali*, than to separate the latter from the genus *Stephanoceras*, only on account of their similarity to the '*Callovienses*.' Both families, the *Macrocephali* and the *Callovienses*, spring from entirely different roots, the latter being traceable from the group of the *Parkinsoni*, the other, on the contrary, very likely from the '*Humphriesiani*' or the species allied to *Steph. Brocchi*.

The Indian species of the *Macrocephali* have quite a peculiar interest for the Palæontologist on account of the many developmental series which can be made out among them, a thing which would have been impossible with materials derived from European localities, as there the *Macrocephali* are restricted to a single layer. Thus nearly every form can be traced here in India, in the different changes which it undergoes in time, from one stage to the other, till all the family disappear again from this country. That it was not yet altogether extinguished

appears from some upper cretaceous species from Southern India, which must be placed with the '*Macrocephali*.' Thus we may expect yet *Macrocephali* to be found in Tithonian and in lower or middle cretaceous beds.

The groups or developmental series which I am able to distinguish in this genus are altogether eight, besides two isolated species. They can be distributed into two sections, viz., *Macrocephali rectecostati* and *Macrocephali curvicostati*, the latter of which seems to replace the European family of the *Callovienses* here in India, because the full grown form of the *curvicostati* resembles often, to a certain extent, the full grown form of certain species of the *Callovienses*, the inner whorls being entirely different. The first section is characterised by ribs, which go straight or nearly so over the siphonal side; the second section by ribs, which make a more or less strong bend towards the front on the same part of the shell.

In the first section I can distinguish the following groups and species: (a) group of *Steph. macrocephalum*, Schl., with the mutations *Steph. macrocephalum*, Schl., *St. transiens*, W., and *Steph. Maya*, Sow.; (b) group of *Steph. tumidum*, Rein., with the mutations *Steph. tumidum*, Rein., *St. Polyphemus*, W., and *Steph. sub-tumidum*, W.; (c) group of *Steph. semilaeve*, W., with the mutations *Steph. semilaeve*, W., and *Steph. arenosum*, W.; (d) group of *Steph. lamellosum*, Sow., with the mutations *Steph. lamellosum*, Sow., *St. Grantanum*, Opp., and *Steph. elephantinum*, Sow.; (e) group of *St. Morrisi*, Opp., with the mutations *Steph. Chariense*, W., and *St. chrysoolithicum*, W.; (f) group of *St. Ymir*, Opp., with the mutation *St. bullatum*, Orb.; (g) isolated species, *Steph. diadematum*, W.

In the second section, I distinguish: (a) group of *Steph. dimerum*, with the mutations *Steph. dimerum*, W., *Steph. magnumbilicatum*, W., *Steph. fissum*, Sow., and *St. Nepalense*, Gray; (b) group of *Steph. subtrapezianum*, W., with the mutations *St. subtrapezianum*, W., *Steph. subcompressum*, W., and *Steph. opis*, Sow.; (c) isolated species, *Steph. eucyclum*, W.

Though twenty-three species could be distinguished, all the forms which in reality occur in the Kacch Jura have not yet been named, as several species, which were in too bad a state of preservation as to be described properly, have not received a special designation.

Of these species, those identical with European forms occupy also in Kachh, as in Europe, the true "Macrocephalus-beds." The other species, however, range from the uppermost beds of the Puchum-group up to the Kuntkote sandstone, i. e., from the highest beds of the Bath to the uppermost beds of the Oxford group, each of them keeping in the meantime strictly to its own layer.

One thing which deserves special notice is the peculiar arrangement of the lobes in nearly all the species which are of Oxfordian age, which is equally repeated in the species of the two different sections or in the single groups. In these forms the lobes from the first lateral to the second auxiliary are tied up to an enormous saddle, all the saddles reaching much higher up, and thus causing a considerable deviation in the general direction of the lobes from the radius of the spiral.

Long since, it was apparent that the group of the *Macrocephali* was one of the most important among all the Jurassic Ammonites, not only because they characterised a well defined horizon in the European jurassic series, but also very nearly allied forms had been found over the whole world, and it was to a certain degree supposed that these also ought to signify about the same geological time, indicating for the beds, in which they were enclosed, a nearly Callovian age. The first undeniable forms of the group, which were described from territories out of Europe (I shall not quote the rather vague indications of *St. macrocephalum* and *St. bullatum* from America by Buch and Giebel), were the Indian ones. These were followed very soon by the discovery of *Macrocephali* in the Petchora District of Northern Russia. In 1852 allied forms were described by Sharpe from the Sunday river in South Africa; almost at the same time Gay figured some of them from Chili in South America; a few years ago the late Professor Pander of St. Petersburg showed me some *Macrocephali* (*Amm. Wosnessenskyi*, Grev. ?), said to come from Alashka, and in the Quarterly Journal of the Geological Society, London, 1870, Moore describes among the jurassic fossils of Australia two Ammonites of the genus *Stephanoceras*, one of which he attributes to *Steph. macrocephalum*, Schloth.

These few indications may prove sufficiently the large geographical distribution of the family, but though there is no doubt that the *Macrocephali* in most of the cases indicate jurassic strata, yet the true horizon which they occupy in the jurassic series cannot be determined from these fossils, as is shown clearly from the Indian species of *Macrocephali*, which not only range through the larger part of the jurassic series, but even reappear in upper cretaceous beds.

Section I.—MACROCEPHALI RECTECOSTATI.

(a.) Group of *STEPHANOCERAS MACROCEPHALUM*, *Schlth.*

1. *STEPHANOCERAS MACROCEPHALUM*, *Schlotheim*. Pl. XXV; Pl. XXVII, Fig. 1a, b, (non c); Pl. XXXIII, Fig. 5.

- 1820. *Ammonites macrocephalus*, Schlotheim: Petrefaktenkunde, p. 70.
- 1830. *Ammonites macrocephalus*, (Schlth.) Zieten: Verst. Württemb., p. 6, pl. 5, fig. 4, (non fig. 1).
- 1834. *Ammonites formosus*, Sowerby: Transact. Geolog. Soc., Lond., II Ser., Vol. v, pl. 23, fig. 7 and expl.
- 1847. *Ammonites macrocephalus compressus*, Quenstedt: Cephalop., p. 184, pl. 15, fig. 1.
- 1857. *Ammonites macrocephalus*, (Schloth.) Oppel: Jura formation, p. 547, (pars).
- 1872. *Stephanoceras macrocephalum*, (Schloth.) Gemmellaro: Sopra alcune faune Giuresi e liasiche, p. 23, pl. iv, fig. 1.

This Ammonite has a beautiful flat rounded form, which undergoes no changes in the different stages of growth in the single specimens. The whorls envelope each other nearly totally, so that only a very small portion of the former whorls is visible in the very narrow umbilicus. They are covered with fine, rather sharp, polytome ribs, of which the stems near the umbilicus are nearly always totally obliterate. The ribs go straight over the siphonal side, becoming, however, more and

more indistinct, as the individuals grow older. The beginning of the body-chamber is quite smooth, but near the aperture are a few, broad, not very strong folds, which go over the siphonal side, and down to the middle of the sides of the whorl. The last quarter of the body-chamber deviates from the regular spiral, the umbilicus getting wider and the mouth of the shell thus being contracted. The length of the body-chamber is about three quarters of the last whorl.

The lobes are quite regular, arranged in the direction of the radius of the shell. The siphonal lobe bears four long branches, and is as long as the first lateral lobe; external saddle with one nearly central and one eccentric secondary lobe; first lateral lobe rather narrow, terminating in one long branch; first lateral saddle with one secondary lobe; second lateral lobe like the first one, but much smaller; there are, up to the umbilical suture, yet three very small auxiliary lobes.

I shall indicate the measurements of three examples, which may give a sufficient idea of the variability of the species—

	I.	II.	III.
Diameter of the shell	133 mm.	128 mm.	59 mm.
„ of the umbilicus	13	15	7
Height of the aperture from the umbilical suture	80	60	33
„ of the „ from the preceding whorl	42	36	20
Thickness of the „	70	47	30

The largest specimen at my disposal is 225 mm. in diameter. It has a great part of the body-chamber preserved, and as the last air-chambers are much shortened, the specimen seems to be full grown. This seems, however, not the largest size the species could attain. The smallest full grown specimen I know of has about 170 mm. in diameter.

Remarks.—The species *Stroph. macrocephalum* is one of the most common fossils in the Kachh jurassic strata. It occurs there in three different beds, which are, however, very nearly related to each other. The geologically oldest of the specimens were found in the gray limestone with corals belonging to the uppermost layers of the Puchum group, associated with *Oppelia serrigera*, Waagen; in this bed not less than sixteen specimens were collected at Jumara. They differ from the typical form by a somewhat smaller umbilicus, being, however, in every other respect identical. The other two beds which contain the true *St. macrocephalum* must be assigned to about the same geological horizon: they are, the 'Golden Oolite' below, and above it a series of shales with layers of yellowish-gray limestones and fine gray-brown oolites. The difference of the fauna in both beds is very small, and only traceable from the different mineralogical character of the rock. Out of these layers, which form the lower part of the Charee group, were collected eighteen specimens in the 'Golden Oolite' at Keera hill near Charee; two in the shales at some locality in the Joora hills; thirteen in the shales north-west of Jumara; nine in the shales north-west of Soorka, and one west of Jumara. Altogether about sixty specimens of *St. macrocephalum* are preserved in our Museum from the Kachh Jura,

The variability of the species is not very large, and consists chiefly in differences of the transversal diameter of the whorls and of the number of the ribs. The first case is illustrated by the measurements given above; the figured specimen (Pl. XXVII, fig. 1) is one of the flatter varieties, most of the other specimens being a little thicker: the greatest thickness of the shell always lies immediately above the umbilicus. As to the variation of the number of ribs, this is not very large; the specimens here vary between 90 and 110 ribs on the whorl at a diameter of about 130 mm. The ribs seem weaker and finer when the specimen is a little weather-worn.

The distinctions from *St. tumidum* consist in the flatter whorls and smaller umbilicus of our species, also the body-chamber is more distinctly ribbed in *St. tumidum*; from all the other species it is distinguishable by the fine, sharp and polytome ribs, which are not visible near the umbilical edge, but leave a smooth zone which surrounds the umbilicus. As Orbigny's figure of "*Amm. macrocephalus*" does not show this latter peculiarity, I have not cited this book above. I am also doubtful if *St. Ishmae*, Keyserling, which is generally quoted as a synonym of *St. macrocephalum*, is really to be united with this species, the ribs showing a somewhat different character. *St. dicosmum*, Gemmellaro, on the contrary, very likely represents only a specimen of *St. macrocephalum*, provided with its body-chamber.

As I have already formerly stated, *St. macrocephalum* is extremely characteristic for the lower Kallovian beds of Europe. For the Indian specimens we may suggest the same age, as it does not occur here isolated, but in the society of many other species which in Europe keep to the same horizon. From the investigations of Dr. Stoliczka into the geology of the Kachh Jura, it appears beyond any doubt that *St. macrocephalum* is found there exclusively below the beds with *Perisph. anceps* and *Pelt. athleta*, and above the limestones with species of the Bath-formation.

2. STEPHANOCERAS TRANSIENS, *Waagen, n. sp.* Pl. XXXII, Figs. 2a, b, 3a, b.

1871. *Stephanoceras macrocephalum* (Schl.) Waagen: Records, Geol. Surv. of India, 1871, p. 93, (pars.) specimen from Lodai.

The species most nearly allied to the true *St. macrocephalum* is the species I am going to describe under the above name.

The general form of the species is depressed from both sides, rounded, loaf-shaped. The umbilicus is very small, about one-seventh of the diameter of the shell. The shell is covered all over with fine ribs, which are divided at the middle of the sides into three or four branches.

The smallest stage of growth I am able to examine is represented by a specimen of 35 mm. in diameter coming from the Dhosa oolite of Lodai. At this size, the whorls are very compressed, about one quarter higher than broad, the

broadest a little above the umbilicus. The sides of the whorls are considerably flattened, joining the nearly perpendicular umbilical wall in a rounded edge, and sloping slowly and gradually towards the rounded siphonal side. They are covered with fine very numerous ribs, which start from the umbilical edge, and proceed nearly in a straight line, only a little curved towards the front at about the middle of the sides, where they are divided into three or rarely four branches towards the siphonal side of the shell. The umbilicus is very small and deep. In the inner whorls of this specimen, the stems of the ribs which start from the umbilical edge are barely developed at all, and thus the earlier stages of growth of *St. transiens* are barely distinguishable from the true *St. macrocephalum*.

Larger specimens deviate very little from the form just described. A specimen from the Dhosa oolite, north-west of Soorka, measuring 150 mm. in diameter, agrees exceedingly well with the one from Lodai, the only differences consisting in the sides of the whorls being a little more rounded, not quite so flat, and the ribs, which become a little stronger as the shell increases in size, being divided into four or five branches, instead of three. There is no specimen preserved with its body-chamber.

None of the specimens I have got for description shows the lobes sufficiently to draw or describe them accurately. All I can observe is, that the general arrangement of them is such that the lobes of the antisiphonal side and those surrounding the umbilical suture are shifted much towards the front, which leads me to suspect a considerable shortening of the dorsal region of the animal which once occupied the shell. In this peculiarity our species very much resembles *St. Maya*, Sow., which, however, shows it yet much more developed.

The measurements of two specimens are the following:—

		I.	II.
Diameter	of the shell	55 mm.	136 mm.
„	of the umbilicus	7.5	17
Height	of the aperture from the umbilical suture ...	28	74
„	of the „ from the preceding whorl ...	19	39
Thickness	of the „	20.5	54.5

Remarks.—There are only two specimens preserved in our Museum which can without any doubt be assigned to this species, the one coming from Lodai, out of the Dhosa oolite, the other from north-west of Soorka out of the same layers.

In its general form this species is perfectly intermediate between *St. macrocephalum* and *St. Maya*, just as it is also intermediate in its geological position.

Young specimens, up to a diameter of about 30 mm., are not distinguishable from *St. macrocephalum* except by a little more compressed form. Only larger specimens show the characteristic features, which make it possible to distinguish the species, whilst in *St. macrocephalum* the stems of the ribs which start from the umbilical edge are in most cases nearly perfectly obliterate in larger specimens; in *St. transiens*, on the contrary, those stems grow stronger as the specimen grows larger. The umbilicus is generally a little larger than in *St. macrocephalum*, but

smaller than in *St. Maya*. From this latter species *St. transiens* differs, besides its much smaller umbilicus, by much finer ribs, whose stems are by far less prominent in the middle of the sides and near the umbilical edge.

The lobes which are arranged according to the radius of the spiral in *St. macrocephalum* make an angle of about 12° with this radius in *St. transiens*, being shifted towards the front on the antisiphonal side, whilst in *St. Maya* the same angle is as much as 23° .

From other species *St. transiens* is easily distinguishable by the character of the ribs.

The observations made on this species serve well to confirm the law, already stated by Drs. Neumayr and Württemberger to exist in other Ammonites, that the inner whorls of geologically younger species resemble most the full grown state of geologically older species. The character of the ribs in small specimens of *St. transiens* is identical with that exhibited by full grown shells of *St. macrocephalum*; now, the latter is a Kallovian species, whilst the former is a member of a lower Oxfordian fauna.

3. STEPHANOCERAS MAYA, Sowerby. Pl. XXVIII, Fig. 1a, b, 2a, b. Pl. XXXI, Figs. 2, 2a, 2b.

1840. *Ammonites Maya*, Sowerby: Transact. Geolog. Soc., Lond., II Ser., Vol. v, p. 719, pl. 61, fig. 8 and expl.

(*Ammonites macrocephalus*, (Schl.), Orbigny, Oppel, and several other authors).

1863. *Ammonites Nepalensis*, (Gray), H. F. Blanford: Journ. As. Soc., Vol. 32, p. 128, pl. i, fig. 6, (non Gray, non Blanford, 1865).

This form resembles extremely the true *St. macrocephalum*, which makes it very excusable that some authors, not being provided with specimens from the same locality, but judging only from Sowerby's drawing, have united both species. In examining, however, specimens from the same localities from which Sowerby originally described his species, one will very soon be convinced that there are some characters in *St. Maya* which make it absolutely necessary to distinguish it from *St. macrocephalum*.

Stephanoceras Maya has a flat rounded form, a tolerably large umbilicus with smooth perpendicular walls and compressed rounded whorls. Those latter are covered with fine, distinct ribs, which begin on the umbilicus with a single stem, but are divided nearly at the middle of the sides into three or four branches, which go not quite straight, but a little bent forward over the siphonal side. The stems of the ribs are never obliterated, as in *St. macrocephalum*, but even aged examples of about 200 mm. in diameter show them quite clearly and distinctly prominent.

The lobes are most extraordinary. The siphonal lobe has two large branches on each side, and is much longer than the first lateral one. The external saddle goes very high up, and is in young specimens without distinct secondary lobe,

but in adult individuals there is an indistinct one developed. The first lateral lobe is narrow, not very long, and finishing in three short branches. The first lateral saddle goes as far up as the external, and is provided with a secondary lobe. The second lateral lobe is much shorter than the first lateral, but in other respects of the same shape, and has a direction against the umbilical margin. The second lateral saddle goes much farther up than the first lateral, and has in every respect the same form as the latter. Of the following three auxiliary lobes one has yet the direction against the umbilical margin, the other two have a regular position, being rectangular to the radius of the spiral. The position of the whole of the suture is such that the radius, which touches the top of the second lateral lobe, goes at the same time through the ground of the external saddle. In other respects the suture is quite regular, symmetric on both sides of the shell.

The measurements of two specimens from Kuntkote are the following :—

		I.	II.
Diameter	of the shell	172 mm.	48 mm.
„	of the umbilicus	28	10
Height	of the aperture from the umbilical suture ...	81	29
„	of the „ from the preceding whorl ...	46	18
Thickness	of the „ about ...	80	20

Remarks.—This species seems not to be very rare at Kuntkote in the red ferruginous somewhat oolitic sandstone, as there are not less than six specimens from that locality preserved in our Museum. Another specimen, which I cannot distinguish from the true *St. Maya*, comes from the Dhosa oolite north-west of Jara. The occurrence of this species in the Dhosa oolite, though as a great rarity, is one of the facts which led me to consider the Kuntkote sandstone as belonging to some zone in the Oxford group.

St. Maya is geologically the youngest species of the group of *St. macrocephalum*, and even the last jurassic representant of the whole section of the ‘*Macrocephali*’ as yet known, if none of the ‘*Macrocephali*’ described from other parts of the world, besides Europe, belong to yet higher beds.

The difference in shape from the true *St. macrocephalum* is very little, and the resemblance of both species so close that up to this time every body considered *St. Maya* as identical with *St. macrocephalum*, Schloth. Nevertheless differences exist, and on close examination they seem more than sufficient to consider both species as very distinct. Already the much larger umbilicus and ribs, whose stems near the umbilicus never become obliterated, might be sufficient to distinguish the species, but the arrangement of the lobes indicates changes in the animal, far larger than the changes in the shell could suggest.

From *St. transiens* Sowerby's species differs by a larger umbilicus, less numerous and more prominent ribs and lobes, which form in their general direction an angle of 23° with the radius of the spiral, whilst in *St. transiens* this angle is only 12°.

It is of great interest to mention that *St. Maya* is not limited to the Kachh Jura: the specimens of *Amm. macrocephalus*, mentioned by Dr. Stoliczka from the Spiti shales in the valley of Spiti, Central Himalaya, as well as those mentioned and figured as *Amm. Nepalensis* by Mr. H. F. Blanford in the Asiatic Society's Journal, belong also, without any doubt, to *St. Maya*, Sow. Thus three important species of the Kachh jurassic strata are identical with species from the Spiti shales: *Steph. Maya*, Sow., *Harp. Kobelli*, Opp., and *Perisph. frequens*, Opp., the first holding in Kachh its position in upper Oxfordian, the second in Kimmeridgian, and the third in Tithonian beds. It seems therefore possible that the Spiti shales represent strata from the Oxford to the Tithon-Group.

(b.) Group of *STEPHANOCERAS TUMIDUM*, *Reinecke*.

1. *STEPHANOCERAS TUMIDUM*, *Rein. sp.* Pl. XXVI; Pl. XXVII, Figs. 1c, 2a, b.

1818. *Nautilus tumidus*, Reinecke: *Maris protogaei Nautilus et Argonautas*, fig. 47.

1830. *Ammonites macrocephalus* (Schloth.) Zieten: *Verst. Württemb.*, pl. 5, fig. 1.

1830. „ *tumidus*, (Rein.) Zieten: l. c. pl. 5, fig. 7.

1847. „ *macrocephalus tumidus*, Quenstedt: *Cephalop.*, p. 183, (pars.).

This is a species which was not exactly recognised for a long time; even Oppel, misled by the drawings of Orbigny, has understood under this name not the same form which Reinecke had described in 1818. I have examined, I can say, several thousands of specimens, coming from the same localities, as Reinecke's originals, and I have found among them not a single example of the form of Orbigny's figure, but hundreds which very well agree with the drawing of Zieten and of Reinecke himself.

Stephanoceras tumidum is a middle-sized species. The former whorls, up to the beginning of the body-chamber, are in all stages of growth identical; they are rounded, about twice as broad as high. The umbilicus is always a little wider than in *St. macrocephalum*, being one-sixth of the whole diameter of the shell, whilst in the just mentioned species it is only one-eighth to one-tenth. The whorls are covered with fine, sharp, polytome ribs, which go straight over the siphonal side; the stems of these are never obsolete as in *St. macrocephalum*.

The body-chamber is strongly ribbed as far as the aperture, but the ribs are much broader and less numerous than on the air-chambered part of the shell. The aperture is a little contracted, with a protracted, rounded, tongue-shaped ventral projection; the transversal diameter is a little reduced in comparison with the other parts of the shell. The length of the whole body-chamber is about $\frac{3}{4}$ of a whorl, and the last part of it is a little deviating from the spiral, thus widening the umbilicus very much. That the specimen I have just described is full grown is proved by the two last air-chambers, which are much narrower than the preceding ones,

The lobes are of the general type of the "*macrocephali*," arranged along the radius of the shell; they show, however, remarkable differences from those of *St. macrocephalum*. The differences lie in the external and first lateral saddles. Whilst the latter species has in the former, two, in the latter one, secondary lobe, in *St. tumidum* there are in the external saddle three secondary lobes, the middle one being the smallest, and in the first lateral saddle, there are two with a very small median third one. The auxiliary lobes, two in number, are well developed, separated from the second lateral and from each other by saddles, of which every one has a secondary lobe. That this is not the case in *St. macrocephalum* the drawing on pl. 33, fig. 5, sufficiently shows.

The dimensions of four specimens from Keera hill near Charee are the following :—

				I.*	II.	III.	IV.
Diameter	of the shell	...	...	175 mm.	120 mm.	58 mm.	28 mm.
"	of the umbilicus	...	...	35	21	14	7
Height	of the aperture from the umbilical suture	...	...	84	63	31	15
"	of the " from the preceding whorl	...	...	58	33	18	8
Thickness	of the "	...	...	88	68	37	18

Remarks.—The specimens for description at my disposal are 26, all from Keera hill near Charee. There is yet another specimen out of the "*macrocephalus shales*" on the way between Kumagoona and Urira, also belonging to this species.

Stephanoceras tumidum is very easy to distinguish from the allied species. From *St. macrocephalum* it is distinct by the more inflated form of the shell, the wider umbilicus, the lobes and the different shape of the body-chamber; from all the other '*macrocephali*' by the fine, sharp, polytome ribs and the general form of the shell. The species seems not to become larger than 200 mm. in diameter, at least I have no larger example to examine, and the specimens of this size show the characteristics of full grown individuals.

In Europe, *St. tumidum* is always found in the society of *St. macrocephalum*, and signifies, as well as the latter species, layers of lower Kalluvian age.

2. STEPHANOCERAS POLYPHEMUS, *Waagen, n. sp.* Pl. XXIX.

The general form of the shell is very much like *St. tumidum*, but the dimensions are much more gigantic. The umbilicus is tolerably small, the whorls inflated, twice as broad as high, covered with broadish rounded ribs, which start from the umbilical edge, and are divided in the middle of the sides into two or three branches which go straight over the siphonal side. The body-chamber is smooth, with only a few broad, flat ribs on both sides of the siphonal part near the mouth of the shell.

* No. I has the body-chamber preserved.

Among the very ample materials which our Museum has got of this species, the first stages of growth are nevertheless not represented. The smallest specimen I have for description comes from the Dhosa oolite of Vanda, and measures already 73 mm. in diameter. The specific characters are at this size well developed, the whorls being inflated, covered with roundish, prominent ribs, which originate at the umbilical edge, and divide on the middle of the sides into two or three branches. The umbilicus is rather large, the inner whorls well exposed.

This form remains nearly unchanged up to a diameter of 220 to 240 mm. The only differences from the smaller specimens then consist in the ribs being more rounded, flattened, and distant from each other, and the appearance of a number of single ones between the dichotome ribs. Only a short distance before the beginning of the body-chamber a change is effected. The whorl becomes quite smooth, and remains so up to the mouth of the shell, where, however, a few broad undulations near the siphonal part are again observable. The body-chamber deviates somewhat from the regular spiral, the umbilicus becoming considerably larger.

The lobes are nearly of the same type as those of *St. macrocephalum*. The siphonal lobe has got four branches, and is a little longer than the first lateral. The external saddle has three secondary lobes, which become larger in progressing from the outer to the inner ones, the outermost one being the smallest. The first lateral lobe terminates in two principal branches, the inner of which is larger. The first lateral saddle has one principal secondary lobe in the middle. The second lateral lobe is of the same shape as the first one, but much smaller. The two following saddles have secondary lobes. In small specimens there is after the second lateral lobe only one lobe more; in adult ones, however, there are yet three lobes interspaced by broad, divided saddles.

The largest specimen known to me comes from Lodai, and has 460 mm. in diameter, whilst the aperture is 238 mm. broad. All the individuals do not grow as large as that, but the smallest full grown specimen I have for examination has still 280 mm. in diameter, a size which is barely attained by any other species. The length of the body-chamber is three-quarters of a whorl.

The measurements of three specimens are the following :—

					I.	II.	III.
Diameter	of the shell	...	...	...	330 mm.	168 mm.	94 mm.
"	of the umbilicus	...	...	...	70	27	24.5
Height	of the aperture from the umbilical suture	...	...	...	150	99	44
"	of the " from the preceding whorl	...	...	...	90	60	26
Thickness	of the " " " " "	...	...	...	145	118	54

The specimen No. I has preserved its entire body-chamber.

Remarks.—This species is one of the most common and most characteristic fossils of the Dhosa oolite, and does not occur in any other layer of the Kachh Jura. I formerly thought, some specimens from the golden oolite would belong to the same species, but from the very extensive materials brought by Dr. Stoliczka

from Kachh, it appears that there exists yet another species in the golden oolite, which I distinguish now as *St. chrysoolithicum*, Waagen, *n. sp.*

St. polyphemus has been collected in the Dhosa oolite of the following localities: Lodai (eleven specimens); Joora hills (six specimens); north of Gudjinsir (one specimen); south-east of Jooria (one specimen); south of Lair (one specimen); north-west of Soorka (three specimens); Vanda (fourteen specimens).

When full grown, the species is easily distinguishable from any other of the '*Macrocephali*' already by its gigantic dimensions, which no other species attains, and the peculiar smooth, inflated shape of the body-chamber. Smaller specimens are not so easily recognised, but the broad, rounded ribs are always characteristic enough to identify the species. Only quite young individuals are sometimes difficult to determine, as the character of the ribs is not always well developed then. They very much resemble in that stage *St. tumidum*, Rein., the ribs being less broad and sharper, but besides the coarser and less numerous ribs, they differ from that species by a much wider umbilicus. From *St. Chariense* our species is distinguishable by the broader siphonal part of the shell and from *St. Morrisi* by the more inflated form. *St. chrysoolithicum* has got rounder ribs, a smaller umbilicus, and a much sharper umbilical edge.

The species is, so far as known, entirely wanting in the European jurassic strata, the true "*macrocephali*" being there almost entirely wanting in any other than the "Kelloway group."

There is very little doubt that *St. Polyphemus* originated, here in India, from *St. tumidum*, from which it is only different by coarser ribs, larger umbilicus and its enormous size. The developmental vigour, which is expressed in this gigantic species, diminishes, however, very soon again, and the next form in the developmental series is a small, pygmy-like species.

3. STEPHANOCERAS SUBTUMIDUM, *Waagen, n. sp.* Pl. XXVIII, Fig. 4a, b,

1840. *Ammonites Herveyi*, Sowerby: Transact. Geolog. Soc., Lond., II Ser., Vol. v, p. 719, Woodcut (non *Ammonites Herveyi*, Sow., 1818 M. C., pl. 195: non *Amm. Herveyi*, Sow., 1840: Transact. Geol. Soc., Lond., II Ser., Vol. v, pl. 23, fig. 5).

In the same connection in which *St. Maya* stands to *St. macrocephalum*, in the same connection stands *St. subtumidum* to *St. tumidum* or *Herveyi*.

Our species is a rather inflated form, with rounded whorls without umbilical edge and small umbilicus, but the latter commonly a little wider than in *St. tumidum*. The whorls are covered with fine, sharp ribs, which begin on the umbilical suture and become dichotome or trichotome where they reach the siphonal side. On the middle of the siphonal side they are a very little bent forward.

The lobes on the specimens which I have for description are not sufficiently preserved to show the details of their drawing, but one can easily observe that their general position keeps the same angle with the radius of the spiral as in *St. Maya*,

The specimen figured by Sowerby was a rather large one. I can give only the measurements of a small example coming from the red layers of Kuntkote. These measurements are—

Diameter	of the shell	...	...	...	...	...	48 mm.
"	of the umbilicus	...	...	...	...	...	10
Height	of the aperture from the umbilical suture	...	...	...	...	...	25
"	of the " from the preceding whorl	...	...	...	...	...	15
Thickness of the	"	...	...	...	...	...	35—37

Remarks.—The species was originally described by Sowerby as *Amm. Herveyi* from the red iron layers between Kuntkote and Rahpoor (as one must understand the "Shahpoor" of Captain Sykes) in the eastern part of Cutch, called Wagur. In the Museum are four rather small specimens from the same locality and layer, identical in shape, but partly with dichotome, partly with trichotome ribs.

St. subtumidum is easy to distinguish from any form of the *macrocephali* occurring in India by the want of an umbilical edge on the whorls, and caused by this, the beginning of the ribs near the umbilical suture. In this respect our species represents the extreme in the developmental series, the umbilical edge being sharp in *St. tumidum*, rounded in *St. Polyphemus*, and wanting entirely in *St. subtumidum*.

From the true *St. Herveyi*, which does not occur in India, the species is distinguishable by the general arrangement of the lobes, which form an angle of more than 20° with the radius of the spiral.

The bed in which the species is found in society of *St. Maya*, &c., is very likely of upper Oxfordian age.

(c.) Group of STEPHANOCERAS SEMILAEVE, *Waagen*.

1. STEPHANOCERAS SEMILAEVE, *Waagen*, n. sp. Pl. XXVIII, Fig. 3a, b.

This species is very nearly allied to the true *St. macrocephalum*, and is in fact a parallel form to it in the same beds, both very likely having originated from one and the same as yet undescribed species in somewhat older layers. As it is, *St. semilaeve* itself gives rise in its turn to a small group of forms, of which one species could be distinguished as *St. arenosum* in the beds with *Asp. perarmatum*.

The general form of the species is rounded, compressed, thick, lenticular. The umbilicus is small, surrounded by tolerably high perpendicular walls, which join the sides of the whorls in a rounded edge. The whorls are about one-third higher than broad, with a broadly rounded siphonal side; ribs sharp, but not prominent, disappearing entirely in large specimens.

The smallest specimen I have got for description has 45mm. in diameter. The whorls are rounded with a very broad siphonal part; the sides of the whorls are covered with sharp, fine filiform ribs, which originate on the umbilical edge and

run from there, rather strongly turned towards the front, to about the middle of the sides, there being divided mostly into three branches, which go entirely straight over the siphonal part of the shell. Both the cast and the shell show identical sculpture.

This shape remains to about 60 to 70 mm. diameter of the shell. Then the siphonal side becomes narrower, the greatest transversal diameter of the whorls lying then a little above the umbilical edge. The ribs retain as yet the same thin, filiform character on the shell as in former stages of growth; on the casts, however, they seem broad, round, and flattened, barely perceptible. From this size up to a diameter of 145 mm. the shell changes very little in shape, except that the ribs near the umbilicus become a little less distinct. At this diameter, the chambered part of the shell seems to have attained about its full size, and larger specimens are provided with the body-chamber. As soon as this latter part begins the general shape of the shell changes considerably; the ribs disappear entirely, and only in the beginning of it are slight traces still observable. After that, the body-chamber remains entirely smooth up to the aperture. The umbilical suture deviates slightly from the regular spiral, the umbilicus getting wider. The umbilical wall changes from the vertical to a sloping position, which increases, until, near the aperture, the umbilical edge is entirely lost. The length of the body-chamber occupies an entire whorl.

The lobes are much of the type of those of *St. macrocephalum*, only deviating in some minor details, such as the external saddle being a little broader, &c.

The measurements of four specimens are the following:—

	I.	II.	III.	IV.
Diameter of the shell	62 mm.	97 mm.	144 mm.	180 mm.
„ of the umbilicus	10	13	19	32
Height of the aperture from the umbilical suture ...	34	51	76	87
„ of the „ from the preceding whorl ...	21	31	37 ?	40
Thickness of the „	25	42	59 ?	68

Of the specimens III and IV the former is provided with the beginning and the second with the entire body-chamber.

Remarks.—There are altogether eight specimens of this species preserved in our Museum, which were all collected by Dr. Stoliczka in the vicinity of Soorka at two different places in the shales with *St. macrocephalum*.

There are several species very nearly allied to *St. semilaeve*, which even might be considered as partly identical, but which, nevertheless, show constant differences. These differences must be noticed, if the law of transmutation of the forms is to be established clearly, and the easiest way to do so is to separate different forms under different specific designations. This may justify my separating this species from *St. arenosum*, which is the most closely allied to it. The differences between the two species lie in the ribs, which are filiform on the shell, round, and very indistinct in the cast in *St. semilaeve*, whilst they are broad, round,

and well distinguishable on the cast, and of the same description, but very weak on the shell, in both cases nearly vanishing in the middle of the narrow siphonal side in *St. arenosum*.

From *St. macrocephalum* our species is distinguishable by the absence of the smooth zone, which surrounds the umbilical edge in the former species. *St. transiens*, W., and *St. Maya*, Sow., agree in this respect with *St. semilaeve*, but are distinguishable by much finer ribs and the general arrangement of their lobes. The other species of '*macrocephali*' cannot be compared with *St. semilaeve*.

2. STEPHANOCERAS ARENOSUM, *Waagen, n. sp.* Pl. XXXVI, Fig. 5a, b, c.

I am about to describe a very nice but very rare species under this designation. The whole aspect of the shell is a little like *St. Lalandeanum*, but it does not require a very careful examination to discover the differences.

The general form of the shell is compressed, lenticular, with a small umbilicus. The whorls are compressed, about as high as broad, with rather flat sides, but rounded siphonal part and umbilical edge. They are covered with very faint, slightly curved, rounded ribs, which begin a little thickened on the umbilical margin, become then very weak, and are divided at about the middle of the sides into two or three branches, which are a little bent forward, become a little stronger near the siphonal side, go then straight over this part of the shell, and become again very faint in the middle of it.

The lobes are very characteristic; they are rather finely and deeply cut out, but still always of the common type of the *macrocephali*, and are arranged according to the radius of the spiral. The siphonal lobe is a little shorter than the first lateral one, and has on each side two not very long branches; the external saddle is broad, with one rather large median secondary lobe; the first lateral lobe is long and narrow, and terminating in three branches; the first lateral saddle goes a little farther up than the external one, and has no distinct secondary lobe; the second lateral lobe is much shorter than the first one, and finishing in two asymmetrical branches; the next saddle is again without distinct secondary lobe. There are yet one or two auxiliary lobes.

The materials for this species are not sufficient to state how large the species can grow. The measurements of one of the specimens however are—

Diameter of the shell	...	...	...	...	...	97 mm.
„ of the umbilicus	...	...	...	...	...	17
Height of the aperture from the umbilical suture	...	...	...	...	...	44
„ of the „ from the preceding whorl	...	...	...	...	...	27
Thickness of the „	...	...	...	...	...	37

Remarks.—Two specimens of this species which are here in the Museum are preserved in a very hard, gray, sandy, calcareous rock entirely similar to the rock in which at the same locality *Asp. perarmatum* is preserved, that is, near Lodai.

Another specimen has been collected by Dr. Stoliczka in the Dhosa oolite of Vanda.

The species is easy to distinguish from other allied forms. It shows the greatest affinities to *St. macrocephalum*, but the flatness and smoothness of the sides of the whorls, the ribs, which are not sharp, but rounded and rather broad, the differences of the lobes, give sufficient points of distinction between both forms. *St. lamellosum*, which also could come into comparison, has regular dichotome, high, and sharp ribs, whilst in our species they are polytome and very faint. From *St. semilaeve*, *transiens*, and *Maya* this species differs by the peculiar shape of the ribs, and the form and general arrangement of the lobes. All the other till now described species may be distinguished from *St. arenosum* already by the much larger transversal diameter of their whorls.

St. arenosum has not yet been found in Europe. In India it seems to occur in lower Oxfordian layers, as belonging to the fauna of the Dhosa oolite.

(d.) Group of STEPHANOCERAS LAMELLOSUM, Sow.

1. STEPHANOCERAS LAMELLOSUM, Sow. Pl. XXXIII, Fig. 1a, b.

1840. *Ammonites lamellosus*, Sowerby: Transact. Geolog. Soc., Lond., Vol. v, pl. 23 and expl.
(*Ammonites macrocephalus*, Orbigny, Oppel, Bronn, and several other authors).

The species is not very common in Kachh, and I have only few specimens from which to describe it. Though the figure by Sowerby is not very instructive, it is possible to recognise the species among the Kachh materials, but it would not have been possible to identify European specimens with it.

The general form of the species is tolerably flat, with a rather large umbilicus. The whorls are not very high, but with slightly flattened sides, which causes the somewhat flat aspect of the whole shell. The ribs, which cover the whole Ammonite, are strong, and, when the shell is preserved, very prominent.

The smallest specimen of *St. lamellosum* I have got for description has 40 mm. in diameter; the whorls are depressed, considerably broader than high, the umbilicus is tolerably wide and very deep, surrounded with an obtuse, indistinct umbilical edge. The ribs are thick, high, and not very numerous, starting from the umbilical edge and being divided a short distance above it into two or three branches which go with a little bend towards the front over the siphonal side.

When the specimens grow a little larger, the height of the whorls increases rapidly, the ribs lose the bend on the siphonal side and become quite straight. At a diameter of about 90 to 100 mm. the species seems to be full grown, and all the specimens of this size show the entire body-chamber, which occupies the whole last whorl. There is no difference between the sculpture of the body-chamber and the air-chambered part of the shell; also the umbilicus does not get wider.

The lobes are visible in none of the specimens.

The measurements of two specimens from the golden oolite of Charee are the following:—

		I.	II.
Diameter	of the shell	51 mm.	82 mm.
"	of the umbilicus	12	19
Height	of the aperture from the umbilical suture ...	25	37
"	of the " from the preceding whorl ...	16	25
Thickness	of the "	31	38

The specimen No. II is provided with part of the body-chamber.

Remarks.—*St. lamellosum* is one of the rarer shells of the Kachh Jura, where it occurs exclusively in the beds with *St. macrocephalum*. It was formerly known only from the golden oolite of Charee, from which our Museum possessed four specimens. Stoliczka, in his last trip to Kachh, not only collected the species there in two good specimens, but found it also in the "macrocephalus shales" north-west of Jumara and north of Kumagoona.

The nearest allied form to this species is *St. Grantanum*, from which species *St. lamellosum* is chiefly distinguishable by its more compressed form, more numerous and less prominent ribs. Also *St. Grantanum* seems to have attained a somewhat larger size than the species here in question. From other allied forms the species can be easily distinguished by the absence of a well defined bend in the ribs on the siphonal side of the body-chamber.

2. STEPHANOCERAS GRANTANUM, *Oppel*. Pl. XXXI, Figs. 6a, b.

1840. *Ammonites Herveyi*, Sowerby: Transact. Geol. Soc., Lond., II Ser., Vol. v, pl. 23, f. 5 and expl. (non Sowerby, 1818, M. C., pl. 195; non Zieten).

1846. *Ammonites Herveyi* (Sow.) Orbigny: Pal. Franç. Terr. Jur. I, p. 428, pl. 150, (non Sow, 1818).

1857. *Ammonites Grantanus*, *Oppel*: Jura-formation, p. 548.

The species was named by *Oppel* on referring to *Orbigny's* figure and also to the figure given by *Sowerby* in the Transactions of the Geological Society, and it is, therefore, easy to determine what *Oppel* meant by this designation. The specimens from Kutch agree even in the smallest details with *Orbigny's* excellent drawing.

It does not seem that *St. Grantanum* has ever become very large, an example of about 120 mm. being the largest I know. The general form of the shell is very constant, so that young specimens and such as are advanced in growth look nearly identical. The umbilicus is tolerably wide, the whorls rounded, depressed, about twice as broad as high, covered with very high, sharp ribs, which begin near the rounded umbilical edge, and, slightly bent forward, go straight over the siphonal side, after having been divided into two or three branches nearly on the middle of the sides. I count on the siphonal side of a specimen of 71 mm. in diameter 48 ribs; near the umbilicus there are 22. As in *St. lamellosum* so in this species, the

shape and sculpture of the body-chamber does not in any way deviate from that observable on the other whorls. The lobes cannot be observed on any of the Kutch specimens.

The largest specimen of 120 mm. in diameter is not well enough preserved to take also the other measurements. It seems that this shell, soon after it had been imbedded and filled up with stony matter, was washed out again and then was lying like a pebble on the bottom of the sea, because the cast is covered with oysters and holes of boring shells.

The measurements of another example are the following :—

Diameter of the shell	...	...	...	...	71 mm.
" of the umbilicus	...	...	...	...	15
Height of the aperture from the umbilical suture	...	...	...	...	37
" of the " from the preceding whorl	...	...	...	...	22
Thickness of the " ... ..	...	...	...	...	48

Remarks.—There are fifteen specimens of this species in our Museum; eleven of them came from the golden oolite of Keera hill near Charee, one from Jumara out of a yellowish gray hard limestone with iron concretions, one from north-west of Soorka out of the "macrocephalus shales;" the last two came from Kaora in Putchum, and show clearly that the highest beds in that island are of Callovian age.

St. Grantanum is very easy to distinguish from *St. Herveyi* by the much less numerous and much more prominent ribs, in fact those peculiarities of the ribs may distinguish the species from all the other *macrocephali* in the Kutch Jura, except *St. lamellosum* and *St. elephantinum*, Sow., the latter of which, though having the same kind of ribs, is distinct by its much wider umbilicus. *St. lamellosum* can be distinguished by its compressed form and the less strong ribs.

The species is not common in Europe. I know only a few specimens from Suabia and from some French localities; it occurs there, it seems, exclusively in the "*macrocephalus*" strata. The same is the case with the Indian specimens.

3. STEPHANOCERAS ELEPHANTINUM, Sowerby. Pl. XXXI, Figs. 3, 3a; Pl. XXXII, Fig. 4a, b, c.

1840. *Ammonites elephantinus*, Sowerby. Transact. Geolog. Soc., Lond., II Ser., Vol. v, pl. 23, fig. 6 and expl.

Orbigny in his Prodrôme expresses his views regarding this species, stating that he thinks it possible that *St. elephantinum* might be only a variety of *St. Herveyi*. That it is impossible that the true *Herveyi* described in 1818 by Sowerby is here alluded to is clear on the first glance. Orbigny had only his *Herveyi* in mind, which is identical with the species described before. The similarity between *St. Grantanum* and *elephantinum* is really very great, but there are always sufficiently large differences to consider both forms as separate species.

The general form of the species is somewhat patelliform, with large umbilicus and broad depressed whorls. The whorls are covered with strong very prominent ribs, which go straight over the siphonal part of the shell.

The smallest specimen I have for description has 26 mm. in diameter. At that size there exists a strong resemblance to certain forms of the section '*coronati*' of the Genus *Stephanoceras*, such as *St. subcoronatum*, Opp., etc. The umbilicus is large, the whorls rounded, without any umbilical edge, covered with ribs, which start near the umbilical suture, and run then up as high ridges to the middle of the sides, there being divided, without forming a tubercle, into three or sometimes two branches, which turn a little backwards and then go straight over the siphonal side of the whorl.

This form changes very little in larger specimens, except that the whorls get slowly more and more depressed, the ribs are no longer so much reverted, and become regularly dichotome.

At a diameter of 55 mm. the body-chamber commences in many of the specimens, and at 100 to 120 mm. diameter the species seems to have been full grown. The ribs are then remarkably straight: they are not bent forward on the sides of the whorls, and go perfectly straight over the siphonal side. There are some single undivided ones intercalated between the regularly dichotome ribs. On a specimen of 108 mm. in diameter I count on the siphonal side 51 and near the umbilicus 28 ribs. The body-chamber does not deviate in the slightest degree from the regular spiral.

In none of the specimens I have got for description are the lobes sufficiently well preserved, to describe or draw them accurately. This much, however, is visible that they are arranged in the direction of the radius of the spiral.

The measurements of a small and a large specimen are the following:—

					I.	II.
Diameter	of the shell	...	...	...	26 mm.	108 mm.
"	of the umbilicus	...	...	...	9	42
Height	of the aperture from the umbilical suture	...	...	...	11.5	44
"	of the " from the preceding whorl	...	...	...	8.5	28
Thickness of the	"	...	...	...	15	63

The specimen No. II has preserved nearly its entire body-chamber.

Remarks.—*St. elephantinum* is represented in our Museum by seven specimens, which all come from the Dhosa oolite. Five of them have been collected by Dr. Stoliczka in that bed at Vanda. Another has been found by Mr. Wynne at Lodai, and the last at Kota, west of Lodai near the Runn.

The species is easily distinguishable from every other kind of the '*macrocephali*' occurring in India, only *St. Grantanum* could possibly be mistaken for it; but the much larger umbilicus and the stronger and scarcer ribs in Sowerby's species are features which make a distinction not very difficult. There is, however, no doubt that both species belong to the same developmental series.

(e.) Group of *STEPHANOCERAS MORRISI*, *Oppel*.

1. *STEPHANOCERAS CHARIENSE*, *Waagen, n. sp.* Pl. XXX, Fig. 2a, b; Pl. XXXI, Figs. 1, 1a, 1b.

At the first glance this species seems to be an intermediate form between *St. Morrisi* and *St. macrocephalum*, but on closer examination it soon appears that the relations to the first species are closer than to the second one. Thus *St. Morrisi* may be considered as the parent species of *St. macrocephalum*, but it is certainly the parent species of *St. chariense*: all three species agree in having the smooth zone which surrounds the umbilicus, but *St. Morrisi* and *St. chariense* have broad rounded ribs, whilst *St. macrocephalum* has got them sharp and prominent.

The general shape of the shell is inflated, lenticular, with small umbilicus and rather narrow siphonal part. The aperture is somewhat triangular, the ribs not very fine, broadly rounded, principally visible only on the siphonal side of the shell; the lobes are much like those of *St. macrocephalum*.

The young stage of the species differs a little from more largely grown specimens, and it is therefore necessary to describe both stages separately. Young examples up to a diameter of the shell of about 70 mm. have rather depressed broad whorls. The umbilicus is deep and small, the ribs flat, broad and rounded; they are, it seems, polytome, but the stems, in which several of the outer ribs unite towards the umbilicus, are always obliterated. In this stage the species has a certain resemblance to *St. Morrisi* and *St. chrysolithicum*, W., but the ribs are much flatter and not so distinct, and the siphonal side is much narrower, rounded, than is the case in the mentioned species, and this makes those forms easily distinguishable.

In larger specimens the umbilicus has scarcely at all increased in diameter, but the whorls have become much higher, and in comparison with their height much thinner. The ribs do not increase in their breadth, and appear, therefore, much more numerous in larger than in smaller specimens; but they never become so numerous as in *St. macrocephalum*, and they always remain round and flat. I do not know specimens larger than 125 mm. in diameter, and therefore I cannot ascertain if the form of the species does not change again in farther stages of growth or in getting the last body-chamber.

The lobes are very similar to those of *St. macrocephalum*. The siphonal lobe is a good deal longer than the first lateral. The external saddle has two secondary lobes, the first lateral one. The auxiliary lobes are two or three, but not well developed.

The measurements of two specimens are—

				I.	II.
Diameter	of the shell	...	...	105 mm.	69 mm.
	„ of the umbilicus	...	...	13	12
Height	of the aperture from the umbilical suture	...	...	63	32
	„ of the „ from the preceding whorl	...	...	34	21
Thickness	of the „	...	...	58	45

Remarks.—Of this species not more than ten specimens are preserved in our Museum, which proves that it is much rarer than the true *St. macrocephalum*. They have all been found in the same bed together with the mentioned species in the following localities: Keera hill near Charee in the “golden oolite” (four specimens); north-west of Jumara in the “macrocephalus shales” (five specimens); north-west of Soorka in the same beds (one specimen).

St. chariense in many respects very much resembles *St. macrocephalum*, and could easily be mistaken for this species, if attention were not paid to the broad rounded ribs and the more triangular section of the whorls in *St. chariense*, which make a distinction between both forms not so very difficult. From *St. Morrisi*, Opp., our species differs also by the shape of the whorls and finer ribs. The same characters distinguish it from *St. chrysoolithicum*, W., whose ribs, moreover, start from the umbilical edge.

St. chariense has not yet been described from any European locality, nevertheless I remember having seen once there a specimen which very probably must be considered as belonging to this species. It came from the macrocephalus beds in the Brillthal near Hallstadt, Austrian Alps.

2. STEPHANOCERAS CHRYSOOLITHICUM, *Waagen, n. sp.* Pl. XXX, Fig. 1a, b, c.

1847. *Ammonites tumidus* (Rein.) Orbigny: Pal. Franç. Terr. Jur., I, p. 469 (pars), pl. 171 (non Reinecke.)

1857. *Ammonites tumidus* (Rein.) Oppel: Jura form., p. 550 (pars.) (non Reinecke).

1871. *Stephanoceras Polyphemus*, Waagen; Records, Geol. Surv. of India, vol. iv, p. 93, (pars).

Formerly I had united this species with my *St. Polyphemus*, as among the materials then at my disposal, small specimens of the mentioned species had been very scarce, and thus a close comparison between the fossil of the golden oolite and the specimens from Lodai could not be well executed. Since then the beautiful fossils collected by Dr. Stoliczka in Kachh showed me clearly that the form of the golden oolite belonged to a different species from what I had understood formerly to be *St. Polyphemus*, and that the former and not the latter one was identical with *Amm. tumidus*, Orbigny, not Reinecke. I am therefore compelled to retain the name *St. Polyphemus* for the species of the “Dhosa oolite”, and unite the species of the “golden oolite” with the form called by d’Orbigny *Amm. tumidus* under the new name of *St. chrysoolithicum*, Waagen.

The general form of the shell is strongly inflated, nearly globular, with a small umbilicus, surrounded by high walls which are a little overhanging. The whorls are depressed, nearly twice as broad as high, covered with broad, round, not very prominent ribs, which start from the rather sharp umbilical margin, and are divided a short distance above it into two, three, or even four branches.

The stems of the ribs are somewhat bent towards the front, but the branches go perfectly straight over the siphonal part of the shell.

There is very little difference between young and full grown specimens. The smallest specimen I have for description has 84 mm. in diameter, but shows throughout the typical form which does not change in larger shells, except that at the beginning of the body-chamber the umbilical edge becomes less distinct, and the ribs begin to disappear; the body-chamber itself is smooth, without any ornamentation near the aperture.

The species grows very large, though not quite as large as *St. Polyphemus*, and specimens of about 200 mm. in diameter seem to be the largest. There is, however, no specimen of a similar size preserved in our Museum.

The lobes are very much of the type of those in *St. tumidum*, the only differences consist in all the lobes being more slender than in that species. The measurements of a specimen from Keera hill are the following:—

Diameter of the shell	...	...	...	...	84 mm.
„ of the umbilicus	...	...	...	...	17
Height of the aperture from the umbilical suture	...	...	...	...	43
„ of the „ from the preceding whorl	...	...	...	...	23
Thickness of the „	...	...	...	...	56

Remarks.—This species is very rare in the Kachh Jura, and preserved in our Museum only in three specimens coming all three out of the “golden oolite” of Keera*hill near Charee.

It is not very difficult to distinguish *St. chrysoolithicum* from the other allied forms. It differs from *St. tumidum* by its rounded, broad, coarser ribs, and the considerable size the species attains; from *St. chariense* by the broader and more rounded siphonal part of the shell; from *St. Polyphemus* by a smaller umbilicus, sharper umbilical edge, and more rounded ribs; from *St. Morrisi* by much more inflated whorls.

It is not surprising that the species has been united with *St. tumidum* by Orbigny as well as by Oppel, because the affinity of both species is rather close, and the occurrence of them in the same bed did not tend to show the necessity of distinction. The case is, however, different here in India, where *macrocephali* occur throughout the jurassic formation, and where only a careful examination and definition of the single species can show which form is characteristic for the one, which for the other, horizon. Thus I may be justified in introducing a new name for the form here in question, in order to state that it is a different species from others allied to it, but occurring in different beds.

St. chrysoolithicum is a rare species in Europe too. I remember having seen it only from some French localities and from Balin in Galizia.

(f.) Group of *STEPHANOCERAS* Ymir, Oppel.1. *STEPHANOCERAS BULLATUM*, Orbigny. Pl. XXXII, Fig. 1a, b.

1845. *Ammonites bullatus*, Orbigny: Pal. Franç. Terr. Jur., p. 412, pl. 142, fig. 12.
 1847. " *platystomus* (Rein.) Quenstedt: Cephalop., p. 148, pl. 15, figs. 3, 4.
 1857. " *bullatus* (Orb.) Oppel: Jura form., p. 549.
 1858. " *bullatus* (Orb.) Quenstedt: Jura., p. 479, pl. 64, fig. 13.
 1872. *Stephanoceras bullatum* (Orb.) Gemmellaro: Sopra alcune faune Juresi e Liasiche, p. 20, pl. 3, figs. 4 & 7.

Though I am not sure if the specimens figured by Quenstedt and Gemmellaro, with which the Indian form principally agrees, are in reality the same species as that which was understood by Orbigny to be *Amm. bullatus*, yet I cannot make a distinction, as no sufficient material of French specimens is at my disposal to ascertain the constant differences. So much, however, is certain, that Quenstedt's and Gemmellaro's figures represent that species or variety which is most characteristic for the beds with *St. macrocephalum* in the south-eastern part of Europe.

The general form of the species changes very much with age, and specimens without body-chamber have an entirely different aspect from the ones with that part of the shell preserved.

The body-chamber begins in the two specimens I have for description at a diameter of the shell of about 50 mm. Before this size is attained, the general form of the shell is about that of a small barrel, the transversal diameter of the whorls being larger than the diameter of the shell. The umbilicus is very small and deeply funnel-shaped, the siphonal part of the shell flatly rounded, sides of the whorls barely any existing. The whorls are covered with flat, rounded, numerous ribs, which are single, but indistinct at the rounded umbilical edge, and divide then in passing over the siphonal part into two or three branches.

With the beginning of the body-chamber, the whorl deviates strongly from the regular spiral, first following a straight centrifugal line for a distance of about 15 mm. and then turning under an angle of 100° to 105° towards the aperture. At the same time the transversal diameter of the whorl is considerably shortened, and thus the mouth of the shell is narrower than the transversal section of the whorl at the beginning of the body-chamber. The ornamentation of the body-chamber consists of single, flat rounded ribs, which are principally visible on the siphonal part of the shell; they are stronger on the specimen not figured than on the figured one, and disappear nearly entirely a short distance before the mouth of the shell. The length of the body-chamber is about three quarters of a whorl.

The lobes are in none of the specimens sufficiently well preserved to give a drawing of them; however, it is possible to observe that they are nearly identical with Quenstedt's drawing. The siphonal lobe is tolerably slender, but rather short, much shorter than the first lateral lobe. External saddle with two secondary lobes, a smaller near the siphonal and a larger near the first lateral lobe. First

lateral lobe rather broad, longer than the siphonal; first lateral saddle broad, with a short, thick secondary lobe; second lateral lobe broad and short. There are barely any auxiliary lobes visible.

The measurements of the figured specimen are—

Diameter of the shell	...	...	...	...	...	...	66 mm.
" of the umbilicus	at end of body-chamber	...	...	...	...	...	20
" " "	at the beginning of body-chamber	...	...	...	...	...	6
Height of the aperture	at the mouth of the shell	from the umbilical suture	...	...	...	...	20
" of the " " " "	" " " " "	from the preceding whorl	...	...	...	...	18
" of the " "	at the beginning of the body-chamber	from the umbilical suture	...	...	...	...	20
Thickness of the aperture	at the mouth of the shell	...	...	...	...	...	43
" of the " "	at the beginning of the body-chamber	...	...	...	...	...	58

Remarks.—The two specimens of this species I have for description have been collected by Dr. Stoliczka, the one in the "golden oolite" of Keera hill near Charee, the other in the macrocephalus shales north of Kumaguna.

Easy as it is to recognise the species from Quenstedt's excellent drawings, just as difficult is it to become certain about the name one ought to use for it, as Orbigny's figure must really be very badly drawn if it should be taken to represent the species which is generally called *Amm. bullatus*. However, this question can only be settled by comparison of Orbigny's original specimen, but until that is done, nothing is left but to adhere to the name which is generally used for the form.

Stephanoceras bullatum is one of the most characteristic species of the zone of *St. macrocephalum* in Europe.

(g.) ISOLATED SPECIES.

1. STEPHANOCERAS DIADEMATUM, *Waagen, n. sp.* Pl. XXX, Fig. 3a, b, c; Fig. 4a, b.

This species is one of the most striking forms of the Indian Jura. It attains very large dimensions, but specimens with preserved body-chamber are wanting among the materials at my disposal, and I am therefore not able to state how large the species may grow.

The whole shell is round, almost like a bullet, with a tolerably wide umbilicus in the middle. The whorls are strongly depressed, about thrice as broad as high; the surface of them comes up from the umbilical suture in a nearly perpendicular wall; this is followed by a somewhat rounded umbilical edge, which immediately passes into the broad, flat, rounded siphonal side of the whorl. The ribs which cover the whorls are developed in a rather different manner in the different stages of growth of the shell. Yet very young, possessing a diameter of about 12 mm., the individuals slightly resemble young specimens of *St. tumidum*: the ribs are very fine, closely arranged and sharp, but there is always a wider umbilicus and more depressed and broader whorls, which enable us to distinguish both species. At a diameter of 40-60 mm., the appearance of the individuals is somewhat different, as the ribs are

now very high, sharp, and comparatively few in number. They begin very strong on the inner side of the umbilical edge, but already after a length of 5-10 mm. they are, in passing on to the siphonal side, divided into two strong and high branches, which go, slightly bent forward in the middle, to the opposite umbilical edge.

When the species is growing larger, the strong dichotomy of the ribs disappears by degrees, the ribs become more numerous, not only by the single ribs being divided into three or four, but because between these new accessorial ribs are intercalated on the siphonal side. The shell appears then covered with rather fine but high ribs, which remain until the shell exceeds a diameter of more than 150 mm.; with a yet larger diameter the ribs seem to disappear and the shell to become smooth.

The lobes are not less different in this species according to the age of the single individual, but they change only in some details, not in their general arrangement. The siphonal lobe is always about equal in length to the first lateral; the external saddle is narrow, and has in small specimens no distinct secondary lobe, whilst in adult specimens two small ones are observable; the first lateral lobe is slender, with a long terminating branch; the first lateral saddle is a little broader than the external, and has one distinct and one indistinct secondary lobe. The second lateral lobe is of the same shape as the first one, but much shorter; the second lateral saddle is very broad with three secondary lobes in young specimens, whilst in the adult it is much narrower and only with one secondary lobe. There are in all stages only two auxiliary lobes.

The measurements of three specimens are the following:—

				I.	II.	III.
Diameter	of the shell	...	...	...	142 mm.	88 mm. 55 mm.
"	of the umbilicus	...	...	...	36	14 19
Height	of the aperture from the umbilical suture	...	...	...	60	39 23
"	of the " from the preceding whorl	...	...	...	35	25 15
Thickness	of the " ...	...	...	...	104	74 46

Remarks.—The species is represented in our Museum by fourteen specimens, eleven of which come from the golden oolite of Keera-hill near Charee; two others have been collected by Dr. Stoliczka in the macrocephalus shale north-west of Jumara, and one in the same beds south of Jooria.

The form, which is possibly the nearest allied to *St. diadematum*, is *Amm. sublaevis* or *modiolaris*, but the affinity is more apparent than real, as the inner whorls of both species are entirely different. Larger specimens of both species can easily be distinguished by the single character of the edge round the umbilicus being much sharper, and the umbilicus, therefore, much more conoidal in *Amm. sublaevis* than in our species. *St. tumidum*, which also shows a certain affinity, has got a much smaller umbilicus, much less depressed whorls and different lobes. Another species, which in certain varieties could be mistaken for *St. diadematum*, is *Am. Goliathus*, Orb., but it is to be observed that the latter species has always got a certain kind of ridge running along the middle of the siphonal side, which proves its affinity to *Am. Lamberti*.

Section II.—MACROCEPHALI CURVICOSTATI.

(a.) Group of STEPHANOCERAS DIMERUM, *Waagen*.1. STEPHANOCERAS DIMERUM, *Waagen*, n. sp. Pl. XXXIII, Figs. 2a, b, c, 3a, b.

This species is rather small for a form of the *macrocephalus* family; it is nearly the smallest I know as yet. Most of the examples lying before me are preserved with nearly the whole body-chamber, and do not yet measure more than 75 mm. in diameter.

The youngest specimen I have to observe is not more than 12 mm. in diameter. The shell is preserved, and therefore the ribs which cover the whorls are high and sharp, strictly dichotome. The whorls are depressed, about twice as broad as high, the umbilicus tolerably wide, very deep. The ribs begin on the umbilical suture; they are divided into two branches on the outer edge, and are considerably bent in front on the middle of the siphonal part of the shell. The number of the ribs is at the diameter mentioned 40 on the siphonal side and 20 near the umbilicus.

Larger specimens, from a diameter of about 30 mm., change a little in shape, and show, therefore, a somewhat different aspect. The whorls become higher, the siphonal side more rounded. The ribs no more begin on the umbilical suture, but on the umbilical margin, which is now developed; they are still mostly dichotome, and bent forward on the middle of the siphonal side. The body-chamber deviates a little from the regular spiral, and shows near the mouth a little finer, higher, and very often trichotome ribs. On the figured specimen $\frac{3}{4}$ of the last whorl are body-chamber, which is preserved not quite to the mouth. I count on this specimen on the siphonal side 61, and on the sides of the whorl 29 ribs.

The lobes are not preserved on any of the existing specimens, as they are generally covered up by the end of the body-chamber, which has about one whorl in length; the only thing I can state is that they are in their general direction arranged according to the radius of the spiral.

The measurements of three specimens are the following:—

	I.	II.	III.
Diameter of the shell	12 mm.	51 mm.	70 mm.
„ of the umbilicus	4	12	15
Height of the aperture from the umbilical suture ...	6.5	26	35
„ of the „ from the preceding whorl ...	4	15	22
Thickness of the „	10	31	38

Remarks.—The species is represented in our Museum from many localities. The geologically oldest specimens come from the gray limestones of the Putchum Group at Jumara, where it seems not to be very rare. At the other localities it has been collected together with *St. macrocephalum*. From the golden oolite of Keera hill near Charee are three specimens; one is preserved in a hard, dark red sandstone from east of Kaora in Putchum, and one in a yellow and red-spotted fine hard sandstone from the Joora hills, on the road from Jooria to Dhosa. Two

specimens have been collected by Dr. Stoliczka in the macrocephalus shales north-west of Soorka, one in the same beds north-west of Jumara, and one north-west of Lodai, at the base of Hulamah hill.

St. dimerum is in certain respects not easy to distinguish from *St. Herveyi*, but the smaller and more deeply impressed umbilicus, the bending of the ribs, and the always small dimensions of our species are sufficient points to separate them. From *St. subtumidum* it is distinguishable by the general disposition of the lobes. The other species of the group of *St. macrocephalum* are partly distinct by having much stronger and fewer, or not dichotome ribs, which do not bend forward on the middle of the siphonal side, partly by having rounded and broad ribs, which disappear in larger stages of growth.

2. STEPHANOCERAS MAGNUMBILICATUM, *Waagen, n. sp.* Pl. XXXIV, Fig. 2a, b.

It is very difficult to decide whether Sowerby, in describing the Kachh fossils, understood this or the following species under the name of *Ammon. fissus*, as both species are very nearly allied to each other, and Sowerby's reduced figure does not even show the width of the umbilicus. However, the measurements given in the explanation to pl. 61 of Vol. V, (Ser. II) of the Transactions of the Geological Society, seem to indicate an Ammonite with somewhat compressed whorls, and as this character agrees more with the following than with the present species, I reserve the name of *St. fissum* for the following, and introduce the new name of *St. magnumbilicatum* for the present species.

The general form of the shell of this species is *macrocephalus*-like with thick inflated whorls but with a rather large umbilicus. The whorls are roundish, very little higher than broad, with flat sides and a very broadly rounded, siphonal part. They are covered with strong, sharp, not very numerous ribs, which begin on the rather distinct umbilical edge, go nearly straight over the sides of the whorls, and are divided into two or three branches a little below where the siphonal and lateral parts of the whorl touch each other. The bend of the ribs towards the front on the middle of the siphonal side is slight, but distinct.

There is no specimen to observe the first stages of growth, the smallest individual at my disposal having already 80 mm. in diameter. At this size the whole form of the shell as well as the sculpture are perfectly developed, and change no more up to a diameter of 154 mm., the largest specimen I have for description. There are, however, among the materials of this species at our Museum two varieties represented, the one with more flattened, the other with more rounded sides of the whorls, in consequence of which the aperture of the first variety is more ovate, that of the second more circular.

The lobes are not visible on any of the specimens; so much is, however, observable, that they are arranged in their direction nearly according to the radius of the shell.

The measurements of three different specimens are the following :

			I.	II.	III.
Diameter of the shell	...	...	80 mm.	129 mm.	154 mm.
„ of the umbilicus	...	...	18	33	44
Height of the aperture from the umbilical suture	...	...	37	62	68
„ of the „ from the preceding whorl	...	...	23	42	— ?
Thickness of the „	...	...	46	54	67

In the specimens II and III the last three quarters of the last whorl are body-chamber.

Remarks.—There are five specimens of this species preserved in our Museum, which have all been collected by Dr. Stoliczka in the macrocephalus shales north-west of Soorka.

St. magnumbilicatum is not difficult to distinguish from all the allied forms by its large umbilicus, sharp ribs, and inflated whorls. In the bend of the ribs on the siphonal side this species differs from all the species described in the first section, except from *St. Maya* and *subtumidum*, the former of which has got, however, a smaller umbilicus and the latter less sharp and more numerous ribs. From *St. dimerum* it is distinguishable by the larger umbilicus and much larger size; from *St. fissum* by the more inflated whorls.

There exists in the general appearance of the species also some resemblance to certain forms of the European group of the “*callovienses*”; however, the inner whorls of our species are entirely different.

3. STEPHANOCERAS FISSUM, *Sowerby*. Pl. XXXVI, Fig. 4a, b; Pl. XXXVII, Fig. 1a, b.

1840. *Ammonites fissus*, Sowerby: Transact. Geol. Soc., Lond., II Ser., vol. v, pl. 61, fig. 11 and expl., page 719.

As I stated before, it was only with great hesitation and after repeated investigation into the matter that I fixed on this form as being the same as was understood by Sowerby to be *Amm. fissus*. However, there is no other Ammonite in the Kachh Jura which so closely resembles Sowerby's drawing and description as this, and thus I venture to describe the species which I have figured on plates XXXVI and XXXVII under Sowerby's name.

The form of this species is subjected to great variations according to age and state of preservation. The smaller state of growth, which is represented in the inner whorls of the specimen figured pl. XXXVI, fig. 4, resembles closely *St. Maya*, and is in fact scarcely distinguishable, except perhaps by the somewhat larger umbilicus. At this size, the diameter being about 35 mm., the whorls are compressed, a little higher than broad, covered with very thin ribs, which originate a little stronger on the umbilical margin and proceed simple till about the middle of the sides of the whorls. There they are replaced by three or four finer ones, which go with a slight bend towards the front over the siphonal side. The umbilicus is flat, but surrounded by somewhat overhanging walls.

Specimens exceeding a diameter of 35 to 40 mm. show more depressed rounded whorls, a larger umbilicus, and ribs which are less numerous, but much stronger and more prominent than in smaller specimens. The ribs are, however, less strong on the cast than if the shell is preserved. They are mostly trifold, sometimes bifid, and show in the beginning the bend on the middle of the siphonal side only very slightly. This latter character, however, increases, the bend becoming stronger as the shell grows larger, and specimens of a diameter of about 120 mm. have the ribs on the siphonal side so strongly bent that they recall certain forms of the "*Amalthei*."

At the beginning of the last body-chamber the siphonal side of the shell becomes quite smooth, and then the species resembles somewhat certain forms of the '*Parkinsoni*' group.

The lobes are only partly preserved in a few of the specimens I have got for description, but show very clearly that their general arrangement is quite the same as in *St. Maya* or *subtumidum*, the lobes from the first lateral to the first auxiliary being tied up to a large sutural saddle. The siphonal lobe is everywhere badly preserved, but seems to be a little longer than the first lateral; external saddle not very broad, with two small secondary lobes; the first lateral lobe is broad and short, a little asymmetric, terminating in three branches; the first lateral saddle shows a small secondary lobe, and goes much higher up than the external; second lateral lobe like the first, but much smaller; second lateral saddle also with a small secondary lobe, and going up again much higher than the first; the two auxiliary lobes and their saddles go then straight down in the direction of the radius.

The measurements of three different specimens are the following:—

				I.	II.	III.
Diameter of the shell	...	...	...	132 mm.	66 mm.	45 mm.
" of the umbilicus	...	...	...	40	21	11
Height of the aperture from the umbilical suture	...	...	...	59	26	21
" of the " from the preceding whorl	...	...	...	37	16	13
Thickness of the " " " "	...	...	...	48	24	19

Remarks.—There are six specimens of this species preserved in our Museum, which all come from the upper beds of the Charee and the lower of the Katrol groups. The best preserved specimen has been collected by Dr. Stoliczka at Keera hill, in the uppermost layers of the oolites of the Charee group, which indicates about the region of *Asp. perarmatum*; another smaller specimen is from the same beds and locality. Four specimens come from the oolites with *Asp. perarmatum*, two from Lodai, one from the Joora hills, and one from north of Dhosa. The latter specimen is interesting on account of the rock in which it is preserved, as this seems in every respect identical with the rock of the Trumo river in Wagur, an equivalent of the Kuntkote sandstone. The last specimen has been found in the Kuntkote sandstone itself at Kuntkote.

If full grown, the species is not difficult to distinguish from all the other allied forms by its peculiarly bent ribs, which in the side-view give the shell some resemblance to certain species of the *Parkinsoni*-group. Small specimens show a great

affinity to *St. Maya*, but have always a somewhat larger umbilicus. All the "*Callovienses*," which could be compared with *St. fissum*, differ by the entirely different shape of the inner whorls.

4. *STEPHANOCERAS NEPALENSE*, Gray. Pl. XXXV, Fig. 2a, b, 3a, b.

1829. *Ammonites Nepalensis*, Gray: Hardwick's Illustrations, plate 160 (P), figs. 1, 2.*

1865. *Ammonites Nepalensis*, (Gray), H. F. Blanford, in Strachey's Palæontology of Niti, p. 77, pl. 14, figs. 1a, b, (non Blanford, 1863).

All the figures as yet published of this species are so exceedingly bad, that it would have been impossible to identify the species if there had not been at my disposal several typical specimens out of the Spiti-shales, the comparison of which with the Kachh specimens showed beyond any doubt that both belong to one and the same species.

The general form of the species is very much like *St. magnumbilicatum*. The whorls are inflated, round, without umbilical edge; the umbilicus large and very deep, the ribs very strong, mostly dichotome, and with a very strong curve towards the front on the siphonal side.

The younger stages of growth, though exceedingly variable, are yet very characteristic. I have with great labour taken out the inner whorls of two specimens which belong beyond any doubt to the species, and found in the one case the whorls thick and inflated as in young specimens of *St. tumidum*; in the other case they were rather compressed, higher than broad; but both were covered with the same characteristic ribs, which cannot easily be mistaken. The ribs are low, broad, and rounded, with deep narrow spaces between them; they start from near the umbilical suture, as an umbilical edge is entirely wanting; their direction is in the beginning nearly radial, only a little turned towards the front, then on the middle of the sides they are divided into two or three branches, or several new ones are intercalated between them; they all take a rather strong turn backwards, and run in this latter direction up to the siphonal side, where they make again a new bend and form a curve towards the front. The umbilicus is in none of the specimens very large.

When the shell attains a diameter of about 50 mm., it bears a strong resemblance to *St. subtumidum*, Waagen, the whorls being strongly inflated and without umbilical edge, but the ribs on the cast as well as on the shell are much higher and sharper and much more curved in front on the siphonal side.

At a diameter of the shell of about 60 to 70 mm. the body-chamber commences, and then the umbilicus increases in width, the ribs become more distant

* It is very difficult to state the exact number the plate ought to get, as the plates were not numbered at all originally. The "Illustrations of Indian Zoology" have been published apparently in two volumes: Vol. I bears the date 1830 to 1832; Vol. II, the date 1833 to 1834. On the plate on which the *Ammonites* are figured is engraved the year 1829, and thus this plate ought to form part of the Vol. I. But in the general list of plates, published after the whole had been finished, the *Ammonite* plate is put down as the last of the whole number, and thus the number of the plate would be 160.

from each other and higher. No other change, however, is visible up to the end of the body-chamber. The length of this latter part of the shell is not quite one whorl; the mouth of the shell is not preserved in any of the specimens.

The lobes are, in the specimens I have got for description, not well enough preserved in order to give a drawing of them, but the preservation is sufficient to observe that the general arrangement of the lobes is exactly the same as in *St. Maya*, *subtumidum*, or *fissum*, the lobes from the first lateral to the first auxiliary being tied up so as to form a large sutural saddle. The details, as far as one can see them, are rather remarkable: the siphonal lobe is a little longer than the first lateral, the external saddle is very narrow, and without distinct secondary lobe; the first lateral lobe is broad and short, terminating a little asymmetrically in three branches; the first lateral saddle is also very narrow, with a very small secondary lobe; the second lateral lobe is extremely small, and in no point distinct from the two or three auxiliary lobes which follow.

The measurements of a specimen from Kuntkote are the following:—

Diameter of the shell ...	...	...	...	...	...	117 mm.
„ of the umbilicus ...	...	...	...	...	...	33
Height of the aperture from the umbilical suture ...	...	...	...	...	...	50
„ of the „ from the preceding whorl ...	...	...	...	...	...	? 38
Thickness of the „ ...	...	...	...	...	...	48

Three quarters of the last whorl of this specimen belong to the body-chamber.

Remarks.—*St. Nepalense* is represented in our Museum by four specimens, which have all been collected in the Kuntkote sandstone, three at Kuntkote itself and one on the borders of the Trumo river in Wagur. A very badly preserved specimen, but which very likely also belongs to this species, is from Gangta Bét, an island in the Runn.

Of all the forms as yet described, *St. magnumbilocatum*, W. seems to be the most nearly allied to Gray's species. The differences, however, lie in a developed umbilical edge, flattened sides of the whorls, and straighter ribs in the former species. *St. fissum*, Sow., is distinguishable from *St. Nepalense* by the much more compressed whorls and the larger umbilicus. The differences between *St. Nepalense* and *St. subtumidum* I have already indicated above.

St. Nepalense is one of the most characteristic species of the Spiti shales in the Himalaya, and occurs there very likely together with *St. Maya* in the lower region of the shales.

(b.) *Group of* STEPHANOCERAS SUBTRAPEZINUM, *Waagen*.

1. STEPHANOCERAS SUBTRAPEZINUM, *Waagen*, *n. sp.* Pl. XXXIII, Figs. 4a, b, c.

This species seems to be very rare in the Kachh Jura, as altogether not more than three specimens of it have been discovered.

In general appearance it resembles so very much the common *St. macrocephalum* that it would not have been thought advisable to distinguish it as a separate species, if it had not been recognised as the root of so many other species, which deviate entirely from the true '*macrocephalus*' type.

The species remains very small, and specimens of 100 mm. diameter seem to be full grown. There is no smaller example to observe the former stages of growth, and thus I must limit myself to the description of the full grown form.

The general shape is *macrocephalus*-like, with a small and very deep umbilicus, surrounded by high perpendicular walls, which form a rather sharp and well defined edge with the sides of the whorls. These latter are flat, sloping from the umbilical edge towards the siphonal part of the shell, which is rather narrowly rounded; thus the aperture shows a somewhat trapezoid shape. The ribs which cover the whorls are very fine and high, but not sharp, and are remarkably straight, though directed a little towards the front of the shell. They divide in two branches a little below the middle of the sides, and go then in a slight curve towards the front over the rounded siphonal side. On a specimen from Keera hill I count 78 ribs on the siphonal side of the shell and 31 near the umbilical edge. Towards the end of the body-chamber the ribs become finer and more closely arranged.

The lobes are very poorly visible on every one of our specimens; so much can, however, be observed that the only remarkable feature in them seems to be that the first lateral saddle goes much higher up than the external one.

The measurements of two specimens are the followi :—

					I.	II.
Diameter	of the shell	...	...	...	87 mm.	98 mm.
"	of the umbilicus	...	...	...	16	19
Height	of the aperture from the umbilical suture	...	...	...	41	49
"	of the " from the preceding whorl	...	...	...	27	32
Thickness of the	"	...	...	...	37	44

In both specimens more than three quarters of the last whorl belong to the body-chamber.

Remarks.—Of the three specimens of this species preserved in our Muséum, one comes from the Brachiopoda bed of the Putchum group of Jumara, like *St. dimerum*, another from the "golden oolite" of Keera hill near Charee, and the third from the *macrocephalus* shales north-west of Soorka. The species thus begins in the highest beds of the Putchum and terminates in the lowest beds of the Charee group.

Though very similar to the true *St. macrocephalum*, yet the species is not very difficult to distinguish from it by the ribs beginning at the umbilical edge and being bent towards the front on the middle of the siphonal side and by the trapezoidal shape of the sections of the whorls. Among the European Ammonites *Steph. Galilaei*, Opp., shows a certain resemblance to our species, but the edges along the siphonal side of Oppel's species show that it belongs to quite a different group

2. STEPHANOCERAS SUBCOMPRESSUM, *Waagen, n. sp.* Pl. XXXIV, Fig. 1a, b.

Like the species just described this also very much resembles the true *Steph. macrocephalum*, but can, on a closer examination, be very well distinguished from it.

In its general form the species is rather compressed, with whorls much higher than broad, a rounded siphonal side and a tolerably wide umbilicus, though not so wide as in *Steph. magnumbilicatum*. The ribs are rather fine, and closely arranged, the sides of the whorls roundish.

The smallest specimen I have got for description has 60 mm. in diameter. At this size the species shows a great resemblance to equally large specimens of *Steph. semilaeve*, W., but even then it is possible to distinguish both species. In *St. subcompressum* the whorls are rather inflated, about as thick as broad, with a very broadly rounded siphonal side. The umbilicus is barely wider than in *Steph. semilaeve*, but surrounded by very high, perpendicular smooth walls, which are not developed to such a degree in the species just mentioned, nor is there visible such a distinct umbilical edge as in the species I am about to describe. The ribs are numerous, tolerably sharp, but not very high. They originate on the umbilical edge, run in a somewhat oblique direction over the sides of the whorls, and are divided at about the middle of the latter into mostly three branches, which go with a very slight curve towards the front over the siphonal part of the shell.

Specimens of 100 to 140 mm. diameter seem to be full grown, and are always provided with the greater part of the body-chamber. This latter part of the shell occupies not quite the length of the last whorl. In their general form the larger specimens deviate not very much from the younger stage of growth described above; however, there are some differences which must be noticed. First, the whorls become more compressed, and the umbilicus comparatively wider as the species grows larger. Then the bend of the ribs on the siphonal side of the shell becomes stronger, the ribs themselves being equally well developed and sharp throughout their whole length from one umbilical edge to the other, as well on the body-chamber as on the air-chambered part of the shell; and thus the shell gets a thoroughly characteristic aspect entirely different from all the species as yet described.

The lobes cannot be made out exactly on any of the specimens; so much, however, is visible, that the saddles between the first lateral lobe and the umbilical edge reach somewhat further up than the external saddle, forming such a broad, but low sutural saddle.

The measurements of two specimens are the following:—

					I.	II.
Diameter of the shell	...	...	...	...	60 mm.	132 mm.
„ of the umbilicus	...	...	...	...	12	29
Height of the aperture from the umbilical suture	...	...	...	...	30	64
„ of the „ from the preceding whorl	...	...	...	...	20	47
Thickness of the „	...	...	...	...	29	51

In the specimen No. II nearly the whole last whorl belongs to the body-chamber.

Remarks.—There are four specimens preserved in our Museum, which undoubtedly belong to this species. They have all been collected by Dr. Stoliczka in the macrocephalus shales north-west of Soorka. Three other specimens differ from the typical form by somewhat stronger and scarcer ribs, but yet must very likely be considered as belonging to this species: one of them also comes from the macrocephalus shales north-west of Soorka; another has been collected in the same beds south of Jooria in the Joora hills; the third is from the golden oolite of Keera hill near Charee. Thus the species seems to occur exclusively in the zone of *Steph. macrocephalum*.

Even in young specimens very nearly allied to *St. macrocephalum*, Schl., or yet more to *St. semilaeve*, W., the species in its full grown state can easily be distinguished from the forms mentioned by its much larger umbilicus and the bend of the ribs on the siphonal side, which characters, together with that of stronger ribs which cover the whole body-chamber, distinguish it from all the forms belonging to the first section of the *Macrocephali*. Among the species of the second section *Steph. subtrapezinum*, W., is very nearly allied to *St. subcompressum*, but has a much smaller umbilicus and flatter sides of the whorls. From the following species it differs by coarser and more persistent ribs.

3. STEPHANOCERAS OPIS, *Sowerby*. Pl. XXXVI, Figs. 1a, b, 2, 3.

1840. *Ammonites opis*, Sowerby: Transact. Geol. Soc., Lond., II Ser., vol. v, pl. 23 and expl.

This species is very characteristic in its form and not difficult to recognise: it is, however, not restricted to one single layer, but ranges from middle Callovien to middle Oxford beds.

Stephanoceras opis has very compressed high whorls, and therefore its general form is discoid with rounded margins. The umbilicus is slightly variable in dimensions, sometimes a little wider, sometimes a little narrower, commonly occupying 0·21—0·22 of the whole diameter, in the whole varying from 0·18—0·27, and is surrounded by perpendicular walls, except along the body-chamber, where the walls become sloping, and the umbilical margin more indistinct.

The whorls are high and flat, embracing each other about two-thirds; they are covered with very fine and sharp ribs, which begin on the umbilical margin and are divided on the middle of the sides mostly into three branches. I count on a specimen of 80 mm. in diameter near the umbilicus 41, and on the siphonal margin 122 ribs. Already from their commencement on the umbilical margin, the ribs are directed towards the aperture of the shell, but near the siphonal margin this direction becomes yet stronger, and they go in a distinct curve over the siphonal side. A short distance before the body-chamber begins, not only the umbilicus

becomes remarkably widened, but also the whorls become much more depressed and rounded in their section, and the ribs are developed much more strongly and less numerous. On the body-chamber itself they are nearly regularly dichotome, and disappear nearly totally on the middle of the siphonal side. The aperture itself is not preserved in any of the existing specimens.

The lobes are in no part sufficiently preserved to give a drawing of them, but one can sufficiently observe them to state the important characters. The most remarkable is the general arrangement of the lobes, which is exactly as in *St. Maya*, the lobes from the first lateral up to the first auxiliary being tied up in a large sutural saddle. The siphonal lobe is not very broad and long, with short branches; the external saddle goes far up and has two secondary lobes. The first lateral lobe is broad, linguiform, and finishes in three branches; the first lateral saddle goes yet farther up than the external, and seems to have two secondary lobes. The second lateral lobe is situated obliquely, and is much smaller than the first. There are yet about two auxiliary lobes.

The measurements of three specimens are the following:—

					I.	II.	III.
Diameter	of the shell	...	...	...	121 mm.	80 mm.	50 mm.
"	of the umbilicus	...	...	...	37	15	12
Height	of the aperture from the umbilical suture	...	...	...	52	40	24
"	of the " from the preceding whorl	...	...	...	35	26	18
Thickness	of the " ...	...	...	...	41	25	20

Three quarters of the last whorl of the specimen No. I belong to the body-chamber.

Remarks.—There are altogether eleven specimens of this species preserved in our Museum, which have been found in the following beds and localities: In the iron nodules of the zone of *Perisph. anceps* of Keera hill near Charee two specimens. In the Dhosa oolite of the Jooria hills four specimens; in the same bed on the road from Jooria to Dhosa one specimen; in the same bed north-east of Gudjinsir one; in the same bed north-west of Soorka one, and in the same bed south-west side of Keera hill near Charee one. In the Kuntkote sandstone at Kuntkote two specimens. Thus the species begins in the middle region of the Charee group and goes up into the Kuntkote sandstone or the lowest beds of the Katrol group. The specimens from Kuntkote show no difference whatever from those found in older layers.

Young specimens of *St. opis* show a great resemblance to *Steph. transiens*, W.; however, the umbilicus is always a little wider in the former species, and the ribs make a stronger bend towards the front on the siphonal side of the shell. In distinguishing the full grown shells no body certainly will find any difficulty. From *Steph. subcompressum*, W., Sowerby's species differs by much finer ribs and more compressed whorls; the same characters distinguish it also from all the species of the group of *Steph. dimerum*, W.

(c). ISOLATED SPECIES.

1. STEPHANOCERAS EUCYCLUM, *Waagen, n. sp.* Pl. XXXV, Fig. 1a, b, c.

Though it seems probable that this species derives its origin from the one just described, yet it shows in its lobes such peculiar characters that I prefer describing it as an isolated species.

There is only a single full grown specimen of this species preserved in our Museum, and I therefore am only able to describe the full grown state. *Steph. eucyclum* is certainly a very remarkable species, as it reproduces in its full grown form in several respects the appearance of some *Cosmoceras*, like *Cosm. Duncani*, etc., without having the inner volutions of that genus.

The general form is flat, nearly discoid, with a rather wide umbilicus. The whorls are compressed, a little higher than broad, and covered with high, but rather fine ribs, which rise on the umbilical margin, and bending forward, go simple till about the middle of the sides, here, divided into three or four branches. From there they go over the rounded siphonal side with a nearly imperceptible curve towards the front. On the body-chamber, which is preserved about half a whorl in length, the ribs on the siphonal side disappear entirely, and on the sides of the whorl there are strong markings of ribs. The umbilicus is surrounded by smooth perpendicular walls.

The lobes are very peculiar. They are extremely short and broad, very much like the lobes in *Cosmoc. Jason*. The siphonal lobe is the longest of all; it is divided into four short, little dentated branches; the external saddle is very broad with three short secondary lobes; the first lateral lobe is nearly as broad as high, finishing in three branches; the following saddle not quite so broad as the external one, with two secondary lobes; the second lateral lobe is like the first lateral, but much smaller; there are besides two auxiliary lobes.

The measurements of our specimen are the following :—

Diameter of the shell	...	...	...	...	...	130 mm.
" of the umbilicus	...	...	...	...	...	33
Height of the aperture from the umbilical suture	...	...	...	...	...	57
" of the " from the preceding whorl	...	...	...	...	...	35
Thickness of the " ...	...	...	...	...	...	48

Remarks.—The only specimen of this species in the possession of our Museum comes from the Dhosa oolite of Keera hill near Charee, and belongs, therefore, to the fauna of the beds with *Asp. perarmatum*.

The distinction of this species from all the others is easily effected by the form of the lobes, which never occurs in any other known species of *Stephanoceras*. In its general form *St. eucyclum*, W., is most nearly allied to *St. opis*, Sow., but is distinguishable by coarser ribs and a larger umbilicus. From *Steph. fissum*, Sow., our species is distinct by finer and differently arranged ribs, not to speak of the entirely different lobes. The species of *Cosmoceras*, which might be compared, have all got a furrow on the siphonal side of the chambered part of the shell, which is wanting in *Steph. eucyclum*.

GENUS PERISPINCTES, WAAGEN.

All the other genera treated of in this volume have shown comparatively few difficulties in the grouping and arrangement of the species, partly because the developmental series comprised by each of them had been already known to a large extent in Europe, partly because these could be made out quite satisfactorily from the Indian materials. The case, however, is different in the genus *Perispinctes*. Though it includes the largest number of species among all the jurassic genera of Ammonites, yet the number of species hitherto well described is very small, and thus it is here, more than in other genera, difficult to follow the development of certain forms through different beds. Nevertheless, a commencement has been made in doing this. Dr. Neumayr, first in his Memoir on the Cephalopoda from Balin, and afterwards in his "Fauna der Acanthicus-schichten" ascertained the developmental connection of certain forms and proposed to distinguish three developmental series, *i. e.*, that of *Perisp. Martiusi*, that of *Perisp. procerus*, and that of *Perisp. tenuiplicatus*. These groups do very well for the species of middle jurassic age, but to extend them so far as to include also upper jurassic species is to give a value to the developmental series which it has not in other genera.

Therefore, exactly knowing the difficulties to be overcome, if attempting to establish a sound grouping of the species of the genus *Perispinctes*, it is only with some reluctance that I propose the following divisions and groups, which, in part at least, may not be considered as developmental series in the same way as in the other genera, but which still indicate a very near relationship of the single species, this being in many cases even developmental. However, in order not to deviate entirely from the plan adopted in the other genera I am forced to introduce these divisions.

The genus *Perispinctes* is represented in the Kachh Jura by more than fifty species, which can be distributed into six large sections, most of which comprise several groups. I distinguish: first section: *Perispinctes obtusicostati* with only one group, that of *Per. obtusicosta*, W. This group seems to me principally of Indian distribution, though some of the Russian Ammonites may also belong to it, and even in Europe the group of *Per. Rolandi* seems to bear a certain affinity to the "*obtusicostati*." The Indian species belonging to this group are all of Callovian or lower Oxfordian age, and all restricted to the Kachh Jura. The group comprises five species, all of them new: *Per. obtusicosta*, W., *Per. angygaster*, W., *Per. Dhosaënsis*, W., *Per. omphalodes*, W., and *Per. mutans*, W.

The second section I distinguish as *Perispinctes triplicati*, and this comprises three groups and one isolated species. The first group is that of *Per. Könighi*. Sow., with two species, *Per. hians*, W., and *Per. spirorbis*, Neum., the first of which has been found in the coral beds of the Putchum group of Jumara and the second in the beds with *St. macrocephalum*, where it seems to be rather common.

The second group is that of *Per. procerus*, Seeb., already distinguished by Dr. Neumayr; it is represented in India by three species: *P. cf. funatus*, Opp., *P. altiplicatus*, W., and *P. perdagatus*, W., the former two species of which are found here in the zone of *St. macrocephalum*, the latter in the zone of *P. anceps*. The third group is that of *Per. pseudorion*, W., with the species *P. pseudorion*, and *P. Orion*, Opp., of which the former occurs in the beds with *Per. anceps*, and the latter in those with *Pelt. athleta*. The isolated species I have called *Per. paramorphus*, W.; it is found in great quantities in the beds with *St. macrocephalum*, where it replaces *P. funatus*, which is very rare in India.

The third section is formed by the *Perisphinctes convoluti*, and comprises four groups: (a). Group of *Per. tenuiplicatus*, Brauns, with three species: *P. Balinensis*, Neum., out of the *macrocephalus* beds, *P. lateralis*, W., out of the zone of *Per. anceps*, and *P. calvus*, Sow., out of the Dhosa oolite. (b). Group of *Per. Martiusi*, Orb., with three species: *P. arcicosta*, W., *P. curvicosta*, Opp., and *P. subtilis*, Neum., which three species appear successively from the *macrocephalus* beds up to the beds with *Pelt. athleta*. (c). Group of *Per. congener*, W., with five species: *Per. congener*, W., *Per. Recuperoi*, Gemm., *P. Cobra*, W., *P. aberrans*, W., and *P. Gudjinsirensis*, W., the first of which belongs to the uppermost beds of the Putchum group, the second to the zone of *St. macrocephalum*, the third to the zone of *Per. anceps*, and the fourth and fifth to the zone of *Pelt. athleta*. (d). Group of *Per. praeursor*, W., with only one Indian species, *Per. praeursor*, W. This group attains its further development only in European localities, *P. Frickensis*, Moesch, *P. Galar*, Opp., and *P. platynotus*, Rein., belonging to it.

The largest number of species I have united in the fourth section, *Perisphinctes evoluti*. Though there are so many species, yet I cannot distinguish more than three groups. The first group is that of *Perisphinctes evolutus*, Neum., with the following species: *Per. subevolutus*, W., *P. subcolubrinus*, W., *P. pagri*, W., *P. Pottingeri*, Sow., *P. Katrolensis*, W., and *P. euplocus*, W. The first species is of the beds with *Asp. perarmatum*, the two following out of the Kuntkote sandstone, and the last three occur in the sandstones of the Katrol group. The following group of *Per. Indogermanus*, W. shows a somewhat larger geological range. It is already represented by three species in the *Perarmatus* beds: *Per. Indogermanus*, W., *P. rota*, W., and *P. obliqueplicatus*, W. In the middle and upper Oxfordian there are two species, *P. Martelli*, Opp., and *P. plicatilis*, Sow., which occur in the Kuntkote sandstone. Out of the Katrol sandstone *Per. torquatus*, Sow., and *Per. bathyplocus*, W., belong to this group, and in the Oomia beds it is represented by *Per. cf. suprajurensis*, Orb., *Per. Bleicheri*, Lor., and *Per. occultefurcatus*, W., which replaces *Per. Boidini*, P. de L., of the European Portland beds. The last species which possibly might be brought into relation with this group is *P. eudichotomus*, Zitt., the palæontological position of which is, however, yet very uncertain. The third group (of *Per. chloroolithicus*, Guemb.) does not include many

species, but they are throughout interesting. It begins here in India with *P. chloroolithicus* in the beds with *Asp. perarmatum*, is represented in the Katrol group by *P. alterneplicatus*, W., and terminates in the Oomia beds with *P. frequens*, Opp., and *P. denseplicatus*, W. With the division of the "*Evoluti*" I unite yet two isolated species, whose relations to other forms are entirely unknown as yet: *Per. virguloides*, W., and *Per. sparsiplicatus*, W.

For the fifth section I propose the designation of *Perisphinctes polyloci*. The groups of forms belonging to this division are represented by an enormous number of species in the jurassic districts of Central Europe, whilst, on the contrary, here in India they have furnished but a single species, *Perisphinctes leiocymon*, W., which has been found in the Kuntkote sandstone.

In the sixth section, the *Perisphinctes interrupti*, I place all the species related to *P. polymorphus*, Orb., or *Per. sulcatus*, Hehl. I can distinguish two developmental series, the group of *Per. Rehmanni*, Opp., with the mutations *P. Rehmanni*, Opp., *Per. Greppini*, Opp., *P. anceps*, Rein., and *P. Fraasi*, Opp., of which two species, *P. Rehmanni* and *P. anceps*, occur in the Indian Jura. The second group is that of *Per. sulcatus*, Hehl., with one species, *Per. decorus*, W., out of the Putschum group. Two other species, which have been found in Kachh, I must consider as isolated species, as their relations to other forms are not yet known; they are *Per. arthriticus*, Sow., and *Per. Jooraënsis*, W.

Of these fifty-six species just enumerated, sixteen occur also in the European Jura; they are, *Per. spirorbis*, N., *P. funatus*, Opp., *P. Orion*, Opp., *Per. Balinensis*, Neum., *P. curvicosta*, Opp., *P. subtilis*, N., *P. Recuperoi*, Gemm., *P. Indogermanus*, W., *P. plicatilis*, Sow., *P. Martelli*, Opp., *P. Bleicheri*, P. de Lor., *P. cf. suprajurensis*, Orb., *P. eudichotomus*, Zitt., *P. chloroolithicus*, Guemb., *P. Rehmanni*, Opp., and *P. anceps*, Rein. These species have been found in Europe all through the upper divisions of the jurassic formation, beginning from the beds with *Steph. macrocephalum* up to the upper Tithonian. Five of them are characteristic for the *Macrocephalus* beds, *Per. spirorbis*, N., *P. funatus*, Opp., *P. Balinensis*, Neum., *P. Recuperoi*, Gemm., and *P. Rehmanni*, Opp.: two are characteristic for the zone of *Per. anceps*; they are *P. curvicosta*, Opp., and *P. anceps*, Rein. To the zone of *Pelt. athleta* belong two species, *P. Orion*, Opp., and *P. subtilis*, N.; two species are found in the zone of *Amalth. cordatus*, *P. Indogermanus* and *P. chloroolithicus*, G., and two in the zone of *Pelt. transversarium*, *P. plicatilis* Sow., and *Per. Martelli*, Opp. The last three species, *Per. cf. suprajurensis*, Orb., *Per. Bleicheri*, Lor., and *Per. eudichotomus*, Zitt., belong, the first two to the Portland beds of Northern France and Southern England, and the third to the upper Tithonian bed of Stramberg. In India these species keep to exactly the same geological horizon as that on which they have been found in Europe: thus *Per. spirorbis*, N., *Per. Balinensis*, Neum., *P. funatus*, Opp., and *P. Rehmanni*, Opp., occur here in the beds with *St. macrocephalum*: *P. curvicosta*, Opp., and *P. anceps*, Rein., in the beds just above the latter, *Per. Orion*, Opp., and *P. subtilis*, N., are

found in the society of *Pelt. athleta*, *P. Indogermanus*, W., and *P. chloroolithicus*, Guemb., keep to the Dhosa oolite, *P. plicatilis*, Sow., and *Per. Martelli*, Opp., to the Kuntkote sandstone, and *P. cf. suprajurensis*, Orb., *P. Bleicheri*, L., and *P. eudichotomus*, to the Oomia beds.

Though the number of fifty-six species seems to be very large, there are yet several other species represented in our Museum which had to be laid aside, as only a few not very well preserved fragments existed, which could not suffice for the description or determination of the species; and thus collectors of fossils in the jurassic deposits of Kachh need not be astonished if they will find forms which have not been figured in this volume.

SECTION I.—PERISPHINCTES OBTUSICOSTATI.

(a). Group of PERISPHINCTES OBTUSICOSTA, Waagen.

1. PERISPHINCTES OBTUSICOSTA, Waagen, n. sp. Pl. XXXVIII, Figs. 1a, b, 2, 3a, b.

This species is subject to rather large changes according to its age, and it seems therefore necessary to describe the different stages of growth separately.

The smallest specimen known to me is 30 mm. in diameter. The umbilicus is 12 mm., i. e., 0·4 of the whole diameter, and rather deep; the whorls are depressed, a little thicker than high, covered on the sides with high prominent ribs, which are divided on the siphonal side into 2—3 branches. I count on the sides of the whorl thirteen, and on the siphonal side thirty-six thick rounded ribs.

Among the specimens exceeding a diameter of 30 mm. one can distinguish two varieties, one with a large and one with a small umbilicus, in the former the umbilicus being 0·33—0·36, in the latter, 0·24—0·28 of the whole diameter. According to the changes in the umbilicus the whorls in the latter variety are also more compressed, higher and more involute than in the former, but the character of the ribs remains unaltered. A specimen of the former variety of 80 mm. in diameter has fourteen strongly prominent ribs, whilst on the siphonal margin there are forty-two; the whorls are beautifully rounded, about as broad as high.

The largest example at my disposal is 156 mm. in diameter; the umbilicus is 47 mm., or 0·30 of the whole diameter. Beginning from a size of about 80 mm., the whorls increase rapidly in height, so much so that, whilst in the preceding whorl the height is in proportion to the thickness as 1 : 1·16, the proportion of the same measurements in the next or last whorl is 1 : 0·85. On the last whorl of this specimen, the ribs become fainter by degrees; they form a kind of low rounded tubercles, which are elongated against the siphonal margin, and are here divided for the most part into three low, broad, rounded ribs. I count on the sides of the whorls eighteen, and on the siphonal side sixty-one ribs.

The lobes are of the general type of the genus *Perisphinctes*, the lobes from the second lateral lobe up to the umbilical suture hanging far down and so forming a large umbilical lobe. The siphonal lobe is short, divided into four short narrow branches; the external saddle very broad with a rather large secondary lobe. The first lateral lobe is long and narrow, much longer than the siphonal, with a long terminating branch and two dichotome lateral ones; the first saddle is not very broad, with a tolerably large, oblique secondary lobe; the second lateral lobe is narrow and short; the second lateral saddle short, oblique, with a well defined secondary lobe; there are yet two auxiliary lobes.

The measurements of three specimens of the first variety are—

	I.	II.	III.
Diameter of the shell ...	30 mm.	80 mm.	156 mm.
„ of the umbilicus ...	12	27	47
Height of the aperture from the umbilical suture ...	11	30	66
„ of the „ from the preceding whorl ...	8	24	48
Thickness of the „ ...	15	31	54

Two specimens of the second variety have the following dimensions:—

	I.	II.
Diameter of the shell ...	58 mm.	85 mm.
„ of the umbilicus ...	14	24
Height of the aperture from the umbilical suture ...	28	36
„ of the „ from the preceding whorl ...	18	22
Thickness of the „ ...	22	30

Remarks.—*Prisph. obtusicosta* is preserved in our Museum in twenty-two specimens from different localities: four of them are from the Joora hills on the road from Jooria to Dhosa out of a dark brown marly iron rock with many quartz-grains; they were found here in the society of *Steph. opis*, Sow., *Perisph. anceps*, and *curvicosta*. Two are from a valley north of Dhosa, preserved in the same rock as the preceding; another specimen is from the Keera hill, Charee, apparently coming out of a clay layer with iron nodules: in the same rock from the same locality occur *Stephanoceras opis*, Sow., *fissum*, Sow., *Perisph. anceps*, Rein. and *arthriticus*, Sow. The specimen figured on pl. 38, fig. 3a, b, is from north of Gudjinsir equally out of a clay layer with marl nodules: from the same locality and layer come *Pelt. athleta* and *Perisph. curvicosta*, preserved in the Museum. Four specimens have been collected by Dr. Stoliczka in the *Anceps* beds at Vanda, two at Keera hill near Charee, one in the *Anceps*, one in the *Athleta* beds; one he found in the *Anceps* beds at Samtra, two in the *Athleta* beds north-east of Gudjinsir, and one in the same beds at Lair.

The occurrence of *Perisph. anceps* and *Peltoc. athleta* in the same layer as *Perisph. obtusicosta* may establish for the latter species, with great probability, an upper Callovian age.

2. *PERISPHINCTES ANGYGASTER*, *Waagen, n. sp.* Pl. XXXIX, Fig. 2 *a, b*.

Though very nearly allied to the preceding species, *Per. angygaster* shows some peculiarities, which do not permit me to unite both forms.

The variations of this species are much less than those of the preceding one, and the general form, compressed whorls and a middle-sized umbilicus, is almost in every specimen well developed. The section of the whorls is a flat oval, narrowly rounded on the siphonal side. The whorls are covered with not very prominent and little flexuous ribs, which are strongest on the umbilical margin; from there they become fainter, and are divided at about the middle of the side of the whorl into two, or very often also into three ribs, which pass over the siphonal side. The number of the ribs is very variable; I count on a specimen of 89 mm. in diameter, on the umbilical margin 16, on the siphonal side 65; on another specimen of 95 mm. in diameter, on the umbilical margin 23, on the siphonal side 70 ribs. It will be seen that in the first case, on one inner rib, four appear on the siphonal side, whilst in the other case there are only three outer for one inner rib.

The umbilicus is characteristic in its shape, and requires therefore a particular description: whilst in *Perisph. obtusicosta* an umbilical edge is entirely wanting, in the species now under consideration such an edge is always more or less developed, and bears the nodule-like commencement of the lateral ribs. The width of the umbilicus is a little variable, sometimes being 0.29, sometimes 0.24, of the whole diameter.

The species attains a very large size, and loses then every ornamentation, becoming quite smooth. There is a fragment of a specimen in our Museum, of which the aperture is 104 mm. in height and 78 mm. in thickness; the inner whorls of this fragment, however, show clearly that it belongs to this species.

The lobes are not sufficiently visible on any of the specimens to trace them; it is, however, possible to observe that they are of about the same type as the lobes of the preceding species.

The measurements of four of the specimens are the following:—

				I.	II.	III.	IV.
Diameter of the shell	...	...	...	51 mm.	74 mm.	89 mm.	109 mm.
„ of the umbilicus	..	...	...	13	19	22	32
Height of the aperture from the umbilical suture	...	...	...	23	33	41	44
„ of the „ from the preceding whorl	...	...	...	18	21	25	30
Thickness of the „	...	...	...	19	27	30	33

Remarks.—The localities of this species are about the same as of the preceding one: six specimens are from the Joorah hills, on the road from Joorah to Dhosa, one is from north of Gudjinsir, one from Keera hill near Charee, and two from the low hills south of Mankooa, out of a dark-red sandy layer, with numerous small white oolite grains. The geological position, therefore, is certainly the same as of *Per. obtusicosta*, that is, Upper Callovian.

Among the European jurassic species, there is none with which our species could be compared, except possibly *St. Ajax*, Orb., which species, however, manifests itself at the first glance as belonging to an entirely different group, by the lobes,

which show not the smallest resemblance to those of our species. From *Per. obtusicosta* our species is distinguishable by the compressed whorls, the smaller umbilicus with umbilical edge, the more common occurrence of contraction of the shell, and the finer and more numerous ribs, which are very often divided into three instead of two branches.

3. PERISPINCTES DHOSAENSIS, *Waagen., n. sp.* Pl. XXXVIII, Fig. 4a, b, c.

This is a very remarkable small species, although nearly allied to both those before described. The largest specimen, with entirely preserved body-chamber and aperture, does not exceed a diameter of 55 mm., and the smallest full-grown individual has not more than 45 mm. in diameter.

The umbilicus is comparatively large with an indistinct umbilical edge; the whorls are rounded, with strong broad ribs, which sometimes become very sharp, sometimes are more rounded, and which are divided near the siphonal side commonly into two branches, of which one is often not united with the stem. Thus happens often the strange fact, that alternate ribs rise from the umbilical margin on both sides, go up undivided over the siphonal side, and disappear on the siphonal margin of the opposite side, without being here united together. Commonly, however, the ribs correspond, and the branches of the ribs of the one side are united again in one stem of the opposite side. The number of ribs is in general astonishingly constant in this species, and varies in the specimens of about 45-50 mm. in diameter only from 36-38 on the siphonal side; only two specimens of 55 mm. diameter have forty-eight ribs.

The aperture is oval, with two not very long, narrow, prominent, ear-shaped processes, which have somewhat a direction against the siphonal side; behind those there is a deep contraction of the shell, which is not quite straight, but a little falciform. The length of the body-chamber is about $\frac{2}{3}$ of the last whorl.

The lobes are deep, but simple. The siphonal lobe is broad, with two thin branches on the top, a little shorter than the first lateral lobe; the external saddle is not very broad, with a strong indentation in the middle; the first lateral lobe is tolerably broad and long, with three unsymmetrical branches on the end; the first lateral saddle is as long as the external, equally with an indentation in the middle; the second lateral lobe is very short, unbranched; the two auxiliary lobes have an oblique position, forming a large sutural lobe.

The dimensions of the two typical figured specimens are —

		I.*	II.
Diameter	of the shell	49 mm.	48 mm.
"	of the umbilicus	15	17
Height	of the aperture from the umbilical suture	21	19
"	of the " from the preceding whorl	17	15
Thickness	of the aperture	17	16

* No. I has the apertural margin preserved. No. II has it not.

Remarks.—Our Museum contains eighteen specimens of this species, out of which number thirteen are from the Joora hills, on the road from Jooria to Dhosa, coming from the same rocks as the two preceding species; two are from a valley north of Dhosa, one out of the iron nodules of Keera hill near Charee, and two from west of Barasir on the south side of the Charvar range out of the beds with *Per. anceps*. There can be no doubt that the geological age of *Per. Dhosaënsis* is the same as that of the two preceding species, namely, upper Callovian.

Among the European species of Ammonites, there is not a single jurassic form with which our species could be compared; only the cretaceous fauna contains some species, which show a certain affinity with our Ammonite. Looking through Orbigny's figures, we find before all *Amm. consobrinus*, Orb., which in its peculiar kind of ribbing resembles our species rather closely, but the considerable size, the compressed whorls, and the different lobes may make a distinction easy. Of other cretaceous Ammonites the group of the *fissicostati*, principally young specimens of *fissicostatus* itself, show sometimes a certain resemblance to our species, but nobody, I believe, will mistake full grown specimens of the two species. From *Per. obtusica* and *angygaster* before described, our species differs by its constantly smaller size, the stronger and less numerous ribs, and the simpler lobes.

4. PERISPINCTES OMPHALODES, *Waagen, n. sp.* Pl. XXXVII, Fig. 2a, b.

Though this species is in its general form nearly allied to the one before described, yet I cannot help distinguishing it. It deviates so much from this as well as from the other species of the same group that I cannot well unite it with any of them.

The species remains, like *Per. Dhosaënsis*, very small, the largest specimen measuring not more than 50 mm. in diameter. The whorls are very compressed, very little enveloping each other, and therefore the umbilicus is very large. I count on a specimen of 49 mm. diameter seven whorls, whilst in *Per. Dhosaënsis* at the same size there are only six. There is no specimen to observe the former stages of growth separately, as all of them are provided with the entire body-chamber, but from the exposed inner whorls of larger specimens it is observable that the shell begins with a round, smooth, embryonal bulb, and that the first two whorls are entirely smooth, but already at a diameter of about 2 mm. the sides of the whorls show strong ribbings, which increase in number and strength as the specimen grows larger. The whorls are, up to a diameter of the shell of about 20 mm., rather thick and depressed, with curved sides and rounded siphonal part, but after this size is exceeded, the whorls become more compressed, the sides flattened, and the siphonal side of the shell somewhat ogival. This is principally the case on the body-chamber, which occupies not quite the length of the last whorl.

The ribs which cover the whorls are very characteristic. They start from the umbilical suture, as no umbilical edge exists, and proceed strongly prominent in about a radial direction to the middle of the sides, where most of them are divided into two branches, which run as rounded, high, ridges over the siphonal part of the shell. Sometimes a rib remains undivided, and then it is followed by a short intercalated rib, which is limited to the siphonal side of the shell.

The aperture is preserved on several specimens, but it is not quite identical in all of them: sometimes it is preceded by a contraction of the shell, sometimes not but it is always provided on both sides with a rather long lingular process, which is directed somewhat towards the siphonal part of the shell.

The lobes are not visible on any of the specimens.

The measurements of two specimens are the following:—

					I.	II.
Diameter of the shell ...	...	...	...	...	49mm.	45mm.
„ of the umbilicus ...	...	...	...	...	22	19
Height of the aperture from the umbilical suture ...	...	...	...	...	17	16
„ of the „ from the preceding whorl ...	...	...	...	...	14	13
Thickness of the aperture ...	...	...	...	...	12	13

Both specimens are provided with their body-chamber, and No. I has the greater part of the apertural margin preserved.

Remarks.—Though *Per. omphalodes* seems to be a rather rare shell, yet its geological position is very extended. It is most common, if one can use the expression, in the beds with *Per. anceps*, in which it has been found at Vanda in six specimens, preserved in a hard yellow calcareous marl; another specimen has been collected in the same beds at Keera hill near Charee in a ferruginous nodule, another in the same beds at west of Barasir, on the south side of Charvar range, in a hard gray marl nodule. In the beds of *Pelt. athleta* it has been found north-east of Gudjinsir, in gray marl, the shell of the specimen converted into black kalkspar. The last specimen preserved in our Museum is out of the Dhosa oolite south-east of Nurrha. Thus the species ranges from the zone of *Per. anceps* up to that of *Asp. perarmatum*.

Though the species is very nearly allied to *Per. Dhosaënsis*, yet the differences are not very difficult to point out: they lie in the much larger umbilicus and the more numerous whorls of *Per. omphalodes*. From *Per. mutans*, which resembles the species just described principally in its younger stages of growth, it is easily distinguishable by the absence of a differently ornamented body-chamber.

5. PERISPINCTES MUTANS, *Waagen, n. sp.* Pl. XXXIX, Fig. 1 *a, b*.

Though this species yet belongs to the group of *Perisph. obtusicosta*, the typical form is only to be recognised on the inner whorls, the outer ones, on the contrary, being very much like any other *Perisphinctes* of the group of *Per. plicatilis* or *polyplocus*. This involves the fact that the species in its different stages of growth undergoes certain changes, which are to be noticed.

Young examples, up to a diameter of about 25—30 mm., resemble very much the species before described; the whorls are not very high, rounded, their sides covered with not numerous, strong, rounded ribs, which are divided near the siphonal margin into two branches; between those ribs on the siphonal side are short, free single ones interposed. Exceeding the above-mentioned diameter, the whorls become higher and more compressed, the ribs are no longer so strong, but much more numerous than before, and the umbilicus is much widened. In the full grown condition the species has a body-chamber of about $\frac{3}{4}$ of a whorl in length, the umbilicus is very wide, the involution small. The ribs are very faint on the body-chamber, and it is almost impossible to count them; so far as I can make them out, there seem to be thirty-five on the side of the whorl and about seventy on the siphonal side; the ribs, however, become so faint on this part of the shell, principally a short distance before the aperture, that it is nearly impossible to see them.

The only specimen of this species which is at my disposal has not the lobes preserved, so that I am not able to state any particulars about this point.

The dimensions of the specimen with preserved body-chamber are the following:—

Diameter of the shell	...	...	...	...	...	...	83 mm.
„ of the umbilicus	...	...	...	...	...	...	31
Height of the aperture from the umbilical suture	...	...	...	...	...	...	29
„ of the „ from the preceding whorl	...	...	...	...	...	...	22
Thickness of the „	...	...	...	...	...	...	19

The diameter of the umbilicus is in the young shell 0·27, in the full grown 0·36 of the whole diameter.

Remarks.—The specimen lying before me is from north of Gudjinsir, out of a very hard, dark red, sandy rock. There is no doubt that it is not from the same layer as *Pelt. athleta* in the same locality, as the rock in which the different specimens are preserved is totally different. But what then the age of our species may be is very difficult to determine. Among the jurassic rocks of Cutch I find only two specimens which show a certain resemblance, that is, the rock in which *Asp. iphiceroïdes* is preserved, and the rock of Kuntkote, with *Steph. Maya*, *Nepalense*, *fissum*, etc., and some *Planulati* of Oxfordian or Kimmeridgian aspect. Two fragments of a specimen which also must be considered as belonging to *P. mutans* come from Gangta Bét, the rocks of which island must be considered as identical in age with the Kuntkote sandstone.

Of European species only *Per. Koenighi* might be compared with the Indian form just described, but the regular dichotome ribs of our species, and the changes which it undergoes in consequence of age, render it easy to distinguish both shells. From *Per. Dhosaënsis* of the Cutch Jura the young specimens of our species differ by more numerous ribs, from *P. omphalodes* by a smaller umbilicus. *Per. obtusica* and *angygaster* cannot be mistaken for the species here described, as they have both stronger and less numerous ribs.

SECTION II.—PERISPHINCTES TRIPLICATI.

(a.) Group of PERISPHINCTES KOENIGHI, Sow.

1. PERISPHINCTES HIANS, *Waagen, n. sp.* Pl. LVII, Fig. 2a, b, c.

The specimen which serves as original for the description and figure is by no means a very good one, and I should not have ventured to describe it under a new name if it had not been found in the Putchum group, where Ammonites are very rare in general, and when they are found are always so fragmentary that there is no hope of ever getting better materials of the Ammonite species of this group. Thus, if only to give some idea of the Cephalopod fauna of the Putchum group, it seemed necessary even to describe specimens which would not have deserved a description, if found in other beds.

The general form of *Per. hians* is flat, patelliform, with high whorls and a small umbilicus, and reminds one much of the form of *Per. Könighi*. The innermost whorls are not preserved. At a diameter of the shell of about 120mm., the umbilicus is about one-third of the diameter in width, and is not surrounded by a distinct umbilical wall. The whorls are very compressed and high, with flat sides and rounded siphonal part; they are covered with numerous fine ribs, which are low and rounded. These start from the umbilical suture, and run, somewhat directed towards the front, up to a little above the middle of the sides of the whorls. Here they are replaced by three or four finer ones, which run without interruption over the narrowly rounded siphonal side.

The species grows very large, and seems to become quite smooth in the larger stage of its growth. At a diameter of the shell of 194mm. numerous ribs on the siphonal part of the shell are yet well distinguishable, and also some few undulations near the umbilicus; but exceeding this size, every trace of a rib disappears, though the shell is yet filled with air-chambers. The body-chamber is not preserved on the specimen I have for description.

The lobes are very characteristic on account of the size of the first lateral lobe, which by far exceeds all the others. The siphonal lobe is rather broad, but short; the external saddle broad with a large secondary lobe; first lateral lobe very large, with one very long terminating branch; first lateral saddle small, with an indistinct secondary lobe; second lateral lobe very small, barely distinguishable, hanging down together with two or three auxiliary lobes to a large sutural lobe, which is in length about equal to the siphonal, but much shorter than the first lateral lobe.

The dimensions, as I can measure them, are the following :—

Diameter	of the shell	...	...	...	...	...	158 mm.
„	of the umbilicus	...	...	...	...	...	45
Height	of the aperture from the umbilical suture	...	...	...	...	...	68
„	of the „ from the preceding whorl	...	...	...	...	...	41
Thickness of the	„	...	...	...	...	...	35

Remarks.—The specimen I have for description is from Jumara out of the coral beds of the Putchum group.

In its general form it shows rather close resemblance to two species, *Per. Könighi*, Sow., and *Per. spirorbis*, Neum., but it is very easy to distinguish it from both. First of all *Per. hians* has got a smaller umbilicus than either of the species mentioned, then the ribs are also much finer and much more numerous. All the other species of a similar geological age have much more inflated whorls than *P. hians*.

2. PERISPINCTES SPIRORBIS, Neumayr. Pl. XLI.

1857. *Ammonites calvus*, (Sow.) Oppel: Jura form., p. 550, (non Sow.).

1868. *Ammonites banaticus*, Zittel: Jahrb. d. k. k. Geolog. Reichsanst., p. 605 (pars.).

1869. *Ammonites Könighi*, (Sow.) Brauns: Der mittlere Jura im Nordwestl. Deutschl., p. 133, (pars.), (non Sow.).

1870. *Ammonites spirorbis*, Neumayr: Jahrb. d. k. k. Geolog. Reichsanst., p. 148, pl. VII, fig. 2.

The species is very well described and figured by Neumayr in the "Jahrbuch der k. k. Geologischen Reichsanstalt," Vienna, but as Neumayr had at his disposal no full grown specimen, nor could give a drawing of the lobes, there remains something to add to his observations.

In the very young stage up to a diameter of about 30mm. the whorls are depressed, rounded, and covered with strong rather irregular ribs. At 60mm. diameter the compressed section of the whorls already exists, and at the size, which Neumayr figures, this shape of the whorls is very significant. The ribs which cover the shell are never very strong or high. They are low and rounded, sometimes more expressed, sometimes less, sometimes even in young specimens nearly disappearing. It is not possible to say into how many branches every rib is divided near the siphonal margin, because the rib vanishes near the point of partition. For one rib on the umbilical margin come three to four (four to five on Neumayer's drawing) on the siphonal margin: they pass very faintly over the siphonal side, and are there a little bent to the front. The contractions of the shell are very faint, and not visible on every specimen.

At a diameter of 60mm. the ribs all round the whorl begin to disappear gradually, only slightly swollen parts on the umbilical margin, and very faint indications on the siphonal side, are yet visible. At 180mm. diameter, our largest specimen has the last air-chamber; the body-chamber is for the greater part entirely smooth, only at the beginning there are a few faint undulations apparent on the umbilical margin. A short distance, however, before the aperture there are four or five strong folds, which form a kind of low tubercles near the outer margin; the apertural margin is in none of our specimens well preserved; the length of the body-chamber is about two-thirds of a whorl.

The lobes are slender and very elegant in shape. The body of the siphonal lobe is a little longer than broad, the branches are long and ramified, but do not entirely attain the length of the first lateral lobe. The external lobe is broad, symmetrical,

with a well developed secondary lobe; the first lateral lobe has a very short narrow body with three very long, asymmetrical ramified branches. The first lateral saddle is not very broad, asymmetrical, with a rather small secondary lobe near the first lateral lobe; the second lateral lobe is very small, slender, the same as the four following auxiliary lobes. The lobes from the lateral lobes hang down to a large sutural lobe.

The measurements of three specimens are the following:—

	I.	II.	III.
Diameter of the shell	120 mm.	160 mm.	235 mm.
„ of the umbilicus	39	55	118
Height of the aperture from the umbilical suture ...	47	60	66
„ of the „ from the preceding whorl ...	36	50	57
Thickness of the „	33	41	45

Remarks.—The specimens I have to examine, twenty-five in number, are all from the golden oolite at Keera hill near Charee; therefore it is pretty certain that the species belongs to the fauna of the layers with *St. macrocephalum*.

I think there can be but little doubt about the identity of our specimens with *Per. spirorbis*, Neum. Another question is, if they do not agree with *Amm. calvus*, Sow., which principally described by Sowerby from Cutch has been identified by Oppel with our species. It seems now pretty certain that some of the specimens in the collection of the Geological Society in London belong to Neumayr's species, and so far Oppel was quite right to identify both forms, but as to the original specimen of Sowerby, which, according to his indication, ought to come from the red iron layer of Kuntkote, there seems but little doubt that it represents a different species, as the strong ribs, which in Sowerby's drawing cover the whole body-chamber, are wanting in *Per. spirorbis*. I consider *Per. calvus*, Sow., as allied to *Per. balinensis*, Neum., and thus belonging to the group of *P. tenuiplicatus*, Brauns, as I have indicated in the introduction to the genus. Among all the Kachh Ammonites this species is only allied to the one described before under the name of *Per. hians*. It is, however, easily distinguishable from it by the larger umbilicus and the thicker and less numerous ribs.

(c.) Group of PERISPINCITES PROCERUS, Seebach.

1. PERISPINCITES cf. FUNATUS, Oppel. Pl. XLVII, Fig. 2a, b.

- 1843. *Ammonites triplicatus*, (Sow.) Quenstedt: Floetzgebirge Württembergs, p. 364 (non Sow.).
- 1847. *Ammonites triplicatus*, Quenstedt: Cephalopoden, p. 171, pl. 13, fig. 7.
- 1857. *Ammonites funatus*, Oppel: Jura formation, p. 550.
- 1861. *Ammonites funatus*, (Oppel) Seebach: Hannoverscher Jura, p. 155.
- 1870. *Perispinctes funatus*, (Oppel) Neumayr: Cephalopoden von Balin: Abhandl. d. k. k. Geolog. Reichsanst., vol. V, p. 40; tb. 14, fig. 1.

Though this species is one of the best known among the Callovian *Planulati*, yet I cannot find exactly the same form as occurs in Europe among my materials from Kachh. I have figured on Pl. XLVII a specimen which is certainly very

nearly allied to Oppel's species, and which I scarcely dare to distinguish from it, but which yet does not exactly agree with Neumayr's figure. This is the reason why I prefer to write *Per. cf. funatus*.

The changes in the form, according to the different stages of growth, are only very small in this species, and are limited chiefly to the transversal section of the whorls, which slowly increases in height as the specimen grows larger. The general shape of the species is commonly flat, disciform, and this is more apparent as we examine larger specimens.

The whorls are rounded with a compressed oval aperture. The ribs are not very prominent, stronger on the sides of the whorl, so long as they are single; the branches, however, into which they are divided near the siphonal margin, commonly three in number, are fainter, and nearly entirely vanish on the middle of the siphonal side.

The ribs are well visible up to a diameter of the shell of about 200 mm.; then they become gradually fainter.

The measurements of two specimens are—

						I.	II.
Diameter	of the shell	...	...	...	...	169 mm.	105 mm.
"	of the umbilicus	...	...	...	...	70	36
Height	of the aperture from the umbilical suture	...	...	...	...	56	40
"	of the " from the preceding whorl	...	...	...	...	42	30
Thickness of the	"	...	...	...	...	46	34

Remarks.—The specimens of *Per. cf. funatus* preserved in our Museum, four in number, are all from the golden oolite of Keera hill near Charee, and occur there, as in Europe, in the society of *St. macrocephalum*.

The distinction of our species from other allied forms may sometimes seem rather difficult, but it is not so in reality. The greatest resemblance exists between Oppel's species and *Per. spirorbis*, Neum., but a few indications may be sufficient to make the distinction between the forms easy. *Perisphinctes funatus* has always a wider umbilicus, more depressed whorls and distinct ribs, and in old specimens the form of the body-chamber differs entirely from the same in *Per. spirorbis*. Also the lobes differ in many points, as may be best seen by comparing the drawings; further, *Per. funatus* shows well developed contractions of the shell, whilst they are very faint in the other species. Of other species none is so closely allied as to require a special comparison.

Per. funatus is found in Central Europe in great quantities in the zone of *St. macrocephalum*. It is, however, wanting in the same layers in England.

2. PERISPINCTES ALTIPLICATUS, *Waagen, n. sp.* Pl. XLII, Fig. 1a, b, c, d, e, f.

1871. *Perisphinctes bracteatus*, (Neum.) Waagen: Records Geol. Surv. of India, p. 95 (non Neumayr).

Having had only specimens of small size of this species at my disposal at first, I identified them with Neumayr's *Per. bracteatus*; this has been shown to

be erroneous by new materials obtained in the meantime from Kachh. Therefore, not being able to identify this species with any one as yet described, I propose for it the name of *Per. altiplicatus*.

The general form of the species is discoid, with very wide umbilicus and rounded whorls, about as thick as high, which are covered on both sides with very strong and prominent, although not numerous, folds or ribs. This form remains unchanged up to the very largest size the species may obtain.

Small specimens have in their appearance much resembling species of the division "*Convoluti*", the whorls being depressed, broader than high, without a trace of an umbilical edge, covered by numerous not very sharp ribs, which are divided into two or three branches on the siphonal margin. This shape, however, does not last longer than up to a diameter of 10 to 15 mm. Then the ribs on the sides of the whorls become stronger and more distant, and at the same time rather irregular, some of them being very broad and flat on the top with a furrow in the middle as if they were composed of two combined ribs. In this stage of growth the resemblance to *Per. bracteatus*, N., is very great, so much so that I thought it advisable to unite both species; nevertheless there are also at this stage of growth some distinctive points, which consist chiefly in the less squarish section of the whorls and the greater straightness of the ribs in *Per. altiplicatus*. These peculiarly shaped ribs are divided on the siphonal margin into three or four fine branches, which pass a little bent on the middle of the siphonal side, without interruption to the other side of the shell.

In larger specimens the lateral ribs become more regular, the transversal section of the whorl increasing at the same time in height. At a diameter of the shell of about 180 mm. the body-chamber commences, which occupies about the length of a whorl. This latter part of the shell is a little higher than broad in its section and covered up to its end by not very strong ribs, which are equal in number to those on the preceding whorl, and are restricted to the lateral part of the shell, the somewhat narrowly rounded siphonal part being quite smooth. The shape of the mouth is not observable on the specimens I have for description.

The lobes are highly characteristic, but they are so much distorted that it seems difficult to determine what is the second lateral and what the auxiliary lobe. I shall describe them as I think would be the most natural grouping of the separate parts. The siphonal lobe is short and rather broad, with finely dentated narrow branches; the external saddle very narrow, with a long secondary lobe; first lateral lobe long, much longer than the siphonal, narrow, finishing in three fine asymmetric branches; first lateral saddle extremely broad, with two, obliquely arranged, strongly ramified secondary lobes. Second lateral lobe $\frac{3}{4}$ in length of the first lateral, reversed against the latter one at an angle of 66 degrees, narrow, finishing in three branches, reversed, asymmetrically arranged, in comparison with the first lateral. There are yet three auxiliary lobes. All the lobes beginning

from the outer part of the first lateral saddle hang down to an enormous sutural lobe, twice as long measured on the spiral as the first lateral lobe.

The measurements of the two specimens preserved in our Museum are—

					I.	II.
Diameter	of the shell	...	...	...	165 mm.	293 mm.
"	of the umbilicus	...	...	...	75	150
Height	of the aperture from the umbilical suture	...	...	...	50	80
"	of the " from the preceding whorl	...	...	...	41	68
Thickness	of the " ...	...	...	...	48	65

The specimen No. II has its entire body-chamber preserved.

Remarks.—The species is represented in our Museum by two well preserved specimens, and some bad fragments, which have all been collected in the golden oolite at Keera hill near Charee.

The form of *Per. altiplicatus* is too characteristic to be mistaken, and can always be easily recognised by its strong folds or ribs, which separate it from *Per. funatus*, to which species it is otherwise allied. The distinctive points from *Per. bracteatus*, N., I have already indicated above. There may exist also a certain affinity to *Per. Wagneri*, Opp.

3. PERISPINCTES PERDAGATUS, *Waagen, n. sp.* Pl. XLIV, Figs. 1, 1a.

1871. *Perispinctes euryptychus* (Neum.) Waagen: Records Geol. Surv. of India, p. 95 (non Neumayr).

This species is extremely nearly allied to *Per. euryptychus*, Neum., but the increase of the whorls is different, and when of an equal size *Per. euryptychus* has got more whorls than *P. perdagatus*. This is the reason why it seems necessary to distinguish both species.

Since I gave the first notice about the results of my investigations into the Ammonite fauna of Kachh, a number of specimens of this species have been received from Kachh by our Museum, and these enable me to give a much more accurate and satisfactory determination and description of it than it was possible to do before.

Per. perdagatus has in general a flat, patelliform shape, with a very wide umbilicus and somewhat compressed whorls, which are little higher than broad. The umbilicus is surrounded by a sloping umbilical wall, on the edge of which numerous rounded ribs originate, which cover the sides of the whorls. Those ribs are not entirely equal in strength or distance, but are rather irregular, principally on the inner whorls. The outer part of the whorls is covered by numerous fine ribs, which rise on the siphonal margin and pass without interruption over the siphonal part of the shell.

The smallest specimen preserved in our Museum has 70 mm. in diameter, about the size which is exhibited by Dr. Neumayr's original specimen of *Per. euryptychus*. At this size the latter species has fully one whorl more than our specimen,

and in consequence of that the umbilicus is much wider. In the first stages of growth *Per. perdagatus* has got rounded, depressed whorls, with numerous fine and irregular ribs, which are strongly directed towards the front. At the siphonal margin the ribs show sometimes those parabolical curves which are most developed in *Per. curvicosta*, Opp. However, as the species advances in size, the whorls rapidly increase in height and become more and more compressed. The ribs which are very irregular, sometimes standing in pairs, sometimes single, sometimes very fine, sometimes thick like an elongated tubercle, up to a diameter of the shell of about 35 mm., become slowly more regular, and each of them is regularly replaced on the siphonal margin by three or four finer ribs. The contractions of the shell are not very numerous, nor are they very deep, but they always derange the ribs, between which they are enclosed, considerably.

This shape remains up to the very largest size the species can obtain, only near the mouth on the body-chamber the ribs on the siphonal part of the shell become very weak or disappear entirely.

The lobes are not well seen on any of the specimens; nevertheless it is possible to describe them from the several parts being exposed on different places. The siphonal lobe is very short and broad, with two short terminating branches; external saddle rather narrow, with a small secondary lobe; first lateral lobe tolerably slender, a good deal longer than the siphonal, with three equal terminating branches; first lateral saddle well developed, with a small secondary lobe; second lateral lobe very small. The auxiliary lobes hang down, forming a large sutural lobe, which is, however, not longer than the siphonal lobe.

The measurements of three specimens are the following:—

	I.	II.	III.
Diameter of the shell	70 mm.	105 mm.	143 mm.
„ of the umbilicus	29	59	74
Height of the aperture from the umbilical suture ...	24	36	41
„ of the „ from the preceding whorl ...	20·5	30	34
Thickness of the „	21	32	35

In the specimen No. III two-thirds of the last whorl and in specimen No. II the whole last whorl belong to the body-chamber.

Remarks.—The species just described has been found in the beds with *Per. anceps*, at Keera hill near Charee, and is preserved there always in a yellowish white somewhat oolitic limestone.

Per. perdagatus is subject to slight variations, which are principally expressed in the width of the umbilicus, which is sometimes a little greater, sometimes a little smaller, but never as large as that of *Per. euryptychus*. The other distinctive points as compared with the latter species I have already mentioned above. Of other European Ammonites only one form, described by Pratt, can possibly be compared with *Per. perdagatus*: this is *P. Comptoni*; the original figure of this species is, however, so very indistinct, that it seems barely possible to state anything beyond the similarity of it to *Per. perdagatus*.

(c.) *Group of PERISPHINCTES PSEUDORION, Waagen.*1. *PERISPHINCTES PSEUDORION, Waagen, n. sp.* Pl. XLIII, Fig. 3a, b.

There is only one well preserved specimen of this, which is, however, sufficiently characteristic to serve as the type for a new species.

This specimen has 65 mm. diameter, and is composed up to its end of air-chambers. The general form of the species is patelliform, with rather small umbilicus and thick inflated whorls, which envelope each other for nearly three-quarters of their height. The number of whorls, therefore, exposed in the small umbilicus is very great. The umbilicus is very deep, surrounded by high perpendicular walls, which join the lateral parts of the shell without forming an umbilical edge. The largest transversal diameter of the whorls is situated a little below the middle of their sides, and from that point the shell slopes barely perceptibly towards the very broadly rounded siphonal part of the shell. In all stages of growth the height of the whorls is about equal to their thickness, though in the more advanced stages the height increases a little more quickly than the thickness of the whorls. The whorls are covered by fine low ribs which begin near the umbilicus, go in a slight curve towards the front over the sides of the whorls, and are divided near the siphonal margin mostly into three branches, which with a slight turn backwards cross over the siphonal side of the shell.

Contractions of the shell are entirely wanting.

The lobes are only very badly visible; all I am able to observe is, that they are very finely dentated, with a short siphonal and a long first lateral lobe.

The dimensions of the specimen just described are the following:—

Diameter of the shell	...	...	...	...	...	65 mm.
„ of the umbilicus	...	...	...	...	...	17
Height of the aperture from the umbilical suture	...	...	...	...	...	30
„ of the „ from the preceding whorl	...	...	...	...	...	22
Thickness of the „	...	...	...	...	...	29

Remarks.—The specimen I have just described was collected by Dr. Stoliczka at Vanda in the society of *Harp. lunula*, *punctatum*, etc., in the beds with *Per anceps*. It is preserved in a yellowish-gray marl nodule.

It is not difficult to distinguish this species from *Per. Orion*, Opp., which is the most nearly allied: the absence of contractions of the shell, the much finer ribs, and the smaller umbilicus make it easy to recognise *Per. pseudorion*. On the other hand, our species is certainly also allied, to a certain extent, to some of the species of the group of *P. procerus*, Seeb., but from all these, the singular turn backwards of the ribs on the siphonal part of the shell easily distinguishes our species.

2. PERISPINCTES ORION, *Oppel*. Pl. XXXVII, Fig. 3a, b.

1847. *Ammonites convolutus gigas*, Qu'enstedt: Cephalopod., p. 171, pl. 13, fig. 6.
 1857. *Ammonites Orion*, *Oppel*: Juraform., p. 556.
 1869. *Ammonites curvicosta*, (*Opp.*) *Brauns*: Mittl. Jura in Nordeutschl., p. 130, (pars.) (non *Oppel*).
 1871. *Perisphinctes Orion*, (*Opp.*) *Neumayr*: Abh. d. k. k. Geolog. Reichsanst., Vol. v, p. 43, pl. 10, figs. 2, 3.

It is not easy from Quenstedt's drawing to recognise this species; and Dr. Neumayr's figure also barely represents the type, which is generally found in the *Athleta* beds of the jurassic formation of Württemberg. As far as I remember the species from the specimens in *Oppel*'s collection, it shows a form like *Per. curvicosta*, but with much thicker whorls, and, if I may say so, in every way much clumsier than the species of the "*anceps* beds."

I have figured on Pl. XXXVII a species which I believe represents as nearly as possible the typical form of *Per. Orion*.

The general form of the species is patelliform, with a wide and deep umbilicus, surrounded by a perpendicular wall, which joins the lateral part of the shell without forming an umbilical edge. The whorls are much thicker than high, the thickest near the umbilical margin, and from there tapering slowly towards the very broad siphonal side of the shell. The ribs are not very projecting, and in number about thirty on the sides of one whorl; they divide on the siphonal margin into three to five branches, which are bent rather strongly backwards on the siphonal side of the shell. Each whorl shows at least one very deep contraction of the shell.

The smallest specimen I have for description has 25 mm. in diameter. At this size the species shows a rather close resemblance to *Per. subtilis*, Neum., but this species has besides finer ribs, also more numerous whorls, and thus the whorls increase more slowly in size than in *Per. Orion*. The contractions of the shell are very numerous on small specimens of *Per. Orion*, and cut obliquely through the ribs which cover the whorls. The ribs are rather coarse, and regularly divided into two branches, which make also a bend towards the back on the siphonal side of the shell. Some of them, however, show very clearly those parabolical curves from which *Per. curvicosta* has got its name. When the shell attains a diameter of more than 35 mm. those curves become indistinct and soon disappear entirely.

The lobes cannot be made visible on any of the specimens.

The dimensions of two specimens are the following:—

	I.	II.
Diameter of the shell	35 mm.	70 mm.
" of the umbilicus	13	26
Height of the aperture from the umbilical suture	13.5	27
" of the " from the preceding whorl	10	19
Thickness of the "	15	30

Both specimens are composed entirely of air-chambers.

Remarks.—The two specimens of this species in the possession of our Museum have been collected by Dr. Stoliczka in the *Athleta* beds at Vanda, and are preserved in hard gray marl nodules.

The form of this species is so very characteristic, that it is barely necessary to indicate expressly the distinctive points from other species. The nearest allied form is certainly *Per. pseudorion*, from which species *Per. Orion* very likely derived its origin; however, the smaller umbilicus, finer ribs, and the absence of contractions of the shell in *Per. pseudorion* are sufficient to make a distinction between the two species easy. Though *Per. Orion* belongs to my division of the *Triplicati*, yet there is no species in this division with which Oppel's species could be compared; that there exists, however, a certain, though very small, affinity to *Per. funatus*, Opp., has been already stated by Quenstedt, who considered *Per. Orion* as a transitional form between his *P. convolutus* and *P. triplicatus*.

(d.) ISOLATED SPECIES.

PERISPINCTES PARAMORPHUS, *Waagen, n. sp.* Pl. XLVI, Figs. 1a, b, 2a, b;
Pl. XLVII, Fig. 3.

Though this species is, besides *Per. spirorbis*, N., the most common form of the *Macrocephalus* beds of Kachh, yet I did not exactly know where to put it among all the species of *Perispinctes*, as it will not fit well anywhere. At last I decided to unite it with the *Triplicati*, as it shows at least in its full grown state a certain resemblance to *Per. spirorbis*.

The species grows rather large, up to 200 or 220 mm. in diameter, and is then in its general shape flat, disciform, with a wide umbilicus and compressed whorls, of which the inner ones are rather strongly ribbed, the outer, on the contrary, are entirely smooth.

The smallest specimen I have got for description has 51 mm. in diameter, and represents the inner whorls taken out of a large specimen. The whorls are rounded like a string, and envelope each other very little; the ribs are very strong and few in number, and are very regularly dichotome on the siphonal margin; there are, however, a few ribs which are not divided at all. The umbilicus is tolerably large, without umbilical wall.

In growing larger, the whorls become somewhat higher, the sides flatter, and the whole section of the whorl becomes squarish. The ribs are very broad and strong, and yet regularly dichotome, but already at a diameter of the shell of 100 mm. some trichotome ribs appear, which last in some specimens regularly for a whole whorl; in other cases, as in the specimen figured, there are only a few trichotome ribs, and then immediately the ribs on the siphonal part of the shell disappear entirely, leaving it quite smooth. The lateral parts of the ribs disappear

only on the body-chamber, which remains entirely smooth up to the mouth. The section of the whorls, which has been squarish in middle-sized specimens as mentioned, becomes a high oval in larger shells.

The lobes are tolerably characteristic; they are rather broad and short. The siphonal lobe is short, with two short terminating branches; external saddle broad, with a well developed secondary lobe; first lateral lobe a good deal longer than the siphonal, terminating in five branches; first lateral saddle narrow, with two small secondary lobes; second lateral lobe not well developed, hanging down, like all the auxiliary lobes, to form a large sutural lobe, which is a little longer than the siphonal and a little shorter than the first lateral lobe.

The measurements of two specimens are the following :—

				I.	II.
Diameter of the shell	...	...	...	52 mm.	145 mm.
" of the umbilicus	...	...	...	22	54
Height of the aperture from the umbilical suture	...	...	...	18	54
" of the " from the preceding whorl	...	...	...	16	42
Thickness of the "	...	...	...	21	41

Remarks.—There are nine specimens of this species preserved in our Museum, all coming from the golden oolite of Keera hill near Charee.

The affinities to other species are very small, and only *Per. spirorbis* can be really compared with *Per. paramorphus* at a certain stage of growth, but the strongly ribbed inner whorls, or the entirely smooth body-chamber in *Per. paramorphus*, and the faintly ribbed inner whorls and the ornamentation of the body-chamber near the mouth in *P. spirorbis*, will always distinguish both species.

SECTION III.—PERISPHINCTES CONVOLUTI.

(a.) Group of PERISPHINCTES TENUPLICATUS, *Brauns*.

1. PERISPHINCTES BALINENSIS, *Neumayr*. Pl. XLV, Fig. 2a, b.

1871. *Perisphinctes Balinensis*, Neumayr: Abh. d. k. k. geolog. Reichsanst., vol. V, p. 42, pl. 15 f. 2a, b, c.

The species which Neumayr described under the name of *Per. Balinensis* is highly characteristic. The specimens, however, which he had at his disposal were not so complete as those which have been found in Kachh, as only a small part of the body-chamber is preserved in Dr. Neumayr's original. The shell assumes a somewhat different aspect when the whole body-chamber is preserved, and only then are all the characteristics of the species entirely developed.

The general shape of the species is flat, patelliform, with compressed whorls, flat sides, and a very wide umbilicus, in which the inner whorls are well exposed. Contractions of the shell are very rare, and limited to the innermost whorls. The whorls are covered by fine sharp ribs, each of which is replaced on the siphonal side of the shell by three or four finer ones.

Remarks.—The two specimens of this species in the possession of our Museum have been collected by Dr. Stoliczka in the *Athleta* beds at Vanda, and are preserved in hard gray marl nodules.

The form of this species is so very characteristic, that it is barely necessary to indicate expressly the distinctive points from other species. The nearest allied form is certainly *Per. pseudorion*, from which species *Per. Orion* very likely derived its origin; however, the smaller umbilicus, finer ribs, and the absence of contractions of the shell in *Per. pseudorion* are sufficient to make a distinction between the two species easy. Though *Per. Orion* belongs to my division of the *Triplicati*, yet there is no species in this division with which Oppel's species could be compared; that there exists, however, a certain, though very small, affinity to *Per. funatus*, Opp., has been already stated by Quenstedt, who considered *Per. Orion* as a transitional form between his *P. convolutus* and *P. triplicatus*.

(d.) ISOLATED SPECIES.

PERISPINCTES PARAMORPHUS, *Waagen, n. sp.* Pl. XLVI, Figs. 1a, b, 2a, b;
Pl. XLVII, Fig. 3.

Though this species is, besides *Per. spirorbis*, N., the most common form of the *Macrocephalus* beds of Kachh, yet I did not exactly know where to put it among all the species of *Perispinctes*, as it will not fit well anywhere. At last I decided to unite it with the *Triplicati*, as it shows at least in its full grown state a certain resemblance to *Per. spirorbis*.

The species grows rather large, up to 200 or 220 mm. in diameter, and is then in its general shape flat, disciform, with a wide umbilicus and compressed whorls, of which the inner ones are rather strongly ribbed, the outer, on the contrary, are entirely smooth.

The smallest specimen I have got for description has 51 mm. in diameter, and represents the inner whorls taken out of a large specimen. The whorls are rounded like a string, and envelope each other very little; the ribs are very strong and few in number, and are very regularly dichotome on the siphonal margin; there are, however, a few ribs which are not divided at all. The umbilicus is tolerably large, without umbilical wall.

In growing larger, the whorls become somewhat higher, the sides flatter, and the whole section of the whorl becomes squarish. The ribs are very broad and strong, and yet regularly dichotome, but already at a diameter of the shell of 100 mm. some trichotome ribs appear, which last in some specimens regularly for a whole whorl; in other cases, as in the specimen figured, there are only a few trichotome ribs, and then immediately the ribs on the siphonal part of the shell disappear entirely, leaving it quite smooth. The lateral parts of the ribs disappear

only on the body-chamber, which remains entirely smooth up to the mouth. The section of the whorls, which has been squarish in middle-sized specimens as mentioned, becomes a high oval in larger shells.

The lobes are tolerably characteristic; they are rather broad and short. The siphonal lobe is short, with two short terminating branches; external saddle broad, with a well developed secondary lobe; first lateral lobe a good deal longer than the siphonal, terminating in five branches; first lateral saddle narrow, with two small secondary lobes; second lateral lobe not well developed, hanging down, like all the auxiliary lobes, to form a large sutural lobe, which is a little longer than the siphonal and a little shorter than the first lateral lobe.

The measurements of two specimens are the following:—

				I.	II.
Diameter of the shell	...	...	...	52 mm.	145 mm.
" of the umbilicus	...	...	...	22	54
Height of the aperture from the umbilical suture	...	...	...	18	54
" of the " from the preceding whorl	...	...	...	16	42
Thickness of the "	...	...	...	21	41

Remarks.—There are nine specimens of this species preserved in our Museum, all coming from the golden oolite of Keera hill near Charee.

The affinities to other species are very small, and only *Per. spirorbis* can be really compared with *Per. paramorphus* at a certain stage of growth, but the strongly ribbed inner whorls, or the entirely smooth body-chamber in *Per. paramorphus*, and the faintly ribbed inner whorls and the ornamentation of the body-chamber near the mouth in *P. spirorbis*, will always distinguish both species.

SECTION III.—PERISPHINCTES CONVOLUTI.

(a.) Group of PERISPHINCTES TENUPLICATUS, *Brauns*.

1. PERISPHINCTES BALINENSIS, *Neumayr*. Pl. XLV, Fig. 2a, b.

1871. *Perisphinctes Balinensis*, *Neumayr*: Abh. d. k. k. geolog. Reichsanst., vol. V, p. 42, pl. 15 f. 2a, b, c.

The species which *Neumayr* described under the name of *Per. Balinensis* is highly characteristic. The specimens, however, which he had at his disposal were not so complete as those which have been found in Kachh, as only a small part of the body-chamber is preserved in Dr. *Neumayr*'s original. The shell assumes a somewhat different aspect when the whole body-chamber is preserved, and only then are all the characteristics of the species entirely developed.

The general shape of the species is flat, patelliform, with compressed whorls, flat sides, and a very wide umbilicus, in which the inner whorls are well exposed. Contractions of the shell are very rare, and limited to the innermost whorls. The whorls are covered by fine sharp ribs, each of which is replaced on the siphonal side of the shell by three or four finer ones.

The smallest specimen I have for description consists of the inner whorls of a full grown shell, which I have taken out. It has a diameter of 50 mm., and shows at that size rather thick rounded whorls, which are covered by the tolerably fine ribs, which start from the undefined edge of an umbilical wall and run straight and radial to about the middle of the sides. There they are dissolved into two to four finer ribs, which pass without interruption over the siphonal part of the shell. On the innermost whorls the ribs are all dichotome.

At a diameter of the shell of about 55 to 60 mm. the body-chamber commences, and then the sculpture of the shell changes to a great extent, as well as the form of the section of the whorls.

The whorls which were rounded up to this become now compressed with considerably flattened sides. They are thickest near the umbilical margin, and the sides slope from there gradually towards the narrowly rounded siphonal part of the shell. The ribs are sharp, but not very high, leaving broad intervals between them, and disappear almost entirely a little above the middle of the sides of the whorl before they are replaced by those finer ribs which pass over the siphonal part of the shell. The principal ribs are a little thickened, forming a kind of distinct elongated tubercle on the umbilical margin from a short distance before the mouth of the body-chamber, so that altogether about a dozen of these tubercles are observable.

The length of the body-chamber is $\frac{4}{5}$ of one whorl; the mouth of the shell is not preserved on any of our specimens. The umbilicus generally widens a little from the beginning of the body-chamber.

The lobes are very badly seen, but they appear to be very much like those of the species figured by Dr. Neumayr.

The measurements of two specimens are the following :—

				I.	II.
Diameter of the shell	...	...	...	53 mm.	85 mm.
„ of the umbilicus	...	...	...	21	37
Height of the aperture from the umbilical suture	...	...	...	19	25
„ of the „ from the preceding whorl	...	...	...	14	22
Thickness of the „	...	...	...	19	20

Specimen No. II has the greater part of its body-chamber.

Remarks.—There are two specimens of this species preserved in our Museum, both collected by Dr. Stoliczka, one in the *Macrocephalus* shales north-west of Soorka, the other in the same beds north-west of Jumara.

As Dr. Neumayr has already rightly observed, this species is only really allied to *Per. tenuiplicatus*, Brauns, from which it is distinguishable by its more numerous and straight ribs. Of other species only *Per. aurigerus*, Opp., might be compared, but the entirely different body-chambers of both species make a distinction easy.

The species is found in Europe also in *Macrocephalus* beds.

(2.) PERISPHINCTES LATERALIS, *Waagen, n. sp.* Pl. LVIII, Figs. 3, 3a.

Though there exists only one rather small specimen of this species, yet I thought it necessary to describe and figure it, as it just furnishes the connecting link between the before described species and *Per. calvus*, Sow.

The general form of the shell is very much like that of *Per. Balinensis*. The Ammonite has got compressed whorls with flat sides and a tolerably wide umbilicus without umbilical wall. The whorls are covered by not very numerous ribs, which are strongest on the umbilical wall and almost entirely disappear at the place near the siphonal margin, where they are replaced by three or four finer ones. In this respect the drawing on Pl. 58, Fig. 3, is defective, as this growing fainter of the ribs near the outer part of the shell is not well expressed there.

The inner whorls are, as in the preceding species, roundish in their section, but in the further process of the growth of the shell the whorls become steadily higher in comparison with their thickness. Also the ribs are much more numerous on the inner than on the outer whorls.

A feature, which is very remarkable, is the occurrence of parabolical curves in some of the ribs on the siphonal part of the shell, more so, as *Per. lateralis* occurs in the society of *Per. curvicosta*, which shows those curved ribs best developed. Neither in *Per. Balinensis* nor in *P. calvus* have I ever observed parabolical ribs, while in this species those ribs appear. Was there a kind of epidemic among the Ammonites at the time when the beds with *Per. curvicosta* were deposited which caused this deformation of the ribs?

As in *Per. Balinensis* so also in this species the body-chamber deviates a little from the regular spiral, the umbilicus widening considerably. Of the specimen I have got for description only the last quarter of the last whorl belongs to the body-chamber.

The lobes are very badly preserved and very difficult to make out. However, from different bits exposed on different places I can observe that the siphonal lobe is about as long or a little longer than the first lateral, but not very broad. The external saddle is rather broad with a well developed secondary lobe; first lateral lobe tolerably long, terminating in three asymmetrical branches; first lateral saddle not very narrow, with a small secondary lobe; second lateral lobe barely half as large as the first; auxiliary lobes hanging down to form a sutural lobe, not quite so long as the first lateral.

The measurements of the specimen I have for description are—

Diameter	of the shell	...	...	...	...	...	63 mm.
"	of the umbilicus	...	...	...	...	...	26
Height	of the aperture from the umbilical suture	...	...	...	...	...	23
"	of the " from the preceding whorl	...	...	...	...	...	17
Thickness	of the "	...	...	...	...	...	17

Remarks.—The specimen just described is out of the beds with *Per. anceps* of Keera hill near Charee, preserved in a yellowish limestone.

It is not very difficult to distinguish this species from *Per. Balinensis*, N., by the less sharp and straight ribs, which show sometimes a parabolical curve and by the more compressed and higher whorls. From *Per. curvicosta* our species differs also by the high compressed whorls and more regular ribs; *Per. calvus*, Sow., has got much larger dimensions than *Per. lateralis*.

3. PERISPINCTES CALVUS, Sowerby. Pl. LVI, Fig. 1a, b.

1840. *Ammonites calvus*, J. de C. Sowerby: Transact. Geol. Soc., Lond., II Ser., Vol. v, pl. 61, fig. 9 and expl.

It is highly creditable to Dr. Neumayr's scientific tact that he, not knowing anything of this species but Sowerby's reduced figure, already pointed out the affinity of *Per. calvus* to his *Per. Balinensis*, thinking, however, at the same time that Sowerby's species, like all the others which had been described from Kachh, occurred in the beds with *Steph. macrocephalum*, as the general belief in Europe was that none but *Macrocephalus* beds occurred in Kachh; in fact, that these beds represented the whole of the jurassic formation there, without affording the possibility of distinguishing any other particular horizons.

It was of importance to give a good and detailed description of this species, as it had been mistaken already by several authors, and the name of *Per. calvus* had been principally used by Dr. Oppel to designate the species, which was named afterwards *Per. spirorbis* by Dr. Neumayr. Yet, among all the vast materials collected in Kachh at different times for our Museum, not a single specimen could be found which would at all agree with *Per. calvus*, and I already began to think that the drawing had been composed from different specimens, and that thus the body-chamber possibly belonged to one species, the air-chambers to another. However, all my doubts were dispelled, as Mr. R. B. Foote, of our Survey, on his visit to London, inspected Sowerby's originals and wrote me very accurate notes about this species, and recently Dr. T. Oldham kindly procured me a cast of Sowerby's original, of which I give a drawing in natural size on Pl. LVI.

As there is no specimen of this species among our materials, I cannot say anything particular about the former stages of growth of this species; however, it seems that, as in the other species of the same group, so in this one the whorls increase in height, and become more compressed in the outer than in the inner turns.

The general form of the species is patelliform, with a wide umbilicus, which gets wider as the species grows larger. It is surrounded by an indistinct sloping umbilical wall, which does not form an edge with the lateral parts of the shell. The whorls are compressed, higher than broad, with flattened sides, covered by not very numerous ribs, which are strong on the umbilical margin, where they originate, and disappear almost entirely on the middle of the sides of the whorls; they are directed

obliquely towards the aperture. On the siphonal margin of the shell those ribs are replaced by four or five finer ones, which pass without interruption over the siphonal part of the shell. Contractions of the shell exist, but are very faint, barely distinguishable; there is one on the last and one on the penultimate whorls.

The sculpture just described is that of the air-chambered part of the shell. The body-chamber commences at about 130 mm. diameter of the shell, and is in its beginning in no way distinct from the preceding whorls, but on the latter half of it the siphonal part of the shell becomes smooth; the ribs which originate on the umbilical margin are equally strong up to the margin of the siphonal side, and between every two there is a very short rib, which originates on the siphonal margin and disappears already again on reaching the siphonal side of the shell. The body-chamber is preserved of not quite one whorl's length, without showing yet the mouth.

The lobes cannot be seen on the cast I have got for description.

The measurements of the specimen are the following :—

Diameter	of the shell	...	...	...	182 mm.
"	of the umbilicus	...	...	...	85
Height	of the aperture from the umbilical suture	...	...	...	54
"	of the " from the preceding whorl	...	...	...	43
Thickness of the	"	...	...	...	45

Remarks.—*Per. calvus* is indicated by Sowerby as being preserved in Captain Smee's collection from "Shahpoor or Kuntkote." The original specimen is, however, not preserved in that dark-red sandstone for which I generally use the name of Kuntkote sandstone, but a finely grained red and yellow oolite, and has been collected very likely on the road to Rahpoor in the Dhosa oolite.

The species is tolerably nearly allied to *Per. Balinensis*, N., but easily distinguishable by the more considerable size, the oblique ribs, and quite differently ornamented body-chamber. *Per. lateralis* is also much smaller than Sowerby's species, and shows sometimes parabolical curves in the ribs. As a continuation of the same group in higher beds, very likely *Per. albiemus*, Opp., must be considered, which species, however, differs already to a good extent from *Per. calvus*.

(b.) Group of PERISPINCTES MARTIUSI, Orbigny.

1. PERISPINCTES ARCICOSTA, Waagen, n. sp. Pl. LVIII, Figs. 2, 2a.

This is a rather variable species, but not very difficult to recognise by the compressed body-chamber and coarse ribs. It never grows very large, and I have not yet seen a specimen of more than 80 mm. diameter.

The general form of the species is flat, patelliform, with tolerably wide umbilicus, in which the inner whorls are well exposed. An umbilical wall is only formed on the latter half of the body-chamber. The whorls are rounded in young specimens, compressed in adult ones. They are covered by numerous ribs, which

are sometimes very coarse, sometimes less so, are divided on the siphonal margin into several branches, and show at intervals parabolical curves as in *Per. curvicosta*.

The younger stages of growth are the most variable. They have a great many rounded whorls with very few contractions of the shell, and ribs which are exceedingly variable in number. They are, however, invariably dichotomous, and become polytomous only on the body-chamber. This latter part is the only characteristic portion of the species. It has in the beginning strong trichotome ribs, which begin on the umbilical suture, and are divided into three branches a little above the middle of the sides of the whorl; parabolical curves are very rare on them; these are more confined to the chambered part of the shell. But the trichotome ribs last only for about a quarter of a whorl. Then the ribs become very indistinct in the middle of the sides, and only on the umbilical margin are there a few strong markings of ribs. The siphonal side of the body-chamber remains faintly ribbed up to the end where, a short distance before the mouth, again a few strong ribs cross the sides of the shell.

The mouth of the shell is not well enough preserved in any of the specimens to see whether there are ear-shaped processes or not. The length of the body-chamber occupies not more than two-thirds of the last whorl.

The lobes are somewhat like those of *P. aurigerus*, Opp. The siphonal lobe is short and broad, very little dentated; external saddle very broad, with a very small secondary lobe; first lateral lobe slender, a good deal longer than the siphonal; first lateral saddle tolerably broad, with a small secondary lobe; second lateral lobe very small, but distinct; the very small auxiliary lobes hanging down to a very short sutural lobe.

The measurements of two specimens are the following:—

	I.	II.
Diameter of the shell	68 mm.	60 mm.
„ of the umbilical suture	28	26
Height of the aperture from the umbilical suture	23	20
„ of the „ from the preceding whorl	21	17·5
Thickness of the „	17	14

The specimen No. I has got its entire body-chamber preserved; specimen No. II only the beginning of it.

Remarks.—This species is rather common in the beds with *Steph. macrocephalum* of Kachh. There are preserved in our Museum two specimens out of the golden oolite of Keera hill near Charee; two other specimens have been collected by Dr. Stoliczka in the *Macrocephalus* shales north-west of Soorka, and several smaller specimens in the same beds north-west of Jara.

Per. arcicosta is easily distinguishable from *Per. aurigerus*, Opp., by the differently ornamented body-chamber, and from *Per. curvicosta*, Opp., by the compressed shape of its whorls; it represents the truly intermediate form between the two mentioned species.

2. *PERISPINCTES CURVICOSTA*, *Oppel*. Pl. XXXIX, Figs. 4, 5*a*, *b*, 6*a*, *b*.1847. *Ammonites convolutus parabolis*, Quenstedt: Cephalop., p. 169, pl. 13, fig. 2.1857. „ *curvicosta*, *Oppel*: Jura form., p. 555.1870. *Perispinctes curvicosta*, (*Opp.*), *Neumayr*: Cephalopoden fauna von Balin: Abh. d. k. k. Geolog. Reichsanst., vol. 5, p. 34, pl. 12, figs. 2, 3.

Though a good deal of variation occurs also in this species, this variation is always confined within such limits that it never causes any great difficulty in recognising the species.

The changes according to age are very small and insignificant. The common shape of the species is flat, with a large umbilicus and rounded whorls. The whorls are covered with comparatively fine ribs, very irregular, however, in size and direction, which are indistinctly divided on the siphonal side into two or three ribs. These branches do not go straight over the siphonal side, but are subjected to alterations of two different kinds, by the first of which all are affected by a slight curvature backwards in the middle of the siphonal side, by the second, however, only some, and a different number in different specimens. If we follow such a branch rib from its beginning near the siphonal margin, we find that the so affected rib, instead of going straight on, makes on the siphonal margin a strong curvature backwards, producing a somewhat ear-shaped, and slightly prominent spine-like nodule; the farther passing of the rib over the siphonal side is indistinct, there is only on the opposite side a similar nodule observable. This peculiar form of the ribs is to be found on several forms of upper jurassic *Perispinctes*, and is not exclusively characteristic for the species allied to *Per. curvicosta*; it is, however, one of the things which may render it easy to recognise the forms belonging to the latter group.

The lobes are simple and not very much ramified; the siphonal and first lateral lobes are about equal in length, the external saddle is broad, with a well developed secondary lobe. The lobes from the second lateral are hanging down to a deep sutural lobe about as deep as the first lateral.

The characteristics of the species which I am describing lie in the rounded whorls, the irregular ribs, and the small size, which hardly exceeds a diameter of about 70 mm., mostly not growing even so large. The three specimens, of which I give here the measurements, have their body-chamber preserved for the greater part of its length. The measurements are—

				I.	II.	III.
Diameter	of the shell	...	...	44 mm.	43 mm.	51 mm.,
„	of the umbilicus	...	...	19	18	29
Height	of the aperture from the umbilical suture	...	...	14	14	16
„	of the „ from the preceding whorl	...	...	12	11	15
Thickness	of the „	...	...	11	12	15

Remarks.—There are preserved in our Museum eight specimens of *Per. curvicosta*; three of them come from the oolite of the Joora hills on the road from Jooria to Dhosa, from the same layer as *Per. obtusicosta*, *angygaster*, and *Dho-*

saënsis; two were found in marl-nodules north of Gudjinsir together with *Pelt. athleta*; one is preserved in a yellow marl rock from Jumara, and two have been collected in the beds with *P. anceps* at Keera hill near Charee.

The species is easily distinguished from *Per. arcicosta* by the more depressed whorls and the differently ribbed body-chamber.

Per. curvicosta is very characteristic for the upper Callovian layers of Europe.

3. PERISPINCITES SUBTILIS, *Neumayr*. Pl. XLIII, Fig. 4a, b.

1847. *Ammonites convolutus ornati*, Quenst.: Cephalop., p. 170, pl. 13, fig. 1.
 1857. „ *sulciferus*, Oppel: Jura form., p. 565, (non Münster).
 1858. „ *convolutus ornati*, Quenst.: Jura, p. 541, pl. 71, fig. 9.
 1863. „ *sulciferus*, Oppel.: Pal. Mitth. I, p. 155, pl. 49, fig. 4, (non Münster).
 1869. „ *curvicosta*, (Opp.) Brauns: Mitth. Jura. Nordd., p. 130, (pars).
 1871. „ *Perispinctes subtilis*, Neumayr.: Abh. d. k. k. Geolog. Reichsanst., vol. V, p. 37. pl. 14, fig. 3.

Though the only specimen of this species I have got for description is a somewhat large one, yet I do not think it exceeds the general size of the species, so far that it would be necessary to consider it as a new species. In all other respects it agrees very well with Oppel's drawing and description.

As in all the other species of this group so in this one the body-chamber is the most characteristic part of the shell. The inner whorls can be recognised too, but they are more difficult to distinguish from the allied forms.

The general shape of the full grown species is flat, with a wide, shallow umbilicus and compressed whorls, which are covered by mostly polytome ribs. The latter part of the body-chamber is, however, nearly entirely smooth.

Small specimens have a very different aspect. Up to a diameter of the shell of about 25 mm., the whorls are roundish, as thick as high, covered by numerous ribs, which are rather unequal in strength, a little inclined towards the front, and mostly dichotomous on the siphonal margin. Parabolical curves, which are so common in *Per. curvicosta*, only appear exceedingly rarely. Each turn of the inner whorls shows about two or three contractions of the shell.

As the shell grows larger, the whorls become more and more compressed, and the ribs mostly polytome, in consequence of which the ribs on the siphonal side of the shell become finer. The body-chamber begins at a diameter of the shell of 33 mm., but the sculpture does not change on the first half of this part of the shell. About the middle of the length of the body-chamber there is yet a slight contraction of the shell observable, and after this only the lateral parts of the shell show yet some very faint ribs, but the siphonal part seems quite smooth, as far as it can be observed on the somewhat rough cast which alone exists of this species.

The length of the body-chamber occupies not quite one whorl, but it is not preserved as far as the mouth in the specimen I have got for description.

The lobes are not sufficiently visible on any part of the specimen to draw or describe them.

The measurements of the specimen are the following:—

Diameter	of the shell	...	...	...	...	...	48 mm.
„	of the umbilicus	...	...	...	...	...	22
Height	of the aperture from the umbilical suture	...	...	...	...	...	15.5
„	of the „ from the preceding whorl	...	...	...	...	...	14
Thickness of the	„	...	...	...	...	...	11

Remarks.—The only specimen of this species from Kachh existing in our Museum has been found by Dr. Stoliczka at Vanda in the beds with *Pelt. athleta*.

From the two species of the same group described before, *Per. subtilis* can be easily distinguished by the peculiar shape of its body-chamber, and by the nearly total absence of parabolical curves in the ribs.

(c.) Group of PERISPHINCTES CONGENER, *Waagen*.

1. PERISPHINCTES CONGENER, *Waagen*, *n.sp.* Pl. LVII, Fig. 1a, b; Pl. LVI, Fig. 2.

Though it is very probable that this species also derives its origin from *Per. Martiusi*, and is a parallel species to *Per. aurigerus* or a similar form, yet the further development of this type in higher beds is so characteristic and produces species so singularly shaped, that I thought it necessary to unite these forms, deriving from *Per. congener*, in a separate group.

The materials for this species at my disposal are rather defective, but as it is a species of the Putchum group, and no hope exists of ever getting better materials, I must content myself to describe the specimens, bad as they are.

Per. congener is a rather large species, and a specimen of about 170 mm. in diameter is entirely composed of air-chambers.

The general form of the species is flat, with compressed whorls and a large umbilicus, in which the inner whorls are well exposed. The inner whorls are, however, never preserved in the specimens from the Putchum group, and I thus can only describe the full grown form. The smallest stage of growth I can observe represents a specimen of about 80 mm. diameter. At this size the whorls are already a good deal higher than broad, and covered on their sides by not numerous, high, distant ribs, which are divided on the siphonal margin into three to five branches, which cross without interruption the siphonal part of the shell. The umbilicus is surrounded by an umbilical wall, which becomes indistinct in larger specimens. Otherwise the form changes little with the advancing growth of the shell. The last whorl of a specimen of 166 mm. diameter shows twenty-five to

twenty-six strong ribs on both sides, which are, however, not all quite equal in strength; each of them is divided or rather replaced on the siphonal margin by four or five finer ribs which cross without interruption over the far projecting siphonal part of the shell. The ribs are all straight, arranged nearly according to the radius of the spiral.

Contractions of the shell will exist very likely on the inner whorls; the outer whorls do not show any of them.

The lobes are simple, not much ramified. The siphonal lobe is tolerably broad, with two rather long terminating branches; external saddle not very broad, with a small secondary lobe, which is shifted somewhat towards the first lateral lobe; first lateral lobe somewhat longer than the siphonal; first lateral saddle a little narrow, with a small secondary lobe; second lateral lobe distinguishable, but already a little shifted so as to form the sutural lobe, which is composed of three (one larger and two smaller) auxiliary lobes.

The measurements of the described specimen are the following:—

Diameter	of the shell	...	...	...	174 mm.
„	of the umbilicus	...	...	...	77
Height	of the aperture from the umbilical suture				
„	of the „ from the preceding whorl				
Thickness of the	„			...	

Remarks.—There are three specimens of this species in our Museum, one complete and two fragmentary, which have all been collected by Dr. Stoliczka in the coral beds of the Putchum group at Jumara.

The only species for which *Per. congener* could be mistaken is *Per. funatus*, Opp., but our species has got much coarser ribs and quite different lobes. From *Per. Recuperoi*, Gemm., our species differs by more compressed whorls. A figure which very much resembles *Per. congener* is that given by Orbigny (Pal. Franç. Terr. Jur. I) on pl. 149, fig. 2, under the name of *Per. Bakeriae*, Sow., only in the contractions of the shell it deviates from the Kachh species.

2. PERISPINCTES RECUPEROI, *Gemmellaro*. Pl. XLIII, Figs. 1a, b, 2a, b.

1872. *Perispinctes Recuperoi*, Gemmellaro: Sopra alcune faune Giuresi e Liassiche, p. 26, pl. V, figs. 9—11.

This species, which has been detected only lately in the *Macrocephalus* beds of the island of Sicily, seems not to be so very rare in the same beds of the Kachh Jura.

The general form of the species is discoid, with rounded whorls and a very wide umbilicus, which is not surrounded by an umbilical wall. The sides of the whorls are covered by rather numerous thick ribs, which are divided into four or five branches on reaching the siphonal part of the shell. The whorls envelope each other very little, and bear some rare contractions of the shell, which are limited to the inner turns.

The smallest specimen I have to examine has 40mm. in diameter. The whorls are very depressed, a good deal broader than high, covered by fine ribs, which originate at the umbilical suture, run in a slight curve towards the front up to the siphonal margin, and are then very regularly divided into two branches, which cross with a slight curve backwards over the siphonal part of the shell. I count on the last circuit forty ribs on the lateral part of the shell, and eighty-one in the siphonal part. There are three very deep and oblique contractions of the shell on the last two whorls of this specimen. What is, however, peculiarly interesting is the rather frequent occurrence of parabolical curves on the ribs of the siphonal part of the shell. It is not clear from the position of these curves on the different specimens of the species I am about to describe what morphological meaning ought to be attributed to them. The contractions of the shell are certainly the most likely to be considered as remnants of former apertural margins, but then, what are the parabolical curves, which also have been thought to be of the same meaning. On small specimens of *Per. Recuperoi*, some of which are excellently preserved, one observes nearly regularly, after a contraction of the shell, a pair of parabolical curves standing immediately in front of it and forming together with the contraction a figure which could well correspond to an apertural margin, which, however, I have never actually observed as an apertural margin on any species of *Perisphinctes*. Besides that the parabolical curves are at certain distances from the contraction of the shell, yet twice repeated, without a repetition of the contraction, and thus the animal must have formed two different kinds of apertural margins, one preceded by a contraction of the shell and another without the latter. That, however, the contractions of the shell and parabolical curves have a certain connection is clear from the fact that on larger specimens of *Per. Recuperoi* as soon as the former disappear the latter also are no longer observable.

A specimen of about 90mm. diameter (that is, nearly the size of Gemmellaro's figure) exhibits an entirely different aspect from the one just described. The whorls are always still a little broader than high, but instead of the fine ribs of smaller stages of growth, they are now covered on both sides by thick lateral ribs, which are about thirty in number on one circuit; these are divided on the siphonal margin into mostly three branches, which go with a bend towards the front over the siphonal side of the shell, and are more than one hundred on one circuit. Parabolical curves do yet but very rarely occur, and the contractions of the shell are also very rarely observable. The last of these latter I can distinguish at a diameter of the shell of 90mm., yet about 20mm. in front of it parabolical curves are visible.

At 120 mm. diameter, the body-chamber commences, but the sculpture does not change in the least on this part of the shell. The only change which is observable is, that the siphonal part of the shell gets more narrowly rounded on the latter half of the body-chamber. This latter part, however, is not preserved on any of the specimens up to the mouth.

The lobes do not agree in every particular with Gemmellaro's drawing, but as they are taken from a larger specimen, those differences are explicable. The siphonal lobe is very short and broad; external saddle broad, with a very small secondary lobe; first lateral lobe very little longer than the siphonal, terminating in three branches; first lateral saddle not very broad, with a small secondary lobe; second lateral lobe very small, but distinguishable, three auxiliary lobes (one larger and two smaller) hanging down to a very short sutural lobe.

The measurements of three specimens are the following:—

	I.	II.	III.
Diameter of the shell	40mm.	90mm.	152mm.
„ of the umbilicus	29	46	80
Height of the aperture from the umbilical suture	13	26	46
„ of the „ from the preceding whorl ...	11	22	40
Thickness of the „	16·5	26	44

The specimen No. III has got a large part of the body-chamber preserved.

Remarks.—All the specimens of *Per. Recuperoi*, Gemm., in the possession of our Museum have been collected by Dr. Stoliczka. There are six specimens out of the *Macrocephalus* shales north-west of Soorka, and two specimens out of the same beds north-west of Jumara.

As Gemmellaro already very rightly observed, this species seems to be rather nearly related to *Per. euryptychus*, Neum., but is distinguishable by the more regular ribs and different lobes. From *Per. congener*, W., Gemmellaro's species can be distinguished by much thicker whorls and finer ribs on the siphonal side.

3. PERISPINCTES COBRA, *Waagen, n. sp.* Pl. XLV, Fig. 1a, b, c.

There is only one specimen existing of this exceedingly remarkable species, but as this is well preserved, and the bed in which it occurs is exactly known, I think it right to describe it under a separate specific designation.

Like the species just described, this also undergoes rather considerable changes in its different stages of growth; however, it is difficult for me to state them exactly, as the shape of the younger shell can be guessed only from the inner whorls of the only specimen existing. The general form of the shell is thick, patelliform, with a wide, deep, funnel-shaped umbilicus and thick rounded whorls, which are covered by coarse distant ribs, which start from the umbilical margin, and disappear again before reaching the siphonal side, leaving this part of the shell quite smooth.

The inner whorls are finely ribbed, and the ribs very likely dichotome on the siphonal part of the shell as in the preceding species. Contractions of the shell are very rare; there is, in fact, only a single one existing on the specimen I have got for description at a diameter of the shell of about 65 mm. The finely ribbed state of the whorls lasts till about 30 mm. diameter, then the ribs follow each other

at larger intervals, and become at the same time thicker and broader. At 60 mm. the siphonal part of the shell is already entirely smooth, and at 85 mm. the body-chamber commences. On this latter part of the shell the sculpture is only very slightly different from that of the preceding whorl, except that the ribs on the lateral parts of the shell are no longer so thoroughly radial as on the inner whorls, but a little inclined towards the mouth of the shell. On the specimen I have got for examination, the body-chamber is preserved of not quite the length of one whorl.

The lobes are well ramified, and thus more complicated than in the preceding species. The siphonal lobe is broad, but not very short; external saddle narrow, with a long and slender secondary lobe; first lateral lobe broadish, terminating in three asymmetrical branches; first lateral saddle about as broad as the external, with an eccentric secondary lobe; second lateral lobe already a little shifted backwards, but yet well distinguishable, small, terminating in three small branches; auxiliary lobes hanging down to form a sutural lobe about as long as the siphonal.

The measurements of the only specimen are the following:—

Diameter	of the shell	...	...	...	...	...	125 mm.
"	of the umbilicus	...	...	...	...	...	69
Height	of the aperture from the umbilical suture	...	...	...	...	...	31
"	of the " from the preceding whorl	...	...	...	...	...	28
Thickness	of the " ...	...	...	...	...	...	33

Remarks.—The only specimen by which this species is represented in our Museum has been collected by Dr. Stoliczka in the beds with *Per. anceps* on the road which leads through the Charvar range south of Bhooj.

Per. cobra is very easily distinguishable from any of the allied species by the peculiarly smooth siphonal part of its whorls. Only *Per. aberrans*, W., has in its more advanced stages of growth a similar appearance, but then the ribs are much higher and sharper, and the size of the shell much more considerable than in *Per. cobra*.

4. PERISPINCTES ABERRANS, *Waagen, n. sp.* Pl. XL, Figs. 1a, b, c, 2a, b.

This is one of the most extraordinary forms of *Perispinctes* ever met with. I was for a long time in doubt if I should not better place the species in the genus *Simoceras* of Zittel, but after having with great labour prepared the lobes, I think it is not possible that it can be anything but a *Perispinctes*.

Young specimens have a certain resemblance to *Per. curvicosta*, but the ribs are so regular that one never would mistake one species for the other. The general form of the species is flat, with rounded, string-shaped whorls, which barely touch each other. The ribs on the sides of the whorls are very numerous in young specimens, 38 by 30 mm. in diameter, and strongly directed towards the front. As the species grows larger the ribs become scarcer and more distant. At 75 mm.

diameter twenty-six ribs, at 100 mm. diameter on another specimen thirty ribs, and at 165 mm. diameter there are only eighteen ribs on one whorl; but in the same proportion as the number decreases, the ribs become higher and stronger, at last resembling elongated nodules.

In young specimens the ribs are on the siphonal margin very distinctly divided into two or three branches, which pass a little bent in front over the siphonal side. In old individuals those branches disappear nearly entirely, and the siphonal side seems quite smooth, only when the shell is very well preserved one sees slight traces of ribs passing over this part of the shell.

The contractions of the shell, characteristic for the genus *Perisphinctes*, are extremely developed in this species. On the inner whorls there is only one of them visible on every $1\frac{1}{2}$ whorl; on the outer whorls, on the contrary, two exist on every whorl. They are very strongly directed towards the front, and make on the siphonal side a rounded angle of about 90 degrees.

The lobes are fine and very much ramified. The siphonal lobe is broad, with very long, fine terminal branches, not quite as long as the first lateral: external saddle not very broad, quite filled up with two secondary and the branches of the surrounding lobes; first lateral lobe very narrow, finishing in three fine, long, asymmetrical branches; first lateral saddle narrow, with one long secondary lobe; second lateral lobe indistinct, smaller than the first auxiliary; auxiliary lobes four in number, rapidly decreasing in size, hanging down altogether far below the first lateral and so forming a deep sutural lobe.

The measurements of two specimens are—

					I.	II.
Diameter	of the shell	...	...	...	75 mm.	165 mm.
"	of the umbilicus	...	...	...	38	98
Height	of the aperture from the umbilical suture	...	...	...	29	38
"	of the " from the preceding whorl	...	...	...	27	35
Thickness	of the "	...	...	...	? 25	40

Remarks.—The two specimens which I have here for examination are both from Keera hill near Charee, out, as it seems, of a somewhat clayey layer with yellowish white marl nodules, the horizon of which is beyond doubt equivalent to the beds with *Pelt. athleta*.

There is no European species as yet described with which our species could be compared. The only species allied is *Per. cobra*, W., which is, however, distinguishable by its smaller size and more numerous and less prominent ribs.

5. PERISPINCTES GUDJINSIRENSIS, *Waagen, n. sp.* Pl. XXXIX, Fig. 3a, b.

The form of this species is very particular, and not like any other species of the genus. The species does not attain any large size, has a very wide umbilicus and very broad depressed whorls. The ribs are very prominent, and give the shell its characteristic appearance.

Young specimens of the species have broad, very depressed whorls, a wide umbilicus and very fine numerous ribs, often interrupted by deep contractions of the shell, and so resemble very much young specimens of certain species of the group of the *Convoluti*. The aspect of the shell becomes only different at 30-35 mm. diameter. The distance between the ribs increases then gradually; they become more prominent on the sides of the whorls and go uninterruptedly, divided mostly into three branches, over the siphonal side. Of the contractions of the shell, which are very deep and a little bent in front, there is now one on about every half whorl. The body-chamber has entirely the same ornamentation as the preceding whorl, and shows a contraction at the beginning and at the middle of its length, the length being exactly one whorl.

I am not able to describe the lobes, as in the specimen I have to examine all the chambered parts of the shell are covered by the body-chamber.

Another specimen, which has been collected lately by Dr. Stoliczka, shows the inner whorls more clearly than the one figured, and one can observe that, as in *Per. Recuperoi*, Gemm., so also in this species the rather frequent contractions of the shell correspond with parabolic curves of the secondary ribs on the siphonal part of the whorls, and the same peculiarity as to two different kinds of aperture, one preceded by a contraction of the shell, the other not, is also here observable. The strong, distant lateral ribs, which are one of the characteristics of the species, do not commence here before a diameter of about 60 mm. is exceeded.

The fine ribs on the sides of the inner whorls are dichotome on the siphonal margin up to a diameter of the shell of about 40 mm., and trichotome from that up to 60 mm. A specimen, which has not yet got the strongly ribbed portions of the shell, resembles very much Neumayr's drawing of *Per. Orion*, Opp. It is, however, well distinguishable.

The lobes on this specimen also are not visible.

The measurements of two specimens are the following:—

						I.	II.
Diameter	of the shell	...	...	...	...	93 mm.	60 mm.
"	of the umbilicus	...	...	...	...	50	29
Height	of the aperture from the umbilical suture	...	...	...	...	24	18
"	of the " from the preceding whorl	...	...	...	...	22	15
Thickness	of the " ...	...	...	...	...	35	24

Specimen No. I has the entire body-chamber preserved; No. II only the first beginning of it.

Remarks.—There are two specimens of this species preserved in our Museum, the one, collected by Mr. Wynne, has been found in the *athleta* beds north of Gudjinsir, the other, collected by Dr. Stoliczka, comes out of the same beds from Vanda.

As I remarked before, *Per. Gudjinsirensis* has at certain stages of growth a rather close resemblance to *Per. Orion*, Opp., but is always distinguishable by the

finer ribs on the inner and the coarse ribs on the outer whorls. From *Per. aberrans* the species differs by a much more rapid increase in thickness, and from all the other species of the group by the peculiar shape of its body-chamber.

(d.) *Group of PERISPHINCTES PRÆCURSOR, Waagen.*

1. *PERISPHINCTES PRÆCURSOR, Waagen, n. sp.* Pl. XLIX, Figs. 4a, b, 5a, b.

It is a very interesting little species which I am going to describe under the name of *Per. præcursor*. I selected this designation in order to show that the proper development of the group is only attained in higher beds, and that the species I have now under review is only a sort of præcursorial type. It is strange that all the geologically younger species of the group have been exclusively found in European jurassic beds, and that after *Per. præcursor* had disappeared, the group is already extinct again in the Kachh Jura.

Per. præcursor is in its general form somewhat like *Per. curvicosta*, only that the whorls and ribs are much more regular. The whorls are perfectly rounded, exactly as high as thick, and barely at all enveloping each other. Yet the umbilicus is not very large, as the whorls increase rapidly in every way. The latter are covered by numerous rounded ribs, which start from near the umbilical suture, go in about a radial direction up to the middle of the sides, and being there divided into mostly three fine branches, run somewhat inclined backwards without interruption over the siphonal part of the shell. The inner whorls seem to be nearly smooth; however, they are not well enough preserved on any of the specimens to state this with certainty. The sculpture before described belongs all to the body-chamber, which begins already at about 15 mm. diameter of the shell. This latter part occupies about three quarters of a whorl and terminates in an apertural margin, which seems to be decorated by a high, prominent collar; it is, however, on none of the specimens perfectly preserved.

The lobes are not well visible on any of the specimens; it is, however, possible to observe that the siphonal lobe is very long and broad; the external saddle also broad, with a small secondary lobe; first lateral lobe very small; all the other lobes running down in a straight line without forming a large sutural lobe.

The measurements of two specimens are the following:—

					I.	II.
Diameter	of the shell	...	...	...	26 mm.	29 mm.
„	of the umbilicus	...	...	...	10	11·5
Height	of the aperture from the umbilical suture	...	...	...	10	10·5
„	of the „ from the preceding whorl	...	...	...	9	9
Thickness	of the „	...	...	...	10	10

Both specimens have nearly the entire body-chamber preserved.

Remarks.—There are three specimens of this species preserved in our Museum, which have all been collected by Dr. Stoliczka in the Dhosa oolite of Vanda.

Though *Per. præcursor* bears a certain resemblance to *Per. curvicosta*, Opp., yet the affinity between the two species is very small. Thus it is also not difficult to distinguish our species from *Per. curvicosta* already by the absence of contractions of the shell and parabolical curves of the ribs. There exists, however, a real affinity to *Per. galar*, Opp., which species is nevertheless distinguishable by a smaller umbilicus and a strange bend in the body-chamber.

SECTION IV.—PERISPHINCTES EVOLUTI.

(a.) Group of PERISPHINCTES EVOLUTUS, Neumayr.

1. PERISPHINCTES SUBEVOLUTUS, *Waagen, n. sp.* Pl. XLV, Figs. 3a, b. ;
Pl. XXXIX, Fig. 7.

This species is very nearly allied to *Per. evolutus*, Neum., and is chiefly distinguishable by the deep contractions of the shell, of which about two occur on every whorl.

I have got no large specimen for description, but even small ones are so characteristic in their appearance that I do not hesitate to describe the species from them.

The general shape of the species is thick, patelliform, with a very wide umbilicus. The whorls are rounded, very depressed, much thicker than high. They are covered by numerous straight ribs, which are a little inclined towards the front, divided into two branches on the siphonal margin, from where they pass over the siphonal part of the shell, growing a little fainter in the middle of it. What is very remarkable is the occurrence of parabolic curves, which, though very rare, are visible, in one or the other instance, on every one of the specimens. These curves very likely disappear in more full grown shells.

There is very little difference between the inner and the outer whorls of this species; the number of ribs, however, varies in different specimens rather considerably; whilst in one specimen there are thirty-eight on the lateral part of one whorl, one counts forty-eight on a whorl in another specimen.

The lobes are very little ramified and very short. Siphonal lobe very short and broad; external saddle broad, with a central secondary lobe; first lateral lobe very broad and short, terminating in three short branches; first lateral saddle broad, with an indistinct secondary lobe; second lateral lobe not distinguishable, hanging down together with the auxiliary lobes to form a sutural lobe of about the length of the first lateral.

The dimensions of two specimens are the following :—

				I.	II.
Diameter of the shell	...	...	...	56mm.	36mm.
„ of the umbilicus	...	...	...	27	20
Height of the aperture from the umbilical suture	...	...	...	16	10
„ of the „ from the preceding whorl	...	...	...	14	9
Thickness of the aperture	...	...	...	21	16

Both specimens are composed entirely of air-chambers.

Remarks.—There are four specimens of this species preserved in our Museum, three of which have been collected by Dr. Stoliczka in the Dhosa oolite north-west of Soorka; the fourth specimen is from the Dhosa oolite of the Joora hills.

Per. subevolutus is chiefly allied to two species: *Per. evolutus*, N., and *Per. Indogermanus*, W.: from the former it is distinct by the strong and numerous contractions of the shell; from the latter by more numerous and less prominent ribs. Other species of the Kachh Jura can barely come into consideration. Of European species some might be compared, but they are not sufficiently known to go into details about them.

2. PERISPINCTES SUBCOLUBRINUS, *Waagen, n. sp.* Pl. XLIX, Fig. 3a, b.

There exists only one excellent specimen of this species in our Museum; it represents a form very nearly allied to *Per. colubrinus* (Rein.) Quenst., and I therefore have chosen the name of *Per. subcolubrinus* for it.

The general shape of the species is flat, patelliform, with well rounded whorls and a very wide umbilicus, which is never surrounded by any trace of an umbilical wall. The whorls are covered by strong rounded ribs, which originate near the umbilical suture, run from there straight and nearly radial to the siphonal margin, and are there divided into two, sometimes into three branches, which go straight, without interruption, over the siphonal part of the shell. The whole shell has in its appearance much of a species of the section of the '*Convoluti*,' although, on account of its near relation to *Per. subevolutus*, it can only be placed in developmental connection with the latter.

The whole shell changes very little in its different stages of growth, except, perhaps, that the ribs on the lateral parts of the shell are more inclined towards the front on the inner than on the outer whorls.

The species shows rather numerous deep and very oblique contractions of the shell, of which two can be counted on every turn. They are, as in the preceding species, on the inner whorls in connection with parabolic curves, on the ribs which follow immediately in front of the contraction. These parabolic curves are indistinct on the outer whorls.

The specimen I have got for description has yet a very small part of its body-chamber preserved; it shows, however, on the preceding air-chamber no sign of being full grown.

The lobes are very short and broad as in the preceding species. Siphonal lobe very broad and short; external saddle very broad, with a very small secondary lobe; first lateral lobe broad and short, terminating in three short branches; first lateral

saddle very narrow, without secondary lobe ; second lateral lobe very small, hanging a little down and forming together with the three auxiliary lobes a sutural lobe, which is a little longer than the siphonal and first lateral lobes.

The measurements are the following :—

Diameter of the shell	...	...	...	...	97 mm.
„ of the umbilicus	...	...	...	...	48
Height of the aperture from the umbilical suture	...	...	...	...	28
„ of the „ from the preceding whorl	...	...	...	...	22
Thickness of the „	...	...	...	...	28

Remarks.—The specimen which has served for the description of the species was collected by Dr. Stoliczka in the red iron-sandstone of Kuntkote. The species seems to be very rare in that bed.

Per. subcolubrinus resembles very much, as I have already remarked, *Per. colubrinus*, Rein. It is, however, distinguishable by less numerous and not so regularly dichotome ribs. From *Per. subevolutus* it can be distinguished by less depressed whorls and less regular ribs.

3. PERISPINCTES PAGRI, *Waagen, n. sp.* Pl. XLII, Fig. 2a, b, c.

Like *Per. curvicosta*, so also this species attains no remarkable size. The whorls are extremely broad, depressed, and very little involute, and covered with tolerably fine ribs.

The changes which the species undergoes according to age are small. Young specimens have the common aspect of the *Convoluti*, and are so closely allied to *Per. Orion*, Opp., that it is almost impossible to distinguish the species in the former stages of growth.

The ribs are very fine, commonly tripartite on the siphonal margin, and often showing the parabolic curvature, which is common in *Per. curvicosta*. The ribs on the sides of the whorls remain closely arranged till the beginning of the body-chamber, or up to about 70 mm. diameter. Then they become more distant and a little sharper, but the change is not very striking, and they are trichotome as before. The branches do not go quite straight over the siphonal side, but are in the middle a very little bent backwards: the parabolic curvatures, however, do not occur on specimens more than 30 mm. in diameter.

The sutures are rather short, with broad saddles and narrow lobes. The siphonal lobe is broad and commonly a little longer than the first lateral; the external saddle is very broad, with a very small secondary lobe; the first lateral lobe is narrow, finishing in three short branches; the first lateral saddle is a little narrower than the external, and also with a very small secondary lobe; the second lateral lobe, as also are the following two auxiliary lobes, is very small, and hanging down to a tolerably deep sutural lobe.

The measurements of two specimens are the following :—

					I.	II.
Diameter of the shell	...	...	...	...	77 mm.	107 mm.
„ of the umbilicus	...	...	...	...	40	55
Height of the aperture from the umbilical suture	...	...	...	...	21	28
„ of the „ from the preceding whorl	...	...	...	...	19	25
Thickness of the „	...	...	...	...	28	34

Remarks.—There are eight specimens in our Museum, six coming from the red iron rock of Kuntkote in Wagur, very likely of Oxfordian age; the two remaining have been collected by Dr. Stoliczka at Gangta bét in the same beds.

The species is very closely allied to *Per. Orion*, Opp., so that it seems necessary to state some of the distinguishing points so as to enable every one to recognise the species. In comparison with *Per. Orion*, *Per. pagri* has whorls a little more strongly depressed, the ribs are finer and more numerous, and a smaller number of branch ribs on the siphonal side corresponds with one lateral rib than in Oppel's species; besides that the lobes are shorter, simpler, and less ramified than the drawings of Quenstedt and Neumayr show in *Per. Orion*. From *Per. subevolutus*, W., which is also closely allied, *P. pagri* is distinguishable by more numerous and mostly trichotome ribs and much broader whorls; by the same characteristics it differs also from *Per. subcolubrinus*.

4. PERISPINCTES EUPLOCUS, *Waagen, n. sp.* Pl. LII, Figs. 2, 2a.

The general form of this species is very peculiar, and seems to me to represent a connecting link between the species described just now and *Per. Pottingeri*, being allied to the former by its rounded whorls, and to the latter by the peculiarly ribbed body-chamber.

The inner whorls, up to the beginning of the body-chamber, are perfectly rounded, very little involute, and covered with fine sharp ribs, which are very peculiarly curved, first backward, then to the front, then again backward, like a reversed S; they are divided into two or three branches about on the middle of the side, so that the longer part of the branches is yet visible in the umbilicus. On the body-chamber the ribs become more straight, higher than the rest, di-or-tri-chotome, but very irregular in size. The apertural margin is not preserved; the length of the body-chamber is about $\frac{3}{4}$ of a whorl.

The lobes are not visible.

The measurements of the single specimen I have for description are the following :—

Diameter of the shell	...	...	...	...	...	82 mm.
„ of the umbilicus	...	...	...	...	...	44
Height of the aperture from the umbilical suture	...	...	...	...	...	23
„ of the „ from the preceding whorl	...	...	...	...	...	20
Thickness of the „	...	...	...	...	...	28

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

Remarks.—*Per. euplocus* has been found in a single specimen in the coarse sandstones of the Katrol group.

The species is easily distinguishable from all the allied species by its ribs, which are divided into several branches on the middle of the sides.

5. PERISPINCTES POTTINGERI, Sowerby. Pl. LI, Fig. 1a, b.

1840. *Ammonites Pottingeri*, Sowerby: Transact. Geolog. Soc., Lond., vol. V, p. 719, pl. 61, fig. 10 and expl.

It is very remarkable that in the upper jurassic *Perisphinctes* both in Europe and in India, though the species are for the greater part not identical, still the younger stages of growth are in very different forms so extremely alike that it is nearly impossible to distinguish them. This is the case also with *Per. Pottingeri* and *Per. torquatus*.

The first stages of growth, and even larger specimens, often up to a diameter of 60 or 70 mm., are distinguishable from equal sized specimens of *Per. torquatus* only by a little more rounded whorls and by somewhat sharper and higher ribs. The whorls are a little squarish, the ribs not very fine and dichotome, contractions of the shell in moderate number, just as in the mentioned species, and the characteristic form of *Per. Pottingeri* is not developed before the beginning of the body-chamber.

The body-chamber can be developed nearly at any size of the individual, but I cannot ascertain if the individual has got already its full development, when it begins to build its differently ornamented body-chamber, or if the animal has the power to destroy the first body-chamber and to build a new one of larger dimensions. As far as my experience goes, I should rather accept the first view.

As soon as the body-chamber begins, the ribs become first tripartite, then their lateral parts get more distant, sharper and higher. This particular condition of the ribs begins often only a short distance before the apertural margin, often half a whorl before it, so that we have in the first case five or six, in the second twelve to fourteen of those high, wing-shaped ribs. The apertural margin is with an ear-shaped process on each side, and without a large projection on the siphonal part.

The lobes are not visible on any of the specimens existing here.

The measurements of three specimens with preserved body-chambers are—

	I.	II.	III.
Diameter of the shell	92 mm.	120 mm.	150 mm.
„ of the umbilicus	47	65	78
Height of the aperture from the umbilical suture ...	25	33	44
„ of the „ from the preceding whorl ...	20	29	33
Thickness of the „	30	46	60

Remarks.—About thirty specimens of this species are preserved in our Museum; they all come from the coarse iron sandstone of the Katrol range, which corresponds to about the middle of the Katrol group.

The most interesting fact in this species is the extreme variation of size, so that there are full grown specimens between 90 and 150 mm. in diameter. A very similar case we find in another species in the same layer, in *Phyll. pychoicum*, where the variation is yet larger, and has caused even the separation of the differently sized individuals into different species.

Per. Pottingeri is allied to *Per. torquatus*, the distinctive points from which I have already indicated. It is also allied to *Per. pagri* by the depressed whorls and the occurrence of parabolical curves on the ribs in smaller stages of growth; it is, however, always easily distinguishable by the different shape of the body-chamber.

5. PERISPINCTES KATROLENSIS, Waagen. Pl. LIII.

A large species, allied to *Per. Pottingeri*, Sow., and besides this latter the commonest in the Katrol range.

The young specimens are very much like individuals of the same size of all the species described on the last few pages. The whorls are a little squarish, the umbilicus wide, the ribs strong, less numerous than in *Per. Pottingeri*, dichotome, with a slight depression in the middle of the siphonal side. At about a diameter of 100 mm., often also later, the ribs become tripartite; at the same time they increase also in strength and sharpness. They become gradually more distant, and at last on the body-chamber very much like those in *Per. Pottingeri*, but never so high and wing-shaped as in that species. On the siphonal part the three branches into which they are divided are very sharp and high, and go uninterrupted over that part of the shell. The transversal section of the body-chamber is not so squarish as that of the other whorls, but rather regularly rounded, with the greatest diameter above the umbilical suture.

The lobes are not visible on any of the specimens in our Museum.

The variations in respect of the size are not so great in this species as in the preceding one, the average diameter of a full grown specimen being 180—200 mm.

The measurements of two specimens, one full grown with body-chamber, the other not yet full grown, but also with a part of body-chamber, are—

						I.	II.
Diameter	of the shell	...	...	...	...	102 mm.	195 mm.
„	of the umbilicus	...	...	...	...	52	115
Height	of the aperture from the umbilical suture	...	...	...	...	28	43
„	of the „ from the preceding whorl	...	...	...	...	24	35
Thickness of the	„	...	...	...	...	32	56

Remarks.—All the specimens in our Museum, about twenty, are from the coarse red iron sandstone, with many bits of fossil wood, of the Katrol range, belonging to about the middle of the Katrol group.

Per. Katrolensis is distinguishable from *Per. Pottingeri* by the much coarser ribs and thicker whorls in young examples, and by the much more considerable size, less high and more rounded ribs, in full grown specimens.

(b.) Group of PERISPINCTES INDOGERMANUS, *Waagen*.

1. PERISPINCTES INDOGERMANUS, *Waagen*, n. sp. Pl. XLVII, Fig. 1a, b, c;
Pl. XLVIII, Figs. 3a, b, 4a, b.

1847. *Ammonites plicatilis*, (Sow.) Orbigny: Pal. franç. Terr. Jurass., I, p. 509, (partim), (non Sow.).

1857. " " (Sow.) Oppel: Jura form., p. 603, (partim), (non Sow.).

1866. " " (Sow.) Oppel: Zone des *A. transversarius*; Geognost. palæont. Beitr. v, Benecke, Schloenbach u. Waagen, vol. I, p. 218, (partim) (non Sow.).

This species was a long time mistaken for the real *Per. plicatilis*, on the one hand, because the drawing of Sowerby is so very bad that it is not possible to recognise the species with any certainty from it; on the other hand, because Orbigny mixed up so many species under this designation, that it was since that time no longer possible to find out the real meaning of Sowerby's original species. Only since Seebach, after having studied carefully Sowerby's originals, asserted that Sowerby's originals are perfectly identical with the drawings given by Orbigny on pl. 191 and 192, under the designation of *Amm. bplex*, it became easier to determine what was the real *A. plicatilis*. Unfortunately, however, Orbigny figured two different species on his two plates, the first of them (191) representing a full grown specimen of *Amm. Martelli*, Oppel. There remain, therefore, only the figures of pl. 192 with which *A. plicatilis* can be identified. As now the form which I have in mind does not agree with these figures, I am obliged to give a new name to European species well known for a long time.

The general shape of *Per. Indogermanus* is rather thick, patelliform, with whorls which are rather depressed, broader than high, and perfectly rounded in the cast. If the shell is preserved the section of the whorls is a little squarish. The ribs on the lateral parts of the shell are high, prominent and sharp, mostly not quite radial, but a little inclined towards the front. On the siphonal margin they are divided mostly into two branches, which are low, broad, and rounded, and go with a slight bend towards the front over the siphonal side of the shell. The whole shell consists of a great many whorls, which barely at all envelope each other; they are provided on every turn with a deep, oblique contraction of the shell. The umbilicus is very wide and shallow. I cannot observe on any of the specimens at my disposal those parabolic curves of the ribs which occur sometimes almost in all the species of the preceding group.

The form of the shell changes very little according to the different stages of growth, but the appearance of specimens provided with the shell, or such as are only internal casts, is very different. If the shell is preserved, the ribs on the lateral parts of the shell are exceedingly high and sharp, and look much straighter than the ribs on the cast. Caused by these high ribs, the section of the whorl gets broad, squarish, and then the resemblance to geologically younger forms like *Per. Martelli*, etc., is very striking, only that the ribs are much less numerous and more prominent. But in casts as well as in specimens provided with shell, the ribs are very low and round on the siphonal side.

The lobes are very complicated and long. The body of the siphonal lobe is about twice as long as broad, with four not very long terminating branches; external saddle not very broad, with a well developed secondary lobe; first lateral lobe narrow, not quite as long as the siphonal, terminating in three not quite symmetrical branches; first lateral saddle extremely narrow, with a small secondary lobe; second lateral lobe not distinguishable separately, hanging down together with the auxiliary lobes to form a sutural lobe as long as the siphonal.

The measurements of two specimens, one European (I) and one Indian (II), are the following:—

		I.	II.
Diameter* of the shell	... ..	100 mm.	140 about.
" of the umbilicus	... ..	64	74
Height of the aperture from the umbilical suture	... ..	24	35
" of the " from the preceding whorl	... ..	20	29
Thickness of the " ... ..	... ..	33	41

Both specimens are entirely composed of air-chambers.

Remarks.—*Per. Indogermanus* is one of the characteristic species of the Dhosa oolite. It is represented from that bed in our Museum from the following localities: Joora hills, in brownish oolite, one specimen; east of Joorun, in a yellow indurated marl, one specimen; south-west side of Keera hill, in very hard brown oolite, four specimens; north-west of Soorka, also in hard brown oolite, two specimens.

The species is rather nearly allied to several other Oxfordian forms, principally to *Per. plicatilis* and *Per. Martelli*. From the first species *Per. Indogermanus* is distinguishable by much thicker and more depressed whorls, from the second, by much coarser ribs and also more depressed whorls. From *Per. evolutus*, Neum., from which our species very likely originated, it is distinguishable by the somewhat squarish whorls.

Per. Indogermanus occurs not rarely also in the zone of *Am. cordatus* of Europe, and our Museum possesses a very good specimen out of these beds from the Vâches noires, Dép. Calvados.

2. PERISPINCTES ROTA, *Waagen, n. sp.* Pl. XLVIII, Fig. 1a, b.

The general shape of the species is flat, patelliform, with a very wide shallow umbilicus without umbilical walls and a great many whorls, which only very little envelope each other. They are rather compressed, a good deal higher than thick, and covered by numerous straight sharp ribs, which start from near the umbilical suture and go, somewhat inclined towards the front, to the siphonal margin, where they are divided into two branches; the latter grow very faint in the middle of the siphonal part of the shell, so that there a smooth space is left. They do not join regularly the branches from the one rib with those of the rib opposite, but are arranged in a strange irregular manner, which is seen best from the drawing, Pl. 48, fig. 1b. Regularity in this point exists throughout only in one of all the specimens I have got for examination.

The smallest specimen of *Per. rota* in the possession of our Museum has 23mm. in diameter. It resembles very much *Per. curvicosta*, is, however, distinguishable by less rounded whorls, which are a little thicker than high; they are covered by very numerous straight ribs, which are divided into two or three branches on the siphonal margin. The branch ribs are indistinctly interrupted in the middle of the siphonal side, and show at intervals slight parabolical curves. Contractions of the shell are about two on each turn.

Larger specimens differ from the smaller ones only by the ribs becoming a little more distant from each other and higher, and at the same time regularly dichotome on the siphonal margin. At about 90mm. diameter the body-chamber seems to commence, though it is very difficult to state anything certain about this point, as all the specimens are covered with thick shell, which cannot be removed. The contractions of the shell become more indistinct in larger specimens, and also more scarce, and parabolical curves of the branch ribs are never observable.

The lobes cannot be observed on any of the specimens, as they are covered up by the shell in every one of them.

The measurements of two apparently full grown specimens with preserved body-chamber are the following:—

					I.	II.
Diameter	of the shell	...	...	...	140mm.	154mm.
"	of the umbilicus	...	...	...	81	88
Height	of the aperture from the umbilical suture	...	...	...	34	39
"	of the " from the preceding whorl	...	...	...	29	34
Thickness	of the "	...	...	...	32	35

Remarks.—This species is, like the preceding one, characteristic for the Dhosa oolite. It has been collected in this layer by Dr. Stoliczka at Vanda in eight specimens, all preserved in finely grained brown oolite; north-west of Soorka, one specimen, in very hard yellowish-gray oolite limestone; north-west of Jara, three specimens, in oolite; Keera hill, one specimen, in fine yellowish-brown oolite.

Per. rota is not difficult to distinguish from any species of *Perisphinctes* as yet described, as the numerous straight sharp ribs, inclined a little towards the front, give the whole shell a very striking appearance, reminding us somewhat of certain species of *Arietites*. The near relationship, however, to the species before described is clearly proved by the younger stages of growth, which bear the general type of the *evoluti* division well expressed.

3. PERISPINCTES OBLIQUEPLICATUS, *Waagen, n. sp.* Pl. XLVIII, Fig. 2a, b.; Pl. XLV, Fig. 4a, b.

Though this species is very nearly allied to the preceding one, it differs from it so much by its smaller size that it seems necessary to distinguish it from *Per. rota*.

Per. obliqueplicatus is in its general shape flat, patelliform, with a very wide and shallow umbilicus and very compressed whorls, considerably higher than thick.

The ribs on the whorls are very numerous and thin, strongly directed towards the front, and divided on the siphonal margin into two branches, which become very indistinct in the middle of the siphonal side of the whorl. They are in most cases not less irregular than in the preceding species. The contractions of the shell are not very deep or distinct, and mostly two in number on one whorl in young specimens, but on the last whorl of the largest specimen in the possession of our Museum there are not less than four contractions of the shell. Parabolic curves of the ribs do apparently not occur in this species in smaller stages of growth.

The smallest specimen I have got for description has 35mm. in diameter. At that size the resemblance to certain forms related to *Per. curvicosta* is very large; however, the whorls are much more compressed and a distinction is easy. The ribs on the flat lateral parts of the compressed whorls are very numerous and straight, inclined towards the front, and divided mostly in two branches on the siphonal margin. The branch ribs are, as also in the adult shell, interrupted in the middle of the siphonal side of the shell.

At a diameter of about 45 mm. the body-chamber seems to commence, but the sculpture of the shell does not change on this part, but consists as before of closely arranged straight ribs; only a very short distance before the apertural margin the ribs lose their straightness to a certain degree and become a little flexuose. The apertural margin seems to have consisted of a broad, smooth contraction of the shell with an ear-shaped process on either side. The length of the body-chamber comprises about one circuit.

The lobes are not sufficiently visible on any of the specimens at my disposal to draw or describe them.

The measurements of three specimens are the following:—

				I.	II.	III.
Diameter	of the shell	...	...	76 mm.	47 mm.	34 mm.
"	of the umbilicus	...	...	42	23	15
Height	of the aperture from the umbilical suture	...	...	20	14	11
"	of the " from the preceding whorl	...	?	18	13	10.5
Thickness	of the " ...	...	...	16	12	9

The specimen No. I has its entire body-chamber preserved.

Remarks.—*Per. obliqueplicatus* is, like the preceding species, characteristic for the Dhosa oolite, and has been collected in these beds by Dr. Stoliczka at Vanda in finely grained brown oolite (four specimens), north-west of Soorka, also in oolite, (two specimens), and north-west of Jara (one specimen).

The species is rather nearly allied to *Per. rota*, W., is, however, distinguishable by its smaller size and more numerous ribs. From *Per. Indogermanus*, W., it differs, as *Per. rota*, W., by higher and more compressed whorls.

4. *PERISPHINCTES PLICATILIS*, Sowerby. Pl. LI, Figs. 2a, b, 3; Pl. LII, Fig. 3.

1817. *Ammonites plicatilis*, Sowerby: Min. Conch. II, p. 149, pl. 166 (very bad).
 1847. *Ammonites plicatilis*, (Sow.), Orbigny: Pal. Franç. Terr. Jur. I, p. 509, (pars.), pl. 192, (non pl. 191).
 1857. *Ammonites plicatilis*, (Sow.), Oppel: Jura. form., p. 603 (pars).
 1864. *Ammonites plicatilis*, (Sow.), Oppel: Palæont. Mitth. I, p. 166.
 1864. *Ammonites plicatilis*, (Sow.), Seebach: Hannov. Jur., p. 156 (pars.).
 1866. *Ammonites plicatilis*, (Sow.), Oppel: Zone des A. transvers. l. c., p. 218 (partim.) and 285.

After the statement of Seebach, that Orbigny's figure represents the true *Per. plicatilis*, and after Oppel had identified the form of the *transversarius*-layers with *Per. plicatilis*, a form which is identical with Orbigny's figure, I think there can be but little doubt that this drawing must be taken as representing *Per. plicatilis*.

The species is a little variable in regard to its ribs, as some specimens are a little finer, some not so finely ribbed, but the principal character, squarish whorls, a large umbilicus, and sharp ribs, which are divided only into two branches at the outer margin, remains always very constant in all the varieties.

Very young specimens have rather round whorls, and numerous contractions of the shell, but already at a diameter of 50 mm. the whorls become high and squarish. The ribs vary a little in their shape, principally in the mode in which they are divided on the outer margin. In some specimens are many single ones among the tripartite ribs, which go undivided over the siphonal side; in others there are sometimes, but very rarely, tripartite ribs between the dichotome ones; but in all the cases they are straight, high, and equally sharp in their lateral and siphonal parts.

On specimens exceeding a diameter of about 120 mm. the ribs get rounder and flatter, and often tripartite ribs are mixed among the others. The section of the whorls grows slowly broader, and the lateral ribs begin gradually to keep a considerable distance from each other. At 200 mm. diameter the section of the last whorl is already one quarter broader than high, the lateral ribs are converted into strong high ridges, which are about one-third of their length distant from each other; on the siphonal side, however, the ribs have disappeared entirely. This shape of the whorls keeps on now to the end of the body-chamber, that is, up to 290 mm. in diameter in a full grown specimen.

The lobes change very much according to age. In young specimens they seem very broad and simple, whilst in older individuals they are well developed. The siphonal lobe is about twice as long as broad, with two very long terminal branches. The external saddle is not very broad, with a rather short secondary lobe; the first lateral lobe has the same proportions as the siphonal, but is not quite so long, and finishes in three, not quite symmetrical branches. The first lateral saddle is very broad, with three secondary lobes; the second lateral lobe stands about 90° reverted, but is of about the same shape as the first lateral; there are yet two auxiliary lobes hanging down to form a sutural lobe.

The measurements of three specimens are the following:—

			I.	II.	III.
Diameter	of the shell	... ..	77 mm.	90 mm.	210 mm.
„	of the umbilicus	... ..	38	45	103
Height	of the aperture from the umbilical suture	... ..	23	26	49
„	of the „ from the preceding whorl	... ..	19	22	39
Thickness	of the „	... ..	18	23	52

Remarks.—*Per. plicatilis* is very common in the red iron rock of Kuntkote (nine specimens); it occurs also in the same layers at Trummo river, Burooria, and Rahpoor in Wagur; the same east of Joorun in Cutch proper, and at Gangta Bét, an isolated island in the Runn. The rock at those different localities varies between a yellow friable sandstone with many small white spots at Rahpoor, and a dark red marly iron rock east of Joorun.

Per. plicatilis is very easy to recognise if one uses the term in the sense I have here applied to it. It is always characterised by dichotome ribs, flat sides, and rounded siphonal part of the whorls. The variability lies in the ribs, which may become sometimes finer, sometimes less so, and in the more or less strong compression of the whorls, which are, however, never as thick as in *Per. Martelli*.

The form I have here in mind is principally characteristic for the zone of *Amm. transversarius*, and is very scarce below and above this layer. It is spread in this horizon throughout the whole of Europe, and even in Russia we find the same form.

5. PERISPINCTES MARTELLI, *Oppel*. Pl. LV, Fig. 3a, b.

1847. *Ammonites plicatilis*, (Sow.), and *biplex* (Sow.), Orbigny: Pal. Franç. Terr. Jur., p. 509 (pars.), pl. 191, (non pl. 192; non *Amm. plicatilis*, Sow.; non *Amm. biplex*, Sow.).
 1863. *Ammonites Martelli*, Oppel: Palæont. Mitth. II, p. 247.
 1866. *Ammonites Martelli*, Oppel: Zone des *Amm. transvers.*; Geog. Palæont. Beitr. v, Benecke, Schlönbach, Waagen, I, p. 285.

Though there is no specimen of this species in the possession of our Museum, in which the characteristic body-chamber has been preserved, yet the middle-sized specimens at my disposal are of so characteristic an appearance that I do not hesitate to use the name of *Per. Martelli* for them.

The largest specimen I have for examination has 88 mm. in diameter. In its general shape it is thick, patelliform, with square whorls and rather small umbilicus, which is surrounded by perpendicular walls. The whorls are densely ribbed, the ribs thin and sharp, originating on the umbilical edge and running, inclined a little towards the front, straight up to the siphonal margin, where they are nearly all divided into two branches, which go with a slight curve towards the front over the siphonal side of the shell.

The form of smaller specimens deviates very little from the one just described, only that in very small shells, the ribs seem to be comparatively more numerous,

and many contractions of the shell are observable, which latter, however, disappear entirely after the shell has exceeded a diameter of 10 mm.

Thus the characteristics of the species, if the body-chamber is not preserved, consist chiefly in the square whorls, the somewhat small umbilicus, and the exceedingly regular straight ribs, which remain decidedly dichotome till a short distance before the beginning of the body-chamber, where they become then trichotome.

The lobes are not observable on any of the specimens.

The measurements of a specimen entirely composed of air-chambers are the following :—

Diameter of the shell	...	...	...	...	...	...	88 mm.
„ of the umbilicus	...	...	...	...	...	...	37
Height of the aperture from the umbilical suture	...	...	...	...	...	...	30
„ of the „ from the preceding whorl	...	...	...	...	...	...	26
Thickness of the „	...	...	...	...	...	...	28

Remarks.—*Per. Martelli*, Opp., is preserved in our Museum in two specimens, which have been collected by Dr. Stoliczka at Gangta Bét, an island in the Runn, in the society of *Per. plicatilis*, Sow., in a gray sandy limestone.

It is not difficult to distinguish *Per. Martelli* from the allied species. It has got finer and more numerous ribs and thicker whorls than *Per. plicatilis*, and less fine ribs and also thicker whorls than *Per. chloroolithicus*, Guemb. From *Per. torquatus*, Sow., and *bathyplocus*, W., Oppel's species is distinguishable by more squarish and less thick whorls.

6. PERISPINCTES TORQUATUS, Sowerby. Pl. LIV.

1840. *Ammonites torquatus*, Sowerby: Transact. Geol. Soc., Lond., vol. V, p. 719, pl. 61, fig. 12 and expl.

Per. torquatus is, though rather variable, very characteristic for certain layers in the Kachh Jura, and seems to abound extremely in those places where its layers are well developed.

Like in all the *Ammonites* of this group, the form of this species is rather insignificant till a considerable diameter is attained, and it is only in examining larger specimens that one is able to characterise the species with sufficient certainty.

Specimens of the very young state have whorls of very various shape, sometimes thicker, sometimes rather thin, with finer or thicker ribs, but the section of the whorls is always a little squarish and the ribs dichotome. Growing larger the whorls become more slender, the ribs a little scarcer, and the aperture distinctly squarish. I can trace this form up to a diameter of more than 100 mm. Then it seems the siphonal side becomes more narrowly rounded, and the ribs for the greater part tripartite. I have no specimen with preserved body-chamber, and I cannot therefore state anything about the form of this part of the shell. The characteristics of the species consist, therefore, in the strictly dichotome ribs, which go in equal

strength over the siphonal side and the squarish whorls, with flat sides and a little depressed siphonal part, in the middle age; in parabolic rounded whorls and tripartite ribs in more advanced stages of growth.

The lobes are not visible on any of the specimens at hand.

The measurements of three specimens are the following :—

	I.	II.	III.
Diameter of the shell	71	100	157 mm.
„ of the umbilicus	29	46	79
Height of the aperture from the umbilical suture ...	24	31	42
„ of the „ from the preceding whorl ...	19	25	35
Thickness of the „ ...	28	38	45

Remarks.—All the specimens our Museum possesses come from the coarse red iron sandstone of the Katrol range, that is, from the middle region of the Katrol group.

There is a certain resemblance between this species and *Per. Achilles*, Orb., but the Kutch Ammonite has always a little broader and more depressed whorls, and retains the *biplex* form much longer than Orbigny's species.

Per. torquatus has not yet been found in Europe. It is doubtful if the form from the Himalayas quoted as *Per. torquatus* is the same species as the Kachh fossil.

7. PERISPHINCTES BATHYPLOCUS, *Waagen, n. sp.* Pl. L, Fig. 1a, b.

Very nearly allied to the preceding species, but distinct always in certain very constant points.

Young specimens of both species, however, resemble each other so much that in many cases it seems not possible to decide to which species some are to be counted. In other cases, on the contrary, even young examples of *Per. bathyplocus* are already thicker and more finely ribbed than similarly sized specimens of *Per. torquatus*.

Individuals of 100 mm. diameter are already distinguishable with sufficient certainty. The whorls are squarish, with flat lateral and siphonal sides, the ribs fine, often tripartite, and indistinctly interrupted on the middle of the siphonal side. Those ribs continue of the same shape till a diameter of 140 mm., with this only difference, that they become by and by regularly tripartite; but exceeding this diameter the shell attains quite a different aspect. The ribs on the sides of the whorls become much stronger and gradually more and more distant, forming high, broad, rounded ridges, extending from the umbilical to the siphonal margin and corresponding with five or six fine, low branch ribs on the siphonal part of the shell. This state remains till a very large size of the individual, only the fine ribs on the siphonal side become slowly fainter and at last vanish entirely.

In very large specimens, which, however, are yet provided with air-chambers to the end of the last whorl, the aperture is about one and a half as broad as high, so is the aperture of a large fragment 100mm. broad and 65mm. high. The ribs on both sides are very prominent, principally at their ends near the siphonal margin, forming here nearly a kind of obtuse tubercle.

The lobes are not sufficiently preserved to draw them, but it is possible to observe that they are rather simple and not very much ramified.

The measurements of a middle-sized specimen are the following:—

Diameter	of the shell	...	...	...	...	...	210 mm.
"	of the umbilicus	...	...	...	...	...	103
Height	of the aperture from the umbilical suture	...	...	...	...	...	57
"	of the " from the preceding whorl	...	...	...	...	...	50
Thickness of the	"	...	...	...	...	...	74

Remarks.—Six tolerably large specimens of more than 150mm. diameter, besides a lot of smaller individuals, are preserved in our Museum, all from the coarse iron sandstone of the Katrol range, the middle region of the Katrol group.

Per. bathyplocus is easy to distinguish from other allied forms by the great thickness of its whorls. One will in consequence of this never confound it with *Per. plicatilis* or *torquatus*; the latter form being also distinct by its coarser ribs, which are not interrupted in the middle of the siphonal side.

8. PERISPINCTES cf. SUPRAJURENSIS, *Orbigny*.

1849. *Ammonites suprajurensis*, *Orbigny*: Paléont. Franç. Terr. jurass. I, p. 563, pl. 223.

There is a very large specimen of an Ammonite in our Museum, which is not well enough preserved to give a drawing of, or to determine it with sufficient certainty, but which yet seems identical in its form with *Per. suprajurensis*, *Orb.*, and which, therefore, seems to be sufficiently interesting to be described.

The specimen has above 300mm. in diameter, and consists only of the outer whorl, the inner whorls being for the greater part destroyed. The umbilicus is large, the whorls about as thick as high, with somewhat flattened sides, and scarce thick elevated ribs on their lateral parts, which are farther distant from each other at the end than at the beginning of the last whorl, and amount to the number of thirty-two on the whole circuit. They are divided into five to six branches on the siphonal margin. The inner whorls seem, from little portions which are preserved, to have been much more finely ribbed.

The lobes are very much ramified, but not sufficiently preserved to be described in detail. So much, however, is visible that the auxiliary lobes do not run down quite straight, but form a very short sutural lobe, contrary to d'Orbigny's indication for *Per. suprajurensis*.

The measurements of the specimen are the following :—

Diameter of the shell	...	...	...	...	...	305 mm.
„ of the umbilicus	...	...	...	...	...	141
Height of the aperture from the umbilical suture	...	...	...	...	...	92
„ of the „ from the preceding whorl	...	...	...	...	...	73
Thickness of the „	...	...	...	...	...	784

The specimen has got its last air-chamber at 275mm. diameter.

Remarks.—The only specimen of this species preserved in our Museum has been collected by Dr. Stoliczka in the lowest beds of the Oomia group at Jadoora.

The determination of this specimen as *Per. suprajurensis* is not quite certain, as the lobes do not quite agree with Orbigny's description, but in other points the identity seems perfect. *Per. suprajurensis* is rather nearly allied to *Per. torquatus*, Sow., but distinguishable by more compressed whorls.

9. PERISPINCTES BLEICHERI, *P. de Loriol*, Pl. LV, Fig. 4a, b.

1873. *Ammonites Bleicheri*, P. de Loriol: Monogr. Etages Jurass sup. de Boulogne, s. m.: Mem. Soc. Phys. et Hist. nat. de Geneve, Vol. XXIII, p. 273, pl. IV, figs. 1, 2.

It was only after long and careful consideration of all the points that I decided on introducing this species under the name of *Per. Bleicheri*, the fact of true Portland species occurring here in India being so strange and unexpected that I thought a more than usual care was necessary. However, I could not succeed in distinguishing the Indian form from Loriol's species, and, though there are slight differences, they seemed not sufficient for the distinction of a new species.

The specimen I have for description is smaller than any of those figured by Loriol, and has not more than 65mm. in diameter. At this size the general shape of the shell is flat, with a rather wide, shallow umbilicus and tolerably thick rounded whorls, which are covered with fine, very sharp and high ribs about fifty in number, which begin near the umbilical suture, go in a nearly radial direction up to the middle of the sides, and are there very regularly divided into two branches, which cross without interruption over the siphonal part of the shell. As the point of division in the ribs lies rather deep towards the umbilical margin, this is on the inner whorls not covered up by the following circuit. There are two or three little distinct contractions of the shell on each whorl, which are, as in Loriol's original specimens, connected with certain irregularities in the ribs; thus the contraction is generally followed by a single undivided rib, and in Loriol's specimens preceded by a tripartite one, but this is the case only in a single instance in my specimen; here usually the preceding rib is regularly dichotome.

The lobes seem to be very simple and little ramified; they are, however, exceedingly badly preserved in our specimen. There seems to be formed no sutural

lobe by the shifted auxiliary lobes, but the latter seem to be arranged in a tolerably straight line.

The dimensions of the specimen thus described are the following :—

Diameter	of the shell	...	...	...	...	66 mm.
"	of the umbilicus	...	...	...	...	28
Height	of the aperture from the umbilical suture	...	...	...	...	24
"	of the " from the preceding whorl	...	...	...	...	20
Thickness	of the "	...	...	...	...	25

Though this specimen seems not to be full grown, it has preserved its temporary body-chamber, in the length of one circuit.

Remarks.—The only unmistakeable specimen of this species existing in our Museum has been collected by Dr. Stoliczka in the Oomia group at Gorpoor. Other specimens, also collected by Dr. Stoliczka, are too badly preserved to allow of an accurate determination, but might belong also to this species; they are from Katrol hill, Kurbya, and Moondan, having been found at these localities also in Oomia beds.

Per. Bleicheri, Lor., has been described very accurately by Mons. de Loriol, and it seems not difficult to identify the species from his figures and description. Our specimen agrees in every respect as perfectly as possible with the Portland species, except the ribs in front of the contraction of the shell, which are tripartite in Loriol's drawing, and for the greater part bipartite in our specimen. As, however, in the specimens from Boulogne the frequency of tripartite ribs seems to increase as the specimens grow larger, and my specimen is a rather small one, the scarcity of those ribs on it seemed to me not of sufficient importance to prevent the identification of the Indian form with the Portland species.

From all the species described before, *Per. Bleicheri* is distinguishable by its rounded whorls and remarkably sharp and high ribs. The developmental connection with *Per. torquatus*, Sow., and the allied forms is not very clear; however, my materials were not sufficient to prove this and the two following species to take their origin from other root species.

10. PERISPINCTES OCCULTEFURCATUS, *Waagen, n. sp.*, Pl. L. Fig. 4 *a, b*,

For a long time I was very doubtful if I should do better by uniting this species with *Per. Boidini*, Lor., or considering it as a separate species. However, as the point of division of the ribs lies constantly higher up the sides of the whorls than in the mentioned species, and is therefore nearly always concealed by the involution of the following whorl, I preferred to introduce this Indian form under a new specific designation.

The general shape of the species is flat, patelliform, with a tolerably wide, shallow umbilicus without distinct umbilical walls. The whorls are rather compressed and flattened on their lateral parts. They are covered with strong and rather numerous ribs, which originate near the umbilical suture, go a little inclined towards the front over the sides of the whorls, and are divided, a little below the siphonal margin, into two branches, which run with a slight curve towards the front over the siphonal part of the shell. There are on a specimen of about 42 mm. diameter, forty ribs on the lateral, and about seventy-eight on the siphonal part of the last whorl on account of some single ribs which are between the others. The point of division of the ribs is only, in very few instances, visible on the exposed part of the inner whorls.

The sculpture of the shell changes somewhat with age. The innermost whorls of the specimen I have got for description are entirely smooth. At a diameter of the shell of about 5 mm. very fine and closely arranged ribs appear, which become more distant from each other when the shell exceeds a diameter of 10 mm; now the definitive form is attained at least for the air-chambered part of the shell; how the body-chamber was ornamented I cannot tell, as this part of the shell is not preserved on my specimen.

The lobes are barely visible; they seem to be very short and tolerably broad, and the auxiliary lobes not forming a sutural lobe.

The measurements of the specimen are the following :—

Diameter	of the shell	...	...	...	...	43 mm.
"	of the umbilicus	...	...	...	...	28
Height	of the aperture from the umbilical suture	...	...	...	...	16
"	of the " from the preceding whorl	...	...	...	...	13
Thickness	of the "	...	...	...	...	14

Remarks.—The only specimen of this species existing has been collected by Dr. Stoliczka in the Oomia-beds on the Idder scarp.

I fear the reasons which led me to distinguish *Per. occultefurcatus* from *Per. Boidini*, Lor., will not be approved of by many who may read these lines, and they will not think it right to introduce a new specific designation for the Indian shell, which agrees exactly with *Per. Boidini* in every respect, except the point of division of the ribs, which lies a little further towards the siphonal part of the shell in *Per. occultefurcatus* than is the case in Loriol's species. The fact, however, of a species of the Portland stone occurring here in India is one of such great importance, and leads to so many suggestions, that, if the identification be not above every doubt, it seems better even to run the risk of making a bad species than to identify without perfect identity.

11. PERISPINCTES EUDICHOTOMUS, Zittel, Pl. LV, Fig. 5, *a*, *b*, *c*.1870. *Ammonites eudichotomus*, Zittel : Pal. Mitth. Vol. II, 1 p. 112, pl. 21, figs. 6—7.1873. *Perispinctes transitorius*, (Opp.) Waagen, Introduction to this volume.

There is only one specimen of this species preserved in our Museum which I considered for a long time as representing the largely umbilicated variety of *Per. transitorius*, Opp., and only now, after a careful comparison of Zittel's drawings for the purpose of the description of the species, I find that the Indian form might better be called *Per. eudichotomus*, which, however, might itself be only a variety of *Per. transitorius*.

The specimen I have for description has 44 mm. in diameter. Its general form is flat, with somewhat squarish whorls and a tolerably wide umbilicus, which is surrounded by a low, indistinct umbilical wall. The whorls are covered by sharp straight ribs, forty-four on each side of the last whorl, which begin near the umbilical suture, go nearly radial over the sides of the whorl, and are divided into two branches a little above the middle of the lateral parts of the shell. The branch ribs run straight over the siphonal side, but are cut out deeply in the middle of it, by which a furrow is formed running along the siphonal part of the shell. There are between the dichotome ribs a few simple ones.

The lobes are not visible, as the whole specimen is covered with its shell.

The measurements are the following : —

Diameter	of the shell	...	...	...	...	...	44 mm.
"	of the umbilicus	...	...	...	...	...	19
Height	of the aperture from the umbilical suture	...	...	...	...	...	16
"	of the " from the preceding whorl	...	...	...	...	...	14
Thickness	of the aperture	...	...	...	...	...	15

Remarks.—The only specimen of this species has been collected by Dr. Stoliczka in the Oomia group at Moondan. It is preserved in a dark ferruginous oolite.

The affinities and distinctions of *Per. eudichotomus* in comparison with other Tithonian species, as *Per. fraudator*, Zitt., or *Per. transitorius*, Opp., &c., have been discussed already in full by Zittel himself, and nothing remains to be added.

From all the species as yet described in this volume, *Per. eudichotomus* is easily distinguishable by the distinct furrow on the siphonal part of the shell. That it derives its origin, however, nevertheless from *Per. torquatus* or *bathyplocus* is very probable from the somewhat squarish section of the whorls, which is very clearly exhibited also by Zittel's species.

(c.) *Group of PERISPHINTES CHLOROLITHICUS, Guembel.*1. *PERISPHINTES CHLOROLITHICUS, Guembel Pl. L., Fig. 3 a, b.*

1864. *Ammonites chlorolithicus*, Guembel: Geogn. Verh. der frank. Alp., p. 55. (Separate reprint from Riehl's Bavaria, Vol. III, 9).
 1866. *Ammonites chlorolithicus*, (Guemb.) Oppel: Zone des Amm. transversarius, Geogn. Palont. Beitr. v. Benecke, Schloenbach u. Waagen, Vol. I. p. 285.

This species is very difficult to recognise from Guembel's very short description, but as I had formerly myself collected a good number of this species in the jurassic beds of Bavaria, it was not so very difficult for me to notice the form also among our Indian materials.

On the whole, one may say that *Per. chlorolithicus* is a species which is distinct from *Per. Martelli* only by somewhat higher whorls and much finer ribs. The general shape of the shell is flat, patelliform, with a rather small umbilicus and compressed whorls, with straight flat sides and a flatly rounded siphonal part. The umbilicus is surrounded by a distinct umbilical wall, which forms, however, no umbilical edge. The ribs originate near the umbilical suture, run straight, but somewhat inclined towards the front over the lateral parts of the whorl, and are for the most part divided into two branches on the siphonal margin, from where the branch ribs, with a slight curve towards the front, go without interruption over the siphonal part of the shell. The number of ribs on the lateral parts of the last whorl of a specimen of 65 mm. diameter is about seventy.

The differences in the form between smaller and larger specimens are not very considerable, only very young shells have more or less depressed whorls with many contractions of the shell; the latter get scarcer in larger specimens, whilst at the same time the whorls increase in height. The form of the body-chamber of this species is not yet known.

The lobes are not very well preserved, at least not sufficiently well to be drawn. They are strongly ramified, but not very long. The siphonal lobe is the longest of all, not very broad, and terminating in two long, slender branches; external saddle broad, with a rather large, well developed secondary lobe; first lateral lobe narrow, but not very long, a little shorter than the siphonal terminating in three slender symmetrical branches; first lateral saddle very narrow, going very high up—much higher than the external—with a very small secondary lobe in the middle; second lateral lobe not distinctly developed, but forming together with the three auxiliary lobes a large sutural lobe, which hangs down as far as the first lateral lobe.

The measurements of the specimen I have for description are the following:—

Diameter of the shell	...	...	...	...	65 mm.
„ of the umbilicus	...	...	...	...	25
Height of the aperture from the umbilical suture	...	...	...	...	22
„ of the „ from the preceding whorl	...	...	...	...	20
Thickness of the „	...	...	...	...	20

Remarks.—The only specimen of this species existing in our Museum has been collected by Dr. Stoliczka in the Dhosa oolite north-west of Soorka, and is preserved in a greenish-brown somewhat oolitic limestone.

The beds in which this species occurs in Europe are not very well adapted to show the exact horizon to which the shell belongs. It is a green oolite, which alone has till now furnished specimens of *Per. chloroolithicus*, and this oolite represents in Bavaria the zones of *Am. Lamberti* up to that of *Pelt. transversarium*. So it is not contradictory to the observations made in Europe if we find the species here in India in the Dhosa oolite, which is as nearly as possible an equivalent of the zone of *Am. cordatus* of Europe.

Per. chloroolithicus is very nearly allied to *Per. Martelli*, Opp., and is in a younger stage of growth only distinguishable from this species by more compressed whorls and finer and more numerous ribs; how the adult form may be distinct from Oppel's species I cannot state, as I have seen as yet no full grown specimen of *Per. chloroolithicus*.

2. PERISPINCTES ALTERNEPLICATUS, *Waagen, n. sp.*, Pl. L., Fig. 2a, b.

As the preceding species was very nearly allied to *Per. Martelli*, so is this one very nearly allied to *Per. torquatus*, and both must be considered as parallel species.

The general form of *Per. alterneplicatus* is flat, with a very large umbilicus and squarish whorls, which are a little higher than thick. The umbilicus is surrounded by a low perpendicular umbilical wall, which forms, however, no umbilical edge. The ribs which cover the whorls are very fine and numerous. They originate near the umbilical suture, and run with a slight curve bent a little towards the front up to the siphonal margin, where half of the number is divided into two branches, which show on the cast a slight depression in the middle of the siphonal side, whilst they go uninterruptedly over that part of the whorl if the shell is preserved. There are one or two simple ribs between two forked ones, which feature is very regularly exhibited throughout the whole of the shell.

The form of the shell does not change in the different stages of growth. Only very young specimens, of course, have depressed whorls, with many contractions of the shell, but already at a diameter of 10 mm. the typical form is attained. In large specimens contractions of the shell are very scarce and very indistinct. I have no specimen to observe the form or ornamentation of the last body-chamber.

The lobes are very much like those of *Per. chloroolithicus*. The siphonal lobe is not very long but rather narrow, with two very long slender terminating branches; external saddle broad, with a small but well developed secondary lobe; first lateral lobe tolerably broad and long, terminating with one very long medial, and two shorter lateral branches; first lateral saddle very narrow without distinct secondary lobes, reaching exceedingly high up, by far higher than the external; second lateral

lobe tolerably distinctly developed but very small; two auxiliary lobes forming a sutural lobe much shorter than the first lateral.

The measurements of the specimen I have for description are the following:—

Diameter of the shell	...	...	...	115 mm.
„ of the umbilicus	...	...	...	54
Height of the aperture from the umbilical suture	...	...	...	38
„ of the „ from the preceding whorl	...	...	...	31
Thickness of the aperture	...	...	...	34

Two-thirds of the last whorl of this specimen belong to its temporary body chamber.

Remarks.—The only specimen of this species in the possession of our Museum has been collected by Dr. Stoliczka in the Katrol-group south of Joorun, and is preserved in a hard iron nodule.

Per. alterneplicatus is rather nearly allied to several species, but can be distinguished without great difficulty from all of them. *Per. chloroolithicus*, Guemb., is more finely ribbed and has more compressed whorls. *Per. Martelli*, Opp. has less numerous ribs, which are regularly dichotome, and in *Per. torquatus*, Sow., the ribs are also much coarser. Thus *Per. alterneplicatus* is a well distinguished species, which furnishes the connecting link between *Per. chloroolithicus*, G. and *Per. frequens*, Opp.

3. PERISPINCTES FREQUENS, Oppel. Pl. LIV, Figs. 2, 2 a; 3, 3 a.

1865. *Ammonites frequens*, Oppel. Paleontolog. Mittheilungen, I, p. 295, pl. 87.

The occurrence of this species in Kutch is of high scientific interest, inasmuch as this, together with the *Steph. Nepalense*, which is also found there, may give a good hint for the parallel of the Spiti shales with the Kutch Jura and with the European Jurassic system.

One of the specimens lying before me is covered with its entire shell, not showing a trace of its lobes. The other, a small one, has only partly preserved the shell, and shows traces of the lobes on the last whorl, but though sufficient to recognize the general form, not sufficiently preserved to draw them.

The smallest specimen preserved from the Kutch Jura is of 50 mm. in diameter. The umbilicus is wide, the whorls very rounded, and thus the shell has, in many respects, some resemblance to some forms of the "*Convoluti*," but the contractions of the shell, so characteristic for this group, are wanting almost entirely on the Kutch fossil. The whorls are about half involute, but the points where the ribs are divided are yet visible in the umbilicus, when the shell of the Ammonite is preserved; if not so, the ribs on the cast seem simple and undivided till they are covered by the following whorl. The ribs are fine, high, and very numerous, fifty on the side of the last whorl, and

forty visible in the umbilicus on the preceding whorl, and 101 on the siphonal side of the last whorl of this specimen of 50 mm. in diameter; they are therefore very regularly dichotome in young specimens.

This alters, however, with the age of the species. A larger specimen, also from Kutch, has dichotome ribs till the beginning of the last whorl, but then the ribs become for the greater part distinctly trichotome, and this state remains, as is shown by specimens from the Spiti shales, till the species attains very large dimensions. It is to be remarked that in those trichotome ribs, the two branches in front are always a little longer than the third behind.

The lobes are finely cut, with long and elegant branches. In young specimens the single lobes have broader bodies than are figured in Oppel's drawings.

The measurements of the two specimens are the following:—

	I.	II.
Diameter of the shell	50 mm.	100 mm.
„ of the umbilicus	21	41
Height of the aperture from the umbilical suture ...	18	34
„ of the „ from the preceding whorl...	12	24
Thickness of the aperture	22	34

Remarks.—*Per. frequens* though not very rare in Kachh, is by no means so common there as in Spiti, and among the vast materials our Museum obtained from the former place, there were not more than four specimens of *Per. frequens* preserved. They all have been found in oolites of the Oomia group, two West of Soorka hill, one at Moondan, and one at Gurpoor.

I formerly attributed this species to quite a different horizon from that which it occupies in reality, led by a piece of oolite very similar to that in which *Per. frequens* was preserved, and which, besides several other shells, contained also some specimens of a *Hemithyris*, which I considered to be *H. myriacantha*, Desl. I cannot state now with all sufficient certainty if my determination then was right or not; that will only be settled when the Brachiopods of the Kachh Jura shall be worked out in detail, but it is certain from Dr. Stoliczka's investigations that *Per. frequens* is a species of the Oomia group.

Per. frequens, Opp., is distinguishable from all the species before described by its less squarish whorls. However, this feature is a little exaggerated in the figure given on pl. XLIV.

4. PERISPINCTES DENSEPLICATUS, *Waagen, n. sp.* Pl. XLVI, Fig. 3 *a, b*; Pl. LV, Figs. 1 *a, b*, 2.

This is the most common species of Ammonite in the Oomia group, but yet good specimens are very rare, as the Oomia beds, for the greater part consisting of coarse sandstones and conglomerates, are not very apt to furnish specimens in good preservation.

The general form of the species changes somewhat according to age, the whorls being compressed in young and more rounded in old specimens.

The smallest specimen I have for description has 35 mm. in diameter, and resembles very much similarly-sized specimens of *Per. frequens*. The whorls are rounded, compressed, higher than broad, covered by very numerous, fine, sharp ribs, which are alternately dichotome and simple; the umbilicus not very large, without umbilical wall. The alternation of the ribs serves well to distinguish this specimen from equally-sized ones of *Per. frequens*.

This form of the shell and the peculiarities of the ribs remain till the shell has obtained a diameter of about 100 mm., with the only difference that at that size the section of the last whorl is a little more depressed, and between each pair of simple ribs are enclosed two to four dichotome ones. The ribs form rather high lamellæ, if the shell is preserved, but are low and rounded, and somewhat flattened on the middle of the siphonal side on the cast.

If the shell exceeds a diameter of 100 mm. the ornamentation of the last whorl changes considerably. The fine ribs on the lateral parts of the whorl become slowly stronger, and take larger distances between them; at the same time they are no longer dichotome, but are replaced at about the middle of the sides of the whorls by four to ten fine branch ribs, which go straight over the siphonal side. At the end of the body-chamber, the latter side of the shell seems to become quite smooth; at least the cast shows barely any traces of ribs there. The body-chamber seems to commence at about 110 mm. diameter of the shell.

The lobes are not very much ramified. The siphonal lobe is rather narrow and long, terminating in four short branches; external saddle not very broad, with a well developed secondary lobe; first lateral lobe short, not very broad, terminating in three tolerably long branches; first lateral saddle not very broad, not reaching higher up than the external, with a well developed secondary lobe; second lateral lobe small, but distinct, not different in shape from the first auxiliary lobe; the three auxiliary lobes are shifted backwards, forming a sutural lobe, which is not quite as long as the first lateral.

The measurements of a middle-sized specimen are the following :—

Diameter of the shell	...	...	...	...	...	97 mm.
" of the umbilicus	...	...	...	...	...	34
Height of the aperture from the umbilical suture	...	...	...	...	...	35
" " " preceding whorl	...	...	...	...	...	25
Thickness of the aperture	...	...	...	...	...	30

Remarks.—The species is preserved in our Museum in several specimens which have all been collected in the Oomia group at the following localities: West of Soorak hill one specimen, in finely grained brown oolite; north of Moondan, eight specimens, in sandy brown oolite; and at Gurpoor, one, also in sandy oolite.

Per. denseplicatus is rather nearly allied to *Per. frequens*, Opp., but is distinguishable by a somewhat smaller umbilicus, dichotome ribs at a size, when Oppel's

species has got already for a long time trichotome ones, and a body-chamber which is perfectly differently ornamented. In this latter respect our species somewhat resembles *Per. metamorphus*, Neum., but differs from it by much finer ribs.

(d.)—ISOLATED SPECIES.

1. PERISPINCTES VIRGULOIDES, *Waagen, n. sp.* Pl. XLVII, Fig. 4 *a, b* ;
Pl. XLIX, Fig. 1 *a, b*.

Though from the form of the smaller specimens of this species it seems very probable that it is very nearly allied to *Per. plicatilis*, Sow., or *Martelli*, Opp., yet the form of the full grown shell deviates so strongly from that of the species just mentioned, that I thought it better to consider *Per. virguloides* as an isolated species.

The general appearance of differently sized specimens varies very much, inasmuch as small ones have got squarish whorls, whilst the whorls in the nearly full grown shell are compressed, with a very narrowly rounded siphonal side.

The smallest specimen I have got for description resembles very much *Per. virgulatus*, Quenst. It has 42 mm. in diameter, the whorls are somewhat compressed, as high as broad, with flat lateral and a little depressed siphonal parts, in consequence of which the section of the whorl is squarish. The umbilicus is wide and shallow, surrounded by indistinct umbilical walls. The ribs are fine and numerous, however, not so fine as in Quenstedt's drawing of *Per. virgulatus*; they are inclined towards the aperture, and divided on the outer margin into two fine branches, which go with a slight curve towards the front over the siphonal side. Contractions of the shell are not visible except on the inner whorls, where two are observable on each circuit.

The form of the shell just described remains nearly unchanged up to a diameter of about 60 mm. Then the siphonal part of the shell begins to project higher and at the same time to be more narrowly rounded, by which the lateral parts of the whorl are caused to slope towards the outer margin, and equally the points of partition of the ribs are better visible in the side-view. Also the curve towards the front of the ribs on the siphonal side is more distinctly developed. There is, however, no specimen in our Museum with body-chamber preserved.

The lobes are not distinctly visible on any of the specimens; it can, however, be made out that the siphonal lobe is very long and rather slender; external saddle not very broad, without well developed secondary lobe; first lateral lobe broad, not as long as the siphonal; first lateral saddle reaching by far higher up than the external, not very broad; second lateral lobe distinct, but very small; auxiliary lobes hanging down to form a sutural lobe a little longer than the first lateral.

The measurements of two specimens are the following :—

				I.	II.
Diameter of the shell	..	..	...	42 mm.	118 mm.
„ of the umbilicus	...	...	...	17	49
Height of the aperture from the umbilical suture	...	...	...	14	34
„ „ „ preceding whorl	...	...	...	11	25
Thickness of the aperture	...	...	...	14	28

Remarks.—This species belongs to the fauna of the Kuntkote sandstone, and has been collected in that bed at two localities : at Kuntkote in the red ferruginous sandstone, six specimens ; and at Gangta Bet in a very hard iron sandstone, five specimens.

Young specimens of this species, as mentioned, very closely resemble *Per. virgulatus*, Quenst., but can easily be distinguished by less numerous ribs and indistinct contractions of the shell. Full grown individuals cannot easily be mistaken for any other species.

2. PERISPINCTES SPARSIPLICATUS, *Waagen, n. sp.* Pl. XLIX, Fig. 2 *a, b*.

This is a very strange species, which, from its general appearance, would be rather attributed to the genus *Stephanoceras*, and considered as allied to *St. Humphriesianum* or a similar species, than as belonging to the genus *Perispinctes*. However, the numerous contractions of the shell, which are observable on closer examination, prove beyond any doubt that it is a true *Perispinctes*.

The general shape of the species is thick, patelliform, with a very wide, deep umbilicus without umbilical walls, and broad, depressed whorls, which barely envelope each other. The whorls are covered by distant, high and sharp ribs, which originate near the umbilical suture, and are divided on the outer margin into two sharp, elevated branches, which go straight without interruption over the siphonal part of the shell. I count, on a specimen of 68 mm. diameter, thirty-three ribs on the lateral and sixty-four on the siphonal part of the last whorl. There are mostly two contractions of the shell on one circuit, which are sometimes preceded by a tripartite rib, but always followed by a single undivided one.

This form remains unchanged from the smallest stages of growth up to the end of the body-chamber ; only the body-chamber seems to be a little contracted towards the end, and causes thus the umbilicus to widen a little. The body-chamber seems to commence at about 90 mm. diameter of the shell.

The lobes are only very badly visible. The siphonal lobe seems very long, and comparatively narrow ; external saddle broad, with a small secondary lobe in the middle ; first lateral lobe yet on the siphonal part of the whorl very small, barely of half the length of the siphonal lobe ; first lateral saddle very broad with a small secondary lobe ; second lateral lobe exceedingly small, but distinctly developed, in a position on the lateral part of the shell ; two very small auxiliary lobes form a sutural lobe about as long as the first lateral.

The measurements of a specimen composed of air-chambers are the following :—

Diameter of the shell	...	...	..	86 mm.
„ of the umbilicus	...	...	...	43 „
Height of the aperture from the umbilical suture	...	...	...	26 „
„ of the „ from the preceding whorl	...	...	...	20 „
Thickness of the „	...	...	...	37 „

Remarks.—The only specimen of this species preserved in our Museum has been collected by Dr. Stoliczka in the lowest beds of the Katrol group, immediately above the Dhosa oolite north-north-east of Gudjinsir, and is preserved in a gray sandy limestone.

The general form of *Per. sparsiplicatus* recalls to memory certain forms of the Russian Jura without, however, exactly agreeing with any of them.

SECTION V. PERISPHINCTES POLYPLOCI.

1. PERISPHINCTES LEIOCYMON, *Waagen, n. sp.* Pl. LII, Figs. 1, 1a.

A very flat, disciform species, with rounded siphonal part, flattened whorls, and large umbilicus.

I have no small specimen to examine, the only well preserved specimen lying before me having a diameter of 145 mm.

At this size the form of the shell is very characteristic; the whorls are flat, strongly compressed, about twice as high as broad, with a very narrowly rounded siphonal side. The ribs are very fine and numerous, with a slight curvature directed against the aperture; near the siphonal margin they are irregularly, that is, sometimes lower down, sometimes higher up, divided into three faint branches, which go straight over the siphonal side. The ribs are interrupted by oblique and rather deep contractions of the shell, of which about one exists on every half whorl.

The lobes are not visible, as the whole part of the shell, which contains the air-chambers, is compressed.

The measurements of the specimen are—

Diameter of the shell	...	...	...	...	145 mm.
„ of the umbilicus	...	...	...	...	61
Height of the aperture from the umbilical suture	...	...	...	...	47
„ of the „ from the preceding whorl	...	...	...	...	38
Thickness of the „	...	...	...	...	38

Remarks :—The specimen I have just described is from the red iron rock of Kuntkote.

Per. leiocymon is allied to several species of the group of *Per. polyplocus*, and it seems necessary to point out the distinctive characters in order to enable others to recognise the species.

The species which are the most nearly allied are *Per. polylocus* and *Per. Lothari*, but both are easy to distinguish from our species by much more distant ribs on the sides of the whorl, which are also more irregularly divided near the siphonal margin and much sharper. By this particular shape of the ribs, *Per. leiocymon* recalls certain forms of the group of *Per. Martiusi*, and forms such a very interesting connecting link between this group and the *Polyloci*, both of which Neumayr had already suspected to be in developmental connection together.

SECTION VI. PERISPHINCTES INTERRUPTI.

(a.) Group of PERISPHINCTES REHMANNI, *Oppel*.

(1.) PERISPHINCTES REHMANNI, *Oppel*, Pl. LVIII, Figs 1, 1a, 1b.

1862. *Ammonites Rehmanni* Opp., Palæont. Mitth. I, p. 153, pl. 48, fig. 1.

1857. „ „ Oppel, Juraform. p. 551.

Only a fragment of this species is preserved in our Museum, but it shows sufficiently all the characteristics of the species to allow of an exact determination.

The whorls are thick and rounded; the umbilicus wide. The ribs are few in number near the umbilical margin; on the middle of the sides are strong spines, and here the primary ribs are replaced by five to six secondary ones, which go up to the siphonal side and finish here, leaving a not very broad flat space in the middle of this part of the shell. The contractions of the shell are oblique, deep and strongly marked.

The lobes are very long and slender. The siphonal lobe is long, narrow, with four very long, ramified and fine branches; external saddle symmetrical, not very broad, with a long but simple secondary lobe; first lateral lobe extremely long and narrow, finishing in one long branch; first lateral saddle asymmetric with a small secondary lobe; there follow yet four lobes, of which the first two are about equal in size. The three last lobes are hanging down to a large sutural lobe.

To give the measurements seems not of any use, as the specimen is only a fragment, and the size and thickness of the whorls may be seen from the drawing.

Remarks.—The fragment of *Per. Rehmanni* I have for examination is preserved in a fine sandy oolitic rock, belonging to the *Macrocephalus* shales, and has been collected at Keera hill near Charee.

Per. Rehmanni is extremely difficult to recognise in so large specimens as that which I have to examine; in fact, the species has never yet been found so large in Europe; and the determination is therefore not beyond doubt.

From the other forms of the same group, which are found in Kutch, *Per. Rehmanni* is distinguishable by more depressed whorls and five to six partite ribs.

2. PERISPHINCTES ANCEPS, *Reinecke*, Pl. LVII, Fig. 4a, b, and
Pl. LIX, Fig. 1a, b.

1818. *Ammonites anceps*, *Reinecke*: Mar. protog. Naut. et Argon., fig. 61.
1830. " *dubius* (Schloth.), *Zieten*: Verst. Württemb., p. 1, pl. 1, fig. 2.
1846. " *Parkinsoni coronatus*, *Quenstedt*: Cephalop., p. 147, pl. 11, fig. 8.
1848. " *anceps* (Rein.), *Orbigny*: Pal. Franç. Terr. Jurass., I, p. 462, pl. 166, 167.
1857. " *anceps* (Rein.), *Oppel*: Jura form., p. 556.
1858. " *anceps* (Rein.), *Quenstedt*: Jura, p. 474, pl. 63, f. 12.
1871. *Perisphinctes anceps* (Rein. sp.), *Neumayr*: Abh. d. k. k. Geolog. Reichsanst., vol. V, p. 44.

It was only after long hesitation that I accepted the name of *Per. anceps* in preference to *Per. Greppini* for our Indian Ammonite, which occurs, like *Per. anceps* in Europe, in beds intermediate between those of *Steph. macrocephalum* and those with *Pelt. athleta*. The fact, however, is, that I cannot distinguish the true *Per. Greppini*, or else there exist here in India intermediate forms which make a distinction extremely difficult. In order, therefore, to enable the European reader to judge himself about the Indian shell, I have figured two varieties, of which one possibly might be considered as *Per. Greppini*. I stick to the old name, as at least a part of my specimens agrees perfectly with *Orbigny's* figures on pl. 167.

I have no small specimen to observe the first stages of growth, but from the inner whorls exposed in larger shells, it seems that they are never as much inflated as is shown by *Orbigny's* figs. 1 and 2, p. 166. The whorls seem to be as broad as high, with a rather prominent siphonal part. They are covered by not very numerous, very high and sharp ribs, which are divided into two branches at about the middle of the sides, and bear on the point of division a rather long and pointed spine. The branch ribs are interrupted by a deep furrow in the middle of the siphonal side of the shell.

As the shell grows larger, the siphonal part of the shell seems to become further projecting, and in larger specimens the point of division of the ribs is always in the lower third of the height of the whorl, just as it is drawn on pl. 167 by *Orbigny*.

Among the larger specimens the same two varieties which have been distinguished by *Orbigny* and have been considered by him as males and females can be recognised. One variety with thick inflated whorls and strong spines grows larger than the other, which has more compressed whorls, and ribs which lose their spines entirely towards the end of the body-chamber. However, in both varieties the ribs are never divided into more than four branches. Contractions of the shell are very deep and numerous in small specimens, but little distinct in large individuals.

The lobes are not visible on any of the specimens.

The measurements of two specimens, one of each variety, are the following :—

					I.	II.
Diameter of the shell	...	...	...	...	144 mm.	80 mm.
„ of the umbilicus	...	...	...	...	62	38
Height of the aperture from the umbilical suture			...	...	46	25
„ of the „ from the preceding whorl...			...	...	35	?
Thickness of the aperture	...	...	...	...	50	20

The specimen No. II has the greater part of its body-chamber preserved.

Remarks.—Though *Per. anceps* seems not to be very common in Kachh, yet it is not very rare either. There have been found in the Joora hills, or the road between Jooria and Dhosa, one specimen, preserved in a finely grained, sandy oolite; at Keera hill near Charee three specimens, preserved in hard iron nodules; and in the Charvar range one specimen, also preserved in an iron nodule. At all the localities mentioned the layers which contained the species were the beds between the oolites with *Steph. macrocephalum* and the shales with *Pelt. athleta*.

As I stated already before, it is very difficult to distinguish *Per. anceps* from *Per. Greppini*, principally as Oppel has not given a figure of the latter species, and I cannot therefore state beyond doubt whether some of the specimens ought not to be considered as belonging to it. From other allied species *Per. anceps* can be distinguished by the somewhat higher whorls and differently arranged ribs.

(b). Group of PERISPHINCTES SULCATUS, *Hehl*.

1. PERISPHINCTES DECORUS, *Waagen, n. sp.* Pl. LVII, Fig. 3a, b, c.

This species with great probability belongs to a small but very characteristic group. Though the point of partition of the ribs is not on the umbilical margin as in *Per. sulcatus*, yet the irregularity in this respect in our species, the ribs being divided sometimes very low down, sometimes high up near the umbilical margin, together with the rapid increase in height of the whorls and the strangely oblique situation of the contractions of the shell, seem to indicate a relationship to Hehl's species.

There is only one specimen of *Per. decorus* preserved in our Museum, and this is only one-half; but as it has been found in the Putchum group, and there is but little hope of ever finding a much better specimen, I am obliged, in order to give some idea of the Cephalopod fauna of the Putchum group, to describe and name even this specimen.

The general shape of the species is flat, patelliform, with a rather small umbilicus surrounded by a not very distinct umbilical wall and very compressed whorls, which are a good deal higher than broad. They are broadest near the umbilical margin, and the lateral parts of the shell slope from there gradually towards the rather narrowly rounded siphonal part. The whorls are covered by very numerous, fine, not very prominent ribs, which originate on the umbilical margin and go in

about a radial direction towards the siphonal side. They are divided very irregularly, sometimes below, sometimes far above the middle of the lateral parts of the shell, into mostly two branches, which are interrupted by a broad furrow in the middle of the siphonal side of the shell. Sometimes the ribs, after having been about parallel for a short space of the circuit, suddenly take another direction, and then five or six ribs seem to originate from the same point on the umbilical margin. This takes place where on the inner whorls contractions of the shell occur, and seems to replace the latter on the outer whorls.

The smaller stages of growth have broad, roundish whorls, about as thick as high, with a very small spine on every rib on the middle of the sides, up to a diameter of the shell of not quite 15 mm. Exceeding a diameter of the shell of 25 mm. the whorls begin to become higher than broad; there are, however, still observable very deep and distinct contractions of the shell, about two to three on each circuit; the latter become only indistinct when the shell exceeds a diameter of 40 to 45 mm.

The lobes are long and very much ramified. The siphonal lobe is tolerably broad and long, with long, slender, terminating branches; external saddle not very broad, with a long narrow secondary lobe in the middle; first lateral lobe very long and narrow, longer than the siphonal, terminating in three very long and thin branches; first lateral saddle very narrow, without distinct secondary lobe; second lateral lobe not distinctly developed, very small, of the form of the secondary lobe in the external saddle; two auxiliary lobes hang down to form a sutural lobe nearly as long as the first lateral.

The measurements of the specimen are the following :—

Diameter	of the shell	...	...	...	...	...	90 mm.
„	of the umbilicus	...	...	...	...	...	32
Height	of the aperture from the umbilical suture	...	...	...	...	...	35
„	of the „ from the preceding whorl	...	...	...	...	...	29
Thickness	of the „	...	...	...	...	...	22

Remarks.—The only specimen of this species existing in our Museum has been collected in the coral beds of the Putchum group north-west of Jumara, and is preserved in a hard yellowish-gray limestone.

It is not difficult to distinguish *Per. decorus* from any other species of the division of the *Interrupti*, as the perfect absence of spines in only half grown specimens and the compressed whorls occur in no other species. Much greater is the resemblance to certain species of the *Parkinsoni* group, but the occurrence of contractions of the shell in our species shows clearly that it belongs to another genus. From *Per. sulcatus*, Hehl., and *Per. polymorphus*, Orb., with which alone our species can be compared, it is distinguishable by ribs, which are not divided at the umbilical margin and by contractions of the shell, which are less distinct and numerous. On the whole, it seems to me that *Per. decorus* represents a transitional form from the group of *Per. sulcatus* to that of *Per. Rehmanni*.

(c). ISOLATED SPECIES.

1. PERISPINCTES ARTHRITICUS, *Sowerby*. Pl. LIX, Fig. 2*a*, *b*, *c*.

1840. *Ammonites arthriticus*, Sowerby: Trans. Geol. Soc., Lond., II Ser., vol. V, pl. 23, fig. 10 and expl.

This Ammonite was for a long time entirely mistaken, as Orbigny in his *Paléontologie Française* has figured under this name a totally different species, which is remarkable by the total want of ribs between the spines and the umbilical margin.

The real *Per. arthriticus* is a middle-sized species, with comparatively small umbilicus, rounded whorls, and very strong ornamentation.

The whorls, though rounded, are a little higher than broad, covered with strong rounded ribs, which begin simple and very few (ten) in number on the umbilical margin, and are elevated to a high rounded spine already before they reach the middle of the sides.

From here they are replaced by five to six finer ribs, of which two or three are in connection with the spine; those secondary ribs have a strong direction against the aperture and are slightly depressed in the middle of the siphonal side; the cast shows a furrow on that part of the shell.

Young specimens very much resemble *Per. anceps*, Rein., but they have always stronger ribs and spines on the sides of the whorls. The contractions of the shell are deep and very numerous in them, commonly three on one whorl, but become much fainter and nearly undistinguishable in larger specimens. The furrow in the middle of the siphonal side is also deep only in young examples.

The lobes are characteristic, much shorter than those of *Per. Rehmanni*, Opp. The siphonal lobe is about twice as long as broad, with slender ramified branches at the end; the external saddle is broad, with a well developed secondary lobe in the middle; the first lateral lobe is about as long as the siphonal, slender, and finishing in one long unsymmetrical branch; the first lateral saddle is narrow, with two small secondary lobes. All the following lobes are equal in size and similar in shape except the two last auxiliary lobes, which are considerably smaller; they all hang down forming a large sutural lobe.

I give the measurements of the largest specimen I have to examine with those of the inner whorls of the same specimen—

				I.	II.
Diameter	of the shell	...	...	38 mm.	105 mm.
"	of the umbilicus	...	...	15	39
Height	of the aperture from the umbilical suture	...	...	14	40
"	of the " from the preceding whorl	...	...	12	32
Thickness	of the "	...	...	20	36

Remarks.—The specimens preserved in our Museum are three in number, all from the iron nodules of Keera hill near Charee. (Beds with *Perisph. anceps*.)

Perisphinctes arthriticus has in its general form much resemblance to *Per. anceps* or *Rehmanni*, but the ribs are thicker and stronger than in both these species, and the flat band along the middle of the siphonal side is wanting already in middle sized specimens.

It is doubtful if the species ever has been found in Europe, as the form which is figured by Orbigny under the designation of *Amm. arthriticus* represents another species.

2. PERISPINCTES JOORAENSIS, *Waagen*. Pl. LII, Fig. 4a, b.

A very remarkable Ammonite, representing the form of *St. Parkinsoni* in a (geologically) much higher layer.

The umbilicus is very wide, the whorls rounded, nearly like a string, about as high as broad. Ribs very numerous, sharp, simple till the outer margin, directed against the aperture. On the outer margin they are divided for the greater part into two secondary ribs, often, however, remaining also quite simple; they are interrupted on the middle of the siphonal side by a flat furrow, which they reach under an acute angle. The contractions of the shell are deep, oblique and very irregular in number. On some whorls of the same specimen are three of them at short distances, on others only one or none at all.

The lobes are not visible.

The measurements of the single specimen I have to examine are the following :—

Diameter	of the shell	...	...	...	56 mm.
"	of the umbilicus	...	...	...	22
Height	of the aperture from the umbilical suture	...	...	...	14
"	of the " from the preceding whorl	...	...	...	11
Thickness	of the "	...	...	...	15

Remarks.—The specimen of this species in our Museum comes from the Dhosa oolite of the Joora hills. The resemblance of the species to some forms of the *Parkinsoni* group is really astonishingly great, and, principally the variety which is figured by Quenstedt as *Parkinsoni depressus* (Jura, pl. 63, fig. 9) is distinguishable only by thicker and less numerous ribs (which characters are, however, variable in *St. Parkinsoni*) and the want of contractions of the whorl. This latter point is the deciding one, as *St. Parkinsoni* never has such contractions, and the occurrence of them in our species shows clearly that it belongs to the neighbourhood of *Perisph. anceps* and allied species, and not to the group of the *Parkinsoni*. From all the species allied to *Per. anceps*, our species is distinct by its fine lateral ribs, the want of spines, large umbilicus, and rounded whorls.

Perisphinctes Jooraënsis has not yet been found in Europe.

Genus ANCYLOCERAS, *Orbigny*.

It is very difficult to say anything definite about this genus, because in the present state of our knowledge of fossil Cephalopoda, it seems very doubtful if the simple fact of an open spiral in a cephalopod shell is sufficient to characterise a separate genus. This much, however, seems certain, that the species of the genus occurring in jurassic beds are something very different from those of the cretaceous formation, as is clearly shown by the lobes, which, in the former case, have the second lateral lobe the largest, whilst in the latter the first lateral lobe is by far the predominant one.

Thus the genus will have to be divided into two, for one portion only of which the name of *Ancylloceras* could be retained. Orbigny, in proposing the genus, mentions both jurassic and cretaceous species, but as only one jurassic species was known to him at that time, it is evident that the name was meant especially for the cretaceous fossils. In consequence of this, there ought to be created a new designation for the jurassic species of *Ancylloceras*, and I should have done so if my materials of this genus had been more complete.

There is a general belief, and to all appearance this seems to be right, that the jurassic *Ancylloceras* take their origin from some species of *Stephanoceras*, more or less allied to *St. Parkinsoni*, Sow. So much the more strange then is it, that *Anc. calloviense* occurs here in India where every trace of an Ammonite of the *Parkinsoni* group is wanting; the occurrence of this species here in India in the beds of *Per. anceps*, whilst it is generally found in Europe in the *Macrocephalus* strata, leads one to suggest that it had been travelling during the interval of time between the formation of the two zones, and is to be considered as an immigrant from the European seas.

1. ANCYLOCERAS CALLOVIENSE, *Morris*. Pl. LVI, Fig. 3a, b.

- 1845. *Ancylloceras calloviense*, Morris: Ann. and Mag. Nat. Hist., ser. I, vol. 15, p. 32, pl. 6, fig. 3.
- 1850. " " (Morr.) Orbigny: Pal. Franç. Ter. Jur. I, p. 588, pl. 230, figs. 1—4.
- 1857. " " (Morr.) Oppel: Jura form., p. 561.
- 1870. " " (Morr.) Neumayr: Abh. d. k. k. geolog. Reichsanst., vol. v.

The species seems not to be very rare at certain localities, but it is always only the innermost whorls which are preserved, and thus the determination is rather difficult.

In all the specimens I have got for examination, the whorls are very regularly spiral, far distant from each other, and slowly increasing in thickness. They are roundish in section, and covered with numerous fine sharp ribs, which are never dichotomous, and each of which bears two little spines, one at the siphonal margin, and one near the middle of the siphonal side. Thus two rows of spines are formed on each side of the whorl, between which a tolerably broad smooth zone

runs along the middle of the siphonal side, as the ribs do not cross over this part of the shell. On the antisiphonal part the ribs are very faint, barely perceptible, with a slight curve towards the front.

The lobes cannot be observed on any of the specimens.

Remarks.—The specimens, which are all rather small and fragmentary, are seven in number, and have all been found at Nurrha in the beds with *Perisph. anceps*.

Though the larger state of growth of the Indian shell is not known to me, yet the inner whorls at my disposal agree so exactly with the inner whorls in Mr. Morris' drawing, fig. 3*b*, that I do not hesitate to unite the fossil from Nurrha with *Anc. calloviense*.

Ancyl. calloviense is found in Europe generally in the beds with *Steph. macrocephalum*.

GENERAL RESULTS.

Though the class of the Cephalopoda is one of the most important among the fossil invertebrate animals, it still might seem a little hazardous to speak of general results besides the description of species obtained from the examination of these remains, as they belong only to a very limited area, and can be attributed only to a very limited number of layers. It cannot, however, be denied that to these Kachh fossils attaches a specially higher interest, because they are the first set of jurassic species which, out of Europe, have been collected according to the more minute divisions of the formation, and which could be therefore described in an accurate monographical manner. It may not, therefore, be deemed too forward on my part if I try to draw some conclusions from the species I have determined in the preceding pages in two different senses, (1) from a geological, and (2) from a palæontological point of view. Both united may then throw some light upon one or other of the principal questions which are now being discussed in the scientific world.

Before, however, I proceed to do so, it is not more than just to mention two names with the utmost gratitude on my part: they are those of Dr. Th. Oldham and of Dr. Ferd. Stoliczka, as without the most important aid from both these men, I never should have been able to found my speculations on so firm a ground as I am in a position to do now. When I had, in 1871, finished the preliminary examination of the Jurassic Cephalopoda of Kachh, and had suggested from the materials then at my disposal that in the jurassic formation of the province just mentioned several palæontological horizons could be distinguished, Dr. Oldham, in his truly scientific love of truth, and well aware of the importance of the discovery thus opened up, despatched the much regretted Dr. Stoliczka in the working season 1871-72 to run once more over the ground and to ascertain if there was any sound foundation for these statements. The latter never lived to see the results of this (as well as of so many other travels and labours which he undertook) appear before the public, but for me it is so much more invaluable to have his authority as to the distribution of the fossils in the different beds, as when proceeding to the field, he still was perfectly convinced that minute geological horizons identical with those of Europe could not exist here in India. My greatest gratitude is, therefore, due to him, that he did not hesitate one moment after having ascertained the fact, not only to accept my divisions, but to improve greatly upon them and to collect all his fossils according to such fixed horizons. The scientific world, therefore, is not indebted to me for the divisions of the Kachh Jura adopted in the present volume, but solely and entirely to Dr. Stoliczka, who had intended to give an accurate geological description of the Kachh secondary formations, and had been prevented doing so before his death only by his joining the Yarkand mission,

In order to give, in the first place, a general idea of the number, the geological and geographical distribution, and the affinities of the single species, I give here a general list in which all those features are easily recognisable, and it is only to be remarked that the following abbreviations are used:—c. = common, n.c. = not common, r. = rare, and v.r. = very rare.

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.									EUROPE.
				PUTCHUM GROUP.	CHAREE GROUP.				KATROL GROUP.		OOMIA GROUP.		
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol sandstone.			
	BELEMNITES. GASTROCOELI. I.—CANALICULATI. (a.) Gr. of <i>B. canaliculatus</i> .												
1	<i>B. Kuntkotensis</i> , Waagen ...	1	I, 3	...	...	...	...	...	c.	n.c.	...	
2	„ <i>orientalis</i> , Waagen ... (b.) Gr. of <i>B. Blainvillei</i> .	5	I, 4	...	...	...	...	v.r.	...	...	...
3	<i>B. spec. indet.</i> ...	6	—	...	...	...	...	...	v.r.	r.	...	
	II.—HASTATI. (a.) Gr. of <i>B. pistilliformis</i> .												
4	<i>B. claviger</i> , Waagen ...	6	II, 2	...	...	...	...	...	...	n.c.	...	
	(b.) Gr. of <i>B. Duvalianus</i> .												
5	<i>B. Katrolensis</i> , Waagen ...	7	II, 7, 8, 9	...	...	...	...	...	c.	?		
6	„ <i>Sauvananus</i> , Orb. ... (c.) Gr. of <i>B. hastatus</i> .	8	II, 6	...	...	...	...	n.c.	...	...	...	Zones of <i>Am. Lamberti</i> and <i>Am. cordatus</i> .
7	<i>B. fusticulus</i> , Waagen ...	9	I, 2	...	...	...	...	...	v.r.	...	...
8	„ <i>Stoliczkanus</i> , Waagen ...	10	I, 1	...	...	...	...	...	n.c.	...	...
9	„ <i>cf. hastatus</i> , Blainv. ...	11	—	...	...	?	c.	n.c.	...	...	...	Zones of <i>Pelt. athleta</i> , <i>Am. Lamberti</i> , and <i>Am. cordatus</i> .
10	„ <i>Jumarensis</i> , Waagen ... (d.) Gr. of <i>B. fusiformis</i> .	12	II, 5	...	v.r.	...	...	...	...	...	...
11	<i>B. Gerardi</i> , Opp. ...	13	II, 3	...	...	r.	n.c.	n.c.	...	...	...
12	„ <i>Calloviensis</i> , Opp. ...	14	II, 4	...	...	n.c.	...	...	...	...	...	Zone of <i>Per. anceps</i> .
13	„ <i>subhastatus</i> , Ziet. ...	14	II, 1	...	n.c.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
	NOTOCOELI. I.—CONOPHORI. (a.) Gr. of <i>B. conophorus</i> .												
14	<i>B. Oldhamianus</i> , Waagen ...	15	I, 5, 6	...	...	r.	r.	...	...	...	...

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.								EUROPE.
				PUTCHUM GROUP.	CHAREE GROUP.				KATROL GROUP.		OOMIA GROUP.	
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol sandstone		
	NAUTILUS.											
	(a.) Gr. of <i>N. lineatus</i> .											
15	<i>N. Wandaensis</i> , Waagen ...	17	IV, 3	r.	Zone of <i>St. macrocephalum</i> .
16	„ <i>Calloviensis</i> , Opp. ...	18	III, 2	..	...	c.	...	...	...	...	...
	(b.) Gr. of <i>N. hexagonus</i> .											
17	<i>N. Kamagunensis</i> , Waagen ...	19	III, 1	...	...	r.	...	...	...	...	..
	(c.) Gr. of <i>N. subinflatus</i> .											
18	<i>N. intumescens</i> , Waagen ...	20	III, 3	...	...	r.	...	...	...	...	..
	(d.) Gr. of <i>N. aganiticus</i> .											
19	<i>N. Kutchensis</i> , Waagen ...	20	III, 4	...	...	v.r.	...	...	...	...	...
	(?) Gr. of <i>N. Mojsisovicsi</i> .											
20	<i>N. Jumarensis</i> , Waagen ...	21	IV, 1, 2	...	r.	...	...	...	...	...	...
	PHYLLOCERAS.											
	(a.) Gr. of <i>Ph. heterophyllum</i> .											
21	<i>Ph. cf. Kunthi</i> , Neum. ...	25	V, 2	v.r.	Zone of <i>Asp. acanthicum</i> and Tithon.
	(b.) Gr. of <i>Ph. taticum</i> .											
22	<i>Ph. vicarium</i> , Waagen ...	26	V, 4	...	...	v.r.	...	...	...	...	...
23	„ <i>Feddeni</i> , Waagen ...	27	VII, 1	...	...	v.r.	...	...	...	...	...
24	„ <i>Jaraense</i> , Waagen ...	28	V, 6	...	...	...	...	v.r.	...	...	...
25	„ <i>insulare</i> , Wangen ...	29	IX, 3	...	...	...	...	...	r.	...	...
26	„ <i>ptychoicum</i> , Quenst. ...	30	VII, 2	...	...	...	...	...	...	v.r.	...
	(c.) Gr. of <i>Ph. Capitanei</i> .											
27	<i>Ph. disputabile</i> , Zitt. ...	31	VI, 1, 2, 3...	...	c.	...	...	...	...	...	...
28	„ <i>Lodaiense</i> , Waagen ...	32	V, 5, VI, 4	...	...	...	...	n.c.	...	...	...
29	„ <i>Benacense</i> , Catullo ...	33	V, 3	...	...	...	...	...	...	r.	...
	(d.) Gr. of <i>Ph. ultramontanum</i> .											
30	<i>Ph. mediterraneum</i> , Neum. ...	34	V, I, VII, 3	...	...	c.	...	...	...	...	...
	LYTOCERAS.											
	(a.) Gr. of <i>L. Eudesianum</i> .											
31	<i>Lyt. rex</i> , Waagen ...	36	VIII, 1	...	...	...	...	...	...	r.	...

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.									EUROPE.
				PUTCHUM GROUP.	CHAREE GROUP.				KATROL GROUP.		OOMIA GROUP.		
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol group.			
32	<i>Lyt. Adeloides</i> , Kud. ... AMALTHEUS.	37	VIII, 2 ...	...	n.c.	...	...	...	...	...	...	Zone of <i>St. ferrugineum</i> .
33	<i>A. pustulatus</i> , Rein. ...	40	IX, 2 ...	...	...	...	r.	...	...	...	...	Zone of <i>Per. anceps</i> .
34	„ <i>Schaumburgi</i> , Waagen ... HAPLOCERAS.	41	IX, 1 ...	...	...	...	r.	...	...	...	...
	(a.) Gr. of <i>H. rasile</i> .												
35	<i>H. cf. tomephorum</i> , Zitt. ... (b.) Gr. of <i>H. psilodiscus</i> .	43	VII, 4 ...	...	...	...	...	...	...	...	v.r.	Tithonian.
36	<i>H. deplanatum</i> , Waagen ... (c.) Gr. of <i>H. Fialar</i> .	44	XI, 9 ...	...	...	...	...	...	...	v.r.	...	
37	<i>H. propinquum</i> , Waagen ... OPPELIA.	45	XI, 4 ...	...	...	...	...	...	...	r.	...	
	(a.) Gr. of <i>O. subradiata</i> .												
38	<i>Opp. subcostaria</i> , Opp. ...	48	X, 1, 2 ...	...	n.c.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
39	„ <i>cf. glabella</i> , Leck. ... (b.) Gr. of <i>O. fornix</i> .	49	X, 7 ...	...	...	...	r.	...	...	...	...	Zone of <i>Am. Lamberti</i> .
40	<i>Opp. fornix</i> , Sow. ...	50	XIV, 7 ...	...	...	v.r.	...	...	...	...	...
41	„ <i>Nurrhaensis</i> , Waagen ... (c.) Gr. of <i>O. superba</i> .	51	XI, 2, XIV, 3, 4, 5, 6.	...	...	c.	...	...	...	...	...
42	<i>Opp. bicostata</i> , Stahl. ... (d.) Gr. of <i>O. flector</i> .	52	XI, 1 ...	...	...	...	v.r.	...	...	...	...	Zone of <i>Pelt. athleta</i> .
43	<i>Opp. trachynota</i> , Opp. ...	54	X, 6 ...	...	...	...	...	...	...	r.	...	Zone of <i>Opp. tenuilobata</i> .
44	„ <i>Kachhensis</i> , Waagen ... (e.) Gr. of <i>O. subtililobata</i> .	55	X, 4 ...	...	...	...	...	...	...	c.	...	
45	<i>Opp. plicodiscus</i> , Waagen ... (f.) Gr. of <i>O. lingulata</i> .	56	X, 5 ...	...	...	...	...	...	...	v.r.	...	
46	<i>Opp. plana</i> , Waagen ...	56	XI, 3 ...	...	...	...	...	...	...	v.r.	...	

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.								EUROPE.
				PUTCHUM GROUP.	CHAREE GROUP.				KATROL GROUP.		OOMIA GROUP.	
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kunkote sandstone.	Katrol sandstone.		
47	(g.) Gr. of <i>O. (Oecotraustes), genicularis</i> . <i>Opp. cf. serrigera</i> , Waagen ...	57	X, 3 ...	r.	...	...	...	...	...	...	...	Zone of <i>Opp. aspidoides</i> .
	ISOLATED SPECIES.											
48	<i>Opp. Orientalis</i> , Orb. ...	58	XI, 5, 6, XII, 8.	...	...	r.	...	...	...	...	...
49	<i>Aptychus</i> of <i>Oppelia</i> ...	59	XI, 8 ...	...	...	...	...	...	...	r.	...	
	HARPOCERAS.											
	(a.) Gr. of <i>H. hecticum</i> .											
50	<i>H. hecticum</i> , Rein. ...	61	XII, 3, 4, 5 ...	n.c.	...	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
51	„ <i>punctatum</i> , Stahl. ...	62	XIII, 9, 10 ...	...	...	r.	...	...	...	...	...	Zone of <i>Per. anceps</i> .
52	„ <i>lunula</i> , Ziet. ...	63	XIII, 1 ...	...	...	r.	...	...	...	...	...	Zone of <i>Per. anceps</i> .
53	„ <i>Lairense</i> , Waagen ...	65	XIII, 3, 4... ..	...	...	...	n.c.	...	...	...	...
54	„ <i>Dynastes</i> , Waagen ...	66	XIII, 6, 7, 8 ...	...	...	...	c.	...	...	...	...
55	„ <i>Rauracum</i> , Mayer. ...	68	XIII, 5 ...	...	...	...	v.r.	...	...	...	...	Zone of <i>Am. Lambertii</i> , or <i>Am. cordatus</i> .
	(b.) Gr. of <i>H. ignobile</i> .											
56	<i>H. ignobile</i> , Sow. ...	69	XII, 1, 2 ...	...	...	c.	...	...	...	...	...
57	„ <i>crassefalcatum</i> , Waagen ...	70	XII, 6, 7 ...	...	...	n.c.	...	...	...	...	...
58	„ <i>trilineatum</i> , Waagen ...	71	XIII, 2 ...	...	...	r.	...	...	...	...	...
	(c.) <i>Isolated species</i> .											
59	<i>H. Kobelli</i> , Opp. ...	...	.....	...	...	...	...	...	...	n.c.	...	
	PELTOCERAS.											
	(a.) Gr. of <i>P. annulare</i> .											
60	<i>P. aegocerooides</i> , Waagen ...	78	XVI, 3 ...	...	...	...	...	v.r.	...	...	...
61	„ <i>Arduennense</i> , Orb. ...	79	XVI, 2 ...	...	...	...	...	r.	...	...	...	Zone of <i>Am. Lambertii</i> ! and <i>Am. cordatus</i> .
	(b.) Gr. of <i>P. Eugeni</i> .											
62	<i>P. propinquum</i> , Waagen ...	79	XVI, 1 ...	...	...	...	...	v.r.	...	...	...
	(c.) Gr. of <i>P. athleta</i> .											
63	<i>P. athleta</i> , Phill. ...	81	XVII, 2, 3... ..	...	...	...	c.	...	...	...	...	Zone of <i>P. athleta</i> .

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.									EUROPE.
				PUTCHUM GROUP.	CHABEE GROUP.				KATROL GROUP.		OOMIA GROUP.		
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol sandstone.			
64	<i>P. semirugosum</i> , W. ...	83	XIV, 1, 2	c.	Zone of <i>Am. cordatus</i> .	
65	„ <i>bidens</i> , Waagen ...	85	XV ...	...	...	...	...	c.	...	...	...
ASPIDOCERAS.													
SECT. I.— <i>PERARMATI</i> .													
(a.) <i>Isolated species</i> .													
66	<i>A. diversiforme</i> , W. ...	90	XVII, 1	v.r.		Zone of <i>Am. cordatus</i> .
(b.) Gr. of <i>A. perarmatum</i> .													
67	<i>A. perarmatum</i> , Sow. ...	91	XVI, 4, 5, 6, 7.	...	...	...	...	c.	?	...	...
68	„ <i>tenuispinatum</i> , W. ...	93	XVII, 3 ...	...	...	...	...	v.r.	...	...	...
(c.) Gr. of <i>A. ponderosum</i> .													
69	<i>A. ponderosum</i> , Waagen ...	94	XX, XXI, 2	c.	Zone of <i>Am. cordatus</i> .	
70	„ <i>Babeanum</i> , Orb. ...	96	XIX ...	...	...	...	...	r.	...	...	...
71	„ <i>sparsispinum</i> , W. ...	98	XVIII ...	...	...	...	...	v.r.	...	...	...
(d.) Gr. of <i>A. Edwardsianum</i> .													
72	<i>A. subdistractum</i> , W. ...	99	XXI, 1 ...	...	...	...	...	...	v.r.	...	...
SECT. II.— <i>HYBONOTI</i> .													
(a.) Gr. of <i>A. pressulum</i> .													
73	<i>A. monacanthum</i> , W. ...	100	XXI, 3	v.r.	...	Zone of <i>Asp. acanthicum</i> .	
74	„ <i>spec. indet.</i> ...	101	XXI, 4 ...	...	...	...	...	...	...	v.r.	...
SECT. III.— <i>CYCLOTI</i> .													
(a.) Gr. of <i>A. longispinum</i> .													
75	<i>A. iphiceroide</i> s, Waagen ...	102	XXIII ...	...	...	...	...	...	...	n.c.	...
76	„ <i>Wynnei</i> , Waagen ...	103	XXI, 5, XXII ...	...	...	...	...	...	...	...	n.c.
(b.) Gr. of <i>Asp. atavum</i> .													
77	<i>A. binodiferum</i> , W. ...	105	XXIV ...	...	...	...	...	...	...	v.r.	...
78	„ <i>spec. indet.</i> ...	106	...	...	...	...	...	...	...	v.r.	...

c. = common, n.c. = not common, r. = rare. v.r. = very rare.

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.								EUROPE.
				PUTUCHUM GROUP.	CHAREE GROUP.				KATROL GROUP.		OOMIA GROUP.	
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol sandstone.		
STEPHANOCERAS.												
SECT. I.— <i>MACR. RECTECOS-TATI</i> .												
(a.) Gr. of <i>St. macrocephalum</i> .												
79	<i>St. macrocephalum</i> , Schl. ...	109	XXV, XXVII, 1, XXXIII, 5.	n.c.	c.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
80	„ <i>transiens</i> , Waagen ...	111	XXXII, 2, 3	...	...	...	...	r.	...	...	...
81	„ <i>Maya</i> , Sow. ...	113	XXVIII, 1, 2, XXXI, 2.	...	...	...	...	v.r.	c.	...	...
(b.) Gr. of <i>St. tumidum</i> .												
82	<i>St. tumidum</i> , Rein. ...	115	XXVI, XXVII, 1, 2.	...	c.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
83	„ <i>Polyphemus</i> , Waagen ...	116	XXIX ...	...	...	...	...	c.	...	...	...
84	„ <i>subtumidum</i> , Waagen ...	118	XXVIII, 4	...	...	...	...	...	r.	...	...
(c.) Gr. of <i>St. semilaeve</i> .												
85	<i>St. semilaeve</i> , Waagen ...	119	XXVIII, 3	...	c.	...	...	...	...	...	...
86	„ <i>arenosum</i> , Waagen ...	121	XXXVI, 5	...	...	...	...	r.	...	...	...
(d.) Gr. of <i>St. lamellosum</i> .												
87	<i>St. lamellosum</i> , Sow. ...	122	XXXIII, 1	...	r.	...	...	...	...	...	...
88	„ <i>Grantanum</i> , Opp. ...	123	XXXVI, 6	...	c.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
89	„ <i>elephantinum</i> , Sow. ...	124	XXXI, 3, XXXII, 4.	...	...	...	...	c.	...	...	...
(e.) Gr. of <i>St. Morrisi</i> .												
90	<i>St. Chariense</i> , Waagen ...	126	XXX, 2, XXXI, 1.	...	c.	...	...	...	...	...	...
91	<i>St. chrysoolithicum</i> , W. ...	127	XXX, 1 ...	...	v.r.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
(f.) Gr. of <i>St. Ymir</i> .												
92	<i>St. bullatum</i> , Orb. ...	129	XXXII, 1 ...	...	r.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
(g.) <i>Isolated species</i> .												
93	<i>St. diadematum</i> , W. ...	130	XXX, 3, 4	...	c.	...	...	...	...	...	...

c. = common, n.c. = not common, r. = rare, v.r. = very rare.

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.								EUROPE.
				PUTUCHUM GROUP.	CHABEE GROUP.				KATROL GROUP.		OOMIA GROUP.	
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol sandstone.		
SECT. II.—MACR. CURVI-COSTATI.												
(a.) Gr. of <i>St. dimerum</i> .												
94	<i>St. dimerum</i> , Waagen	132	XXXIII, 2, 3	n.c.	c.	...	...	...	...	...	...
95	„ <i>magnumbilocatum</i> , W.	133	XXXIV, 2	...	c.	...	...	...	...	...	...
- 96	„ <i>fissum</i> , Sow.	134	XXXVI, 4 XXXVII, 1	...	...	...	...	c.	r.	...	...
97	„ <i>Nepalense</i> , Gray	136	XXXV, 2, 3	...	...	...	...	...	n.c.	...	...
(b.) Gr. of <i>St. subtrapezinum</i> .												
98	<i>St. subtrapezinum</i> , W.	138	XXXIII, 4	r.	n.c.	...	...	...	...	...	...
99	„ <i>subcompressum</i> , W.	139	XXXIV, 1	...	c.	...	...	...	...	...	...
100	„ <i>opis</i> , Sow.	140	XXXVI, 1, 2, 3.	...	...	r.	...	c.	r.	...	...
(c.) <i>Isolated species</i> .												
101	<i>St. eucyclum</i> , Waagen	142	XXXV, 1 ...	...	...	...	...	v.r.	...	...	...
PERISPINCTES.												
SECT. I.—OBTUSICOSTATI.												
(a.) Gr. of <i>P. obtusicosta</i> .												
102	<i>P. obtusicosta</i> , Waagen	146	XXXVIII, 1, 2, 3.	...	...	c.	r.	...	...	...	...
103	„ <i>angygaster</i> , Waagen	148	XXXIX, 2	...	...	c.	v.r.	...	...	...	...
104	„ <i>Dhosaensis</i> , W.	149	XXXVII, 4	...	...	c.	...	...	...	...	...
105	„ <i>omphalodes</i> , W.	150	XXXVII, 2	...	...	r.	r.	r.	...	...	...
106	„ <i>mutans</i> , W.	151	XXXIX, 1	...	...	...	...	...	v.r.	...	...
SECT. II.—TRIPLICATI.												
(a.) Gr. of <i>P. Koenighi</i> .												
107	<i>P. hians</i> , Waagen	153	LVII, 2 ...	v.r.	...	...	...	...	...	...	...
108	„ <i>spirorbis</i> , Neum.	154	XLI ...	...	c.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .
(b.) Gr. of <i>P. procerus</i> .												
109	<i>P. cf. funatus</i> , Opp.	155	XLVII, 2 ...	...	n.c.	...	...	...	...	...	...	Zone of <i>St. macrocephalum</i> .

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.								EUROPE.	
				PUTCHUM GROUP.	CHAREE GROUP.				KATROL GROUP.		OOMIA GROUP.		
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol sandstone.			
110	<i>P. altiplicatus</i> , Waagen	156	XLII, 1	...	r.	Zone of <i>Pelt. athleta</i> .	
111	„ <i>perdagatus</i> , Waagen	158	XLIV, 1	...	...	c.	...	...	...	...	...
	(c.) Gr. of <i>P. Pseudorion</i> .												
112	<i>P. Pseudorion</i> , W.	160	XLIII, 3	...	...	v.r.	...	...	...	...	...
113	„ <i>Orion</i> , Opp.	161	XXXVII, 3	...	...	...	v.r.	...	...	...	...
	(d.) <i>Isolated species</i> .												
114	<i>P. paramorphus</i> , W.	162	XLVI, 1, 2, XLVII, 3.	..	c.	...	...	...	...	...	...
	SECT. III.— <i>CONVOLUTI</i> .												
	(a.) Gr. of <i>P. tenuiplicatus</i> .												
115	<i>P. Balinensis</i> , Neum.	163	XLV, 2	...	r.		Zone of <i>St. macrocephalum</i> .
116	„ <i>lateralis</i> , Waagen	165	LVIII, 3	...	...	r.	...	...	...	...	...
117	„ <i>calvus</i> , Sow.	166	LVI, 1	...	...	...	...	v.r.	...	...	...
	(b.) Gr. of <i>P. Martiusi</i> .												
118	<i>P. arcicosta</i> , Waagen	167	LVIII, 2	...	c.	Zone of <i>Per. anceps</i> .	
119	<i>P. curvicosta</i> , Opp.	169	XXXIX, 4, 5, 6.	...	...	c.	...	...	...	...	...
120	„ <i>subtilis</i> , Neum.	170	XLIII, 4	v.r.		Zone of <i>Pelt.athleta</i> .
	(c.) Gr. of <i>P. congener</i> .												
121	<i>P. congener</i> , Waagen	171	LVII, 1, LVI, 2.	r.	...	...	...	...	...	...	...
122	„ <i>Recuperoi</i> , Gemm.	172	XIII, 1, 2	...	r.	Zone of <i>St. macrocephalum</i> .	
123	„ <i>cobra</i> , Waagen	174	XLV, 1	...	...	v.r.	...	...	...	...	...
124	„ <i>aberrans</i> , Waagen	175	XL, 1, 2	...	...	...	r.	...	...	...	...
125	„ <i>Gudjinsirensis</i> , W.	176	X IX, 3	...	...	...	r.	...	...	...	...
	(d.) Gr. of <i>P. praeursor</i> .												
126	<i>P. praeursor</i> W.	178	XLIX, 4, 5	...	...	...	...	n.c.	...	...	...

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.								EUROPE.
				PUTCHUM GROUP.	CHABEE GROUP.				KATROL GROUP.		OOMIA GROUP.	
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kunkote sandstone.	Katrol sandstone.		
SECT. IV.— <i>EVOLUTI</i> .												
(a.) Gr. of <i>P. evolutus</i> .												
127	<i>P. subevolutus</i> , Waagen	179	XLV, 3, XXXIX, 7.					r.				
128	„ <i>subcolubrinus</i> , W.	180	XLIX, 3						v.r.			
129	„ <i>pagri</i> , Waagen	181	XLII, 2						n.c.			
130	„ <i>Pottingeri</i> , Sow.	183	LI, 1							c.		
131	„ <i>Katrolensis</i> , W.	184	LIII							c.		
132	„ <i>euplocus</i> , W.	182	LII, 2							v.r.		
(b.) Gr. of <i>P. Indogermanus</i> .												
133	<i>P. Indogermanus</i> , W.	185	XLVII, I, XLVIII, 3, 4.					c.				Zone of <i>Am. cordatus</i> .
134	„ <i>rota</i> , Waagen	186	XLVIII, 1					n.c.				
135	„ <i>obliqueplicatus</i> , W.	187	XLVIII, 2, XLV, 4.					r.				
136	„ <i>plicatilis</i> , Sow.	189	LI, 2, 3, LII, 3.						c.			Zone of <i>Pelt. transversarium</i> .
137	„ <i>Martelli</i> , Opp.	190	LV, 3						r.			Zone of <i>Pelt. transversarium</i> .
138	„ <i>torquatus</i> , Sow.	191	LIV							c.		
139	„ <i>bathyplocus</i> , W.	192	L, 1							n.c.		
140	„ <i>cf. suprajurensis</i> , Orb.	193	—								r.	Portland beds.
141	„ <i>Bleicheri</i> , Lor.	194	LV, 4								v.r.	Portland beds.
142	„ <i>occultefurcatus</i> , W.	195	L, 4								v.r.	
143	„ <i>eudichotomus</i> , Zitt.	197	LV, 5								v.r.	Lower and upper Tithon.
(c.) Gr. of <i>P. chloroolithicus</i> .												
144	<i>P. chloroolithicus</i> , Quenst.	198	L, 3						v.r.			Zone of <i>Am. cordatus</i> .
145	„ <i>alterneplicatus</i> , W.	199	L, 2							r.		
146	„ <i>frequens</i> , Opp.	200	LIV, 2, 3								n.c.	
147	„ <i>denseplicatus</i> , W.	201	XLVI, 3, LV, 1, 2.								c.	

c. = common, n.c. = not common, r. = rare, v.r. = very rare.

No.	GENERA AND SPECIES.	Page.	Plate.	KACHH.								EUROPE.
				PUTCHUM GROUP.	CHAREE GROUP.				KATROL GROUP.		OOMIA GROUP.	
					Macrocephalus beds.	Anceps beds.	Athleta beds.	Dhosa Oolite.	Kuntkote sandstone.	Katrol sandstone.		
	(d.) <i>Isolated species.</i>											
148	<i>P. virguloides</i> , W. ...	203	XLVII, 4, XLIX, 1.	...	...	...	...	...	c.	...	...
149	„ <i>sparsiplicatus</i> , W. ... SECT. V.— <i>POLYPLOCI.</i>	204	XLIX, 2 ...	...	...	...	...	...	...	r.	...	
150	<i>P. leiocymon</i> , W. ... SECT. VI.— <i>INTERRUPTI.</i>	205	LII, 1 ...	...	...	...	...	...	r.	...	...
	(a.) Gr. of <i>P. Rehmanni.</i>											
151	<i>P. Rehmanni</i> , Opp. ...	206	LVIII, 1 ...	...	r.	...	...	...	...	...	...	Zone of <i>St. macrocephalum.</i>
152	„ <i>anceps</i> , Rein. ... (b.) Gr. of <i>P. sulcatus.</i>	207	LVII, 4, LIX, 1.	...	...	n.c.	...	...	...	...	...	Zone of <i>P. anceps.</i>
153	<i>P. decorus</i> , W. ...	208	LVII, 3 ...	v.r.	...	...	...	...	...	...	...
	(c.) <i>Isolated species.</i>											
154	<i>P. Arthriticus</i> , Sow. ...	210	LIX, 2 ...	...	...	c.	...	...	...	...	...
155	„ <i>Jooraensis</i> , Waagen. ANCYLOCERAS.	211	LII, 4 ...	...	...	...	...	v.r.	...	...	...
156	<i>A. calloviense</i> , Morr. ...	212	LVI, 3 ...	...	...	n.c.	...	...	...	...	...	Zone of <i>St. macrocephalum.</i>
	CRETACEOUS SPECIES. (Vide Appendix.)											
157	<i>Ammonites Martini</i> , Orb. ...	...	LX, 3 ...	...	...	...	...	...	...	...	...	Aptien.
158	„ <i>Deshayesi</i> , Leym. ...	...	LX, 2 ...	...	...	...	...	...	...	...	...	Aptien.
159	<i>Crioceras Australe</i> , Moore ...	...	LX, 1 ...	...	...	...	...	...	...	...	...

c = common. n.c. = not common. r. = rare, v.r. = very rare.

This list can be considered from two different points of view, that is, from a geological and from a palæontological. In both ways it will not be uninteresting to note the conclusions which present themselves, and I begin with the

GEOLOGICAL RESULTS.

As appears from the preceding list, there are not less than 159 species of fossil Cephalopoda known from Kachh up to the present moment, of which number 156 are from jurassic and 3 from cretaceous beds.

Among the Jurassic Cephalopoda there are not less than 47, or nearly one-third, identical with European species, and this number will very likely be greatly

augmented when the species of *Perisphinctes* of the upper jurassic beds of Europe become better known and described than they are now. The Kachh jurassic species of Cephalopoda are distributed in eight different beds, as distinguished by Dr. Stoliczka, each of which has for the greater part a fauna of its own. The richest in species, but not quite so in individuals, is the Dhosa oolite, with 34 species; a little less rich in species, but so much the richer in individuals, are the *macrocephalus* beds which include the famous "Golden Oolite," and which figure in the list with 31 species. Next comes the Katrol sandstone with 27 species and a great profusion of individuals of the genus *Perisphinctes*. Though the beds with *Per. anceps* show the same number of species, 27, as the preceding, yet these are all not represented in great quantities in these beds except a few *Perisphinctes* allied to *Per. obtusicosta*; and thus, however interesting this fauna, it does not contribute much towards the whole character of the Kachh jurassic cephalopod fauna. This is also the case with the next two beds, the *Athleta* beds with 20, the Kuntkote sandstone with 19 species; and the next two divisions are yet less important on account of the number of species they bear: the Oomia beds with 9 species, though with rather numerous individuals, and the Putchum beds with only 8 species, equally bare of individuals as of species.

Thus there are only three beds which impress their character upon the jurassic deposits of Kachh on account of the number of species as well as of individuals: they are the *macrocephalus* beds, the Dhosa oolite, and the Katrol sandstone, and these also are the beds which will be noticed even in a more superficial survey of the country. It is now worth mentioning that in the first of these beds there are among 31 species 16, or a little more than half the number, identical with European forms; in the second among 34 species there are 8; and in the third, among 27 only 4 identical with species from Europe. Thus the resemblance of the Kachh strata to the European beds seems to decrease on a more superficial review from below upwards. On closer examination of the other, less conspicuous beds, however, it is found that this is not the case, but that even in the Oomia group, the highest jurassic bed with marine fossils in Kachh, there are among 9 species 4 identical with European ones, and that this number will even increase greatly when the other classes of Mollusca shall be described, as many of the *Pelecypoda* of this bed seem to be identical with species from the Portland stone.

If we examine the distribution of the Cephalopoda in the single beds, we find that most of the species are restricted to a single layer, and only very few common to different beds, or recur in two succeeding groups. Thus we have in the Putchum group the following species:

<i>Nautilus Jumarensis</i> , W.	<i>Stephanoceras subtrapezinum</i> , W.
<i>Oppelia cf. serrigera</i> , W.	<i>Perisphinctes hians</i> , W.
<i>Stephanoceras cf. macrocephalum</i> , Schloth. var.	„ <i>congener</i> , W.
„ <i>dimerum</i> , W.	„ <i>decorus</i> , W.

Of these species the three *Stephanoceras* are common to this bed and the beds with *St. macrocephalum* of the Charee group. Yet it would be imprudent to unite, on account of this recurrence of three species, these beds with the next higher ones, because not only the other species of Cephalopoda are forms restricted to the upper division of the Putchum group, but all the other exceedingly numerous fossils, which are found besides the Cephalopoda, bear an entirely different appearance from those of the *macrocephalus* beds.

The only species of the above list which is identical with a European form is *Opp. cf. serrigera*, which occurs in Europe in Upper Bathonian beds; it would, however, be ridiculous, resting on such evidence, to vindicate for the Putchum group also a Bathonian age, but the numerous brachiopods which occur in the society of the above Cephalopoda, and which have an entirely Bathonian character, together with the position of the beds immediately below the beds with *St. macrocephalum*, give a greater appearance of likelihood to the suggestion of the Putchum group being an equivalent of the Bath group of Europe.

The Cephalopoda just mentioned belong all to the uppermost strata of the Putchum group, the lower beds being entirely void of any traces of remains of that class of molluscs.

Palæontologically, but not geologically, the most important group of the Kachh Jura is the Charee group, as this furnishes the greatest number of species identical with those from Europe. Among 112 species contained in this group there are 37 identical with European ones, and some of the very commonest species in Kachh are among the latter.

The lowest division of the Charee group is formed by the *macrocephalus* strata, the longest known among all the Kachh beds, and which were in fact believed to compose the whole of the Jura there. The Cephalopoda fauna of these beds is very rich, and is made up of the following species:—

<i>Belemnites Jumarensis</i> , W.	<i>Stephanoceras Chariense</i> , W.
„ <i>subhastatus</i> , Ziet.	„ <i>chrysoolithicum</i> , W.
<i>Nautilus Calloviensis</i> , Opp.	„ <i>bullatum</i> , Orb.
„ <i>Kumagunensis</i> , W.	„ <i>diadematum</i> , W.
„ <i>intumescens</i> , W.	„ <i>dimerum</i> , W.
<i>Phylloceras vicarium</i> , W.	„ <i>magnumbilicatum</i> , W.
„ <i>disputabile</i> , Zitt.	„ <i>subtrapezinum</i> , W.
<i>Lytoceras Adeloides</i> , Kud.	„ <i>subcompressum</i> , W.
<i>Oppelia subcostaria</i> , Opp.	<i>Perisphinctes spirorbis</i> , Neum.
<i>Harpoceras hecticum</i> , Rein.	„ <i>cf. funatus</i> , Opp.
<i>Stephanoceras macrocephalum</i> , Schl.	„ <i>altiplicatus</i> , W.
„ <i>tumidum</i> , Rein.	„ <i>paramorphus</i> , W.
„ <i>semilaeve</i> , W.	„ <i>Balinensis</i> , Neum.
„ <i>lamellosum</i> , Sow.	„ <i>arcicosta</i> , W.
„ <i>Grantanum</i> , Opp.	„ <i>Recuperoi</i> , Gemm.

Perisphinctes Rehmanni, Opp.

It is certainly no misnomer to call these beds "Macrocephalus beds," because not only *St. macrocephalum* occurs plentifully in them, but besides this, 12 more species of the genus, all more or less allied to this species, belong to this bed. It is a regular cephalopoda layer, not only that the cephalopoda are the most conspicuous forms occurring in it, but they are also prevalent in individuals, and even, probably, in species.

By far the greatest number of the species enumerated are exclusively characteristic for this bed. Only very few begin in lower, none range into higher beds. The former are the species mentioned before: *Steph. macrocephalum*, *St. dimerum*, and *St. subtrapezinum*, which sometimes occur in the highest strata of the Putchum group. It is, however, of importance that the *St. macrocephalum* of the lower beds is a somewhat different variety, and might, if better specimens could be procured, even be distinguishable specifically from the form found in the real macrocephalus beds.

Of the 31 species occurring in the macrocephalus beds of Kachh there are 16 identical with shells already described from Europe; they are—

Bel. subhastatus, Ziet.
Naut. Calloviensis, Opp.
Phyll. disputabile, Zitt.
Lyt. Adeloides, Kud.
Opp. subcostaria, Opp.
Harp. hecticum, Rein.
Steph. macrocephalum, Schl.
 „ *tumidum*, Rein.

Steph. Grantanum, Opp.
 „ *chrysoolithicum*, W.
 „ *bullatum*, Orb.
Per. spirorbis, Neum.
 „ *cf. funatus*, Opp.
 „ *Balinensis*, Neum.
 „ *Recuperoi*, Gemm.
 „ *Rehmanni*, Opp.

All of these belong exclusively to the beds with *St. macrocephalum*, except *Phyll. disputabile*, Zitt., and *Lyt. Adeloides*, which in Europe are generally met within the zone of *St. ferrugineum*, but which there also range into the macrocephalus strata.

These, *Phyll. disputabile* and *Lyt. Adeloides*, Kud, together with *Per. Recuperoi*, Gemm., are the only species in the above list which are restricted to the Mediterranean province of the European Jurassics; one, *St. macrocephalum*, is common to this and the Central European province, and all the others, 12 in number, belong to the latter. Thus, it is clear, that, as our knowledge of the matter stands now, the affinity of this bed in Kachh is nearer to the same bed in the Central European than to that in the Mediterranean province, and even if we consider the character of the whole fauna, we find among the lot barely more than 6 or 7 species of a Mediterranean type. It must be noticed that at the same time the character of the rock is much more like that prevailing in the Central European than that in the Mediterranean province, where hard marbles of varying colours are the richest depositories of the remains of fossil molluscs. It is very remarkable that in countries so remote with similar physical conditions of sea and shore, of which the deposited rock is the result produced, immediately the same features in general facies

reappear which have been observed at home. This shows clearly what an important factor the *facies* differences are for the determination and parallelisation of the single beds.

The Cephalopod fauna enclosed in the next higher bed allows of a less strict comparison. This fauna is composed of the following species:—

<i>Belemnites Gerardi</i> , Opp.	<i>Harpoceras trilineatum</i> , W.
„ <i>Calloviensis</i> , Opp.	<i>Stephanoceras opis</i> , Sow.
„ <i>Oldhamianus</i> , W.	<i>Perisphinctes obtusicosta</i> , W.
<i>Nautilus Kutchensis</i> , W.	„ <i>angygaster</i> , W.
<i>Phylloceras Feddeni</i> , W.	„ <i>Dhosaensis</i> , W.
„ <i>Mediterraneum</i> , Neum.	„ <i>omphalodes</i> , W.
<i>Oppelia fornix</i> , Sow.	„ <i>perdagatus</i> , W.
„ <i>Nurrhaensis</i> , W.	„ <i>Pseudorion</i> , W.
„ <i>Orientalis</i> , Orb.	„ <i>lateralis</i> , W.
<i>Harpoceras punctatum</i> , Stahl.	„ <i>curvicosta</i> , Opp.
„ <i>lunula</i> , Ziet.	„ <i>cobra</i> , W.
„ <i>ignobile</i> , Sow.	„ <i>anceps</i> , Rein.
„ <i>crassefalcatum</i> , W.	„ <i>Arthriticus</i> , Sow.

Ancylloceras Calloviense, Morr.

Among these 27 species there are only 6 which are not restricted to this bed, but go up to the bed with *Pelt. athleta*, and even higher. They are, *Bel. Gerardi*, Opp., *B. Oldhamianus*, W., *St. opis*, Sow., *Per. obtusicosta*, W., *Per. angygaster*, W., and *Per. omphalodes*, W. There is no species of the macrocephalus bed which reappears in this stratum, but the *Belemnites* and the three *Perisphinctes* are characteristic for the latter bed, and that with *Pelt. athleta*.

Of forms identical with European species there are seven mixed up with this fauna—

<i>Bel. Calloviensis</i> , Opp.	<i>Harp. lunula</i> , Ziet.
<i>Phyll. Mediterraneum</i> , Neum.	<i>Per. curvicosta</i> , Opp.
<i>Harp. punctatum</i> , Stahl.	„ <i>anceps</i> , Rein.

Ancyl. Calloviense, Morr.

Five of these are exclusively found in the *Anceps* beds in Europe. Of the remaining two, one, *Ancyl. Calloviense*, occurs there generally in the beds with *St. macrocephalum*; the other ranges through Bathonian and Callovian beds, and is at the same time the only species which the beds of *Per. anceps* of Kachh have in common with the Mediterranean jurassic province in Europe. *Per. anceps* has also been found in the Alps. Among the whole lot there are about three or four species of Mediterranean type.

The facies, clayey beds with nodules, and almost nothing but Cephalopoda remains in them is yet more like the facies prevailing in these beds in Central Europe, than was the case with the *macrocephalus* strata; however, the large development of the genus *Perisphinctes* is a feature which is not known in these beds in Europe.

The next higher horizon with *Pelt. athleta* contains only 20 species of Cephalopoda, which number, however, still equals that contained in the *Athleta* beds of Central Europe. The species are—

Belemnites cf. hastatus, Blv.
 „ *Gerardi*, Opp.
 „ *Oldhamianus*, W.
Phylloceras cf. Kunthi, Nm.
Amaltheus pustulatus, Rein.
 „ *Schaumburgi*, W.
Oppelia cf. glabella, Leck.
 „ *bicostata*, Stahl.
Harpoceras Lairense, W.
 „ *dynastes*, W.

Peltoceras athleta, Phill.
Aspidoceras diversiforme, W.
 „ *ponderosum*, W.
Perisphinctes obtusicauda, W.
 „ *angygaster*, W.
 „ *omphalodes*, W.
 „ *Orion*, Opp.
 „ *subtilis*, Neum.
 „ *aberrans*, W.
 „ *Gudjinsirensis*, W.

As mentioned in the description of the fauna of the beds with *Per. anceps*, five of the species just enumerated are common to the latter and the bed with *Pelt. athleta*, and two, *Bel. Gerardi* and *Per. omphalodes*, go even up into the Dhosa oolite.

Identical with European species are the following :—

Belemn. cf. hastatus, Blv.
Phyll. cf. Kunthi, Neum.
Amalth. pustulatus, Rein.
Opp. cf. glabella, Leck.

Opp. bicostata, Stahl.
Pelt. athleta, Phill.
Perisph. Orion, Opp.
 „ *subtilis*, Neum.

Of all these only one, *Phyll. Kunthi*, is a Mediterranean species, which occurs in Europe in Callovian or lower Oxfordian beds; all the others are characteristic for the zone of *Peltoceras athleta* in the Central European province, except one, *Am. pustulatus*, which is there found generally in the *anceps* beds. This slight anomaly is not surprising, considering the distance of the Indian deposits from the European. There might, however, also be found yet a specific difference between the European and the Indian shell, as I have already pointed out in the description of the species, which would at once do away with the difficulty.

The highest bed of the Charee group which now follows is the Dhosa oolite with a very rich fauna of Cephalopoda composed of the following species :—

Belemnites orientalis, W.
 „ *Sauvannausus*, Orb.
 „ *cf. hastatus*, Blv.
 „ *Gerardi*, Opp.
Nautilus Wandaensis, W.
Phylloceras Jaraense, W.
 „ *Lodaiense*, W.
Harpoceras Rauracum, May.
Peltoceras aegoceroideis, W.
 „ *Arduennense*, Orb.
 „ *propinquum*, W.
 „ *semirugosum*, W.
 „ *bidens*, W.
Aspidoceras perarmatum, Sow.
 „ *tenuispinatum*, W.
 „ *Babe anum*, Orb.
 „ *sparsispinum*, W.

Stephanoceras transiens, W.
 „ *Maya*, Sow.
 „ *Polyphemus*, W.
 „ *arenosum*, W.
 „ *elephantinum*, Sow.
 „ *fissum*, Sow.
 „ *opis*, Sow.
 „ *eucyclum*, W.
Perisphinctes omphalodes, W.
 „ *calvus*, Sow.
 „ *praecursor*, W.
 „ *subevolatus*, W.
 „ *Indogermanus*, W.
 „ *rota*, W.
 „ *obliqueplicatus*, W.
 „ *chloroolithicus*, Guemb.
 „ *Jooraensis*, W.

Of these 34 species six are not restricted exclusively to this bed : three of these, *Bel. cf. hastatus*, *B. Gerardi*, and *Per. omphalodes*, reappear here from the lower divisions, and the three others, *Steph. Maya*, *fissum*, and *opis*, go up from here into the next higher bed.

There are, however, not more than eight species among the whole lot identical with European ones ; they are—

Bel. Sauvanaus, Orb.
 „ *cf. hastatus*, Blv.
Harp. Rauracum, May.
Pelt. Arduennense, Orb.

Asp. perarmatum, Sow.
 „ *Babea*, Orb.
Per. Indogermanus, W.
 „ *chloroolithicus*, Guemb.

Seven of these are exclusively characteristic for the zones of *Amalth. Lamberti* and *cordatus* ; only *Per. chloroolithicus* might possibly go up occasionally into the zone of *Pelt. transversarium* of Europe. The eighth, *Bel. hastatus*, is found anywhere between the zone of *Per. anceps* and that of *Pelt. transversarium*.

There can barely be the question about Mediterranean types among the above species, and though one or the other of them has been found in the red Oxfordian Marble of the Alps or the Karpathians, yet all of them are decidedly Central European species, except possibly *Bel. Sauvanaus*, which belongs to the semi-Mediterranean type of South-eastern France and Switzerland.

What is most striking is the scarcity of European species in this rich and beautiful fauna, as the number of identical species falls off suddenly from $\frac{1}{3}$ in the other beds to $\frac{1}{4}$ in this one. This depends on two reasons, which are equally important : first, these beds are very little developed, and therefore the fauna only very little known in the south-west part of Central Europe, and that in other places, where they are well developed, they exhibit a facies in which Cephalopoda are scarce ; and second, that even in places where all the conditions are favorable, as at the “Vaches noires,” barely one-half of the species existing are as yet described, and our knowledge on this point is yet limited to the works of d'Orbigny, which have been published now about five and twenty years ago. Thus I was even compelled to create a name for a species of the “Vaches noires,” as it happened to occur also in India. It will therefore not be unjustifiable to suggest that this bed also does not deviate from the general ratio of affinity to the European Jurassics.

The next higher division belongs to the Katrol group. This is the Kuntkote sandstone, which put so many difficulties in the way of ascertaining its position among the other divisions of the Kachh Jura, as it is only developed in Wagur and on the Island Gangta Bét, and apparently perfectly wanting in Western Kachh, and it was only on palæontological grounds that it was shown to belong to this place in the series.

Before any discussion, I shall quote the fauna, which consists of the following species :—

<i>Belemnites Kuntkotensis</i> , W.	<i>Stephanoceras fissum</i> , Sow.
„ <i>sp. indet.</i>	„ <i>Nepalense</i> , Gray.
„ <i>fusticulus</i> , W.	„ <i>opis</i> , Sow.
„ <i>Stoliczkanus</i> , W.	<i>Perisphinctes mutans</i> , W.
<i>Phylloceras insulare</i> , W.	„ <i>subcolubrinus</i> , W.
<i>Aspidoceras cf. perarmatum</i> , Sow.	„ <i>pagri</i> , W.
„ <i>subdistractum</i> , W.	„ <i>plicatilis</i> , Sow.
<i>Stephanoceras Maya</i> , Sow.	„ <i>Martelli</i> , Opp.
„ <i>subtumidum</i> , W.	„ <i>virguloides</i> , W.
<i>Perisphinctes leiocymon</i> , W.	

Four of these species, *Asp. perarmatum*, *St. Maya*, *fissum*, and *opis*, have appeared already in the Dhosa oolite and re-appear in this bed, one, *B. Kuntkotensis*, goes up from here into the Katrol sandstone. Thus the Kuntkote sandstone seems certainly to be in nearer relation to the Dhosa oolite than to the Katrol sandstone, or yet less to the Oomia group, to which latter two it seems stratigraphically more or less allied, wherefore the position of the former at the base of the Katrol group is the most likely one.

Of European species there are only three in this bed ; they are—

Asp. cf. perarmatum, Sow.

Per. plicatilis, Sow.

Per. Martelli, Opp.

Only the last of these three species is limited in Europe to a single zone, the zone of *Pelt. transversarium* ; the other two are found generally in beds a little lower, but *Per. plicatilis* belongs at the same time also to the fauna of the before mentioned zone. Thus from these identical species we cannot conclude much about the age of this bed, and it is principally the intermediate position of the fauna, as well as the upper Oxfordian type of many of the species, which led myself and Dr. Stoliczka to fix for this bed a geological position equal to the upper Oxfordian beds of the Central European Jurassics.

Very few of the shells contained in the Kuntkote sandstone recall the forms of Mediterranean species, whilst most of the others, except the *Stephanoceras*, are Central European types.

The Katrol sandstone, as well on account of its great thickness as on account of the great many fossils it contains, is one of the most important groups

of the Kachh Jura. Yet the number of species in it is rather limited. I have described in this volume the following species of this bed:—

<i>Belemnites Kuntkotensis</i> , W.	<i>Aptychus</i> of <i>Oppelia</i> .
„ <i>sp. indet.</i>	<i>Harpoceras Kobelli</i> , Opp.
„ <i>claviger</i> , W.	<i>Aspidoceras monacanthum</i> , W.
„ <i>Katrolensis</i> , W.	„ <i>sp. indet.</i>
<i>Phylloceras ptychoicum</i> , Quenst.	„ <i>iphiceroides</i> , W.
„ <i>Benacense</i> , Cat.	„ <i>binodiferum</i> , W.
<i>Lytoceras rex</i> , W.	„ <i>sp. indet.</i>
<i>Haploceras deplanatum</i> , W.	<i>Perisphinctes Pottingeri</i> , Sow.
„ <i>propinquum</i> , W.	„ <i>Katrolensis</i> , W.
<i>Oppelia trachynota</i> , Opp.	„ <i>euplocus</i> , W.
„ <i>Kachhensis</i> , W.	„ <i>torquatus</i> , Sow.
„ <i>plicodiscus</i> , W.	„ <i>bathyplocus</i> , W.
„ <i>plana</i> , W.	„ <i>alterneplicatus</i> , W.
<i>Perisphinctes sparsiplicatus</i> , W.	

It is to be remarked that these species come from a complex group of strata, several hundred feet in thickness, and that, therefore, more than one palæontological horizon may be easily represented among them, and I shall quote principally *Hapl. propinquum* and *Per. sparsiplicatus*, as having been found in the lowest beds of the sandstone immediately above the Dhosa oolite.

In other respects, this fauna is one of the most concrete in the whole Kachh Jurassics, as only one species, *Bel. Kuntkotensis*, re-appears in this bed from the *Kuntkote sandstone*, and not a single one goes up into the next higher beds.

Only four European species occur in the Katrol sandstone; they are—

<i>Phyll. ptychoicum</i> , Quenst.
„ <i>Benacense</i> , Cat.
<i>Opp. trachynota</i> , Opp.
<i>Asp. monacanthum</i> , W.

Only one of these is found both in the Central European and in the Mediterranean Jurassic provinces, all the others belong exclusively to the latter. This is the only instance in the Kachh Jura where Mediterranean species preponderate over the Central European ones, but here also it might be different if the *Perisphinctes* of the Central European province were better known. All the four species quoted above belong to the beds with *Asp. acanthicum*.

The last deposits in the Kachh Jura which contain marine fossils belong to the lower part of the Oomia group, consisting of conglomerates and sandstones, with exceedingly numerous fossils, among which, however, Ammonites are rather scarce. The species of Cephalopoda which have been collected in these beds are the following:—

<i>Belemnites</i> , <i>sp. indet.</i>	<i>Perisphinctes Bleicheri</i> , Lor.
<i>Haploceras cf. tomephorum</i> , Zitt.	„ <i>occullefurcatus</i> , W.
<i>Aspidoceras Wynnei</i> , W.	„ <i>eudichotomus</i> , Zitt.
<i>Perisphinctes cf. suprajurensis</i> , Orb.	„ <i>frequens</i> , Opp.
<i>Perisphinctes denseplicatus</i> , W.	

a small number of species, which are, however, without exception, restricted to this one bed.

There are four European species among them, of which two could not be identified with sufficient certainty, which makes them, however, not less interesting. The species are—

Hapl. cf. tomephorum, Zitt.

Per. Bleicheri, Lor.

„ *cf. suprajurensis*, Orb.

„ *eudichotomus*, Zitt.

Of these the first and the last are of Mediterranean type, the other two are not so much Central European as rather types from the Anglo-gallic basin of the Portland sea. With these must be counted one further species, *Per. occultefurcatus*, W., which is barely distinguishable from *Per. Boidini*, Lor. *Asp. Wynnei* is an indifferent type, which could as well be found in Mediterranean as in Central European beds, and *Per. frequens* and *denseplicatus* are even in their general appearance perfect strangers to the European Jurassics. Thus, if we consider the identical or the replacing species, we find to our great astonishment the affinities of the marine part of the Oomia beds to be far closer to the Portland strata of Northern France and the island of Portland than to any bed or locality of the Mediterranean province. This affinity is yet further illustrated by the bivalves, among which *Trigonia* of the type of *Trig. gibbosa* are very common.

Above the beds which contain the species just enumerated follows a great thickness of sandstones and shales, with small seams of an impure coal in some places, in which marine fossils are entirely wanting, but in which plant remains are plentiful. These beds compose exclusively the upper jura of Wynne's Geology of Kutch, whilst the beds with marine fossils form his lower jura.

There has been detected by Dr. Stoliczka only one single locality where between the plant beds of the Oomia group and the trap that is above the former yet once more marine beds were exposed. They contained the Cephalopoda described in the Appendix, which proved to be of cretaceous age.

Two of them are identical with species of the Aptien of Europe; they are—

Ammonites Martini, Orb.

„ *Deshayesi*, Lezm.

The third species has been described originally from Australia, *Crioceras Australe*, Moore, and goes far to show the probability of a connection of the Indian and Australian seas also during the beginning of the cretaceous period.

If we then sum up what has been said about the different Cephalopoda faunæ of the different divisions of the Kachh Jura, we find that in the uppermost beds of the Putchum group there are among two European species one of the Bath, and one of the Macrocephalus-beds, both of Central European types; in the *Macrocephalus* beds there are sixteen European species, all of them occurring also in Europe in the *Macrocephalus* beds, and only two are not exclusively

restricted to it, as they begin already in the Bath group. There are among the number, thirteen of Central European and three of Mediterranean type. In the *Anceps* beds among seven European species are five characteristic of the *Anceps* beds of Europe and one for the *Macrocephalus* beds; one occurs from the Bath. to the Tithon. groups, and this is at the same time the only Mediterranean type in these beds. In the *Athleta* beds there are seven European species, of which one is characteristic for the *Anceps* beds of Europe, but all the others for the *Athleta* beds; all are of Central European types. In the Dhosa oolite there are eight European species, which are, without exception, characteristic for the zones of *Amalth.* *Lamberti* and *cordatus* of Europe, and which are also all of Central European types. The Kuntkote sandstone furnished three European species, of which the two, which are satisfactorily determinable, belong to the zone of *Pelt. transversarium* of Europe and are Central European types. In the Katrol sandstone are four European species, of which three are exclusively characteristic for the *Acanthicus* beds of Europe, and one goes from the horizon just mentioned up to the Tithon. group. Three are Mediterranean, one a Central European type. In the Oomia group at last there are four European species, of which two are characteristic for the Portland-stone of the Central European, and two for the Tithon. group of the Mediterranean Jurassic province. Thus we have considering only the European species contained in the Kachh Jura—

Of Kachh	{	I.—Oomia group (lower region)=Portland and Tithonian species	} of Europe.
		II.—Katrol sandstone=species of the <i>Acanthicus</i> beds	
		III.—Kuntkote sandstone=species of the <i>Transversarius</i> beds	
		IV.—Dhosa oolite=species of the <i>Cordatus</i> and <i>Lamberti</i> beds	
		V.— <i>Athleta</i> bed=species of the <i>Athleta</i> bed	
		VI.— <i>Anceps</i> bed=species of the <i>Anceps</i> bed	
		VII.— <i>Macrocephalus</i> bed=species of the <i>Macrocephalus</i> bed	
		VIII.—Putchum group (upper region)=one species of the Bath. group	

It is to be remembered that the succession of the beds I to VIII does not rest on conjecture, as was the case in the little note I published in our Records in 1871. This succession, which is given now, is based upon Dr. Stoliczka's careful examination of the Kachh Jura, and the geological position of *every* species is ascertained beyond any doubt.

Thus I am able to state with perfect confidence, THAT THE SUCCESSION OF THE IDENTICAL SPECIES IN TIME DURING THE JURASSIC PERIOD IN KACHH HAS BEEN GOVERNED BY EXACTLY THE SAME LAWS AS HAVE BEEN OBSERVED IN EUROPE, though the Kachh jurassic district belongs to a marine province, perfectly different from those distinguished in Europe, as I hope to prove presently.

Till now we have only considered the similarity between the European and the Kachh jurassic deposits, but now the differences must be taken into consideration.

There are, as may be seen from the different lists given before, and which need not be repeated here again, about two-thirds of the species described in this volume peculiar to the Kachh jurassic districts and different from European forms. This proportion is, however, not equal in the separate beds, but it is very difficult to state whether this is the result of real differences in the fauna, or, what seems to me more likely, of an insufficient knowledge of the European species in the beds in question. In the upper region of the Putchum group there are three-quarters of the species peculiar to Kachh, in the *Macrocephalus* beds the peculiar species make up not more than one-half, in the *Anceps* beds three-quarters, in the *Athleta* beds two-thirds, and in the Dhosa oolite again three-quarters. Very large is the proportion of peculiar species in the Katrol group, where they amount to five-sixths in the Kuntkote and to six-sevenths in the Katrol sandstones. In the lower division of the Oomia group the proportion falls off to one-half again as in the *Macrocephalus* beds.

The most striking feature of the Kachh Jura is the occurrence of *Macrocephali* in beds which lie far above the horizon, in which in Europe these shells are met with, but yet it is most remarkable that just the few species of the whole family, which are identical with European ones, keep to the same relative geological position as in Europe, being met with below the beds with *Per. anceps*. Starting from there they reappear in manifold and interesting forms till they reach beds which must be considered, from other species identical with European ones which they contain, as equivalents of the upper Oxfordian of Europe. Anything like this has never yet been observed in any jurassic district, European or otherwise, and it shows clearly how precarious it is to determine the age of certain beds only from a family similarity of the fossils, without other more decisive proofs, as from this similarity there would have resulted in this case the identity of the greater part of the jurassic strata of Kachh with the *Macrocephalus* beds of Europe.

Another peculiarity of the Kachh Jura consists in the strange admixture of Mediterranean and Central European types which is observable in nearly all the beds, and, what is rather astonishing, the Central European types predominate, though, geographically, beds with Mediterranean fossils are much nearer. Thus it seems perfectly justifiable to consider the jurassic strata of Kachh as belonging to a marine province, different from any one existing in Europe. This fact has been recognised already by J. Marcou, who established for the jurassic beds of Kachh as well as the Himalayas his Himalayan Jurassic province. The only question now is whether there is any objection to uniting the two districts, the Himalayas and Kachh, into one and the same geological province.

It has been remarked long since that most of the formations of India are there developed after two different types, which have received the designations "Himalayan and Peninsular types," but which more generally would be styled marine and freshwater types. The boundary between these up to the base of the Nummulitics coincides approximately with the crystalline range of the Aravally mountains, to the south-east of which thick sandstones and shales with the remains of fossil plants and vertebrate animals compose the freshwater or æstuary type, whilst to the north-west of it beds of limestone, sandstone, or marl with marine fossils represent the other or marine type. In this respect the Aravally range might be styled, certainly at least for the secondary period, the real backbone of Indian Geology. It has been in former times a dependency of the large Chinese continent, whose drainage very likely fed the rivers which deposited the freshwater or æstuary beds of the larger part of India. Only at the end of the secondary period this continent began to be immersed, as is shown by the geographical distribution of the Bagh beds and the occurrence of marine cretaceous deposits in the Khasi hills. The geographical distribution of jurassic marine fossils in India is thus of the highest interest, as it will show the outline of the south-western extremity of that continent during the jurassic period. Besides the Kachh jurassic beds, which, though not reaching lower down than to the Bathonian group, rest immediately on gneiss, there are a few localities where jurassic fossils have been found in the desert countries of Rajputana north and north-east of Kachh, from which Sowerby has described his *Per. torquatus* and more recently Dr. Carter, on information from Dr. Impey, has mentioned *Ammonites* and *Belemnites* from Koochee, 20 miles west of Jessulmeer.

These localities seem to join the Kachh Jura to the Jura of the Salt range, which, though very much reduced and badly developed, seems similar to the former. It has, however, till now been impossible to observe the transition of the Salt range jurassic strata into the Spiti shales of the Himalayas. The conditions seem there to be very much like those prevailing in Galicia, where jurassic beds of the Central European type come within a few miles of the Karpathic cliff-limestone of the Mediterranean Jura without any features of transition being observable.

To the south of Kachh as yet very few indications of marine jurassic beds are reported. There is a probability that jurassic rocks occur in Kattiawar. In Southern India there have been detected lately marine jurassic beds by Mr. King of our survey not far from the mouths of the Godavery, which partly seem to represent the Oomia group of Kachh. Other beds in the vicinity of Madras, which underlie there the upper cretaceous formation, and which have been considered also as probably jurassic, seem from a recent inspection of the few very badly preserved Cephalopoda more likely to represent the Neocomian of Europe.

Thus there is, though with many interruptions, a shore line established, running in a southerly and easterly direction (forming something like the Bay of Bengal) down from the Salt range to Southern India, and it is probable that it did not stop there, but the ocean, of which this shore was the boundary, extended further to the south and west. The indications for this are few, but not without value. There has been found in the vicinity of Mombas, equatorial Africa, a specimen of *Pelt. annulare* or *athleta*, a species which is found also in Kachh, and the *Trigonia ventricosa*, Krauss, which is rather common in the Kachh Oomia beds, has been described originally by Krauss from jurassic beds of Southern Africa. On the other hand, occur in the Australian jurassic deposits *Trigoniae* allied to *Trig. gibbosa* and *Macrocephali* as in Kachh, and even *Perisphinctes Novo Zelandicus* exhibits a near relationship to European jurassic types. Thus it seems very probable that one large Indian Ocean existed during the jurassic period, of which only the very outskirts have been preserved up to this day in India, the east coast of Africa and the west coast of Australia existing in nearly the same area as the Indian Ocean exists at the present time. The most important fact, however, is, that this ocean communicated with the European jurassic seas, as is clearly shown by the mixture of European with South African types in the Kachh jurassic deposits, which would be inexplicable if Marcou's Americo-Africo-Australian Continent had existed.

From all appearances also those marine districts, on which the Himalayan jurassic strata have been deposited, have been dependent on the same Indian Ocean just pointed out, but nevertheless, the species, which are in common to Kachh and Spiti, are not numerous. They are—

Belemnites Gerardi, Opp.

Stephanoceras Maya, Sow.

„ *Nepalense*, Gray.

Harpoceras Kobelli, Opp.

Perisphinctes frequens, Opp.

This is a very small fraction of species among 156 in the Kachh Jura, and thus the affinity between the Himalayan jurassic beds and those in Kachh seems smaller than the affinity between the latter and the jurassic deposits of Europe.

The number of identical shells in the Himalayan Jura and that of Europe is even reduced to one single species :—

Perisphinctes Groteanus, Opp.*

In consequence of these facts it seems now barely possible to unite the Spiti shales and the jurassic deposits of Kachh in one jurassic province, and I therefore think it advisable to establish for the latter a separate one, for which it will be best to introduce the name of Indian jurassic province. This is chiefly

* Other species, which have been mentioned from the Spiti shales, as *St. macrocephalum*, *Parkinsoni*, *Braikenridgi*, *Per. biplex*, *triplicatus*, etc., have been erroneously determined as such.

characterised by the prevalence of the genus *Stephanoceras* among the Cephalopoda and by the strange mixture of Mediterranean and Central European types among the species identical with European shells.

There is no doubt that this province forms part of a homozyotic cincture, to which also the European jurassic districts belong. But strange to say, there are many indications that the same extends in a south-easterly direction towards Australia, and even, returning, to the Rocky Mountains in California, cutting under a considerable angle through the homozyotic cinctures of the present time. I indicate this, however, only in order to point out in which direction investigations ought to be made.

The case is different with the Spiti shale, or the Himalayan jurassic province, which by the prevalence of the genus *Cosmoceras* and the large number of *Aucellæ*, which are often found in them, recall to a certain extent the characters of the jurassic deposits of the Moscovite province, with which, very likely, they must be classed as forming another homozyotic cincture.

It may be deemed injudicious to draw all these conclusions from the simple knowledge of the Cephalopoda alone, but, if one considers how very little is known of the other classes of Molluscs in the different parts of Europe, and within what narrow geographical limits the single species are generally included, it will certainly be granted that conclusions drawn from the species of Cephalopoda are on a far safer ground than those drawn from the consideration of any other class of Mollusca.

PALÆONTOLOGICAL RESULTS.

In looking through this volume, three things will be found strange and requiring some explanation; first, the number of species; second, the arrangement of the same; and third, the replacement of the old genus of *Ammonites* by a number of other genera, which have not been much used up to the present time.

Regarding the first of these three points, it seems barely necessary to say much, as I have stated already my views on it in full in my paper "*Über die Formenreihe des Ammonites subradiatus*," but nevertheless I may state that I adhere, as in former publications, to the hypothesis of a descendental or rather developmental relation of certain species and even of groups and genera, and that I therefore cannot consider the species as something naturally defined, but only as something artificially fixed. The quarrel, therefore, about good or bad species cannot be considered any longer as an object for the exercise of scientific skill, as the distinction of the forms depends entirely upon the tact and the natural gifts of the observer, and happy he who is able to distinguish the very finest differences of form which organisms undergo in their development in time. Zoologists and Botanists may possibly quarrel about such things, as they have as objects of observation only the animated beings of one geological period, during which no, or

only very small, changes in the specific forms have been effected, but Palæontologists who have to deal with scores of periods, each of which is as rich in organic forms as the actual one, cannot consider it their duty to describe good species in a zoological sense, but must chiefly attempt to mark and describe the changes which the organisms undergo in the course of time.

This, however, cannot be done without pointing out with the utmost carefulness and exactitude certain stages which are conspicuous in one way or the other, and these latter form the palæontological species, a thing very different from the 'species' of the Zoologists, and equally different from the 'varieties' of the same. If a thing thus defined is objected to by Zoologists, as to be called species, they may use the term of mutation, introduced by me into science some years ago and already extensively used in Palæontological works.

This is the ground upon which Palæontology asserts itself as a science of its own, and wherein its fundamental difference from all the other descriptive natural sciences is most striking.

It appears as one of the most important results, obtained from the investigation into the Cephalopoda fauna of Kachh, that it can be proved that the developmental series, as they had been already observed in Europe, can also be traced here in the same completeness and with the same succession of forms. But not only this; in genera also, in which no attempt has been as yet made in Europe to demonstrate the same developmental laws as in the others, this could be accomplished with our Indian materials, by which the general prevalence of the law of transmutation of forms according to the age of the beds in which they are contained is made exceedingly probable.

The advantages of a grouping of the single species according to this law will be easily seen from this volume, where the enormous amount of forms can easily be reviewed under the guidance of developmental series. The utter confusion which was observable in many of the former works on jurassic Ammonites, is easily avoided by these means as well as by the separation of certain groups of forms into separate genera.

The necessity of a distinction of different genera within the former genus *Ammonites* has been already discussed so often, and has been pointed out also by Dr. Stoliczka in the first volume of his cretaceous fauna of Southern India, that it seems unnecessary to repeat here anything which has been said about it. I wish only to say a few words as to the principles on which such a separation ought to be effected.

In former publications, principally the little memoir "Über die Ansatzstelle der Haftmuskeln beim Nautilus und den Ammoniden," I endeavoured to show by certain anatomical and morphological differences, pointed out in the different families, formerly distinguished among the Ammonites to establish a distinction of genera, founded on the same principles, generally observed in similar cases

among Zoologists, and I arrived at the foundation and distinction of a number of genera partly created by myself, partly by other authors.

It was remarked, partly with justice, by Dr. Neumayr that the most important points in the different diagnosis there were only extremely rarely observable in fossil Ammonite shells, which alone are at our disposal, and that most of the species were united in my genera by the simple affinity, genetic or other, of these to the species on which the characteristics of the genus had been observed, and that not even the different features put down as characteristic for the genus could be observed in one and the same species. This is all perfectly true, but nevertheless, I am fully convinced, that, proceeding in this way, I have not done anything different from what is generally done in establishing a genus. I united all the species which showed a certain affinity, and tried to describe from the generality of them the characteristics which now form the diagnosis of the genus. Is not this the same which is every day done in Zoology? In how many genera of mollusca there is the anatomy known only of one single species, and the others are supposed to be similarly organised on account of their general similarity? All this defence, however, is scarcely needed, as my genera have been accepted everywhere without the slightest hesitation, but I wanted first to make the ground firm upon which my genera are founded before coming to another point of Dr. Neumayr's statements. He may be quite right when he finds fault with me, that, though I made extensive use in establishing my genera of the argument of developmental connection of the single species, yet in the diagnosis of the genera I put forth solely the anatomical characters, instead of putting equal strain upon the former too; but, on account of the difficulty in the observation of the anatomical characters to do away with them entirely, and to hold *only* to the developmental affinity, as Dr. Neumayr wants us to do, is certainly going too far.

I therefore perfectly agree with Dr. Neumayr that the most important thing for finding out the generic connection of certain forms is to fix the genetic relation in which they stand together, but after that has been done there remains yet the working up of the facts which have been ascertained in this way, and to deduce from the species which have been recognized as belonging together a generic diagnosis, in order that our followers in the field of scientific investigation may be able to find out what limits the original author intended for his genus. As every body knows, there are no natural limits existing to any genus, and thus, generic designations would be used by every author in a different sense, as science progresses, because, not only the forms derived from *one* certain root species can make up a certain genus, but also other species can in their descendants grow into the same generic form. An excellent example of this apparently strange fact is furnished by the species of the genus *Aspidoceras* occurring in India.

If we look at the "Stammbaum" (pedigree) of the genus *Aspidoceras* as arranged by Dr. Neumayr, we find that the whole genus takes its origin in *Asp. distractum*, Quenst., out of the beds with *Amalth. Lamberti*, and, though

there might be yet species in older beds, all these ought to be only *praecursores* of the mentioned root form, (if Neumayr's plan, to characterise the genus *only* by the pedigree without ever giving a diagnosis, was based on sound principles and had to be adopted). Now, here in India, we have in beds older than the zone of *Amalth. Lamberti* two species of *Aspidoceras*: *Asp. diversiforme* and *Asp. ponderosum*. The first of these two species is a strange transitional form, which is certainly not connected with *Asp. distractum*, and might possibly bear some relation to *Asp. perarmatum*, but is, on the whole, such an extraordinary shell, that not many conclusions can be drawn from it. So much more valuable for the right understanding of the points in question is the second species. This is a perfectly well developed *Aspidoceras*, so much so that, if we would not put down this species as an *Aspidoceras*, we would not be able to call anything else by that name either. There is not observable on the inner whorls this strange arrangement of the ribs which is so characteristic for young specimens of *Asp. perarmatum*, and though I am convinced that this species also, like *Asp. distractum*, derives its origin from some *Perisphinctes* of the *Convolutus* group, yet we may look out for the predecessors of it in the *Macrocephalus* or even in Bathonian beds. On the other hand, *Asp. ponderosum* is certainly the root species of *Asp. Babeanum* and all the "*Biarmati*" of the upper jura. Thus the case is this: *Asp. distractum* derives its origin with the greatest probability from a species somewhat like *Perisphinctes curvicosta*, Opp. (or *Per. Backeriae*, Quenst.,) and barely older than the *Athleta* beds, and is in its turn the root species of *Asp. perarmatum* and similar species; and *Asp. ponderosum* derives its origin from an unknown species in the *Macrocephalus* or even in Bathonian beds, and is in its turn the root species of *Asp. Babeanum* and possibly the greater part of the species of *Aspidoceras*. Thus, following Dr. Neumayr's principle, we would have to divide the genus *Aspidoceras* into two genera, as rising from two different roots, and to introduce a new generic designation for the *Biarmati* and possibly also the *Cycloti*, a thing which he himself most opposes. This fact, however, might even have been ascertained from European materials, as there *Asp. distractum* and *biarmatum* are contemporaneous, and there can be therefore no question of the latter species deriving its origin from *Asp. perarmatum*.

This is only one single instance where there can be traced decidedly two different root species, the descendants of which both grow into the same generic form. In other genera we can observe the same fact, and therefore I say, the developmental connection of forms and their derivation from one single root species *alone* cannot be established in general as the single criterion for the establishment of a genus, but there must be a diagnosis as well, which states what forms ought to be brought into connection with the genus, and the more anatomical facts can be brought to light for the definition of the genus, the firmer will be the ground on which the same will rest.

I perfectly agree with Dr. Neumayr that it is extremely difficult for Palæontologists to observe those anatomical characters, as the objects of observation are nearly always imperfect, and in cases where these can absolutely not be made out, which are, I fear, rather numerous, the developmental connection of the forms will serve well to recognise and congregate the forms which ought to belong to one and the same genus, but this will remain always only subordinate, and never can entirely replace the principal foundation of a genus, the anatomical characters.

I have throughout this volume sufficiently put forth the excellent character of Dr. Neumayr's publications, to show the high esteem I have of his scientific qualities as a Palæontologist, and thus I hope my friend will not misunderstand the single correction just made.

The highest stress of all that has been said till now, however, I lay upon the grouping of the species, which has been executed in this volume, and I consider it as the chief palæontological result, obtained from the investigation into the Jurassic Cephalopoda of Kachh, that here, in the same manner as in Europe, but on a much more extensive scale, can be fixed developmental series, which are in many cases identical with those observed in Europe.

The most important facts which result from the investigations explained in the present volume are then two: first, that in Kachh, in the same manner as in Europe, developmental series exist, which are in part identical with the European ones; and second, that the succession of the identical species in time during the jurassic period in Kachh has been governed by exactly the same laws as have been observed in Europe.

These two deductions read perhaps a little strangely alongside one another, and yet they suggest a conclusion of the highest importance and value.

Nobody, I think, will quarrel any longer about the question how the developmental series came into existence; everybody believes that their origin lies in the transmutation of forms, the transformation of one species into another. I think I have said enough on account of this point in a former work of mine, the "Formenreihe des *Ammonites subradiatus*," and can therefore be brief here. But the manner in which this transmutation came to pass, and by what laws it was governed, is yet a thing of much uncertainty. The general belief follows the opinion of Mr. Darwin, that it is the struggle for existence, natural selection, and the surviving of the fittest which causes the changes in organic life. The case of the Kachh Jurassic Cephalopoda seems, however, not quite to fit into this scheme, as is shown by the two deductions quoted above.

The jurassic strata of Kachh in their geographical as well as in their orographical position and in the lithological characters show so many differences from the

jurassic beds of Europe that it is impossible to think that the general conditions under which the former strata have been formed could have been accurately the same which existed at the same time in the European parts of the jurassic sea; and that therefore the conditions of life were nothing less than identical in both areas. Nevertheless we found that the succession of identical forms in time was governed by exactly the same laws in both countries. Is it now imaginable that the arrangement of circumstances, the natural enemies, the kind of food, the temperature of the sea, the physical condition of the bottom of the sea, &c., were such as to transform, for instance, in the course of time, *Phylloceras vicarium* into *Phyll. ptychoicum* absolutely identical with the European species, whilst in Europe absolutely the same form has been produced by the transformation in time of *Phyll. flabellatum* or *euphyllum*? or that in Kachh from *Phyll. disputabile* the species *Phyll. Benacense* has been produced through the intermediate form of *Ph. Lodayense*, whilst in Europe between the same identical species *Phyll. disputabile* and *Benacense*, two other species, *Ph. Manfredi* and *Puschi*, are intercalated? It is impossible to believe this. For facts like those mentioned which could be augmented by a good many instances, if other groups of *Ammonites* were as well known as *Phylloceras*, the only explanation is, that the changes of form in the organic world were dependent on laws which were innate in them, and had not to rely exclusively on outer circumstances. The latter factors, as struggle for existence, geographical separation, &c., certainly influenced the production of forms greatly, but the fundamental law upon which these influences acted very likely was not the law of variation, as stated by Darwin, but the law of development, or a tendency of the organisms to produce an offspring varying in a certain and defined direction. If this law be true, the time will come when we shall be able to indicate *a priori* with tolerable certainty what certain species a given form can or might produce.*

It is only from a very small fraction of the world of animal life that I have been able to deduce my conclusions, and thus these cannot be taken as anything else but a hint in what direction the truth may be searched for; but nevertheless I personally am convinced that what is true for the *Ammonites* will be true for other animals also, because the whole animated world, animals as well as plants, is one, and follows the same fundamental laws. This truth has scarcely been doubted by any recent philosopher, and has been confirmed to a great extent by the more recent discoveries in science, by which it is shown that animal and vegetable life, though grown out into different stems, have yet sprung from one and the same root.†

* Already Dr. M. Neumayr seems to have had some notion of the existence of this or a similar law, as is shown by some sentences in his "Fauna der Acanthis-Schichten." He says: it is not yet time to pronounce anything about certain questions which ought to be treated of, but everything tends to show that besides the law of natural selection, yet other laws have been in action in the transmutation of forms.

† But why then always stick with such pertinacity to old ideas, why shall we never get rid of the doctrines we once imbibed in the school-room, though we recognise them to be false? There are two things which have been taught us by old father Linnæus, and which are equally untenable, but nevertheless have been learnt by every one

This is not the place to expose my thoughts any further. The few sentences I have written above may suffice to show the position I hold towards those interesting questions; and I have only one wish yet to express, that is, that from the volume I now place before the public, at least my love for scientific truth may be evident.

of us at school, and to which we keep sincerely till our oldest age; they are, first, that all the visible world can be divided into three kingdoms, the mineral, the vegetable, and the animal kingdom; and second, that man is only a species in the latter. Now, would it not be by far more consistent with our knowledge of natural objects to introduce three very different divisions and to distinguish a mineral, an animated, and a mental world? If we accept these divisions, we get rid of the two errors at once, we unite the animal and vegetable kingdoms into one, as they ought to be, and we separate mankind from the former as a separate division, the mental world. It is true that we cannot fill volumes with the description of species of mankind, as we do in other branches of descriptive natural science, but cannot man nevertheless as "microcosmos" with all his history and mental achievements proudly be placed in comparison with all the animated world? Of all the three divisions of the visible creation the easiest for us to penetrate is the mineral or material world, only governed by the laws of Chemistry and Natural Philosophy, a great many of the problems of which may now fairly be considered as having been solved, though some remain yet impenetrable. The second division offers much greater difficulties, *viz.*, the animated world. Though the same laws as in the first division are yet in full action, they are modified and influenced by a power which is, up to the present, fully above our conception, the power of life, *vis vitæ*, but which nevertheless cannot be denied. This power chiefly manifests itself in bodily development, as well in the individuals as in the whole animated world. Though the lowest grades and first beginnings of this second division are of a very low kind, yet they are separated from the first one by a deep gulf, on the one side of which the dead, on the other the animated, matter is placed. The third division, the mental world, offers us the most complicated problems science has ever had to deal with; not only are the laws of Chemistry and Natural Philosophy yet in full action here also, but the laws which were followed by the animated world, though modified, govern here again, and to these is superadded a third factor, the mental power, with its own proper laws. The last factor exists, and everybody can be his own witness for its existence; and, as in the lowest of animated creatures the law of development exists, so the germ of higher organised beings exists, though hidden, in the most miserable specimen of human existence, the germ of mental development, though he personally may not obtain the aim which is achieved by his brethren. As between the first and second divisions, so also between the latter and the third, there exists a deep gulf, on one side of which there is the animated, on the other the intellectual existence, with its mental power, which does not exist in the animated world.

APPENDIX.

DESCRIPTION OF THREE CRETACEOUS CEPHALOPODA FROM KACHH.

Though the remains of cretaceous shells, brought back from Kachh by Dr. Stoliczka, are in a rather bad state of preservation, yet their occurrence in this territory is not only of interest, because the cretaceous formation had not been known there previously, but also because by these few species a bed is indicated which had not been observed to exist in India before. The species which have been collected are the following, reserving a certain uncertainty in their determination, as only fragments are known:—

Ammonites Martini, Orb.

Ammonites Deshayesi, Leym.

Crioceras australe, Moore.

The two first of these species occur in Europe in the lower Greensand, and are, indeed, most characteristic for the Etage Aptien of d'Orbigny; the geological horizon of the third is not known, as it has been found originally in a tertiary boulder bed in Australia.

Thus not only the lowest division of the Neocomian formation with *Perisph. Astierianus* is represented in India at the Chichali Pass, but also the highest beds of it exist here in Kachh.

It is only one locality which has furnished these fossils, Ukra hill, where the beds from which they were collected are exposed above the Plant-beds of the Oomia group and below the trap, which elsewhere also covers the cretaceous formation.

For the *Ammonites* found in these beds I must retain yet the designation "*Ammonites*," as they are not yet attributed to any particular genus, and this is not the place to create for them new generic names.

1. AMMONITES MARTINI, *Orbigny*. Pl. LX, Fig. 3, *a*, *b*.

1840. *Ammonites Martini*, Orb.: Pal. Franç. Terr. cret. I, p. 194, pl. 58, figs. 7-10.

1854. *Ammonites Martini*, (Orb.), Pictet et Renevier: Pal. Suisse, Ter. aptien, p. 22.

1860. *Ammonites Martini*, (Orb.), Pictet et Campiche: Pal. Suisse, St. Croix, p. 253.

The only specimen I have got for description is very defective, and it seems therefore nearly impossible to give a description of the species which might add in any way to the more adequate knowledge of its varieties or kind of development.

The outer whorls of it are even so much mutilated that I believed this *Ammonite* to be a species of the *Rhotomagensis* group, until I endeavoured to separate the better preserved inner whorls, which now clearly exhibit the form of *Amm. Martini*.

The variety to which the specimen belongs is that marked with No. 2 by Pictet, and which most resembles the fig. 9, pl. 58, by Orbigny.

In the general form, this Ammonite recalls to a certain extent the form of some "*Coronati*," as the spines, which are situated at the siphonal side, nearly disappear. Another row of very small tubercles exists on the umbilical margin. The ribs are low and broad, starting in pairs from the outer row of tubercles, intermixed with single, not tuberculated ribs, and bearing in the middle of the siphonal side a slight depression, which is limited on either side by a slight swelling of the ribs.

The specimen is too badly preserved to trace the lobes or to give the measurements.

Remarks.—The only determinable specimen, together with some fragments, has been collected by Dr. Stoliczka at Ukra Hill in a dark-red, somewhat oolitic rock above the Plant-beds of the Oomia group.

The geographical distribution of this species is very extended. It has not only been found in Europe, but also in the Caucasus and in Daghestan as well as in N. Africa.

2. AMMONITES DESHAYESI, *Leymerie*. Pl. LX, Fig. 2, *a*, *b*.

1840. *Ammonites Deshayesi*, (Leymerie) Orbigny: Pal. Franç. Terr. cret. I, p. 288, pl. 85.

1840? *Ammonites consobrinus*, Orbigny: Pal. Franç. Terr. cret. I, p. 147, pl. 47.

1845. *Ammonites Deshayesi*, (Leym.) Forbes: Quart. Journ. Geol. Soc., Lond., I, p. 353, pl. 13, fig. 2.

1850. *Ammonites fissicostatus*, (Phill.) Orbigny: Prodr. 18, 24, Vol. III, p. 113, (non Phill.)

1860. *Ammonites Deshayesi*, (Orb.) Pictet: Pal. Suisse, St. Croix, p. 341.

It is only a fragment of a very large specimen, which I attribute to this species, but yet this is entirely composed of air-chambers.

The sculpture, composed of thick, round, somewhat falciform ribs, which alternately reach the umbilical margin or stop in the middle of the sides, is yet perfectly unchanged at this size, so much so that the drawing of a small specimen need only be enlarged in order to represent this large one, from which it appears also that the number of ribs does not change in more advanced stages of growth.

Remarks.—Found also by Dr. Stoliczka at Ukra Hill in a close-grained yellowish-brown, somewhat oolitic rock.

3. CRIOCERAS AUSTRALE, *Moore*. Pl. LX, Fig. 1, *a*, *b*, *c*.

1069. *Crioceras Australe*, Moore: Quart. Journ. Geol. Soc., Lond., Vol. XXVI, p. 257, pl. XV, fig. 3.

As is so frequently the case with specimens of *Crioceras*, only fragments of our species have been found. Of these there are several of varying size. The specimen figured Pl. LX, fig. 1, is the most perfect, inasmuch as we have portions of three whorls *in situ*. The fragments indicate a very large shell, discoidal, with rounded oval whorls, incurved, the outer whorl fitting rather closely to the inner, but still distinctly separate. The ventral or antisiphonal side of the whorls is slightly concave, conforming to the back of the preceding whorl, and giving to the section of the whorls a slightly cordiform shape, as seen in fig. 1 *b*.

The whorls increase very rapidly in size; while the aperture of the innermost whorl is only 12 mm. high, that of the next is 37 mm., and that of the outer in the same specimen is 94 mm. high. The separation or space between the whorls is about 2 mm.

The species is characterized by the peculiar ribbing of the whorls. On the outermost whorl which appears to be the end of the body-chamber, there are numerous thick, prominent, sharply rounded ribs of nearly equal size throughout. In a few instances these bifurcate at about the middle of the sides of the whorl, forming two ribs, of about equal size, which pass continuously over the back and rejoin again at the other side. The ribs are separated by regularly concave furrows. The curvature of these ribs is peculiar and very characteristic. Starting from the centre of the ventral side, or concave part of the whorl, each rib is curved sharply backwards (from the mouth of the shell), and then passing over what may be called the umbilical margin, it is carried in a slight and gentle double curve to the edge of the back, which it crosses perfectly straight, and so returns with a similar curve up the other side. In this way the passage of any rib across the ventral cavity is very much in advance, or nearer to the mouth of the shell, as compared with the passage of the same rib across the back of the whorl.

In the still more advanced stage of growth the character of the ribs remains very constant, but the relative width of the sulci or furrows become greatly increased, making the ribs appear more sharply acuminate.

On the second whorl the character of the ribbing is very similar to that already described on the outer whorl. But when we come to the innermost fragment of a whorl, indicating the younger stage of growth of the shell, we find very marked differences. The ribs have the same general character, with marked concave sulci between, but every second or third rib is of larger size, and is distinctly marked by two tolerably large, acuminate bosses on each side: the larger of these rows is placed on the edges of the back of shell, giving the section a more quadrate form than in the larger whorls; and the second row is about the middle of the sides, or slightly nearer to the ventral edge.

In Moore's figure where only two whorls are shown, there is an appearance of the outer of these rows of bosses in the smallest or youngest part of the whorl; but there is no sign of the second row. The latter must therefore disappear rather suddenly as the shell increases in growth.

Our specimens agree so fully in all essential characters with that figured by Moore, that we do not hesitate to assign them to that species.

The specimens are all preserved in a ferruginous rock, oolitic in structure, from Ukra Hill; the same locality from which the two preceding species were procured. It is also probably of the same Aptien age (upper neocomian.)

PLATE I.

- Fig. ... 1. BELEMNITES STOLICZKANUS, *Waagen*, p. 10; specimen from the ferruginous sandstone of *Kuntkote*; 1*a*, front view, 1*b*, side view; 1*c*, *d*, *e*, sections through the guard at different heights, 1*f*, Phragmocone, front view.
- Fig. ... 2. BELEMNITES FUSTICULUS, *Waagen*, p. 9; specimen from the ferruginous sandstone of *Kuntkote*; 2*a*, front view, 2*b*, side view, 2*c*, *d*, *e*, sections through the guard at different heights.
- Fig. ... 3. BELEMNITES KUNKOTENSIS, *Waagen*, p. 3; specimen from the ferruginous sandstone of *Kuntkote*; 3*a*, front view, 3*b*, side view, 3*c*, *d*, *e*, sections through the guard at different heights, 3*f*, Phragmocone, side view.
- Fig. ... 4. BELEMNITES ORIENTALIS, *Waagen*, p. 5; specimen from the *Dhosa Oolite* of *Wanda*; 4*a*, front view, 4*b*, side view, 4*c*, *d*, sections through the guard at upper and near lower end, 4*e*, Phragmocone, section, side view.
- Fig. ... 5. BELEMNITES OLDHAMIANUS, *Waagen*, p. 15; specimen from the shales with *Per. anceps* of *Keera hill* near *Charee*; 5*a*, front view, 5*b*, back view, 5*c*, side view, 5*d*, longitudinal section of the guard from front to back with Phragmocone, 5*e*, transversal section.
- Fig. ... 6. BELEMNITES OLDHAMIANUS, *Waagen*, p. 15; specimen from the *Athleta*-bed, south-east of *Nurrha*; 6*a*, front view, 6*b*, back view, 6*c*, side view, 6*d*, longitudinal section of the guard from front to back with Phragmocone, 6*e*, transversal section.

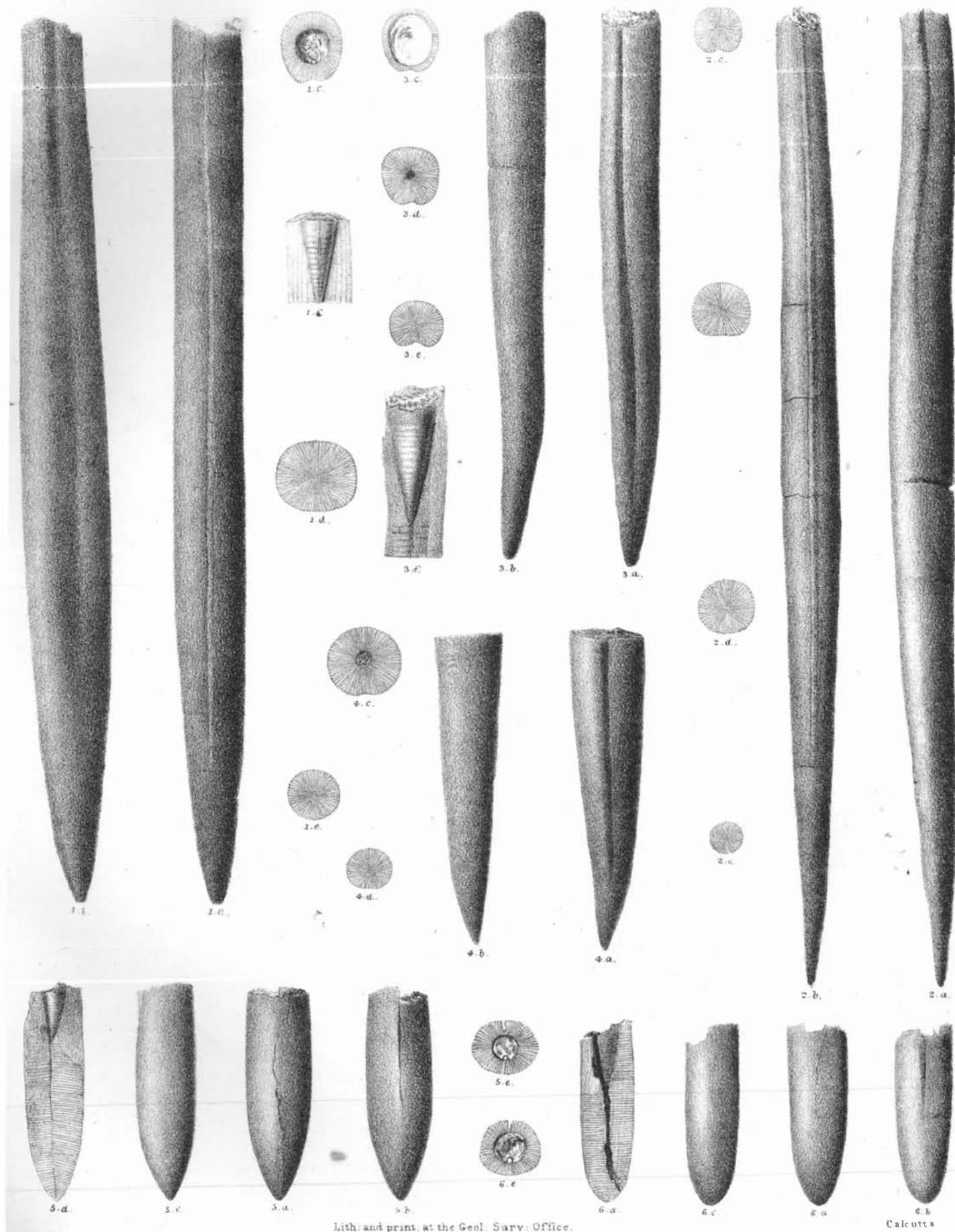


PLATE II.

- Fig. 1. BELEMNITES SUB-HASTATUS, *Zieten*, p. 14; specimen from the *Macrocephalus-beds* between *Kumagoona* and *Oorira*; 1*a*, front view, 1*b*, side view, 1*c—d*, sections through the guard at different heights; 1*e*, longitudinal section of the Phragmocone of another specimen from the same locality, side view.
- Fig. ... 2. BELEMNITES CLAVIGER, *Waagen*, p. 6; 2*a—e*, specimen from light coloured sandstone of the *Katrol-group* of the *Bothor river* near *Jurun*; 2*a*, front view, 2*b*, side view, 2*c, d, e*, sections through the guard at different heights; 2*f—h*, upper end of a specimen out of shales of the *Katrol group*, from *Lodai*, front view and sections.
- Fig. ... 3. BELEMNITES GERARDI, *Oppel*, p. 13; specimen, imperfect at the apex, from the *Dhosa Oolite*, S. of *Samtra*; 3*a*, front view, 3*b*, side view, 3*c—d*, sections through the guard at different heights.
- Fig. ... 4. BELEMNITES CALLOVIENSIS, *Oppel*, p. 14; specimen very likely from *Keera hill*; 4*a*, front view, 4*b*, side view, 4*c—d*, sections through the guard at different heights.
- Fig. 5. BELEMNITES JUMARENSIS, *Waagen*, p. 12; specimen from the *Macrocephalus-beds* of *Jumara*; 5*a*, front view, 5*b*, side view, 5*c—d*, sections through the guard at different heights.
- Fig. 6. BELEMNITES SAUVANAUSUS, *Orb.*, p. 8; 6*a—d*. Specimen from the *Dhosa Oolite*, S. of *Samtra*; 6*a*, front view, 6*b*, side view, 6*c—d*, sections through the guard; 6*e*, longitudinal section through the alveolar region of another specimen from the *Dhosa Oolite*, S. W. of *Lodai*, side view.
- Fig. 7. BELEMNITES KATROLENSIS, *Waagen*, p. 7; specimen from the coarse hard sandstone of the *Katrol range*; 7*a*, front view, 7*b*, side view, 7*c—e*, sections through the guard at different heights.
- Fig. 8. BELEMNITES KATROLENSIS, *Waagen*, p. 7; specimen from the same beds and locality as the above; 8*a*, front view, 8*b—c*, sections through the guard.
- Fig. 9. BELEMNITES KATROLENSIS, *Waagen*, p. 7; specimen out of shales of the *Katrol group* of *Lodai*, longitudinal section of the alveolar region, side view.

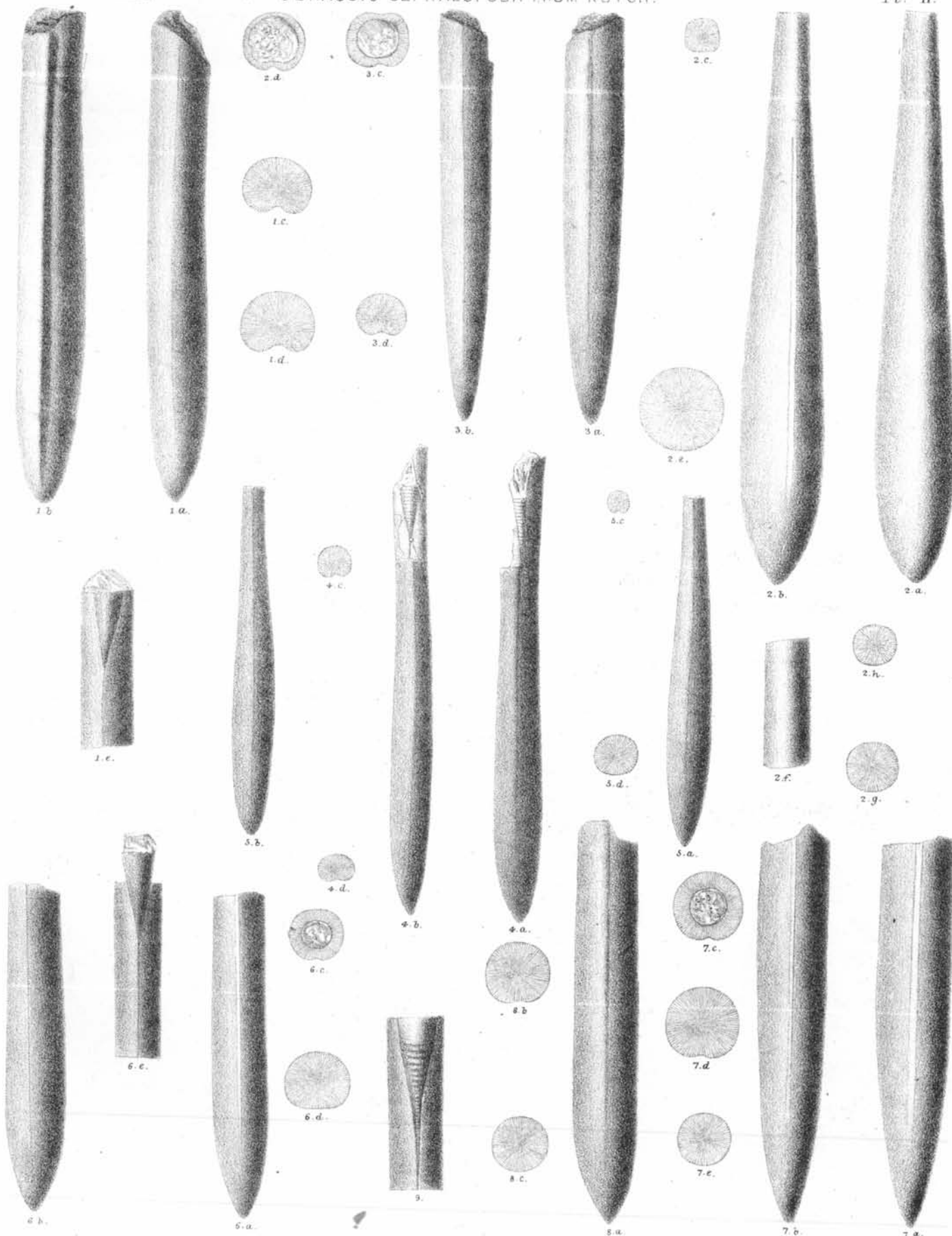
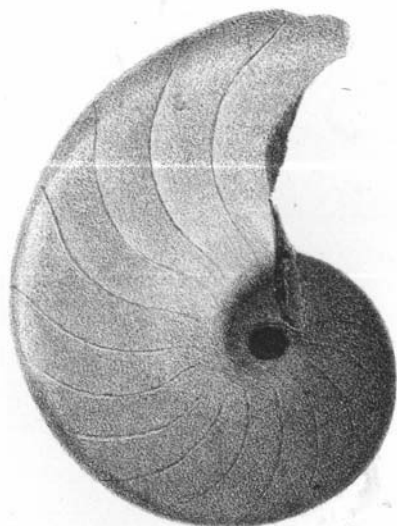


PLATE III.

- Fig. 1. NAUTILUS KUMAGUNENSIS, *Waagen*, p. 19 ; specimen from the upper region of the *Macrocephalus-beds*, N. of *Kumaguna* ; 1*a*, side view, 1*b*, front view.
- Fig. 2. NAUTILUS CALLOVIENSIS, *Oppel*, p. 18 ; specimen from the *Macrocephalus-beds*, N. W. of *Jumara* ; 2*a*, side view, 2*b*, front view.
- Fig. ... 3. NAUTILUS INTUMESCENS, *Waagen*, p. 20 ; specimen from the lowest region of the *Macrocephalus-beds*, N. W. of *Jumara* ; 3*a*, side view, 3*b*, front view.
- Fig. ... 4. NAUTILUS KUTCHENSIS, *Waagen*, p. 20 ; specimen from the beds with *Per. obtusica* of *Wanda* ; 4*a*, side view, 4*b*, front view.



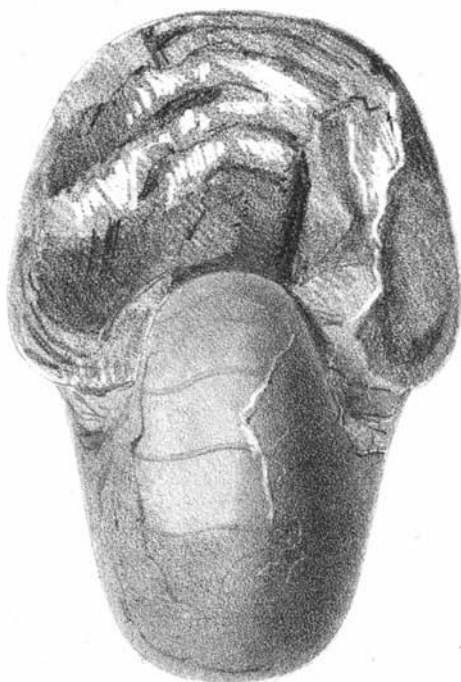
1.a.



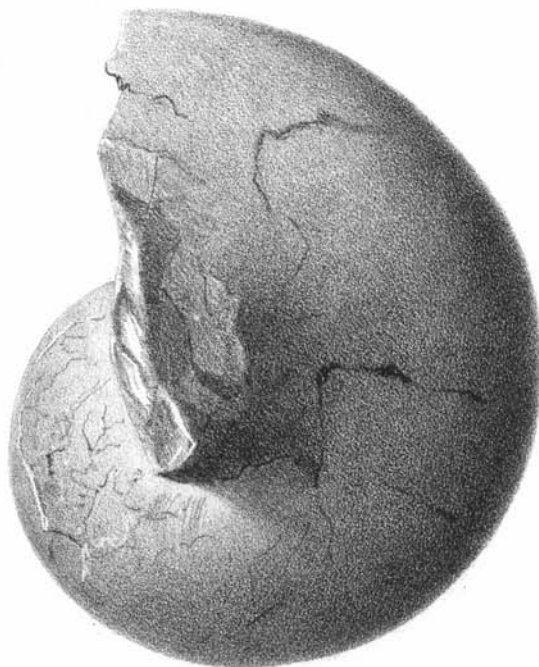
2.b.



1.b.



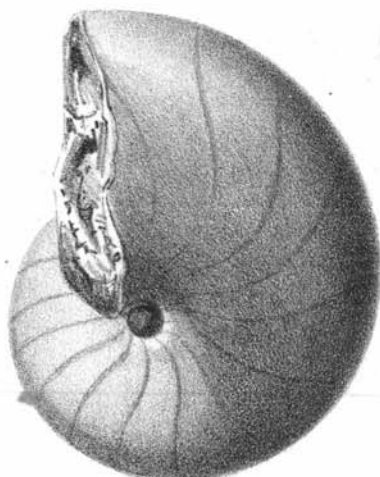
3.b.



3.a.



4.b.



2.a.



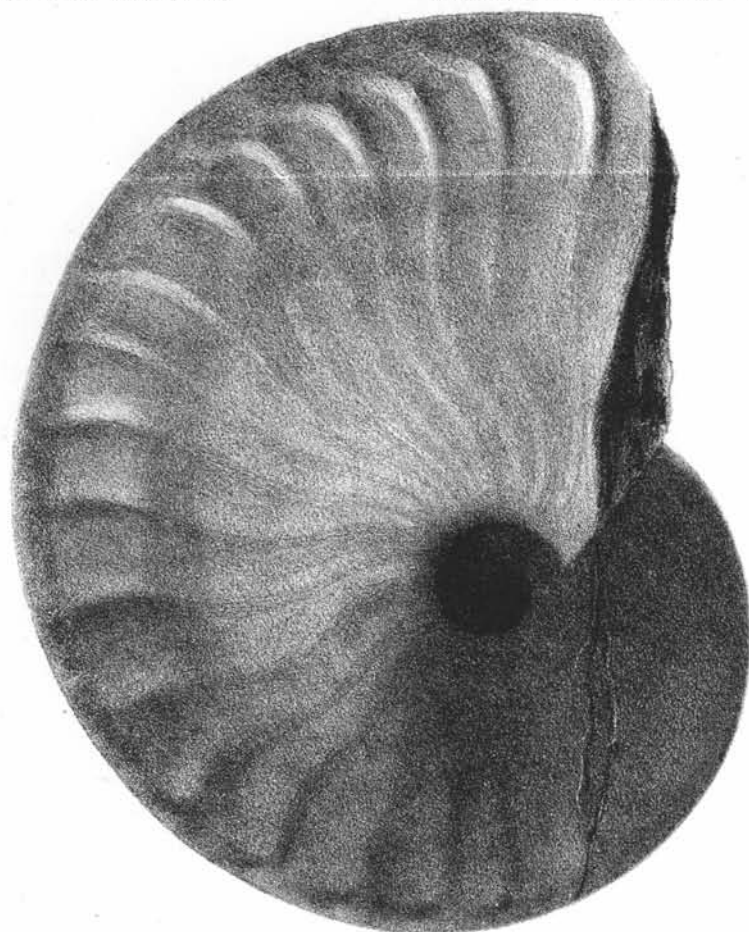
4.a.

Lith. and print. at the Geol. Surv. Office.

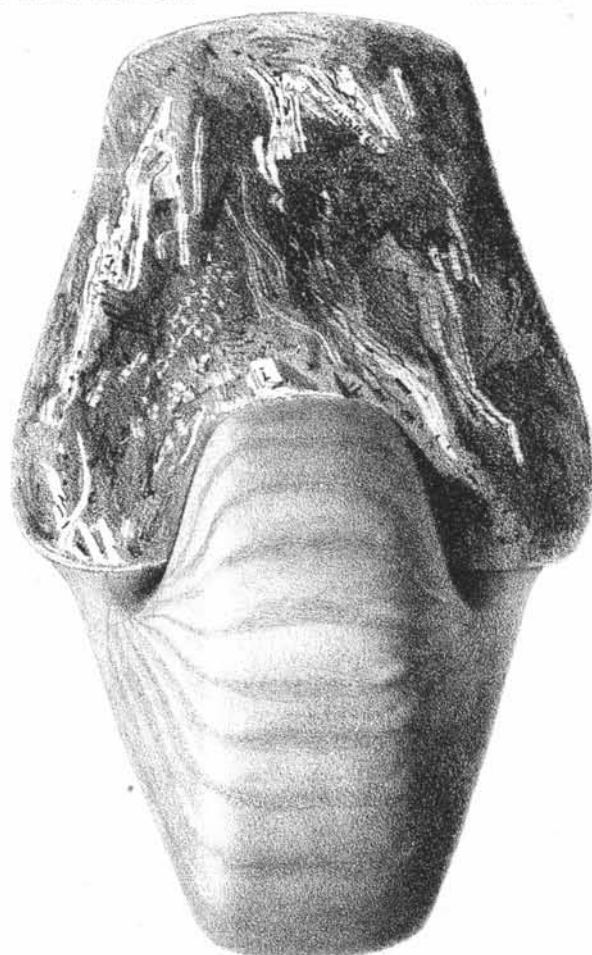
Calcutta.

PLATE IV.

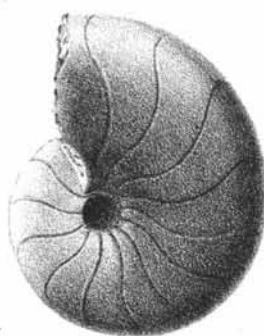
- Fig. ... 1. NAUTILUS JUMARENSIS, *Waagen*, p. 21 ; specimen from the gray limestones of the *Putchum-group* of *Junnara* ; 1*a*, side view, 1*b*, front view.
- Fig. ... 2. NAUTILUS JUMARENSIS, *Waagen*, p. 21 ; young specimen from the same beds and locality as the above ; 2*a*, side view, 2*b*, front view.
- Fig. ... 3. NAUTILUS WANDAENSIS, *Waagen*, p. 17 ; specimen from the *Dhosa Oolite* of *Wanda* ; 3*a*, side view, 3*b*, front view.



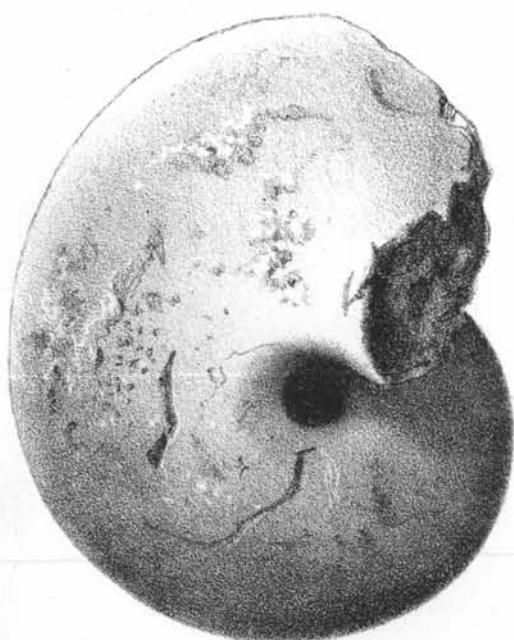
1.a.



1.b.



2.a.



3.a.



2.b.



3.b.

PLATE V.

- Fig. 1. PHYLLOCERAS MEDITERRANEUM, *Neumayr*, p. 34; specimen with preserved shell, more than half of the last whorl belonging to the body-chamber; from the *Macrocephalus shales* north-west of *Soorka*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. PHYLLOCERAS *cf.* KUNTHI, *Neumayr*, p. 25; specimen, with partly preserved shell, from the *Athleta beds* of *Leir*; 2*a*, side-view; 2*b*, front-view; 2*c*, lobes.
- Fig. ... 3. PHYLLOCERAS BENACENSE, *Catullo*, p. 33; fragment of a specimen from the *Katrol group* of east of *Rodur*; 3*a*, side-view; 3*b*, front-view; 3*c*, lobes.
- Fig. ... 4. PHYLLOCERAS VICARIUM, *Waagen*, n. sp., p. 26; fragmentary specimen from the *Macrocephalus beds* north-west of *Jumara*; 4*a*, side-view; 4*b*, front-view; 4*c*, lobes.
- Fig. 5. PHYLLOCERAS LODAIENSE, *Waagen*, n. sp., p. 32; specimen with preserved shell from the *Dhosa-oolite*, west of *Jumara*; 5*a*, side-view; 5*b*, front-view.
- Fig. ... 6. PHYLLOCERAS JARAENSE, *Waagen*, n. sp., p. 28; specimen of a cast from the *Dhosa-oolite*, north-west of *Jara*; 6*a*, side-view; 6*b*, front-view; 6*c*, lobes.

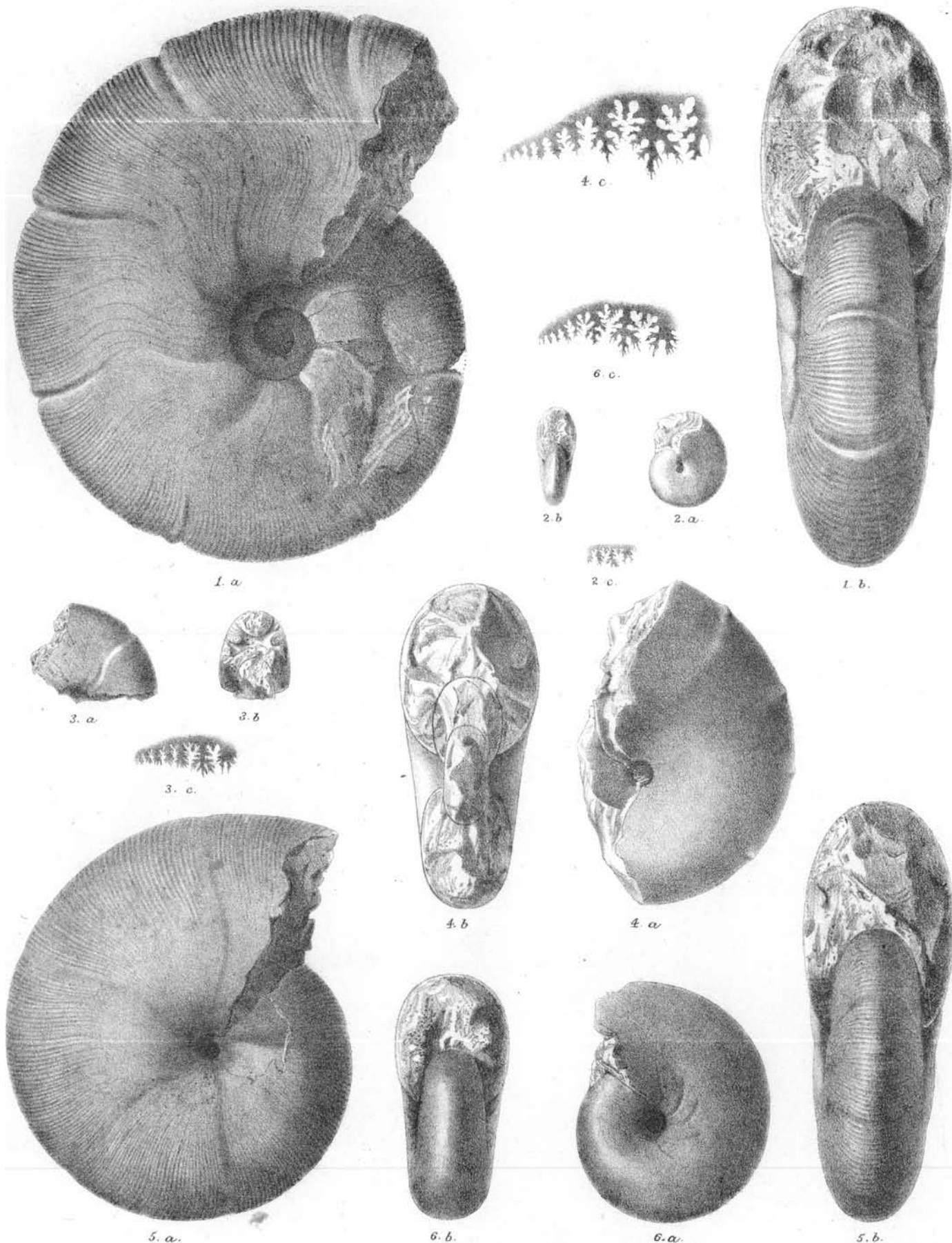


PLATE VI.

- Fig. ... 1. PHYLLOCERAS DISPUTABILE, *Zittel*, p. 31 ; specimen without body-chamber and without preserved shell, showing seven furrows ; from the *Macrocephalus beds* (golden oolite) of *Keera hill* near *Charee* ; 1*a*, side-view ; 1*b*, front-view.
- Fig. 2. PHYLLOCERAS DISPUTABILE, *Zittel*, p. 31 ; 2*a*, inner whorls of a large specimen without preserved shell, showing six furrows, side-view ; 2*b*, lobes from the inner whorls ; 2*c*, lobes from the outer whorls of the same specimen ; from the same bed and locality as fig. 1.
- Fig. ... 3. PHYLLOCERAS DISPUTABILE, *Zittel*, p. 31 ; inner whorls of a large specimen with five furrows, with preserved shell, side-view ; from the same beds and locality as fig. 1.
- Fig. 4. PHYLLOCERAS LODAIENSE, *Waagen*, n. sp., p. 32 ; specimen without preserved shell from the *Dhosa-oolite* of *Lodai* ; 4*a*, side-view ; 4*b*, front-view ; 4*c*, lobes.



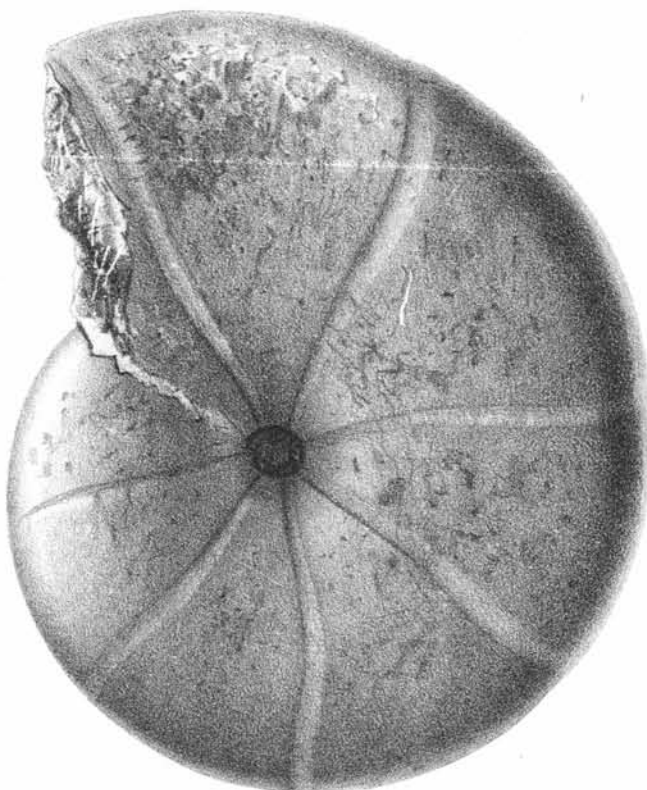
1. b.



2. b.



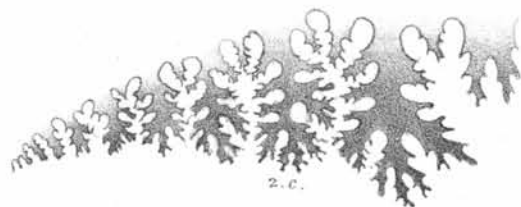
4. c.



1. a.



3.



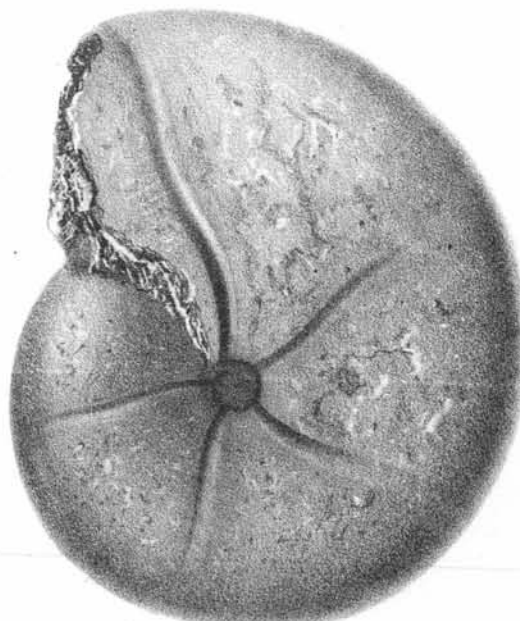
2. c.



4. b.



2. a.



4. a.

PLATE VII.

- Fig. 1. *PHYLLOCERAS FEDDENI*, *Waagen*, n. sp., p. 27; specimen without body-chamber out of *upper Callovian* beds on the road from *Jooria* to *Dhosa*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.
- Fig. 2. *PHYLLOCERAS PTYCHOICUM*, *Quenstedt*, p. 30; specimen without body-chamber out of the *Katrol group* of the *Katrol range*; 2*a*, side-view; 2*b*, front-view; 2*c*, lobes.
- Fig. 3. *PHYLLOCERAS MEDITERRANEUM*, *Neumayr*, p. 34; fragment of a small specimen with preserved shell from *upper Callovian* beds of the *valley west of Soorka hill*; 3*a*, side-view; 3*b*, section; 3*c*, lobes.
- Fig. 4. *HAPLOCERAS cf. TOMEPHORUM*, *Zittel*, p. 43; specimen without body-chamber from the upper beds of the *Katrol group*, south of *Bújuri*; 4*a*, side-view; 4*b*, front-view.



1. b.



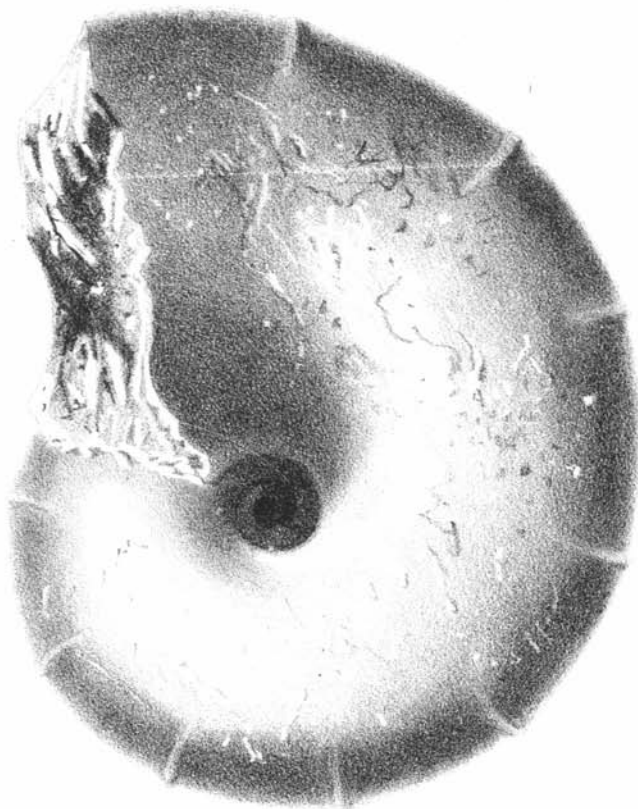
4. a.



4. b.



3. b.



1. a.



1. c.



2. c.



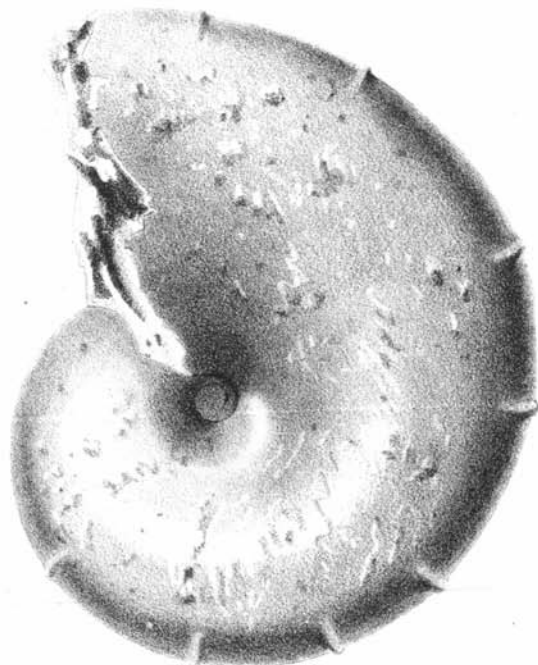
2. b.



3. a.



3. c.

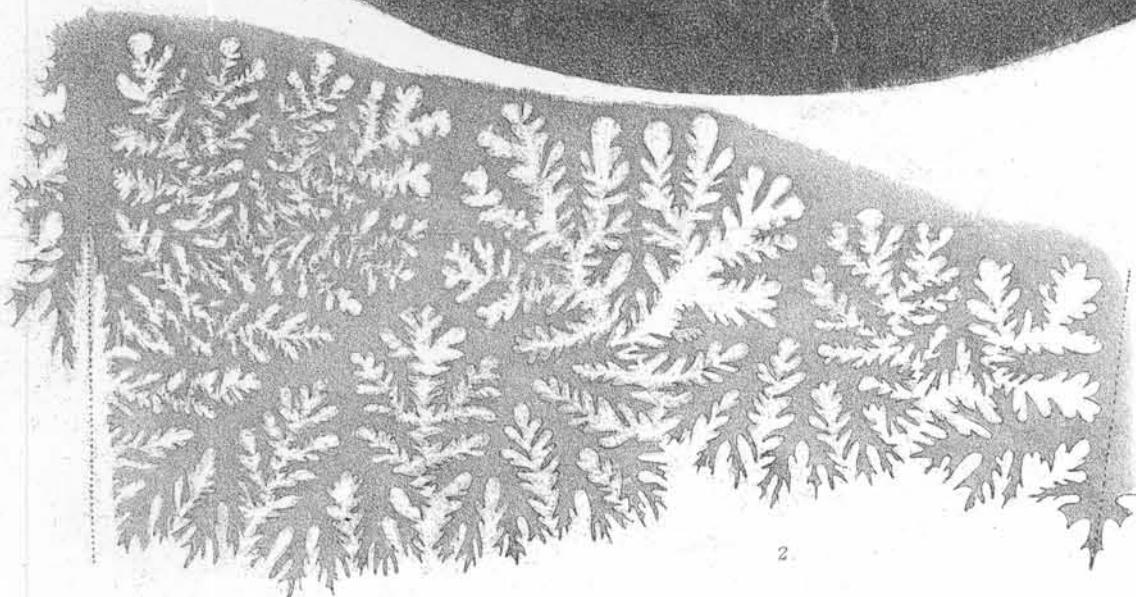
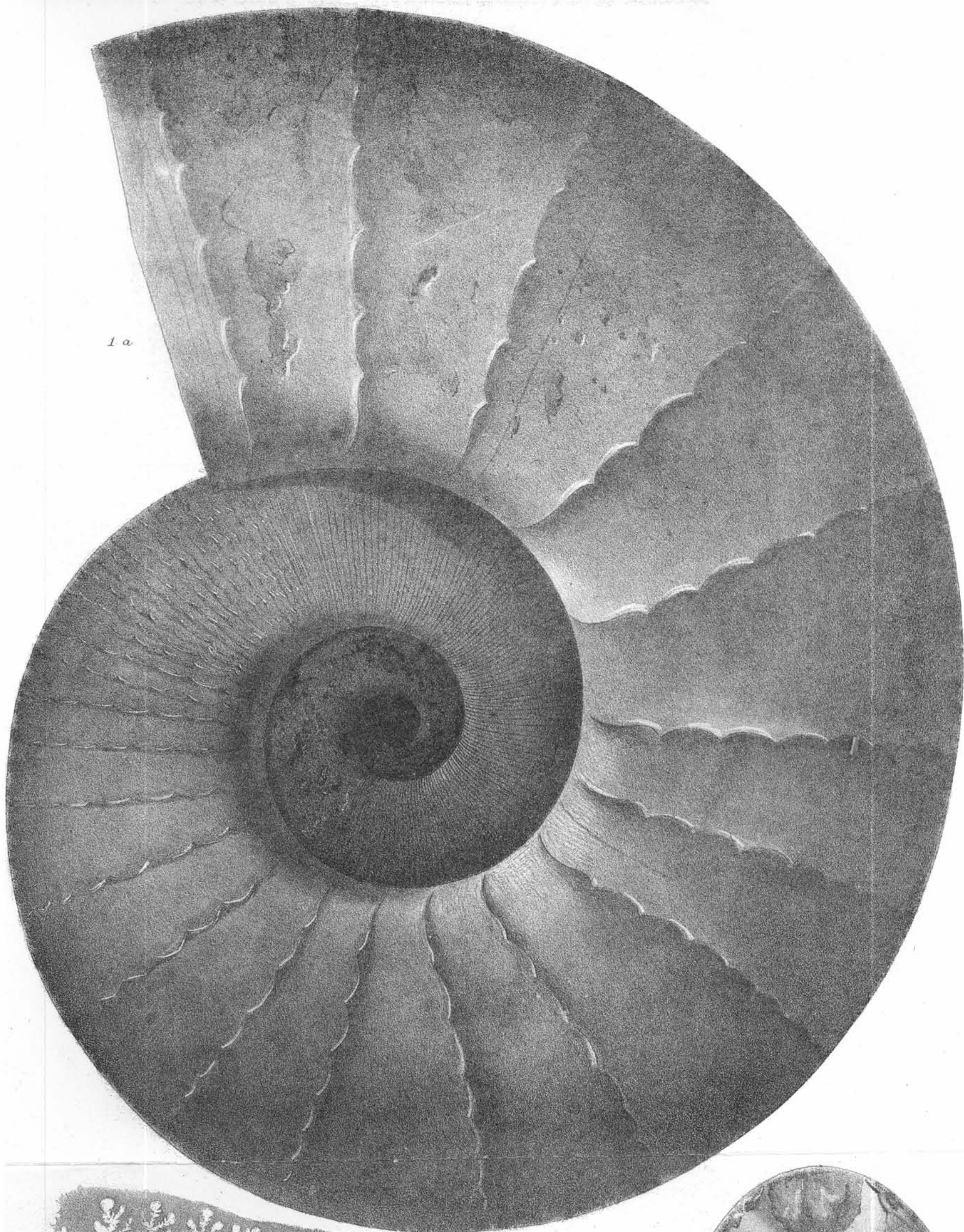


2. a.

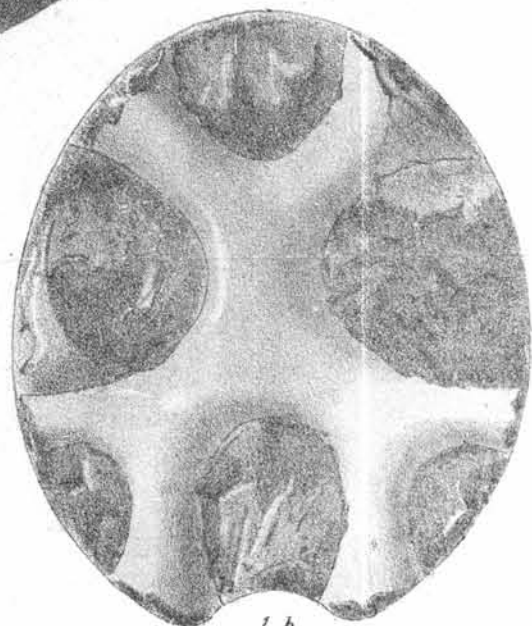
PLATE VIII.

- Fig. ... 1. **LYTOCERAS REX**, *Waagen*, n. sp., p. 36; specimen in 0·5 natural size, from the *Katrol group* near *Charee*; 1a, side-view; 1b, transversal section of one of the inner whorls.
- Fig. 2. **LYTOCERAS ADELOIDES**, *Kudernatsch*, p. 37; lobes of a fragment from the *Macrocephalus beds* (golden oolite) of *Keera hill* near *Charee*.

1 a



2



1. b.

PLATE IX.

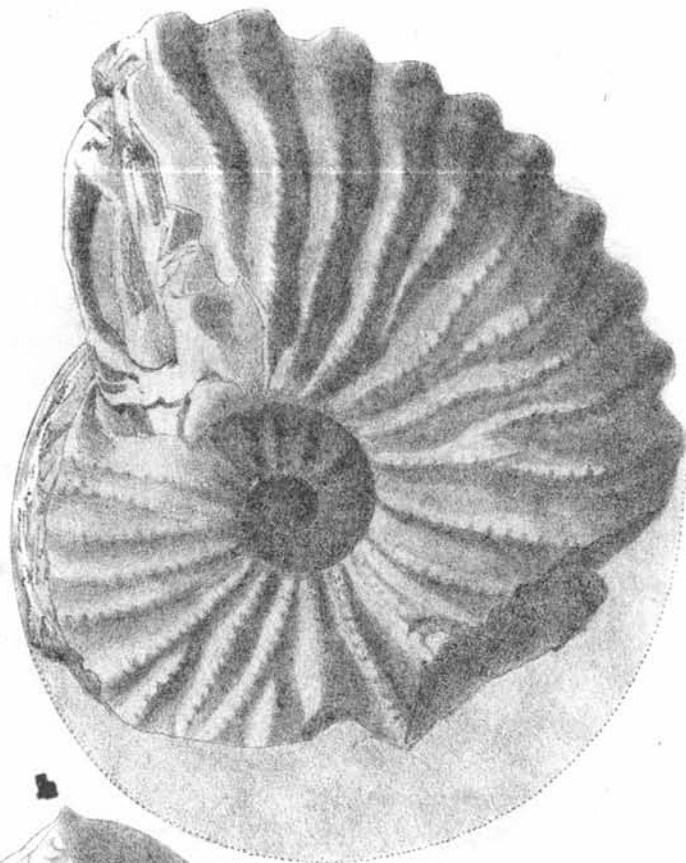
- Fig. ... 1. AMALTHEUS SCHAUMBURGI, *Waagen*, n. sp., p. 41; specimen with preserved body-chamber, without shell, from the *Athleta beds* of *Gudjinsir*; 1*a*, side-view; 1*b*, front-view; 1*c*, back-view.
- Fig. ... 2. AMALTHEUS PUSTULATUS, *Reinecke*, sp., p. 40; specimen with preserved shell, without body-chamber, from the *Athleta beds* far off north-east of *Gudjinsir*; 2*a*, side-view; 2*b*, front-view; 2*c*, back-view.
- Fig. 3. PHYLLOCERAS INSULARE, *Waagen*, n. sp., p. 29; fragmentary specimen, with partly preserved shell, from *Gangta bét*; 3*a*, side-view; 3*b*, front-view; 3*c*, lobes.



1. b.



1. c.



1. a.



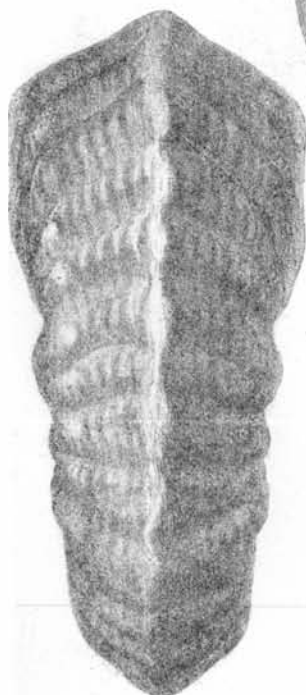
3. b.



3. a.



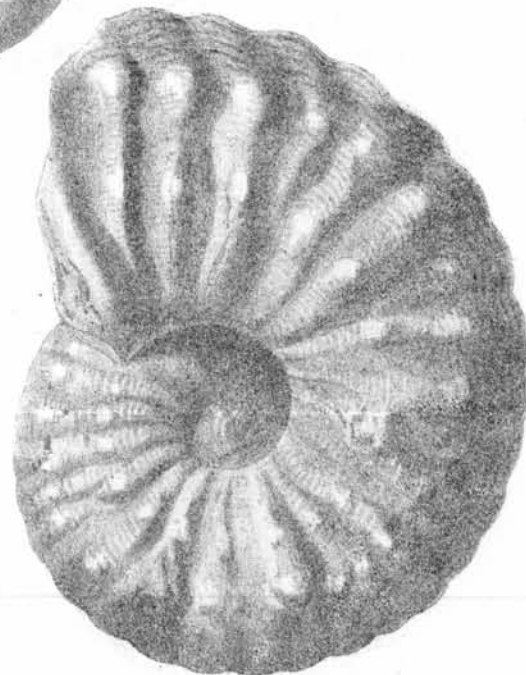
3. c.



2. c.



2. b.



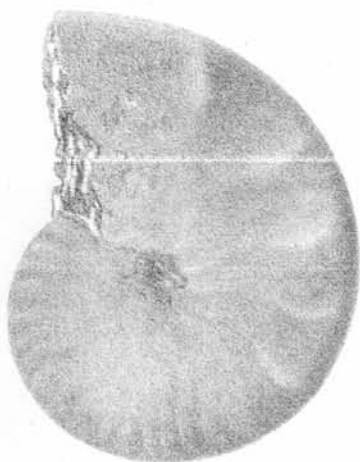
2. a.

PLATE X.

- Fig. 1. *OPPELIA SUBCOSTARIA*, *Oppel*, p. 48; specimen without body-chamber from the *Macrocephalus beds* (golden oolite) of *Keera hill* near *Charee*; 1, side-view; 1a, front-view.
- Fig. ... 2. *OPPELIA SUBCOSTARIA*, *Oppel*, p. 48; inner whorls of a larger specimen from the *golden oolite* of *Keera hill* near *Charee*; 2, side-view; 2a, front-view.
- Fig. ... 3. *OPPELIA* (*OECOTRAUSTES*) *SERRIGERA*, *Waagen*, p. 57; compressed specimen out of calcareous shales of the *Puchum group*, south of *Nurra*; side-view.
- Fig. ... 4. *OPPELIA KACHHENSIS*, *Waagen*, n. sp., p. 55; specimen without body-chamber from the *Katrol group* of the *Katrol range*; 4, side-view; 4a, front-view; 4c, lobes.
- Fig. 5. *OPPELIA PLICODISCUS*, *Waagen*, n. sp., p. 56; small specimen, composed of air-chambers, from the *Katrol group* south of *Madapoor*; 5, side-view; 5a, front-view.
- Fig. 6. *OPPELIA TRACHYNOTA*, *Oppel*, p. 54; small specimen, composed of air-chambers, from the *Katrol group* of the *Joor hills*; 6, side-view; 6a, front-view.
- Fig. 7. *OPPELIA cf. GLABELLA*, *Leckenby*, p. 49; body-chamber and last two air-chambers of a specimen from the *Athleta beds* of *Keera hill* near *Charee*; 7, side-view; 7a, section.



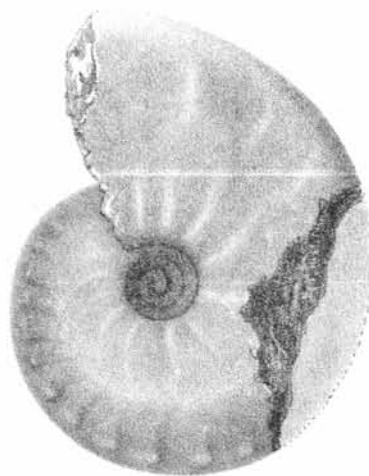
1 a.



1.



2 a.



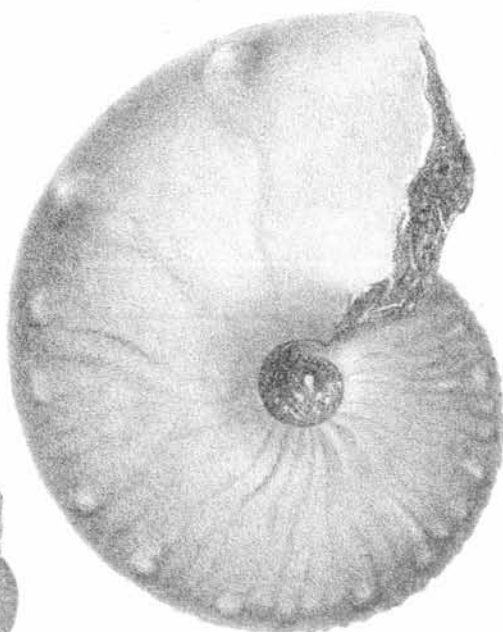
2.



4 a.



5.



4.



4 c.



5 a.



3.



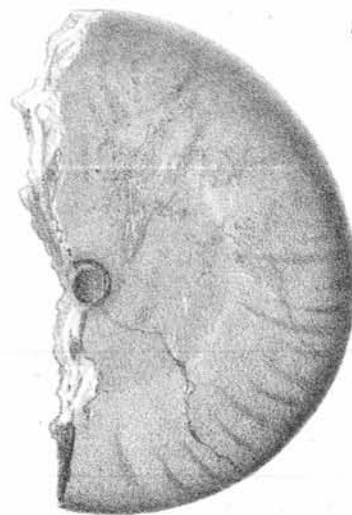
6.



6 a.



7 a.



7.

PLATE XI.

- Fig. 1. *OPPELIA BICOSTATA*, *Stahl.*, p. 52; specimen with preserved body-chamber from the *Athleta* beds south-west of *Barasore*; 1*a*, side-view; 1*b*, front-view; 1*c*, back-view; 1*d*, lobes.
- Fig. 2. *OPPELIA NURRHAENSIS*, *Waagen*, n. sp., p. 51; specimen with preserved body-chamber out of the beds with *Perisph. anceps*, from north-west of *Jumara*; 2*a*, side-view; 2*b*, front-view.
- Fig. ... 3. *OPPELIA PLANA*, *Waagen*, n. sp., p. 56; specimen with preserved body-chamber from the *Katrol* group, south-west of *Nurrha*; 3*a*, side-view; 3*b*, front-view.
- Fig. 4. *HAPLOCERAS PROPINQUUM*, *Waagen*, n. sp., p. 45; specimen without body-chamber from the lowest beds of the *Katrol* group, south side of *Keera hill*, near *Charee*; 4*a*, side-view; 4*b*, front-view.
- Fig. 5. *OPPELIA ORIENTALIS*, *Orbigny*, p. 58; specimen with preserved body-chamber from the beds with *Perisph. anceps* of north-west of *Jara*; 5*a*, side-view; 5*b*, front-view; 5*c*, back-view.
- Fig. 6. *OPPELIA ORIENTALIS*, *Orbigny*, p. 58; fragment of an inner whorl from *Keera hill* near *Charee*; side-view.
- Fig. 7. *OPPELIA*, *species indeterminata*; specimen from the *Athleta* beds of *Barasore*, not mentioned in the text, figured only to show the occurrence of another species of *Oppelia* in the *Athleta* beds.
- Fig. ... 8. *APTICHUS* of *OPPELIA*, p. 59; specimen out of the *Katrol* group of an unknown locality in *Kachh*; 8*a*, outer-view; 8*b*, inner-view; 8*c*, front-view.
- Fig. 9. *HAPLOCERAS DEPLANATUM*, *Waagen*, n. sp., p. 44; specimen without body-chamber from the *Katrol* group of the *Charvar* range, south of *Bhoj*; 9*a*, side-view; 9*b*, front-view; 9*c*, lobes.

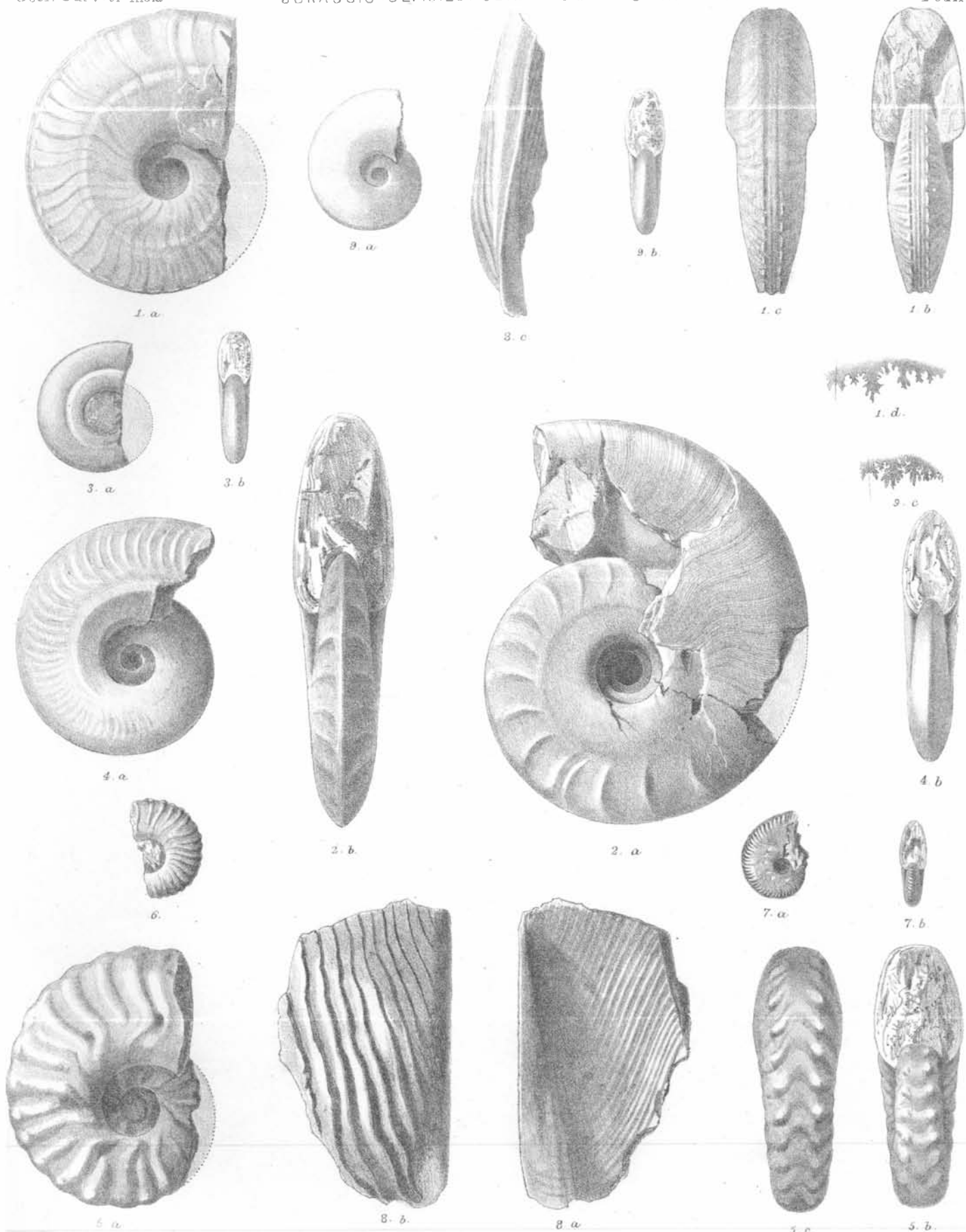


PLATE XII.

- Fig. 1. HARPOCERAS IGNOBILE, *Sowerby*, p. 69; specimen with preserved body-chamber from the beds with *Perisph. anceps*, from *Keera hill*; 1, side-view; 1a, front-view.
- Fig. 2. HARPOCERAS IGNOBILE, *Sowerby*, p. 69; specimen without body-chamber from the same bed and locality as fig. 1; 2, side-view; 2a, front-view; 2b, lobes.
- Figs. 3—5. HARPOCERAS HECTICUM, *Reinecke*, p. 61; large specimen without body-chamber from the *golden oolite* of *Keera hill*; 3, middle whorl side-view; 3a, back-view; 3b, section; 4, inner whorl side-view; 4a, back-view; 4b, section; 5, lobes of the outer whorl from the siphonal to the antisiphonal lobe.
- Fig. ... 6. HARPOCERAS CRASSEFALCATUM, *Waagen*, n. sp., p. 70; specimen without body-chamber from the beds with *Perisph. anceps*, from *Keera hill*; 6, side-view; 6a, front-view.
- Fig. 7. HARPOCERAS CRASSEFALCATUM, *Waagen*, n. sp., p. 70; smaller specimen from the same beds and locality as fig. 6; side-view.
- Fig. ... 8. OPPELIA ORIENTALIS, *Orbigny*, p. 58; fragment of the inner whorls from *Keera hill*; 8, side-view; 8a, back-view; 8b, section.

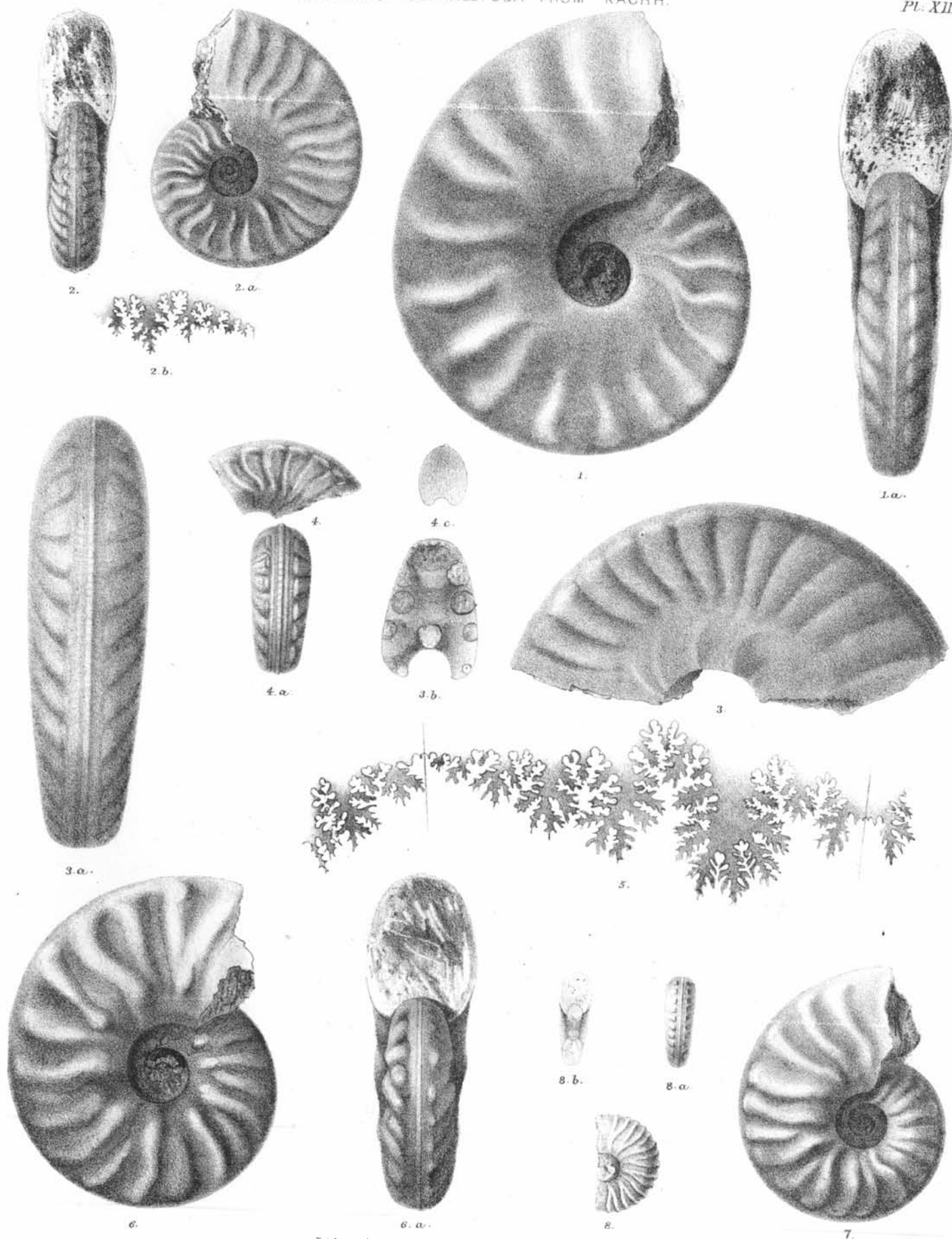


PLATE XIII.

- Fig. ... 1. HARPOCERAS LUNULA, *Zieten*, p. 63; specimen without body-chamber and partly preserved shell from the *beds with Perisph. anceps* of *Vanda*; 1a, side-view; 1b, front-view.
- Fig. 2. HARPOCERAS TRILINEATUM, *Waagen*, n. sp., p. 71; specimen with partly preserved body-chamber from beds a little *below the Dhosa-oolite*; (beds with *Perisph. anceps*?) south-west side of *Keera hill* near *Charee*; 2a, side-view; 2b, front-view.
- Fig. 3. HARPOCERAS LAIRENSE, *Waagen*, n. sp., p. 65; specimen with partly preserved shell, the last half of the last whorl belonging to the body-chamber; from the *Athleta bed* of *Lair*; 3a, side-view; 3b, front-view.
- Fig. 4. HARPOCERAS LAIRENSE, *Waagen*, n. sp., p. 65; fragment of the body-chamber of a small specimen from the *Athleta bed* north-east of *Gudjinsir*; 4a, side-view; 4b, section.
- Fig. 5. HARPOCERAS RAURACUM, *C. Mayer*, p. 68; specimen without body-chamber from the *Dhosa-oolite*, north-west of *Soorka*; 5a, side-view; 5b, front-view; 5c, back-view.
- Fig. 6. HARPOCERAS DYNASTES, *Waagen*, n. sp., p. 66; fragment of a large specimen with preserved shell from the *Athleta bed* south-east of *Nurrha*; 6a, side-view; 6b, section.
- Fig. 7. HARPOCERAS DYNASTES, *Waagen*, n. sp., p. 66; fragment of a small specimen with preserved shell from the *Athleta beds* south-east of *Nurrha*; 7a, side-view; 7b, section.
- Fig. ... 8. HARPOCERAS DYNASTES, *Waagen*, n. sp., p. 66; pyritic cast of a small specimen from the *Athleta beds* of *Keera hill*; 8a, side-view; 8b, front-view.
- Fig. 9. HARPOCERAS PUNCTATUM, *Stahl*, p. 63; specimen without body-chamber from the beds with *Perisph. anceps* of *Vanda*; 9a, side-view; 9b, front-view.
- Fig. ... 10. HARPOCERAS PUNCTATUM, *Stahl*, p. 63; specimen found loose on the ground near *Barasore*, side-view.
- Fig. 11. HARPOCERAS KOBELLI, *Oppel*, Typus, p. 72; specimen with partly preserved body-chamber from the *Katrol group*, south-west of *Nurrha*; 11a, side-view; 11b, front-view.
- Fig. 12. HARPOCERAS KOBELLI, *Oppel*, Variety, p. 72; specimen without body-chamber from the same bed and locality as fig. 11; 12a, side-view; 12b, front-view.
- Fig. 13. HARPOCERAS KOBELLI, *Oppel*, Variety, p. 72; specimen without body-chamber from the same beds and locality as fig. 11; 13a, side-view; 13b, front-view.

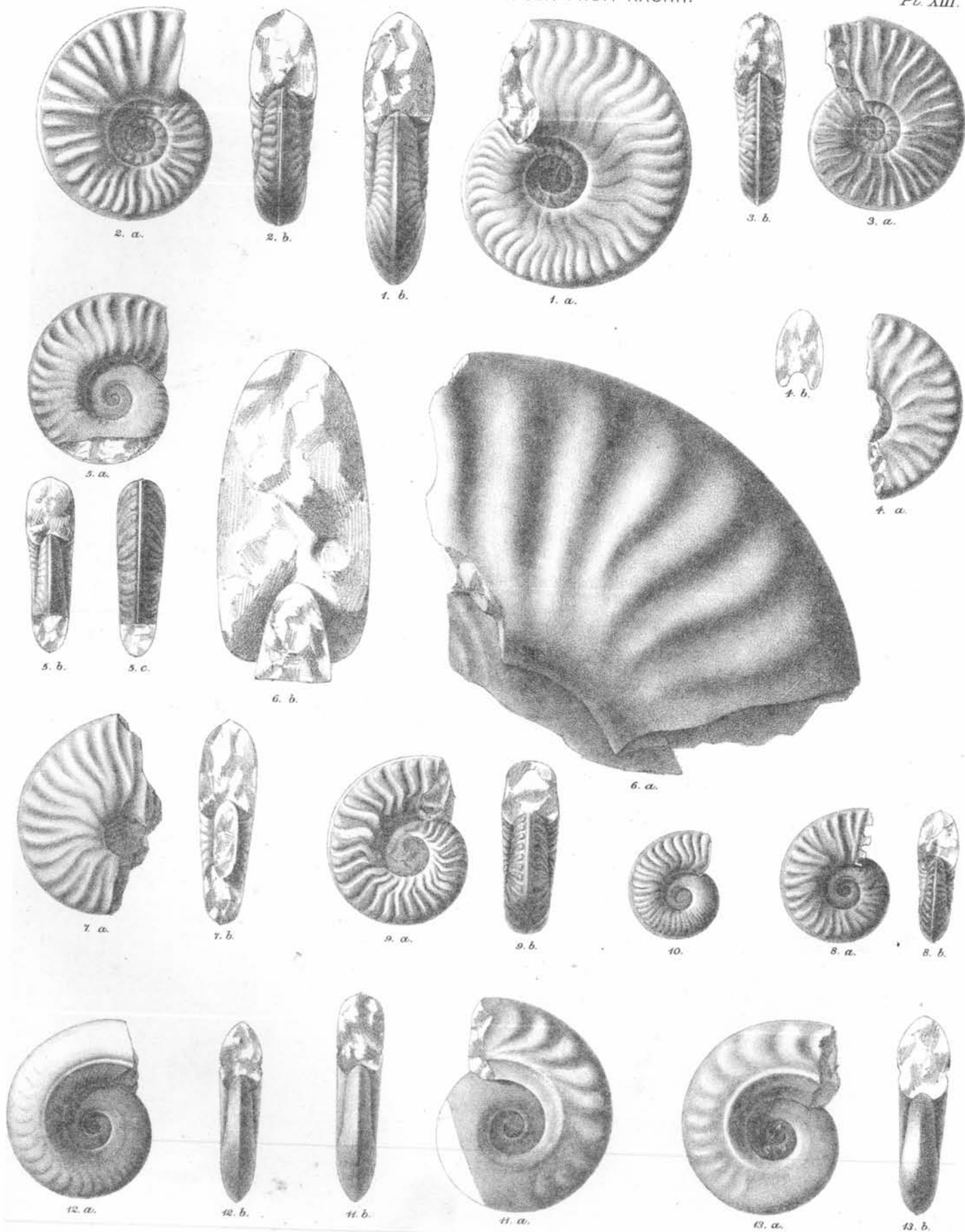
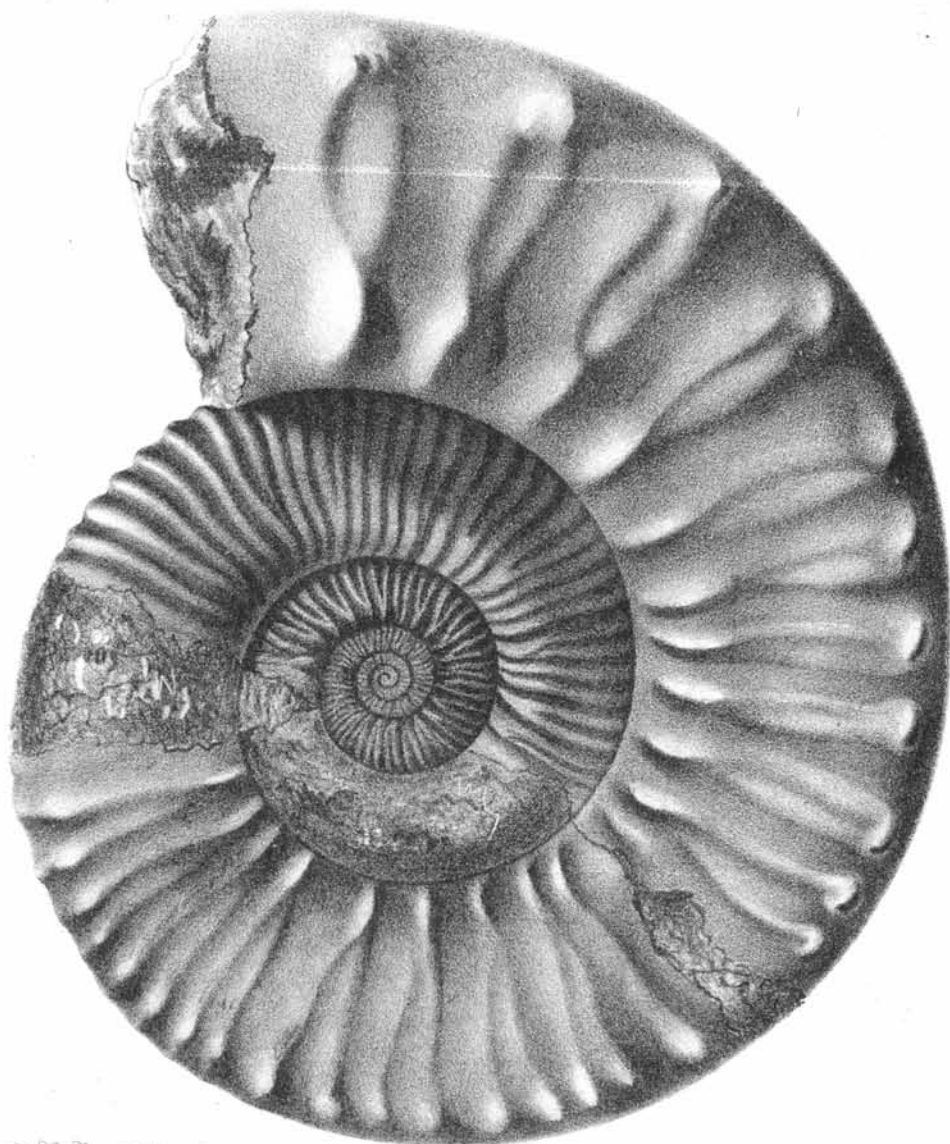
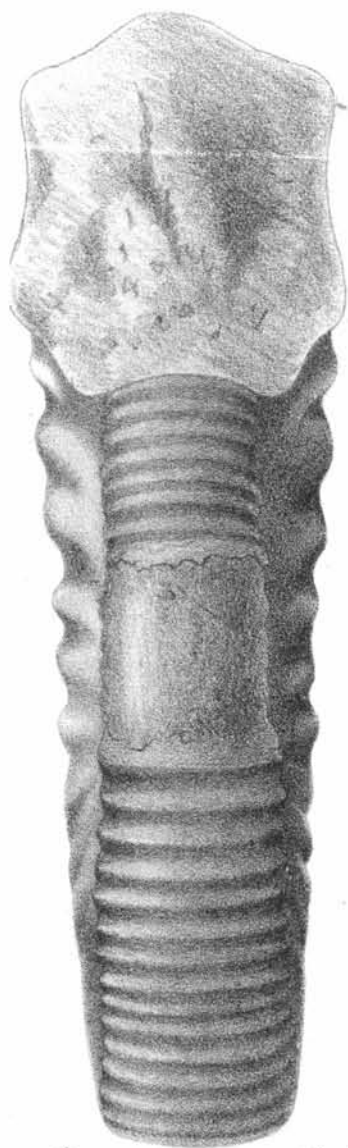


PLATE XIV.

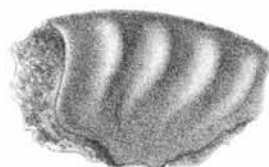
- Fig. ... 1. *PELTOCERAS SEMIRUGOSUM*, *Waagen*, n. sp., p. 83; specimen with the beginning of the body-chamber from the *Dhosa-oolite* of *Lodai*; 1, side-view; 1 *a*, front-view; 1 *b*, lobes.
- Fig. ... 2. *PELTOCERAS SEMIRUGOSUM*, *Waagen*, n. sp., p. 83; small specimen, composed of air-chambers, from same bed and locality as fig. 1; 2, side-view; 2 *a*, front-view.
- Figs. ... 3-6. *OPPELIA NURRHAENSIS*, *Waagen*, n. sp., p. 51; young specimens from the beds with *Per. anceps*, east of *Nurrha*; 3, side-view; 3 *a*, front-view; 3 *b*, lobes; 4, fragment of a very young specimen; 5, aperture of a young specimen; 6, variety with larger umbilicus.
- Fig. ... 7. *OPPELIA FORNIX*, *Sowerby*, p. 50; copy from Sowerby's figure: *Transact. Geol. Soc., Lond., Ser. II, Vol. V, pl. 61, fig. 13.*



1.a



1.



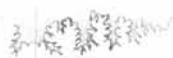
7.



3.a.



4.



3.b.



3.



2.



2.a.

PLATE XV.

- Fig. ... 1. PELTOCERAS BIDENS, *Waagen*, n. sp., p. 85 ; figure two-thirds of natural size, of a specimen with the beginning of the body-chamber, from the *Dhosa oolite* of *Lodai*.
- Fig. ... 2. PELTOCERAS BIDENS, *Waagen*, n. sp., p. 85 ; 2, lobes ; 2*a*, section of the inner whorl, natural size ; from the specimen represented in fig. 1 in reduced size.
- Fig. ... 3. PELTOCERAS BIDENS, *Waagen*, n. sp., p. 85 ; fragment of a half grown specimen from the *Dhosa oolite* of *Lodai* ; 3*a*, side-view ; 3*b*, back-view.
- Fig. ... 4. PELTOCERAS BIDENS, *Waagen*, n. sp., p. 85 ; fragment of a small specimen from the *Dhosa oolite* of the *Joora hills* ; 4*a*, side-view ; 4*b*, section of the whorls.

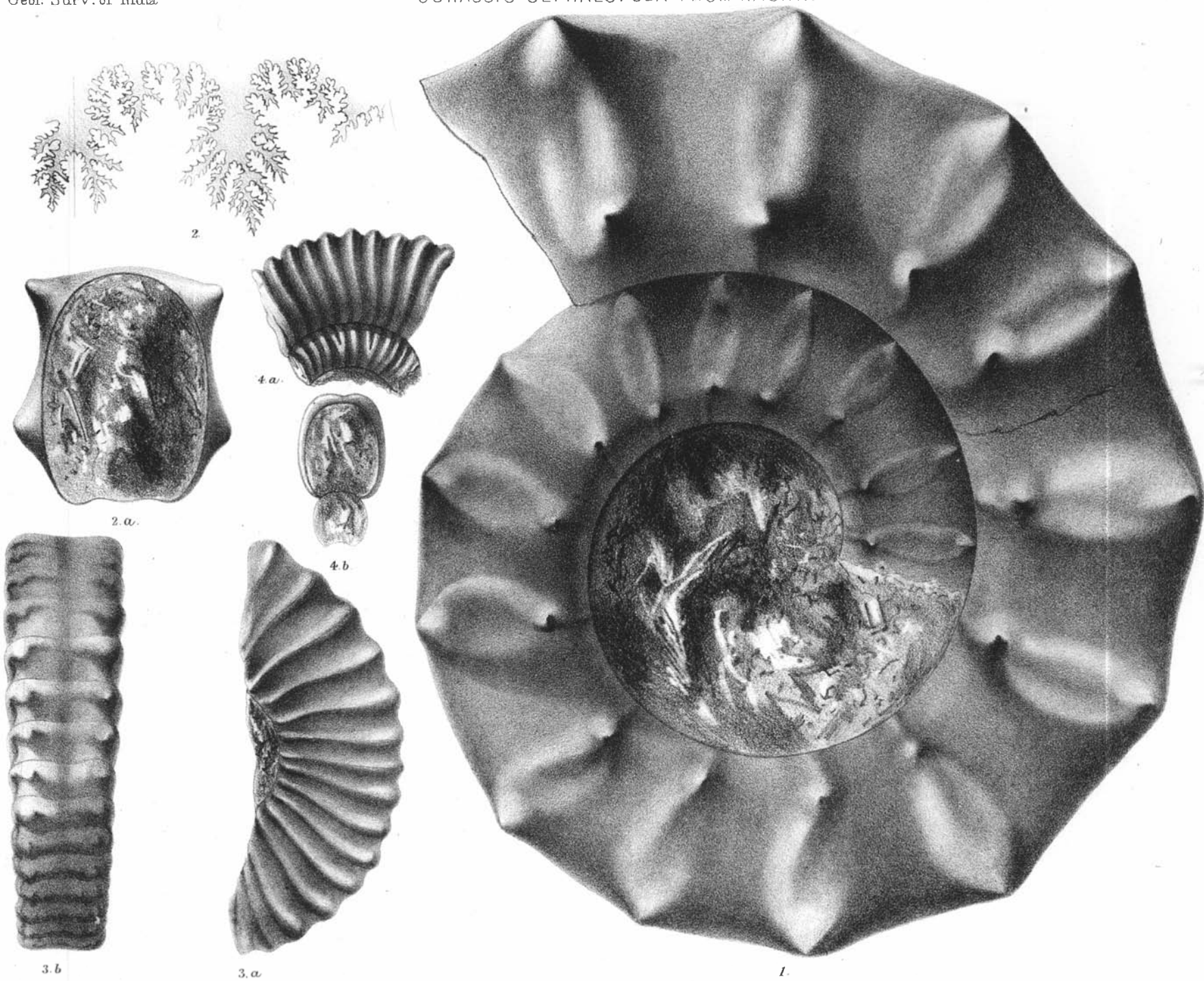
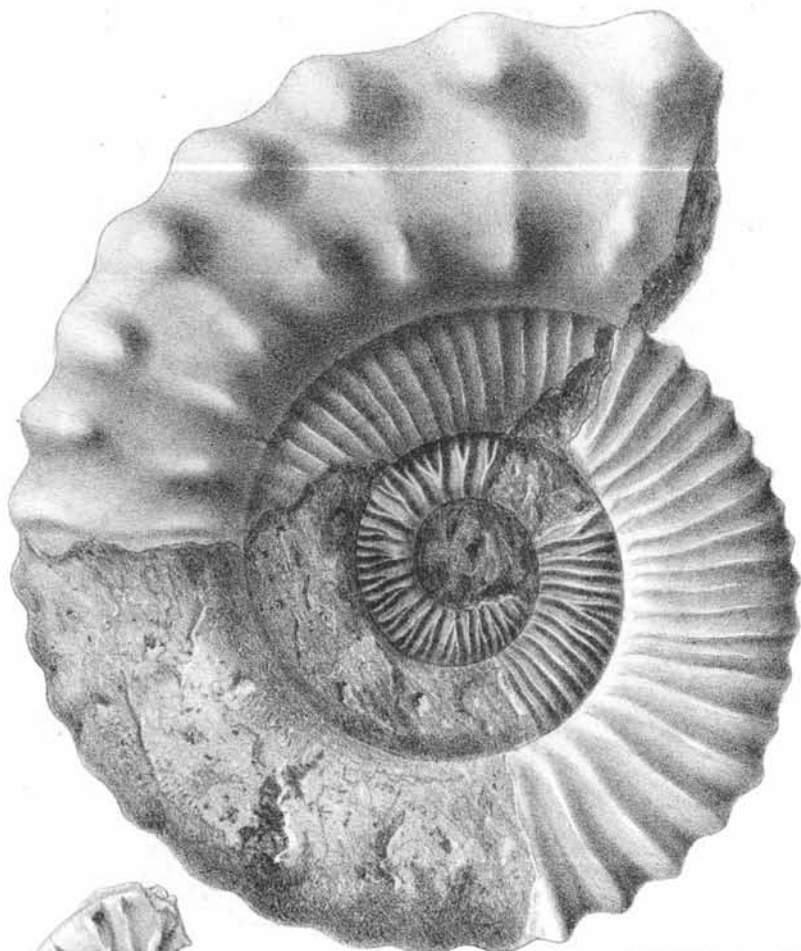
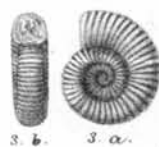


PLATE XVI.

- Fig. ... 1. *PELTOCERAS PROPINQUUM*, *Waagen*, n. sp., p. 79 ; specimen, without preserved shell, entirely composed of air-chambers, from the *Dhosa oolite* north-west of *Kumaguna* ; 1*a*, side-view ; 1*b*, front-view ; 1*c*, portion of the siphonal side of the latter end of the last whorl.
- Fig. 2. *PELTOCERAS ARDUENNENSE*, *Orbigny*, p. 79 ; small specimen ; from the *Dhosa oolite* of the *Joorra hills* ; 2*a*, side-view ; 2*b*, front-view.
- Fig. 3. *PELTOCERAS AEGOCEROIDES*, *Waagen*, n. sp., p. 78 ; apparently full grown specimen, with partly preserved body-chamber, from the *Dhosa oolite* of the *Joorra hills* ; 3*a*, side-view ; 3*b*, front-view.
- Figs. ... 4—7. *ASPIDOCERAS PERARMATUM*, *Sowerby*, p. 91 ; 4 *a, b*, middle-sized specimen from the *Dhosa oolite* of *Vanda*, front and side-views ; 5 *a, b*, very young specimen from the same bed and locality as fig. 4, front and side-views ; 6, somewhat larger specimen, also from the *Dhosa oolite* of *Vanda*, side-view ; 7, lobes of a full grown specimen, from the *Dhosa oolite* of *Lodai*.



1. a.



3. b.

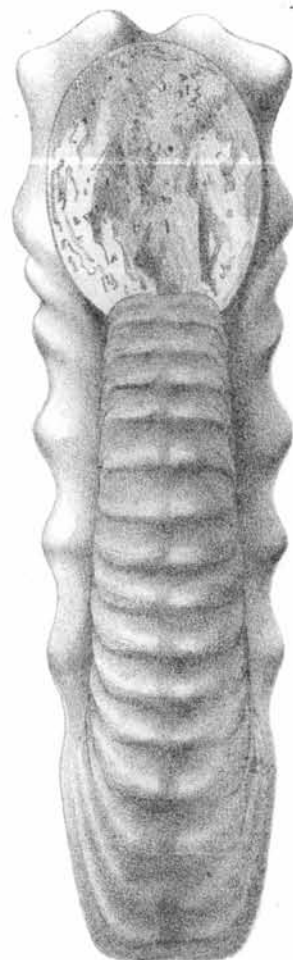
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2. a.



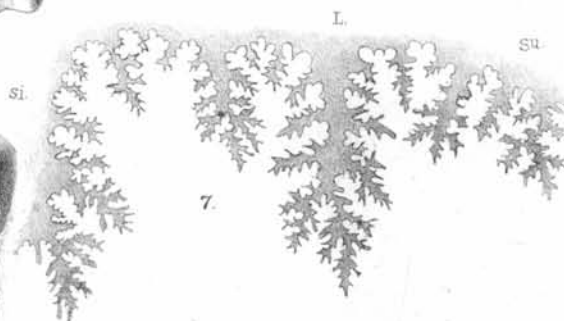
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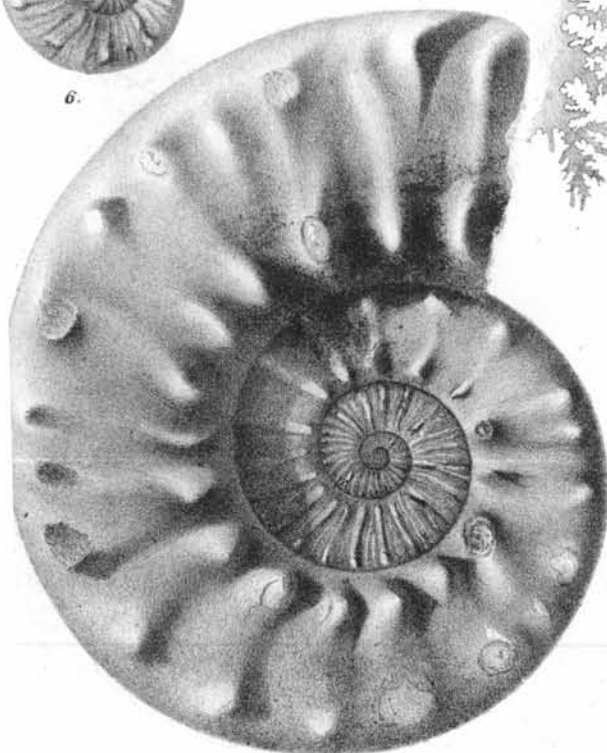
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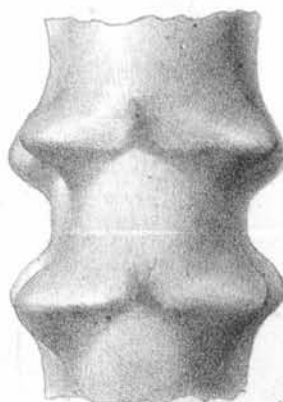
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7.



4. a.



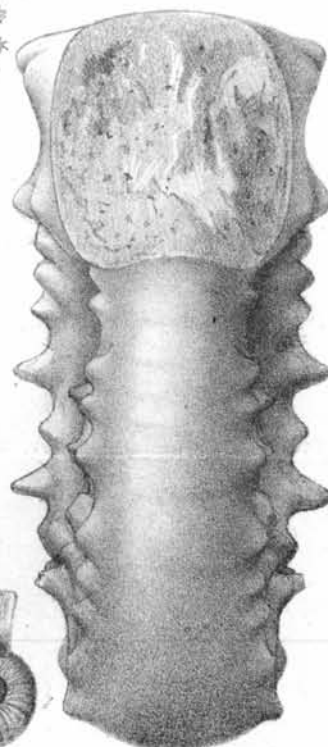
1. c.



5. b.



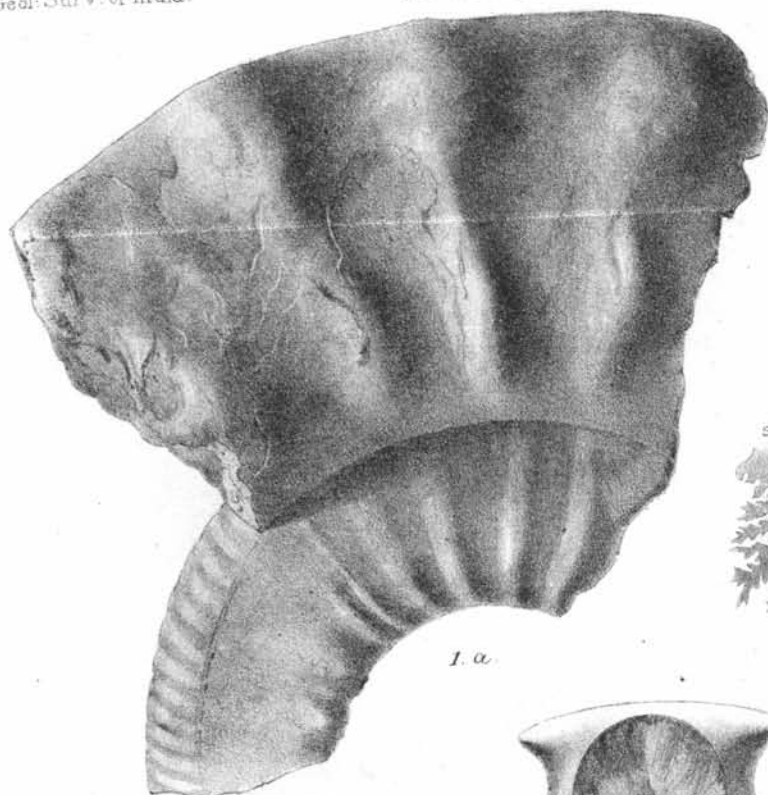
5. a.



4. b.

PLATE XVII.

- Fig. 1. *ASPIDOCERAS DIVERSIFORME*, *Waagen*, n. sp., p. 90; fragmentary specimen with preserved shell, entirely composed of air-chambers, from the *Athleta beds* of north-east of *Gudjinsir*; 1*a*, side-view; 1*b*, section of the outer whorl; 1*c*, impression of the siphonal side of the younger shell left on the antisiphonal side of the inner whorl of the fragment; 1*d*, lobes from the siphonal to the antisiphonal lobe.
- Fig. ... 2. *PELTOCERAS ATHLETA*, *Phillips*, p. 81; fragment of a middle-sized specimen from the *Athleta beds* of *Gudjinsir*; 2*a*, side-view; 2*b*, lobes.
- Fig. 3. *PELTOCERAS ATHLETA*, *Phillips*, p. 81; fragment with preserved shell from the *Athleta beds* of north of *Gudjinsir*; 3*a*, side-view; 3*b*, back-view; 3*c*, section.
- Fig. ... 4. *ASPIDOCERAS TENUISPINATUM*, *Waagen*, n. sp., p. 93; fragmentary specimen with, for the greater part, preserved shell from the *Dhosa oolite* north-west of *Jara*; 4*a*, side-view; 4*b*, back-view.



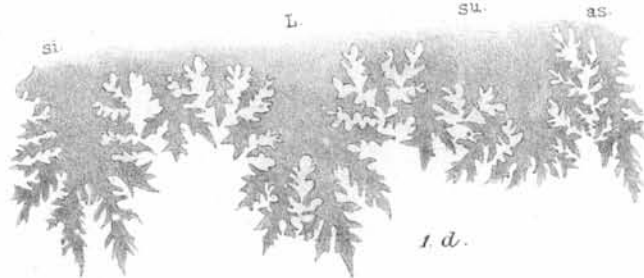
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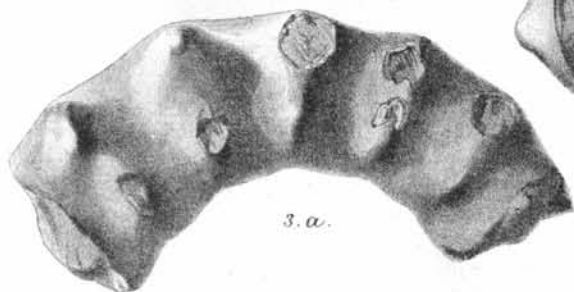
1. c.



1. b.



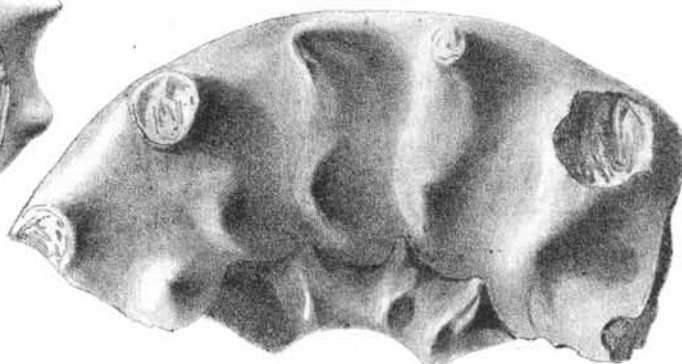
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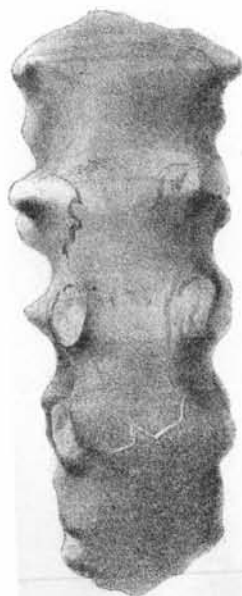
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3. c.



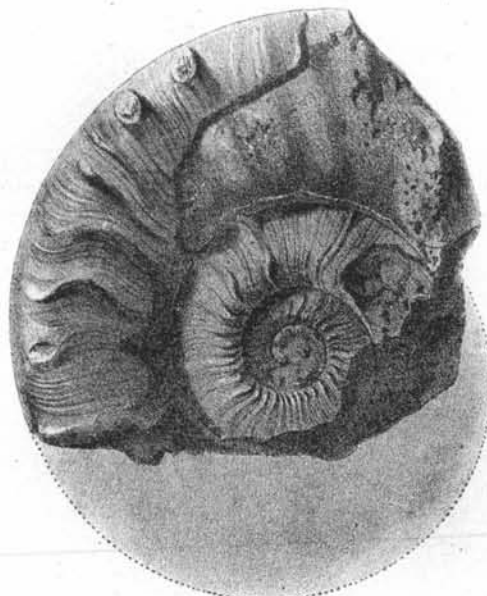
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3. b.



2. b.



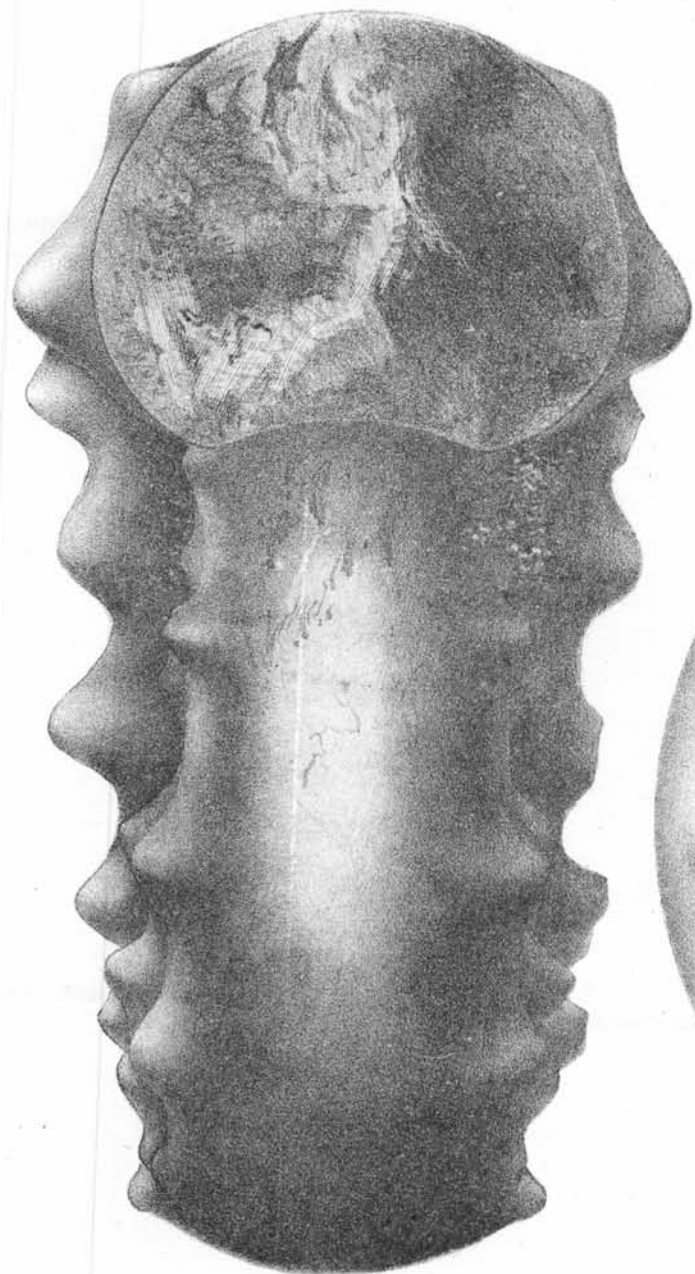
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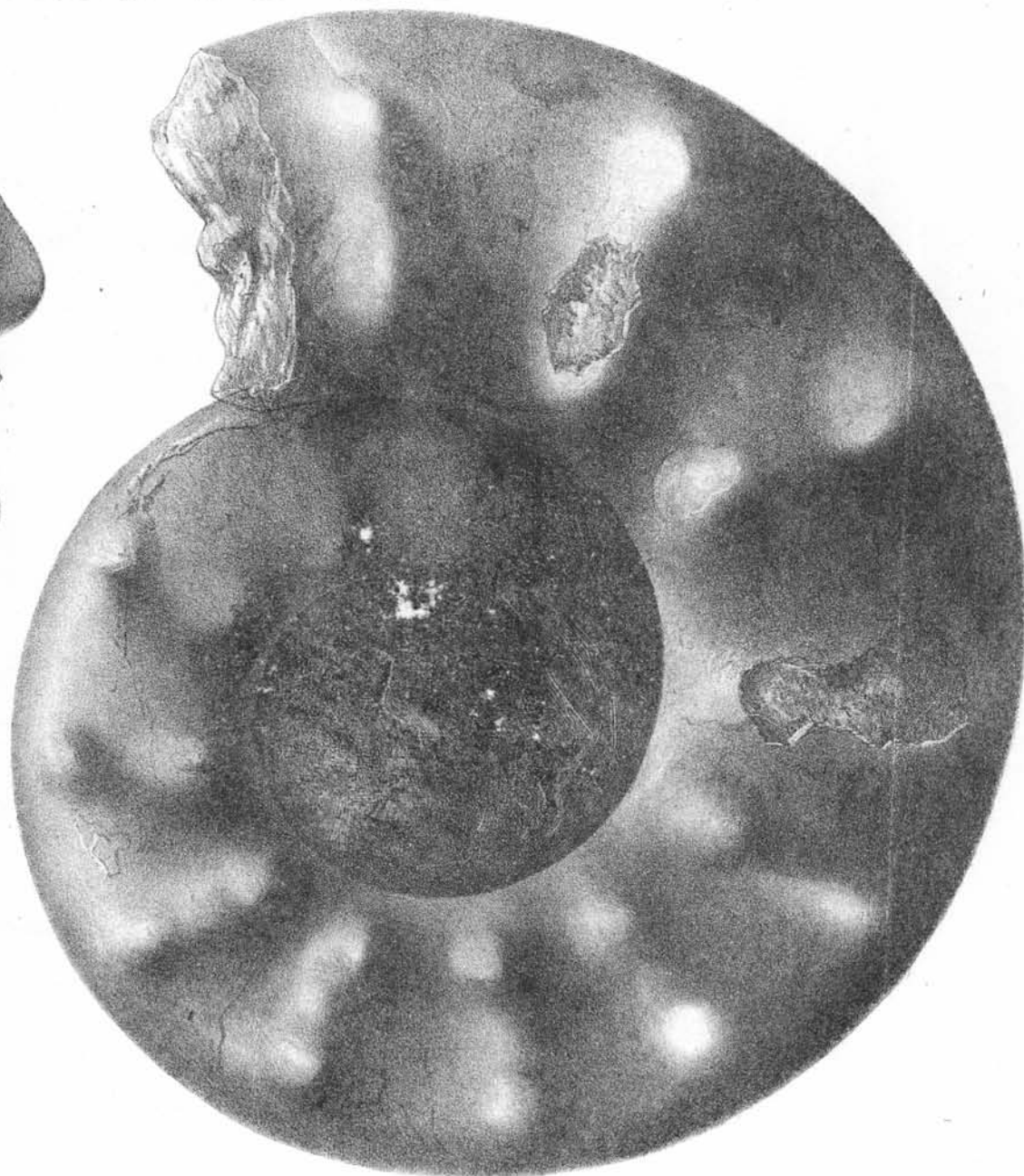
4. b.

PLATE XVIII.

- Fig. 1. **ASPIDOCERAS SPARSISPINUM**, *Waagen*, n. sp., p. 98; specimen without preserved shell, with the beginning of the body-chamber, from the *Dhosa oolite* of *Vanda*; 1*a*, side-view; 1*b*, front-view.



1. b.

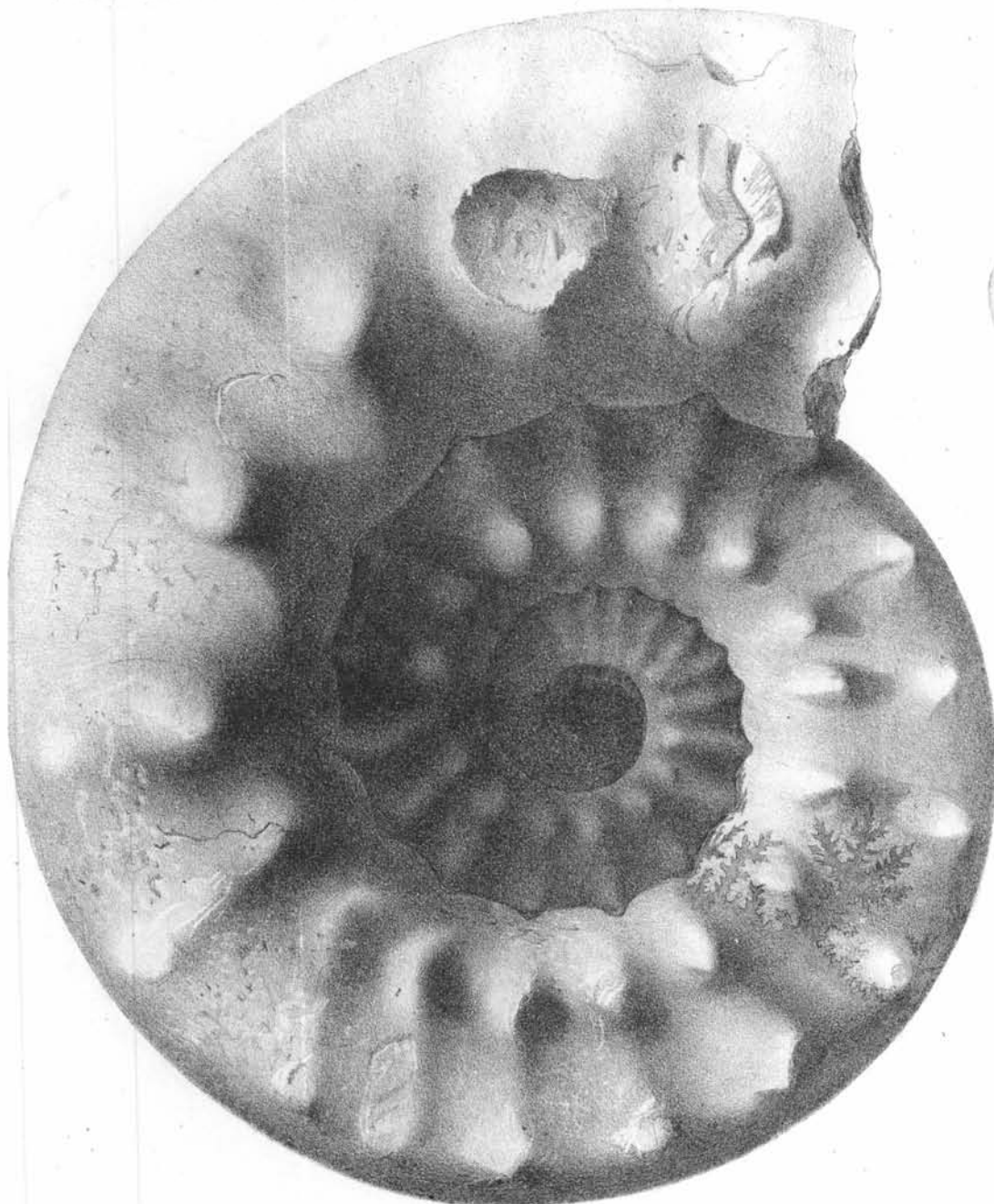


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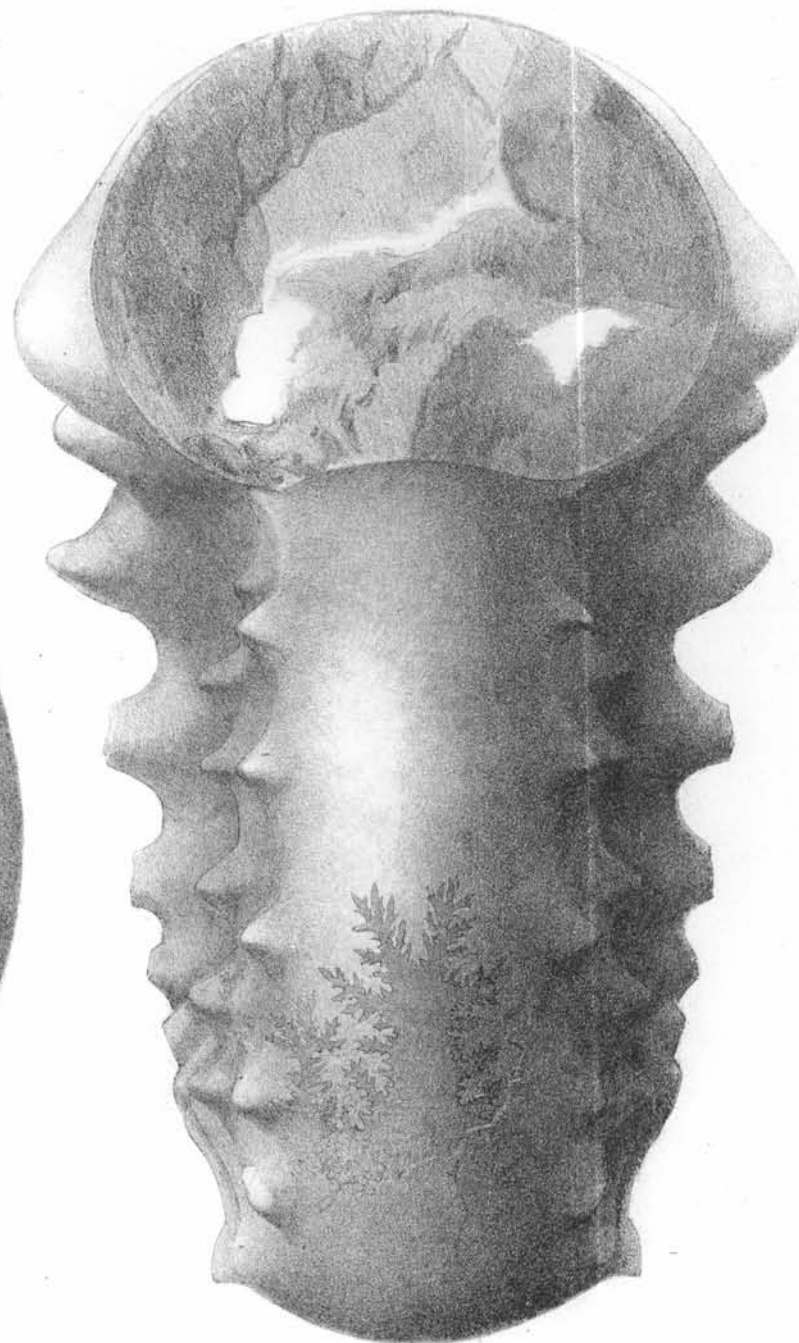
Litho and print. at the Geol. Survey's Office.

PLATE XIX.

- Fig. 1. ASPIDOCERAS BABEANUM, *Orbigny*, p. 95; specimen without preserved shell, without body-chamber, from the *Dhosa oolite* of *Vanda*; 1*a*, side-view; 1*b*, front-view.



1. a.



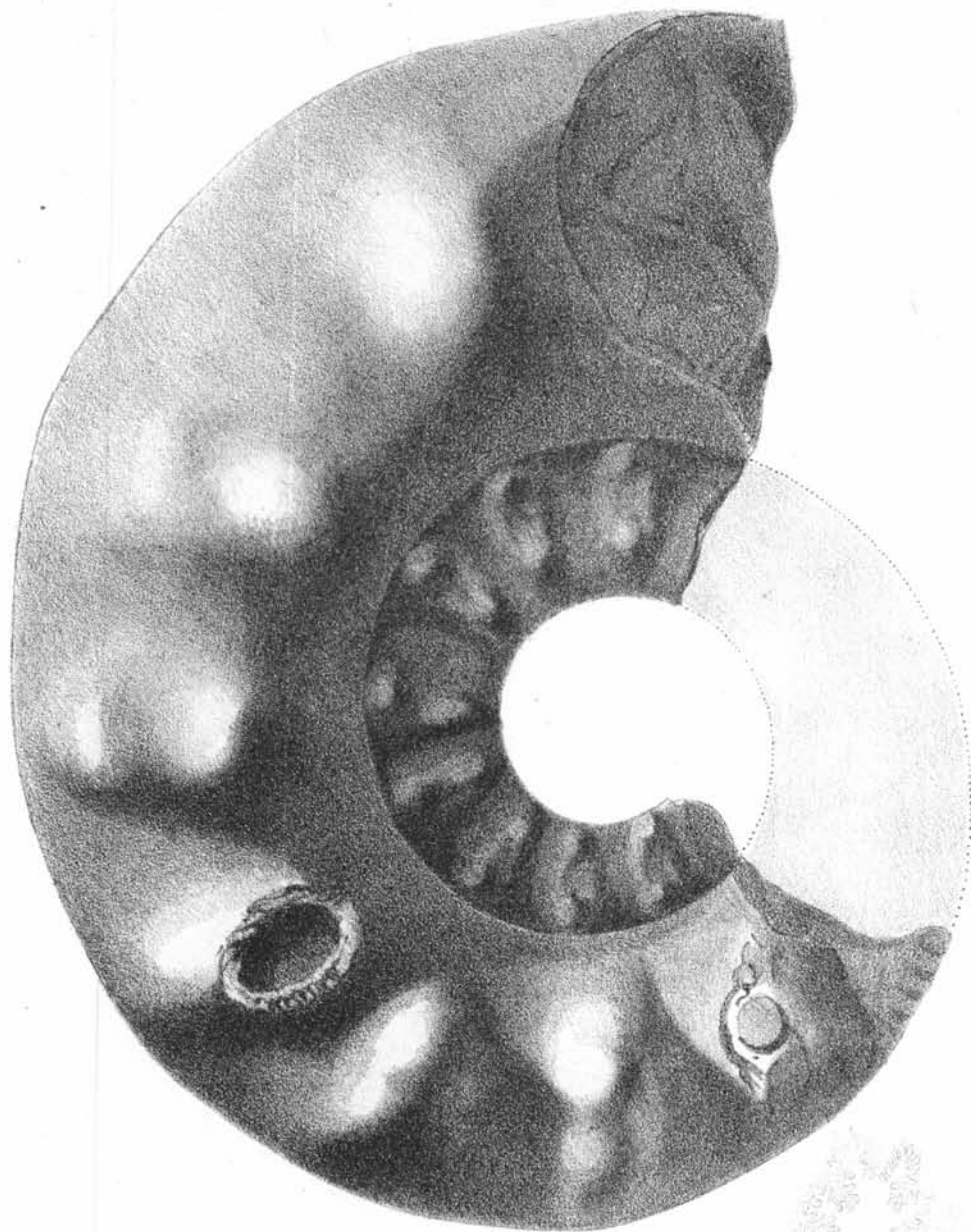
1. b.

Lith. and print. at the Geol. Survey's Office

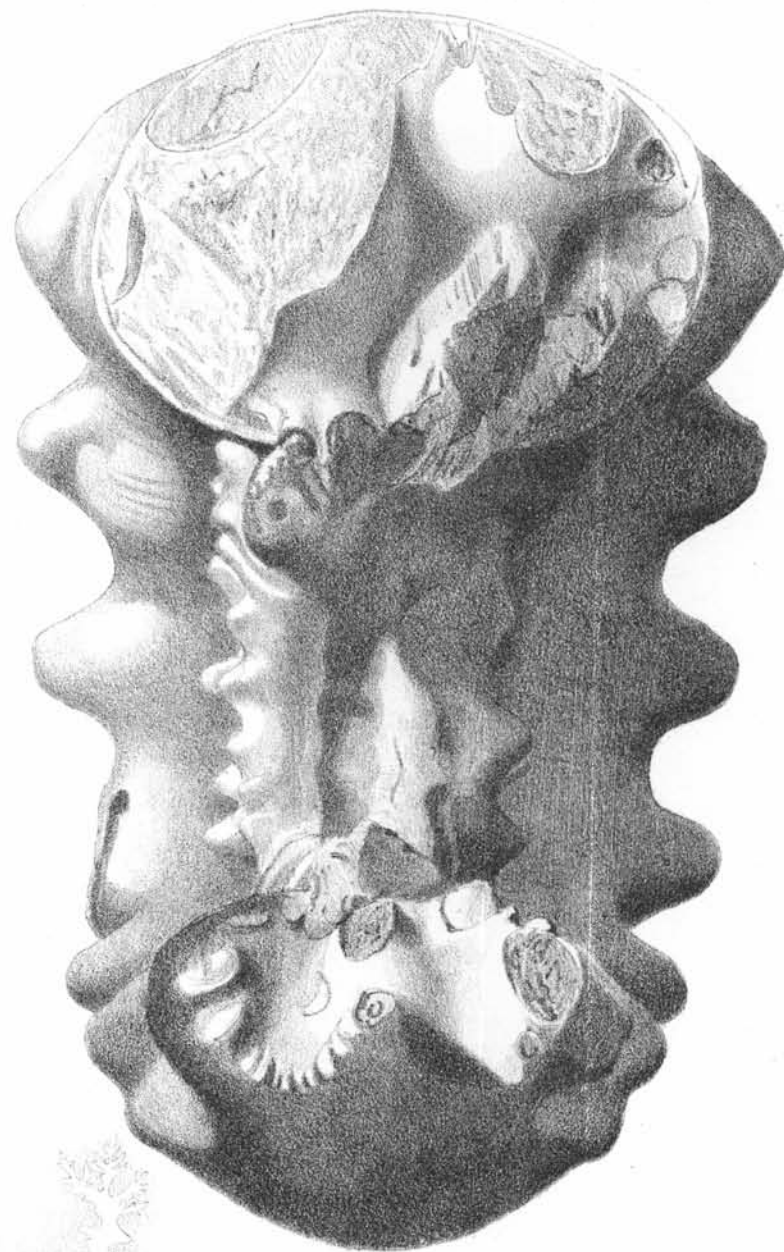
Calcutta.

PLATE XX.

- Fig. ... 1. *ASPIDOCERAS PONDEROSUM*, *Waagen*, n. sp., p. 94; fragmentary specimen with preserved shell, entirely composed of air-chambers, from the *Athleta beds* of north-west of *Jara*, north of *Soorka hill*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.



1.



1.a.

1.b.

PLATE XXI.

- Fig. ... 1. *ASPIDOCERAS SUBDISTRACTUM*, *Waagen*, n. sp., p. 99; fragmentary specimen with partly preserved shell, entirely composed of air-chambers, from the *Kuntkote sandstone* of *Gangta bet*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. *ASPIDOCERAS PONDEROSUM*, *Waagen*, n. sp., p. 94; small specimen, with preserved shell, from the *Athleta beds* of west of *Barasir*; side-view.
- Fig. 3. *ASPIDOCERAS MONACANTHUS*, *Waagen*, n. sp., p. 100; fragment of the body-chamber of a full grown specimen; from the *Katrol group* of the *Katrol range*; 3*a*, side-view; 3*b*, section.
- Fig. 4. *ASPIDOCERAS*, *species indet.*, p. 101; fragment of the body-chamber, cast; from the lowest beds of the *Katrol group* of south of *Bhooj*; 4*a*, side-view; 4*b*, section.
- Fig. 5. *ASPIDOCERAS WYNNEI*, *Waagen*, n. sp., p. 104; small specimen, without shell, from the *Oomia group* of *Jadoora*, *Katrol range*; 5*a*, side-view; 5*b*, front-view.

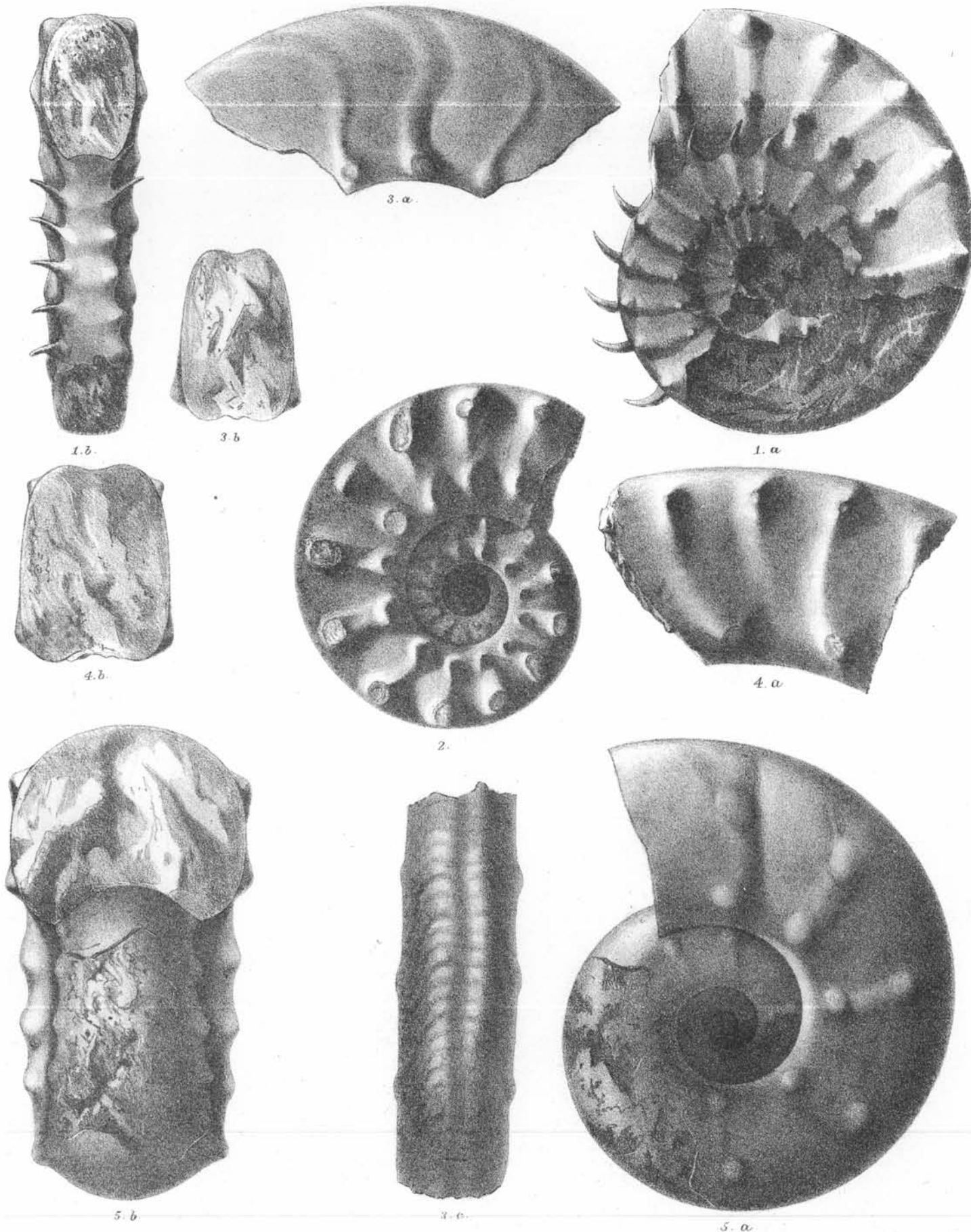
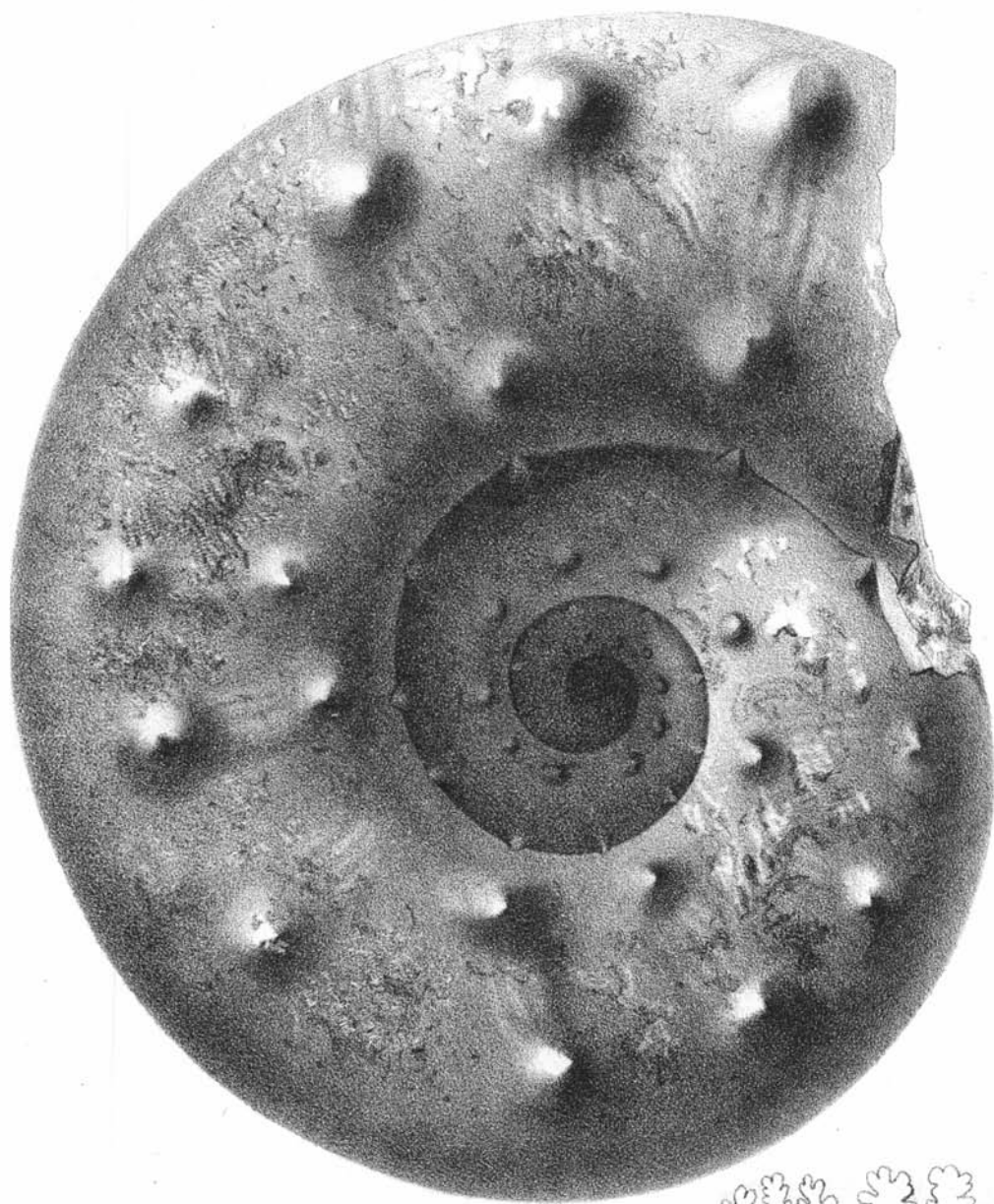
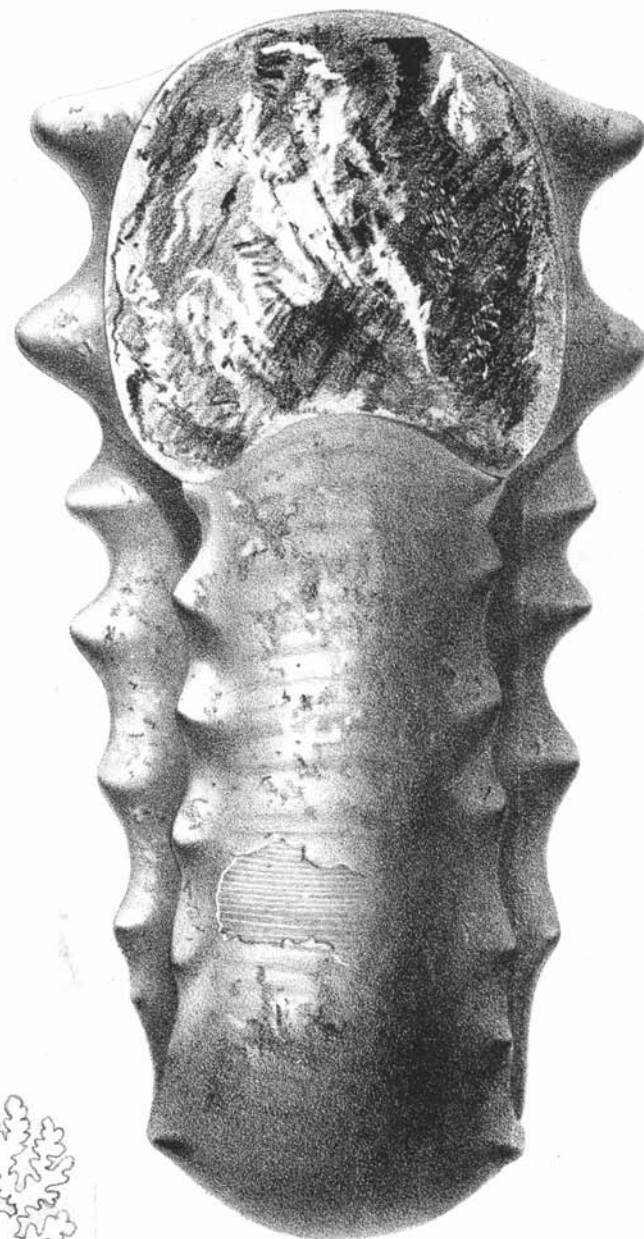


PLATE XXII.

- Fig. 1. ASPIDOCERAS WYNNEL, *Waagen*, n. sp., p. 104 ; specimen, with preserved shell, from the *Oomia* group of the *Katrol* range ; 1*a*, side-view ; 1*b*, front-view ; 1*c*, lobes.



1. a.



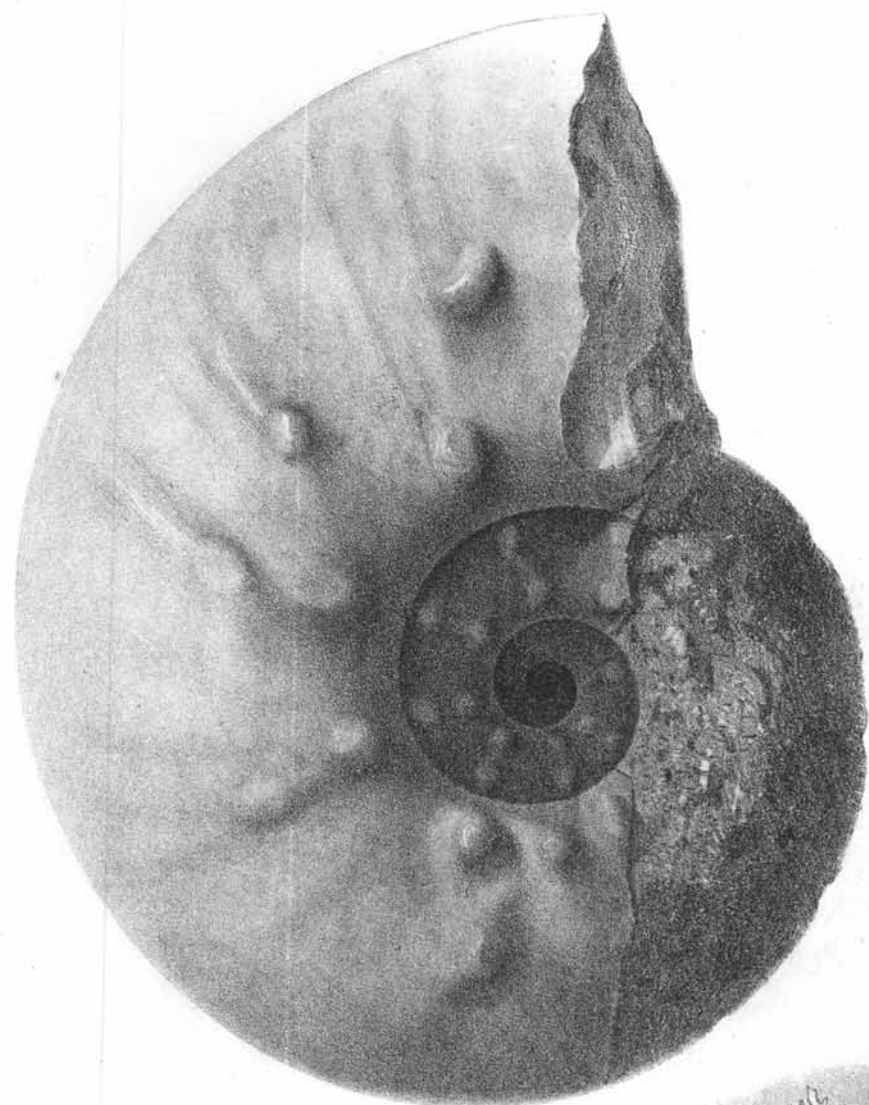
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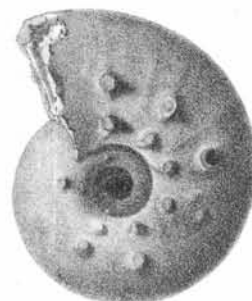
1. c.

PLATE XXIII.

- Fig. 1. ASPIDOCERAS IPHICEROIDES, *Waagen*, n. sp., p. 102; specimen without shell, with preserved body-chamber, from the *Katrol group* of north of *Dhosa*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes (si. siphonal; L. first lateral; *b*, second lateral lobe).
- Fig. ... 2. ASPIDOCERAS IPHICEROIDES, *Waagen*, n. sp., p. 102; small specimen, with preserved shell, from the *Katrol group* of the *Charvar range*; 2*a*, side-view; 2*b*, front-view.



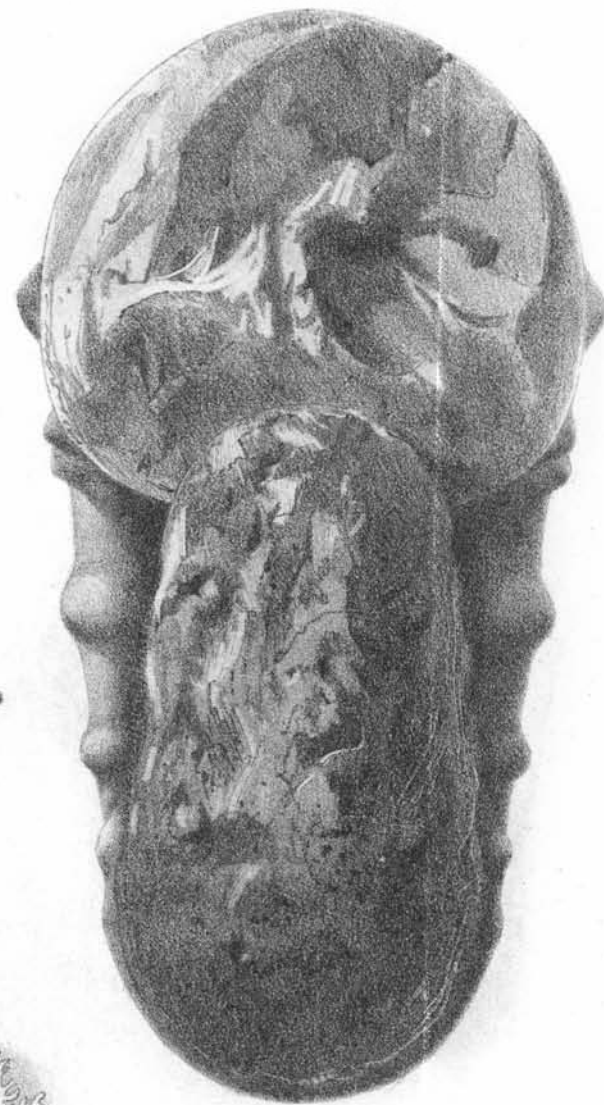
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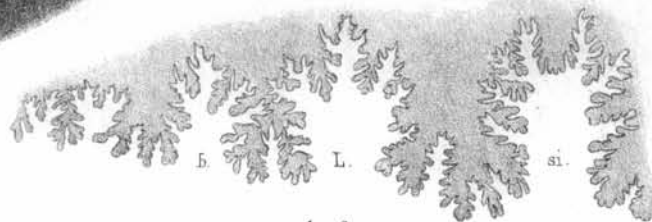
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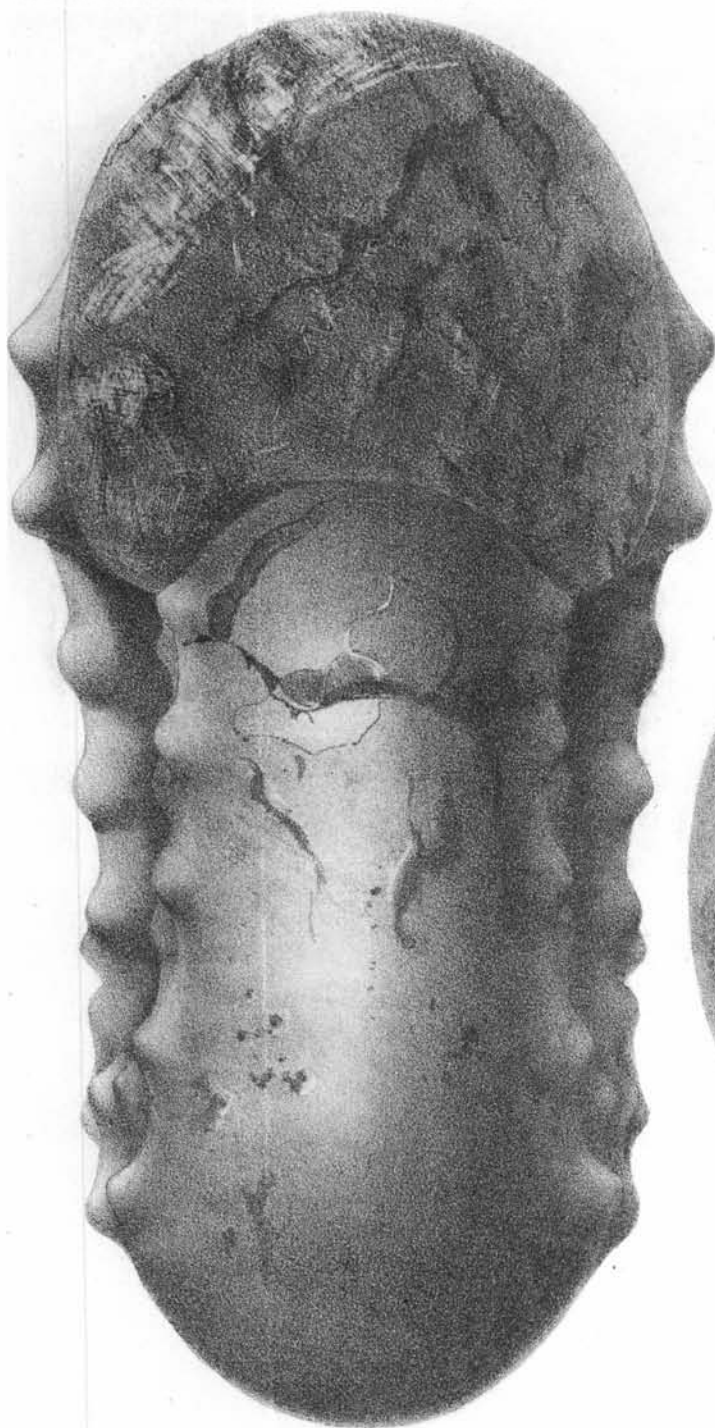
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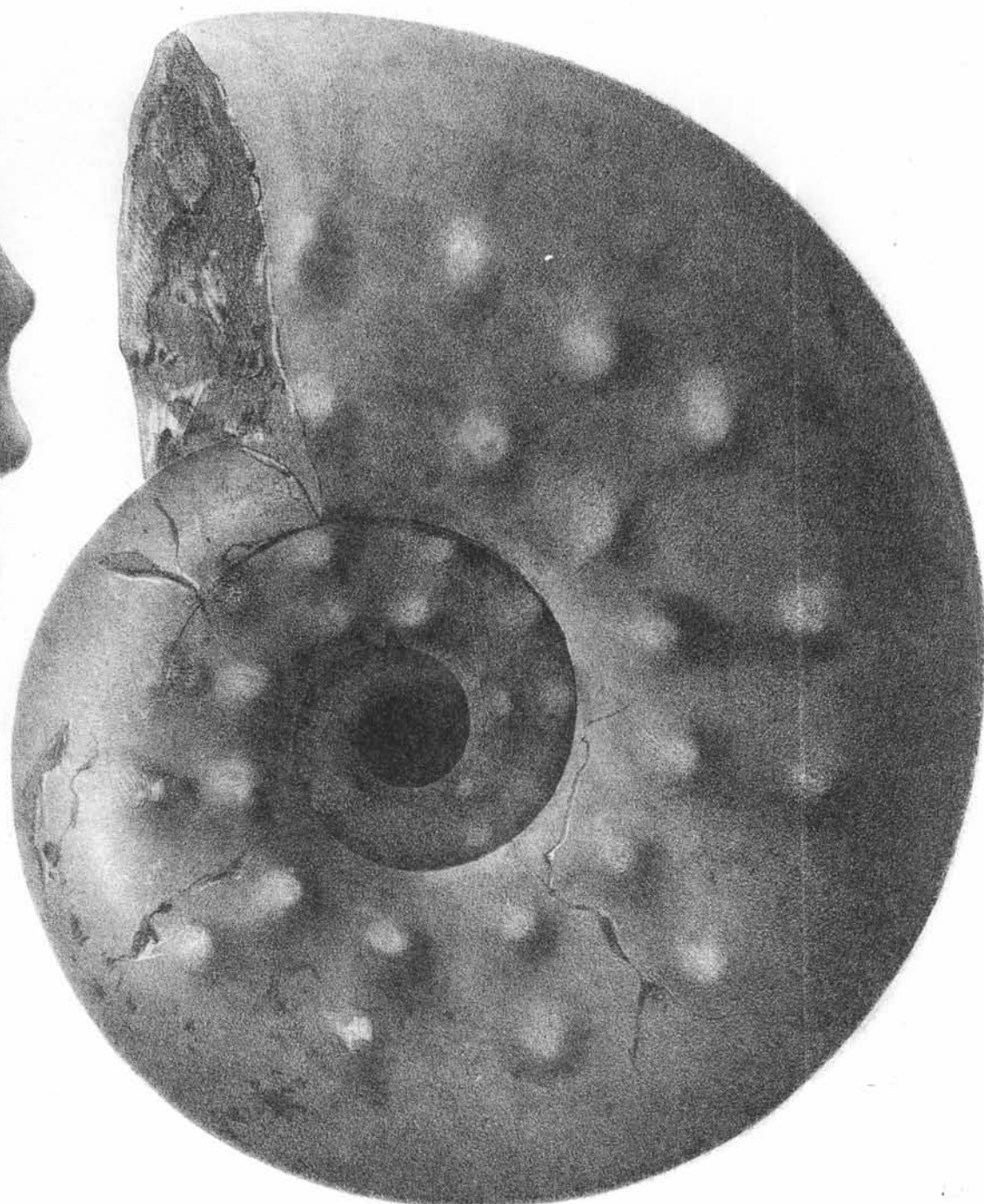
1. c.

PLATE XXIV.

- Fig. 1. ASPIDOCERAS BINODIFERUM, *Waagen*, n. sp., p. 105; specimen without shell, with the beginning of the body-chamber, from the *Katrol group* of north of *Dhosa*; 1*a*, side-view; 1*b*, front-view.



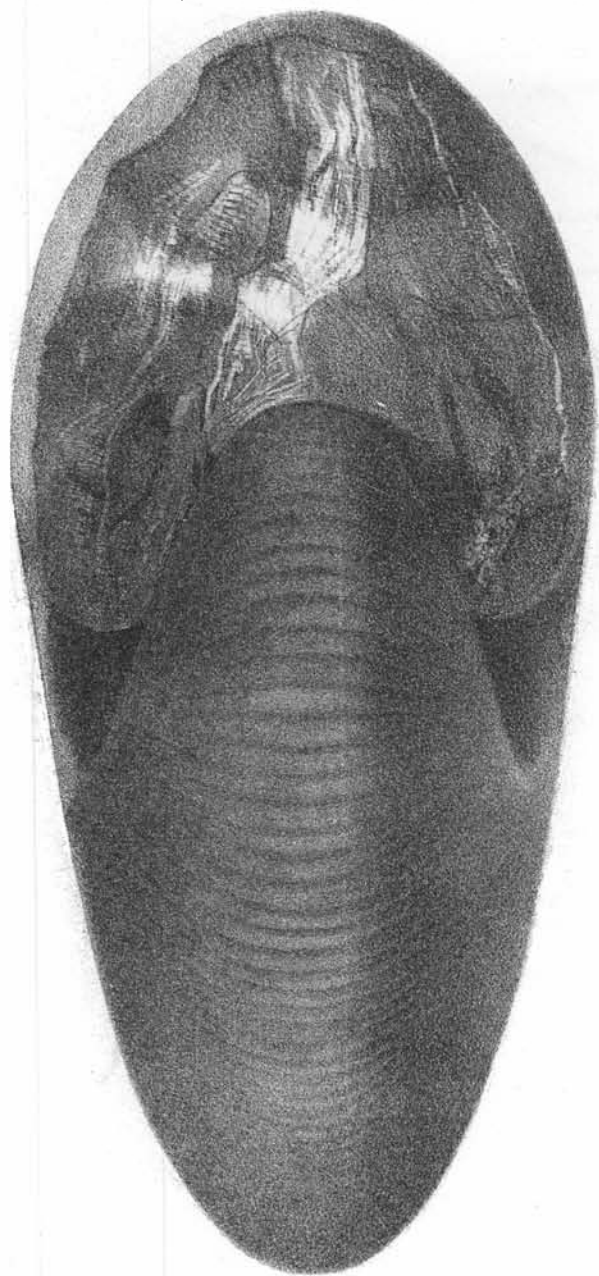
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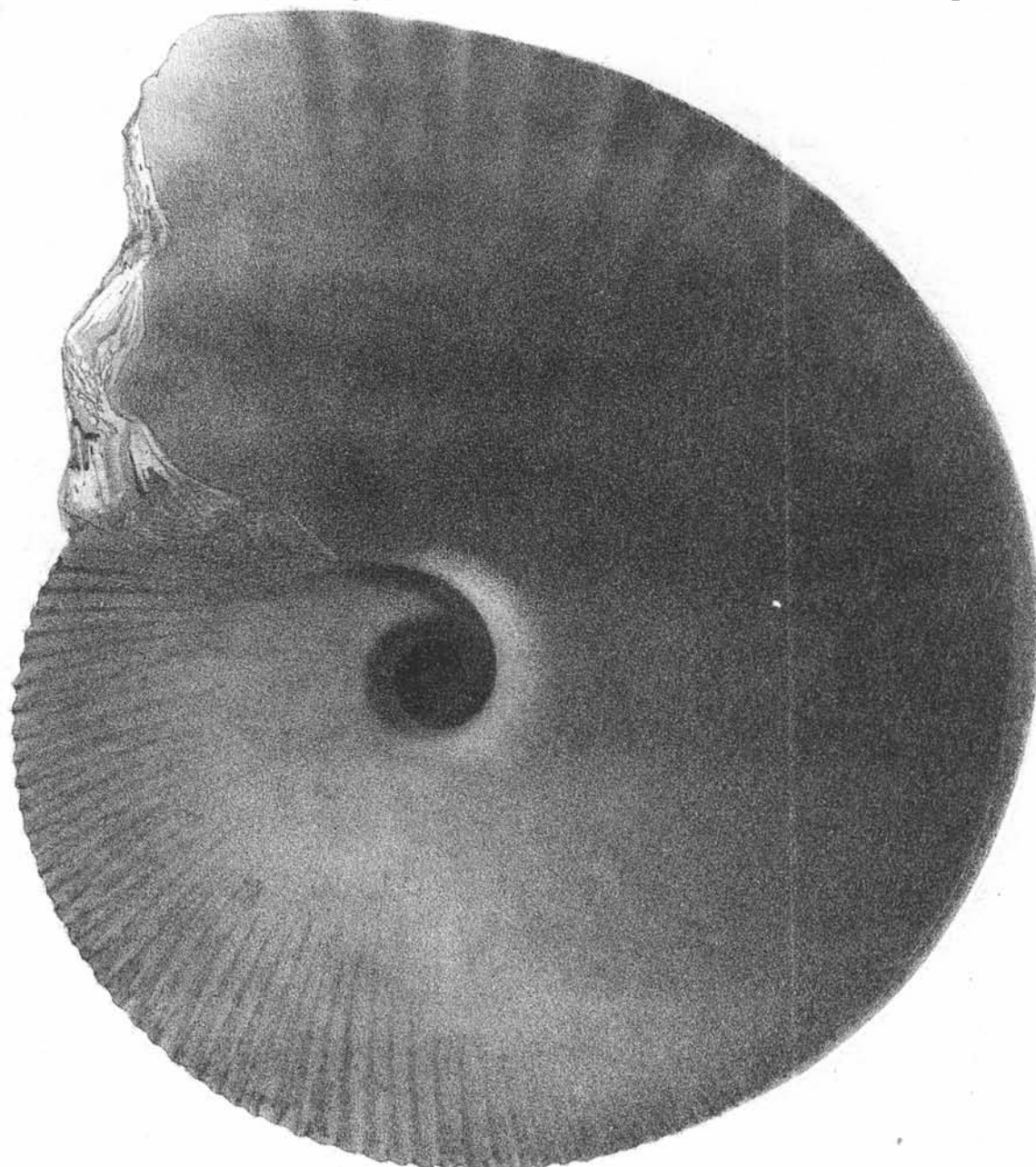
1. a.

PLATE XXV.

- Fig. ... 1. STEPHANOCERAS MACROCEPHALUM, *Schlotheim*, p. 109; specimen with preserved body-chamber, natural size, from the *Macrocephalus shales* north-west of *Jumara*; 1*a*, side-view; 1*b*, front-view.



1. b.

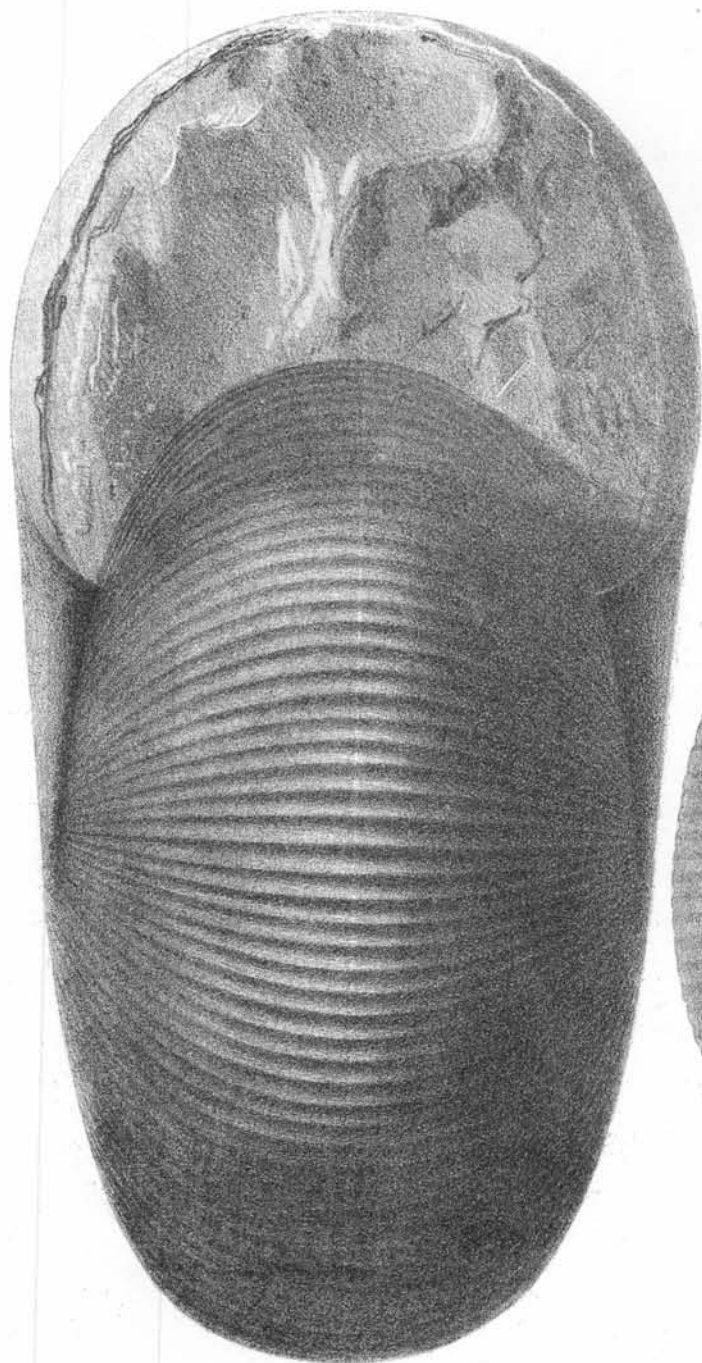


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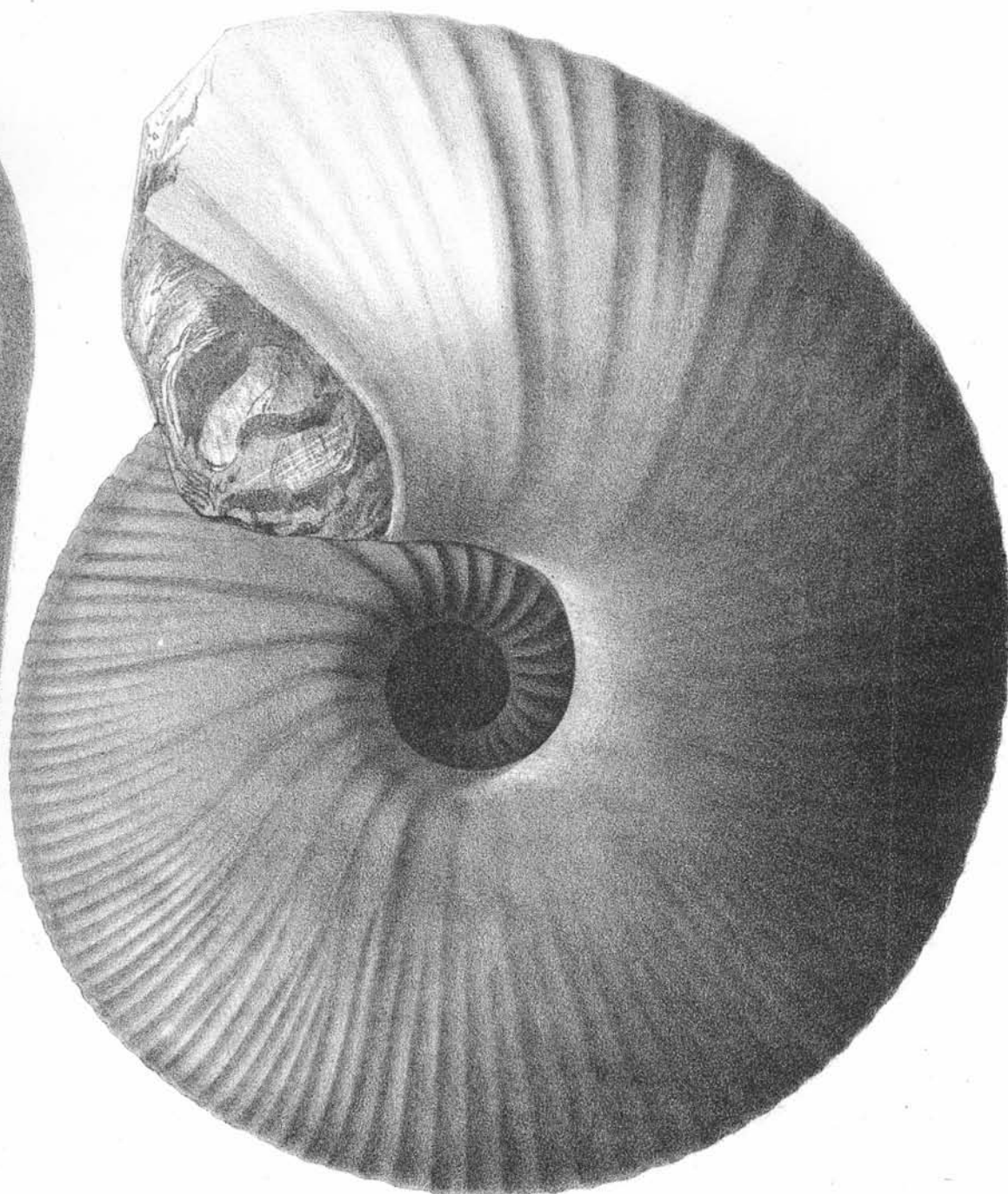
PLATE XXVI.

- Fig. ... 1. STEPHANOCERAS TUMIDUM, *Reinecke*, p. 115; specimen with entirely preserved body-chamber and part of the apertural margin, natural size, from the *golden oolite* of *Keera hill* near *Charee*; 1*a*, side-view; 1*b*, front-view.

•



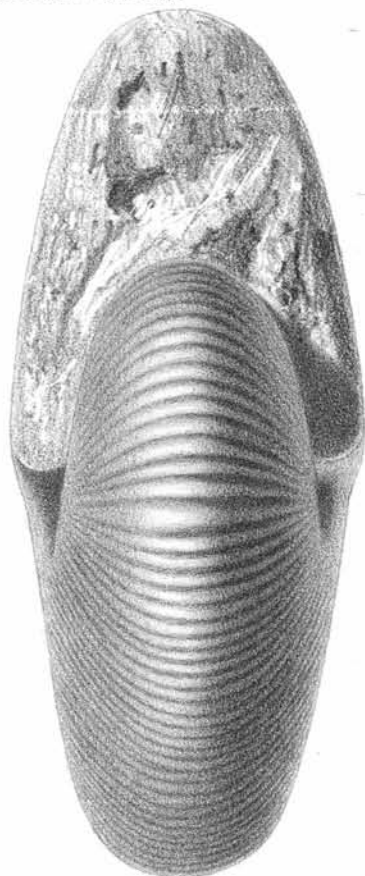
1. b.



1. a.

PLATE XXVII.

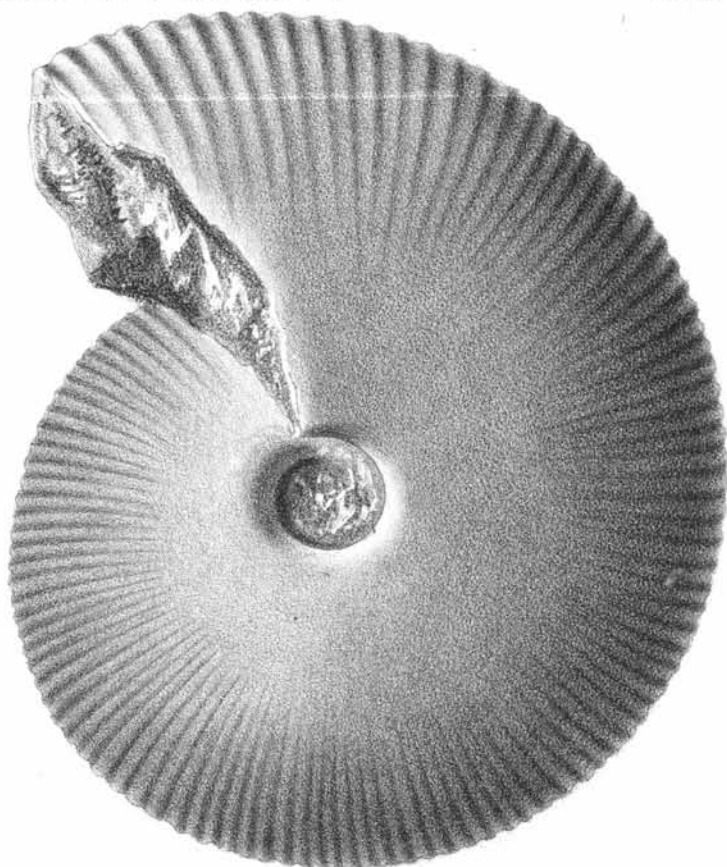
- Fig. ... 1 *a, b*. STEPHANOCERAS MACROCEPHALUM, *Schlotheim*, p. 109; specimen composed of air-chambers, from the *golden oolite* of *Keera hill* near *Charee*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 1 *c*. STEPHANOCERAS TUMIDUM, *Rein.*, p. 115; lobes of a specimen from the *golden oolite* of *Keera hill*.
- Fig. ... 2. STEPHANOCERAS TUMIDUM, *Rein.*, p. 115; specimen composed of air-chambers from the *golden oolite* of *Keera hill* near *Charee*; 2*a*, side-view; 2*b*, front-view.



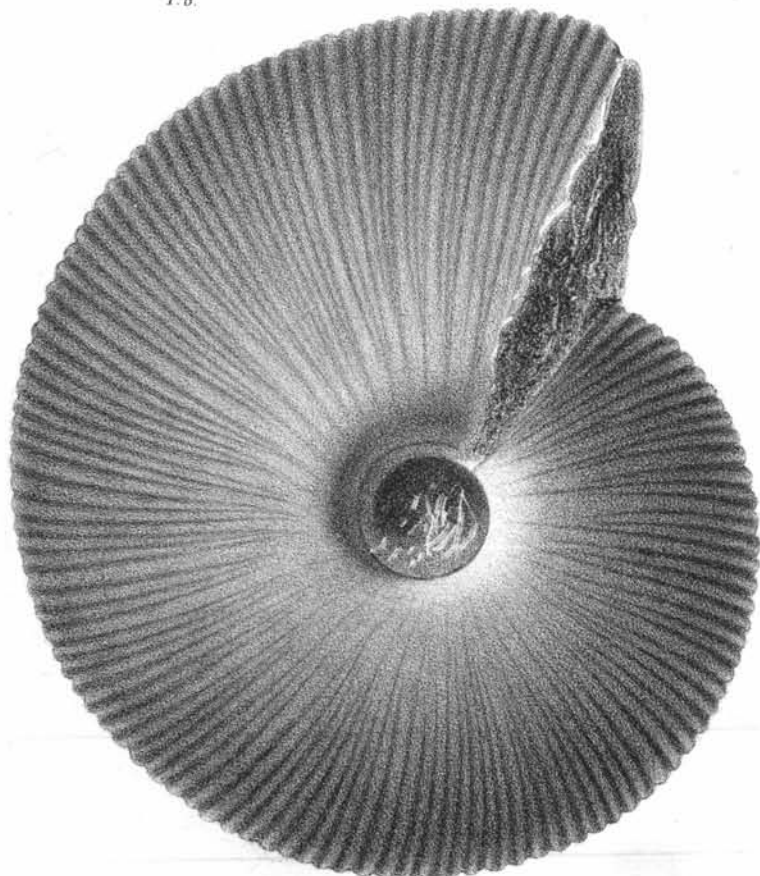
1. b.



1. c.



1. a.



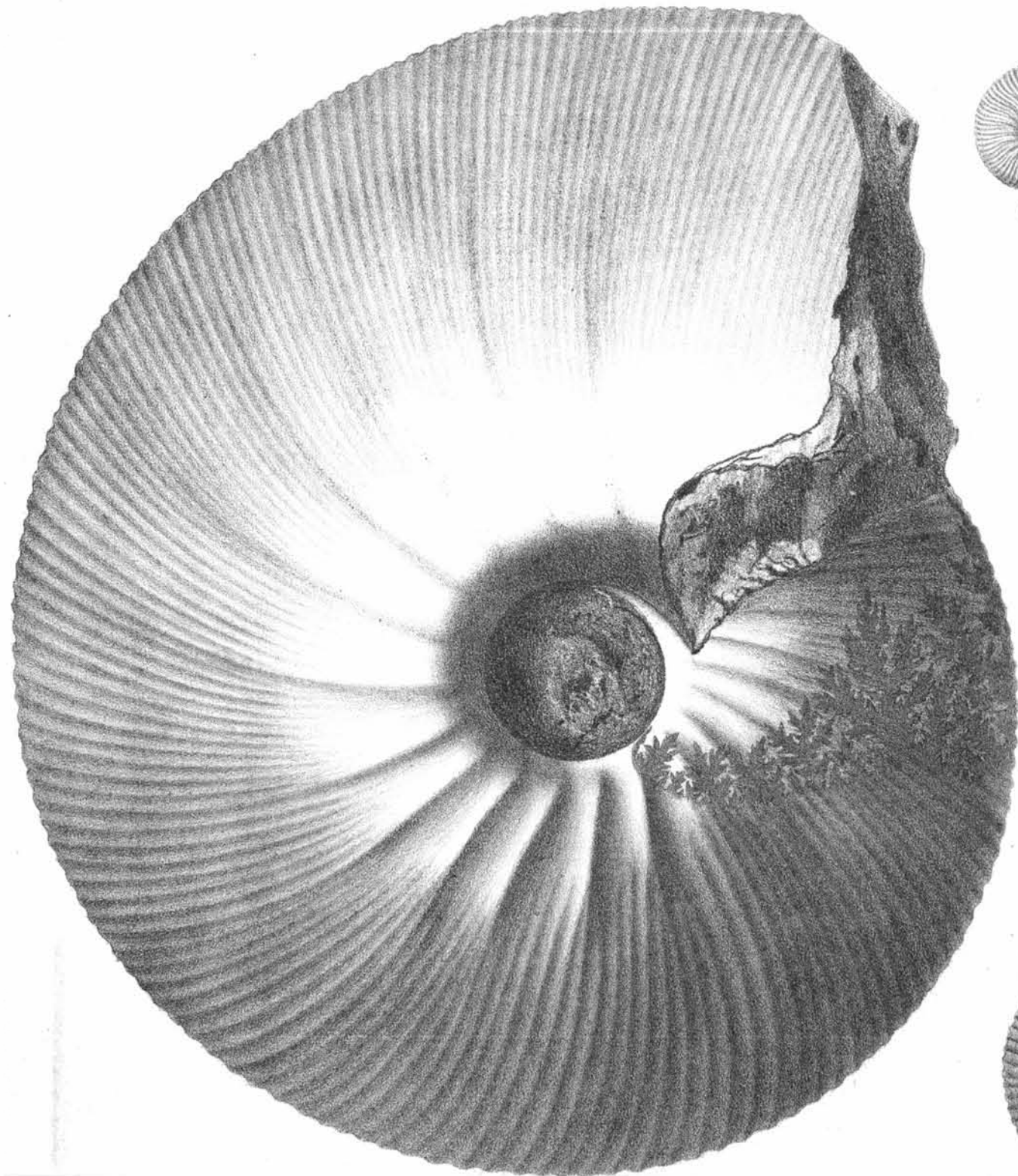
2. a.



2. b.

PLATE XXVIII.

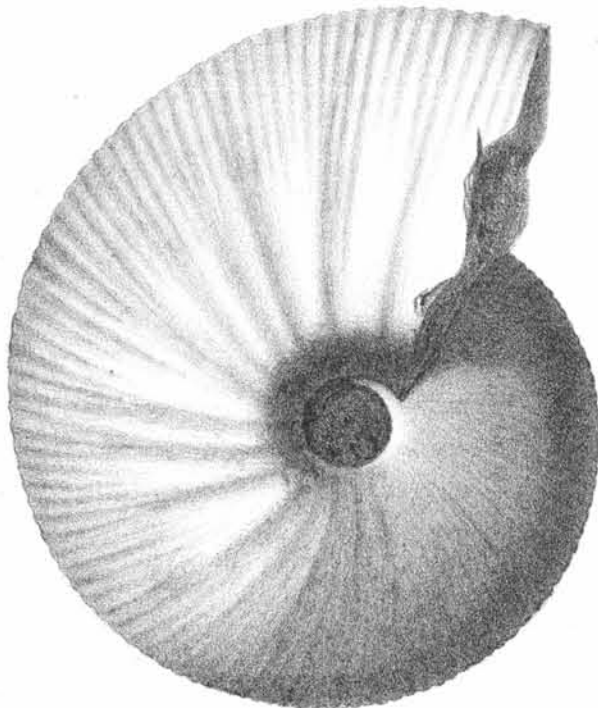
- Fig. ... 1. *STEPHANOCERAS MAYA*, *Sowerby*, p. 113; specimen without shell with partly preserved body-chamber from the *red sandstone* of *Kuntkote*; 1*a*, side-view; 1*b*, front-view.
- Fig. 2. *STEPHANOCERAS MAYA*, *Sowerby*, p. 113; inner whorls of a large specimen with preserved shell from the *red iron-sandstone* of *Kuntkote*; 2*a*, side-view, 2*b*, front-view.
- Fig. 3. *STEPHANOCERAS SEMILAEVE*, *Waagen*, n. sp., p. 119; specimen composed of air-chambers from the *Macrocephalus-shales*, north-west of *Soorka*; 3*a*, side-view; 3*b*, front-view.
- Fig. ... 4. *STEPHANOCERAS SUBTUMIDUM*, *Waagen*, n. sp., p. 118; small specimen from the *red iron-sandstone* of *Kuntkote*; (variety with dichotome ribs); 4*a*, side-view; 4*b*, front-view.



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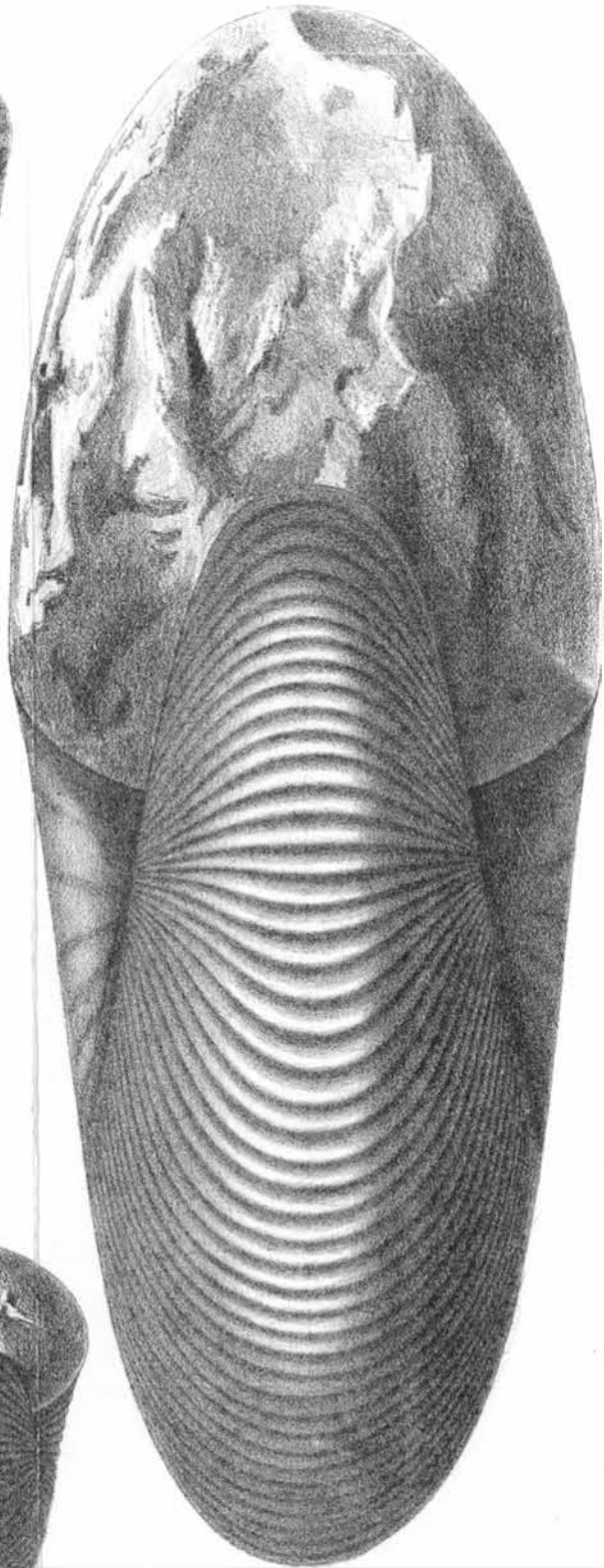
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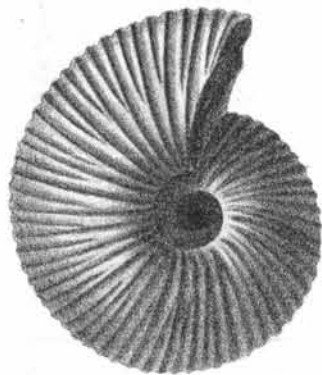
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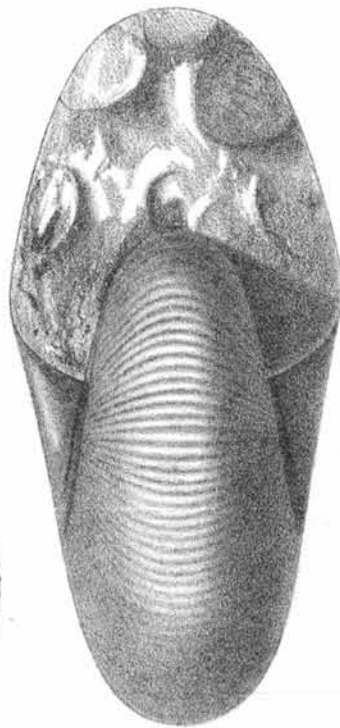
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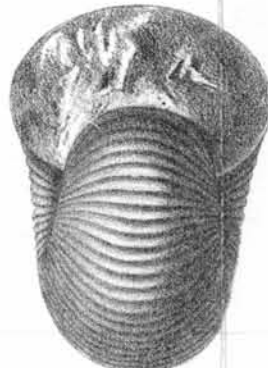
1. b.



4. a.



3. b.



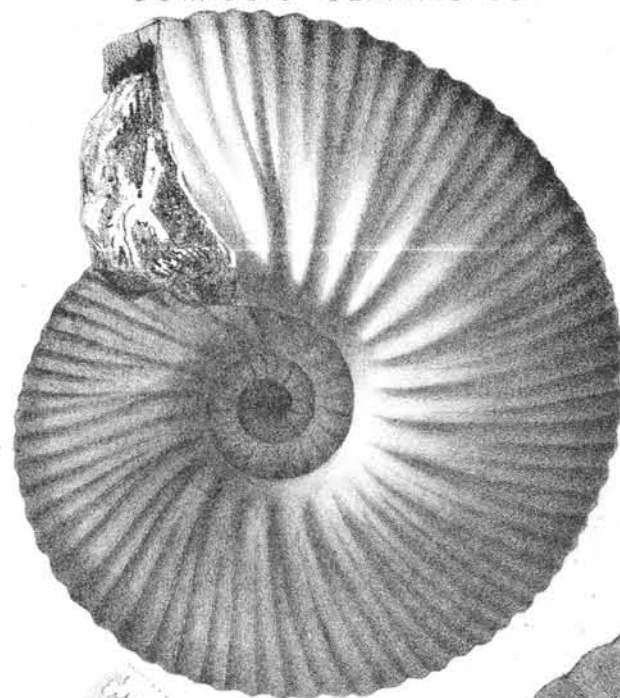
4. b.

PLATE XXIX.

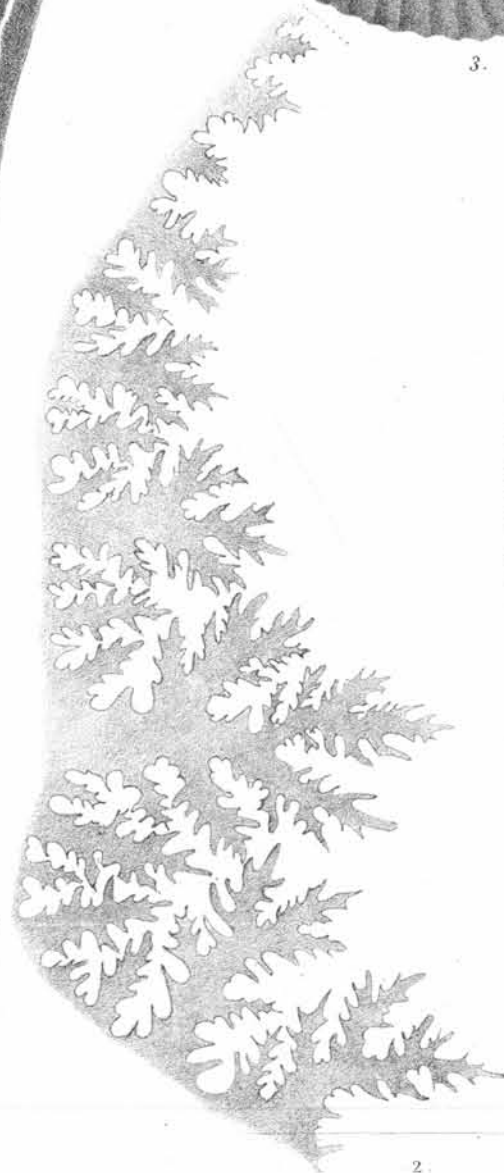
- Fig. ... 1. **STEPHANOCERAS POLYPHEMUS**, *Waagen*, n. sp., p. 116; figure in half natural size of a specimen with nearly entire body-chamber from the *Dhosa oolite* of *Lodai*; 1*a*, side-view; 1*b*, front-view.
- Fig. 2. **STEPHANOCERAS POLYPHEMUS**, *Waagen*, n. sp., p. 116; inner whorls of a large specimen from the *Dhosa oolite* of *Vanda*; side-view.
- Fig. ... 3. **STEPHANOCERAS POLYPHEMUS**, *Waagen*, n. sp., p. 116; lobes of a large specimen, from the *Dhosa oolite* of *Lodai*.



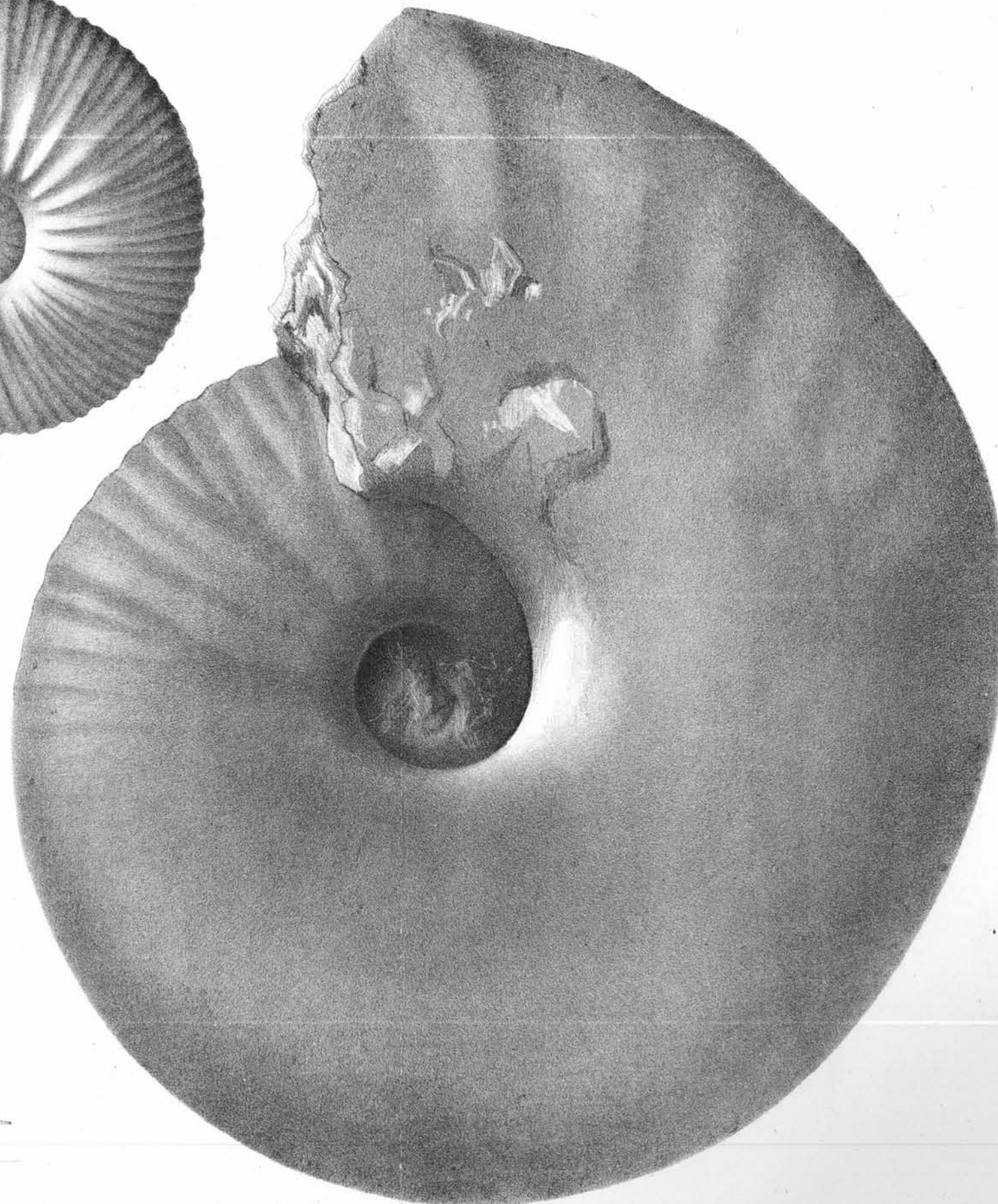
1. b.



3.



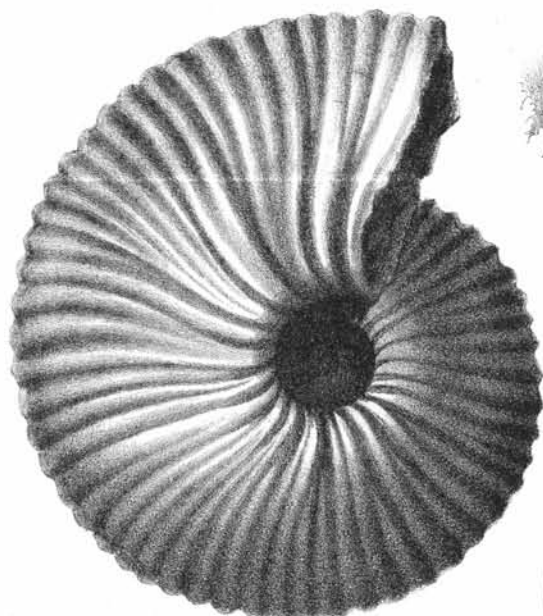
2.



1. a.

PLATE XXX.

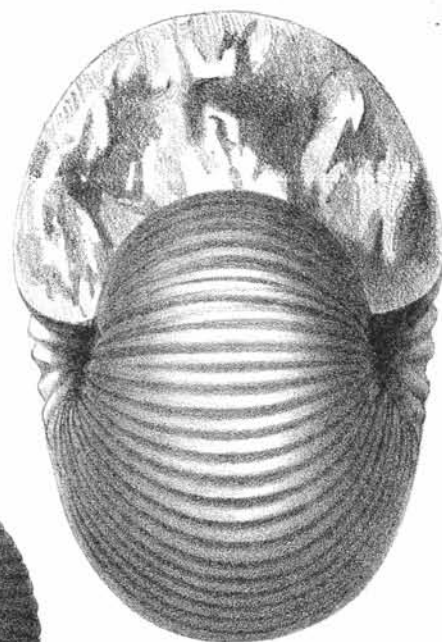
- Fig. 1. *STEPHANOCERAS CHRYSOOLITHICUM*, *Waagen*, n. sp., p. 127; specimen composed of air-chambers from the *golden oolite* of *Keera hill* near *Charee*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.
- Fig. ... 2. *STEPHANOCERAS CHARIENSE*, *Waagen*, n. sp., p. 126; inner whorls of a large specimen from the *golden oolite* of *Keera hill* near *Charee*; 2*a*, side-view; 2*b*, front-view.
- Fig. ... 3. *STEPHANOCERAS DIADEMATUS*, *Waagen*, n. sp., p. 130; inner whorls of a large specimen from the *golden oolite* of *Keera hill*; 3*a*, side-view; 3*b*, front-view; 3*c*, lobes.
- Fig. ... 4. *STEPHANOCERAS DIADEMATUS*, *Waagen*, n. sp., p. 130; specimen composed of air-chambers from the same beds and locality as the preceding; 4*c*, side-view; 4*b*, front-view.



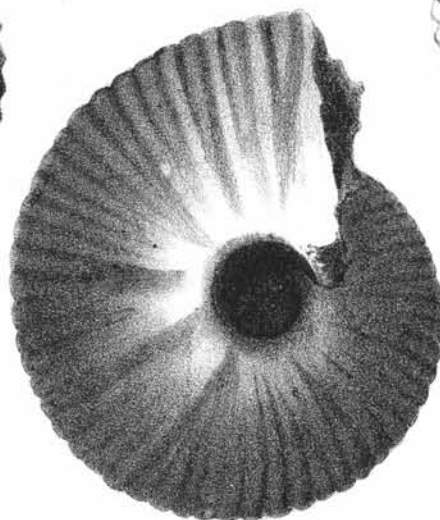
1. a.



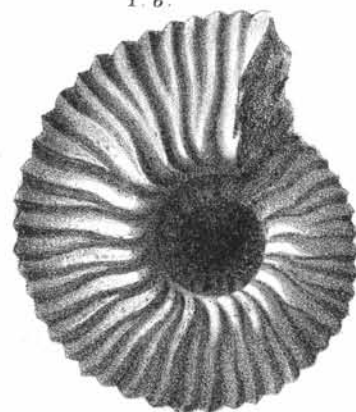
3. c.



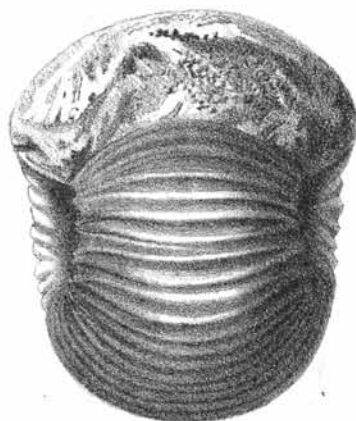
1. b.



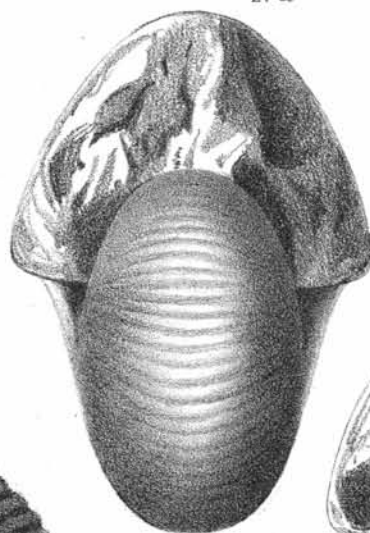
2. a.



3. a.



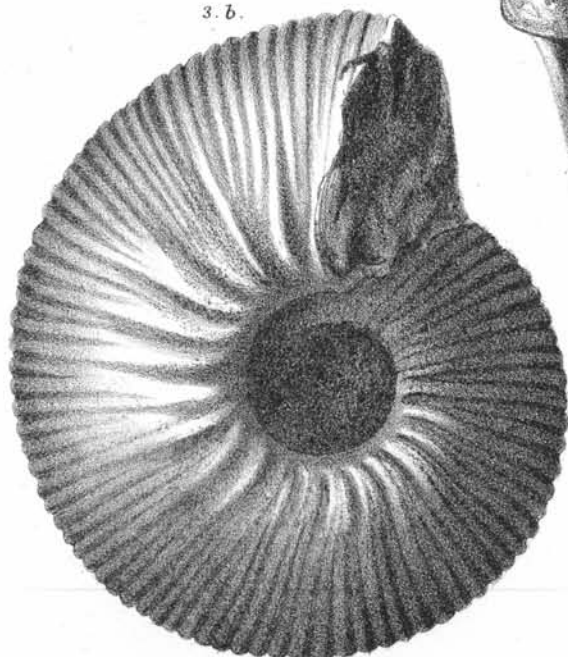
3. b.



2. b.



4. b.



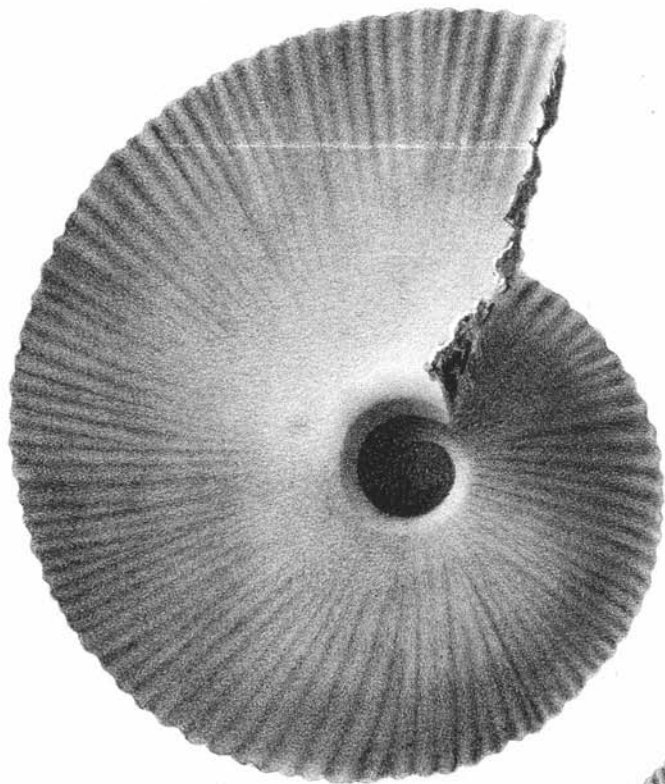
4. a.



1. c.

PLATE XXXI.

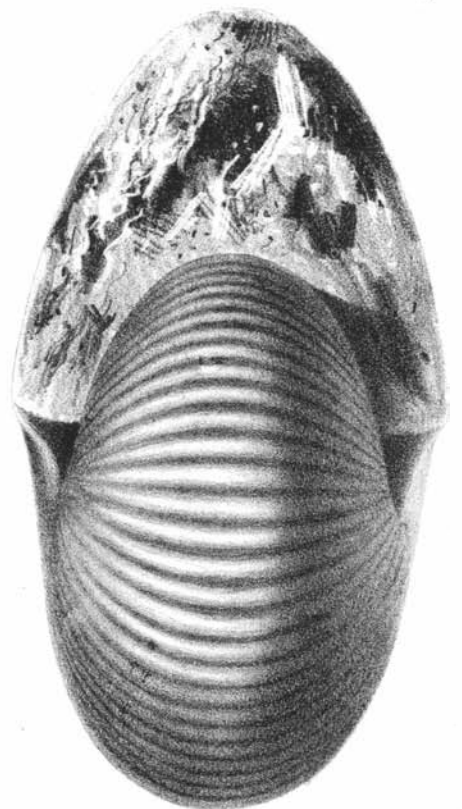
- Fig. 1. STEPHANOCERAS CHARIENSE, *Waagen*, n. sp., p. 126 ; middle sized specimen, composed of air-chambers from the *golden oolite* of *Keera hill* near *Charee* ; 1, side-view ; 1*a*, front-view ; 1*b*, lobes.
- Fig. ... 2. STEPHANOCERAS MAYA, *Sowerby*, p. 113 ; small specimen, from the *Kuntkote-sandstone* of *Kuntkote* ; 2, side-view ; 2*a* front-view ; 2*b*, lobes.
- Fig. 3. STEPHANOCERAS ELEPHANTINUM, *Sowerby*, p. 124 ; specimen with partly preserved body-chamber, from the *Dhosa oolite* of *Lodai* ; 3, side-view ; 3*a*, front-view.



1.



2.a.



1.a.



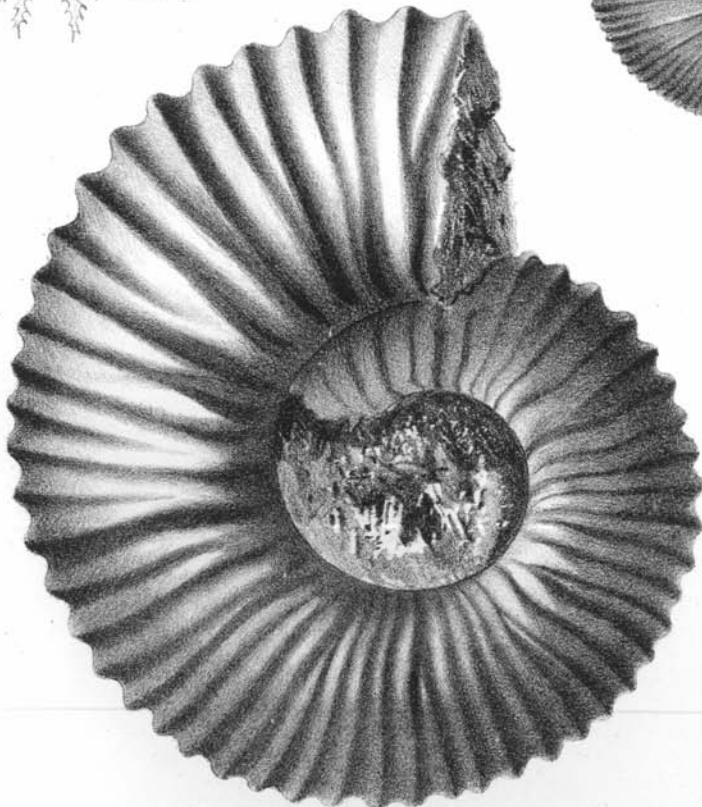
2.



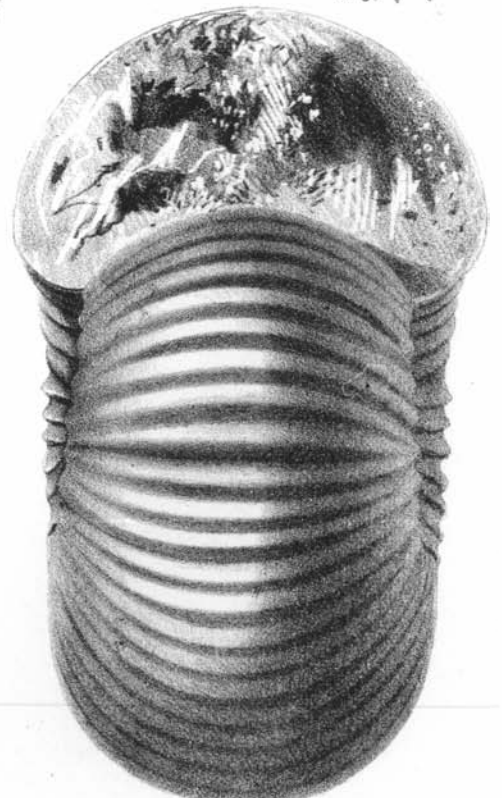
2.b.



2.c.



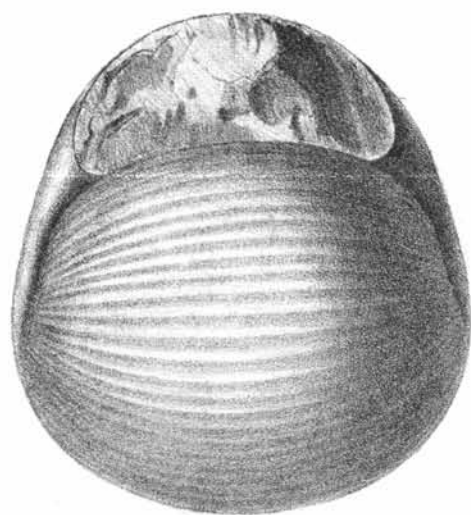
3.



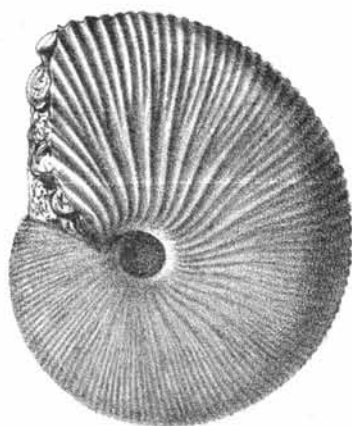
3.a.

PLATE XXXII.

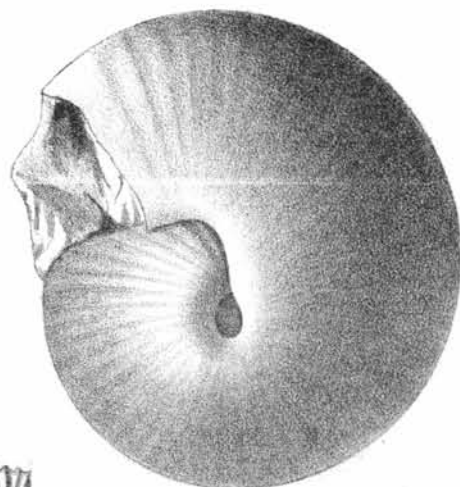
- Fig. ... 1. *STEPHANOCERAS BULLATUM*, *Orbigny*, p. 129 ; specimen with preserved body-chamber from the *golden oolite* of *Keera hill* near *Charee* ; 1*a*, side-view ; 1*b*, front-view.
- Fig. 2. *STEPHANOCERAS TRANSIENS*, *Waagen*, n. sp., p. 111 ; specimen from the *Dhosa oolite* of north-west of *Soorka* ; 2*a*, side-view ; 2*b*, front-view.
- Fig. ... 3. *STEPHANOCERAS TRANSIENS*, *Waagen*, n. sp., p. 111 ; small specimen from the *Dhosa oolite* of *Lodai* ; the break at the aperture indicates the direction of the septum ; 3*a*, side-view ; 3*b*, front-view.
- Fig. ... 4. *STEPHANOCERAS ELEPHANTINUM*, *Sow.*, p. 124 ; small specimen from the *Dhosa oolite* of *Vanda* ; 4*a*, side-view ; 4*b*, front-view ; 4*c*, back-view.



1. a.



3. a.



1. b.



4. a.



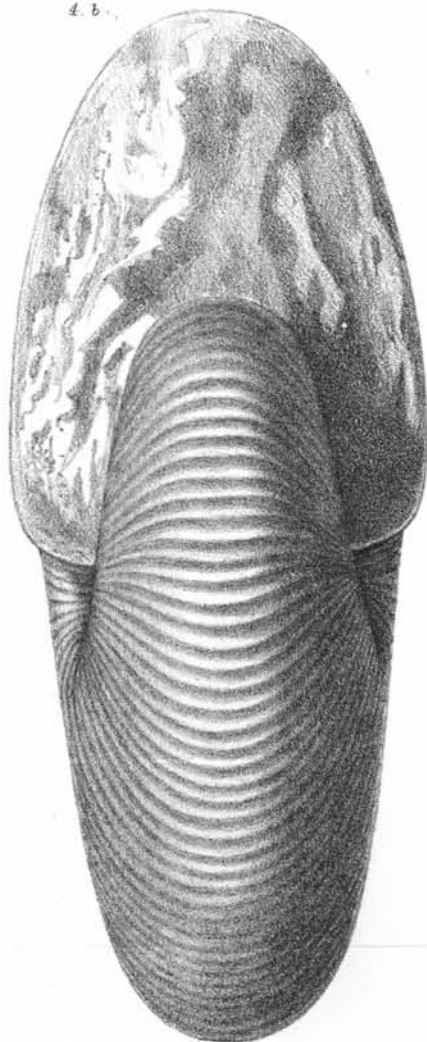
3. b.



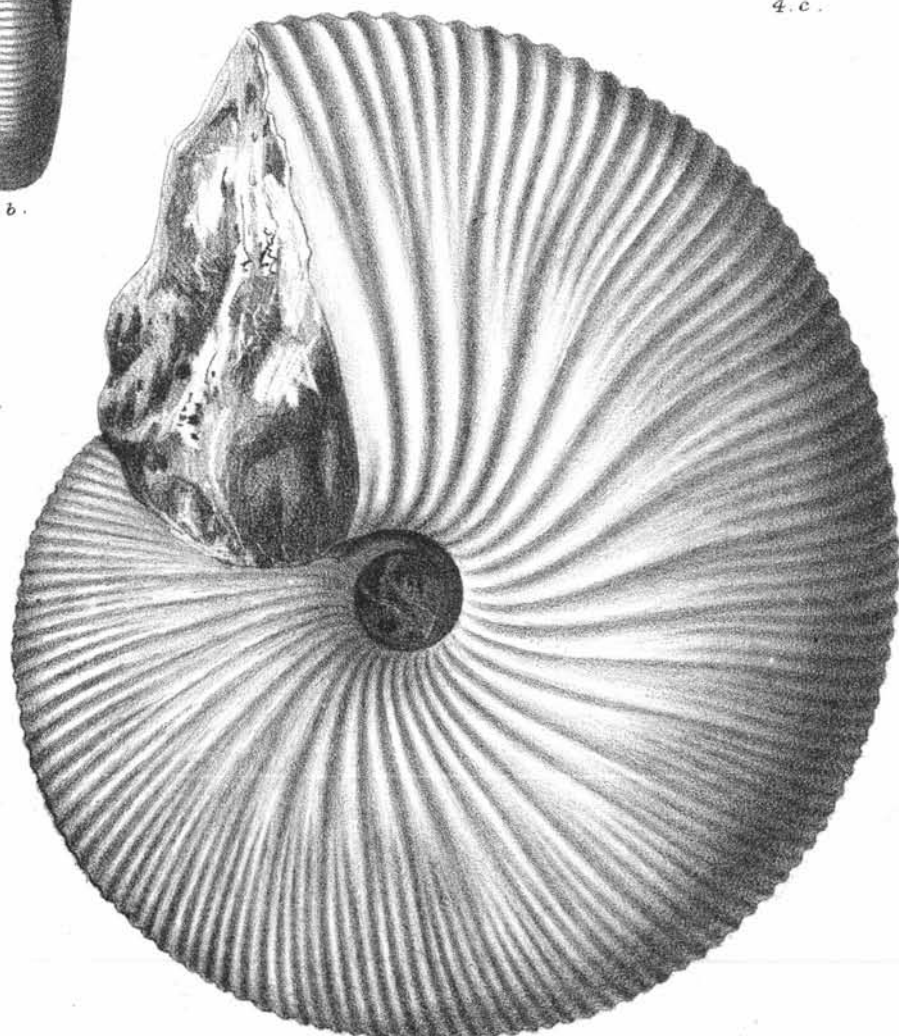
4. b.



4. c.



2. a.



2. b.

PLATE XXXIII.

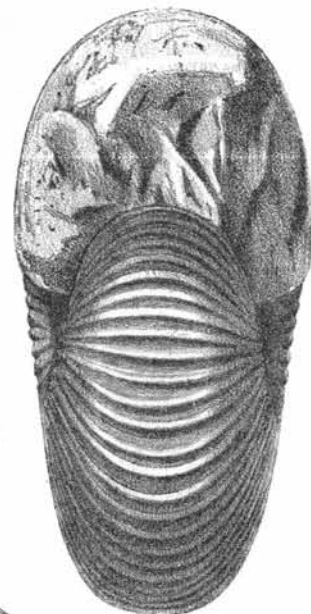
- Fig. ... 1. *STEPHANOCERAS LAMELLOSUM*, *Sowerby*, p. 122; specimen with temporary body-chamber from the *golden oolite* of *Keera hill* near *Charee*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. *STEPHANOCERAS DIMERUM*, *Waagen*, n. sp., p. 132; specimen with preserved body-chamber from the *coral beds* of the *Putchum group* north-west of *Jumara*; 2*a*, side-view; 2*b*, front-view; 2*c*, back-view.
- Fig. ... 3. *STEPHANOCERAS DIMERUM*, *Waagen*, n. sp., p. 132; small specimen from the same beds and locality as the preceding; 3*a*, side-view; 3*b*, front-view.
- Fig. ... 4. *STEPHANOCERAS SUBTRAPEZINUM*, *Waagen*, n. sp., p. 138; specimen with preserved body-chamber from the *golden oolite* of *Keera hill* near *Charee*; 4*a*, side-view, 4*b*, front-view; 4*c*, back-view.
- Fig. ... 5. *STEPHANOCERAS MACROCEPHALUM*, *Schlotheim*, p. 109; lobes of a specimen from the *golden oolite* of *Keera hill* near *Charee*.



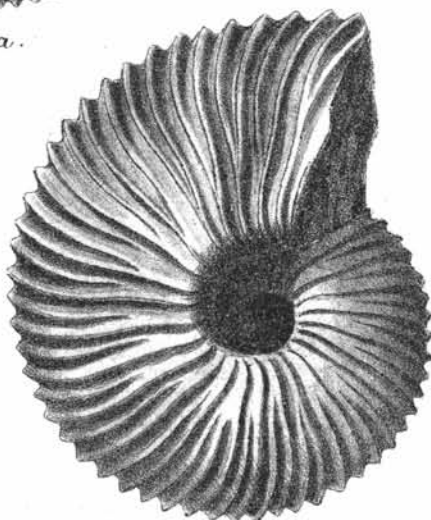
1. a.



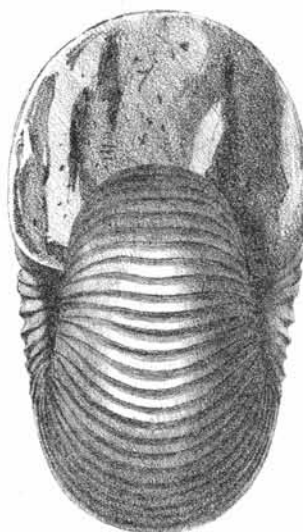
2. c.



1. b.



2. a.



2. b.



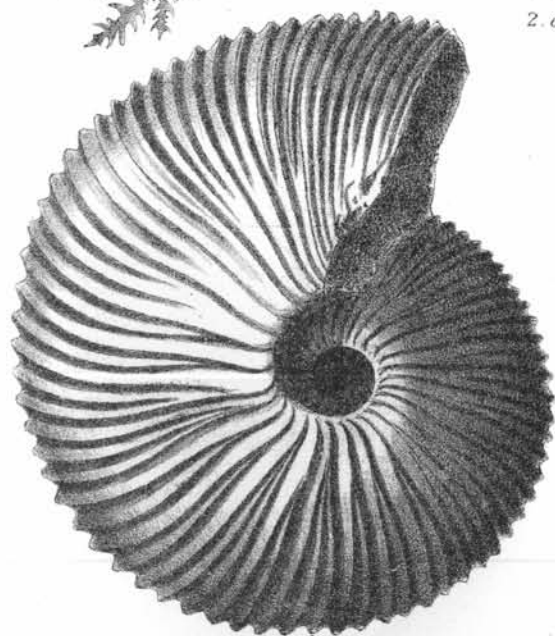
3. a.



3. b.



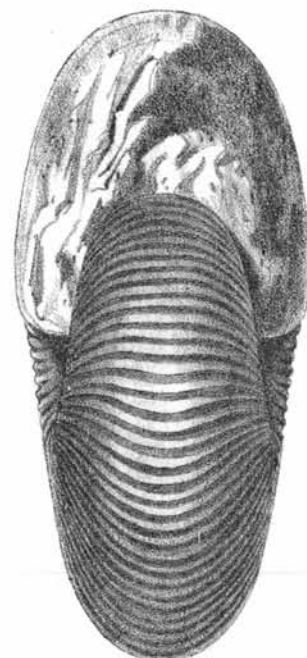
5.



4. a.



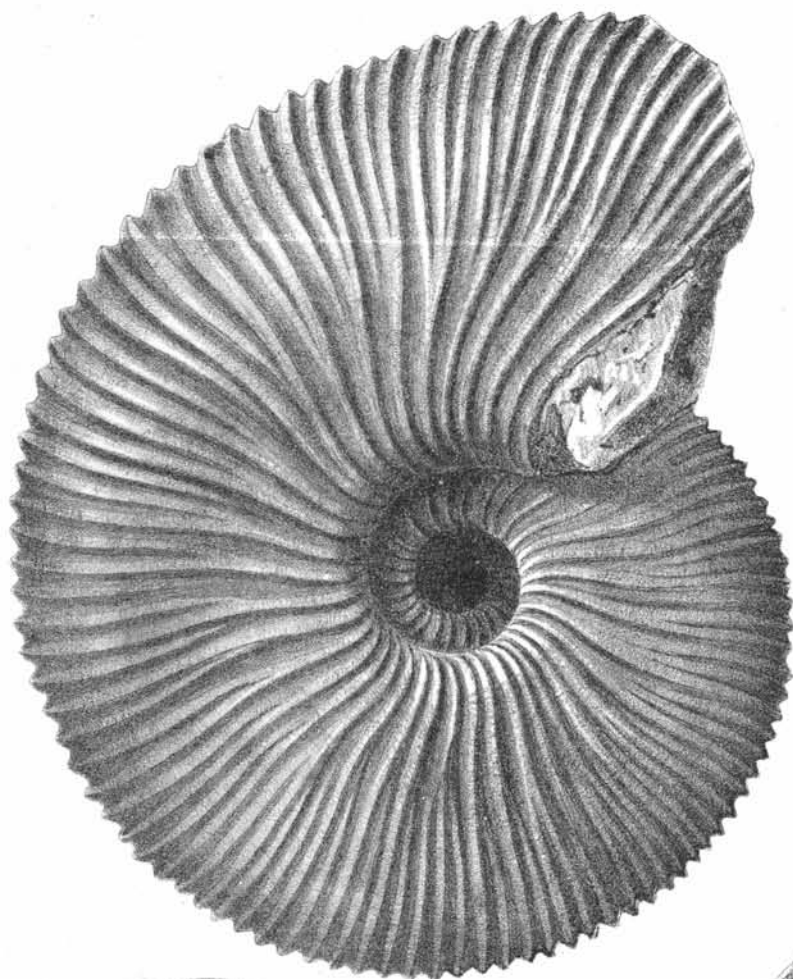
4. c.



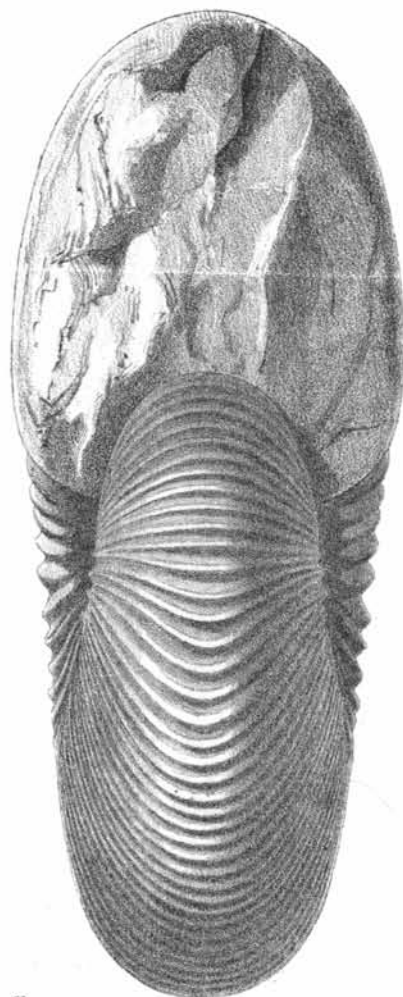
4. b.

PLATE XXXIV.

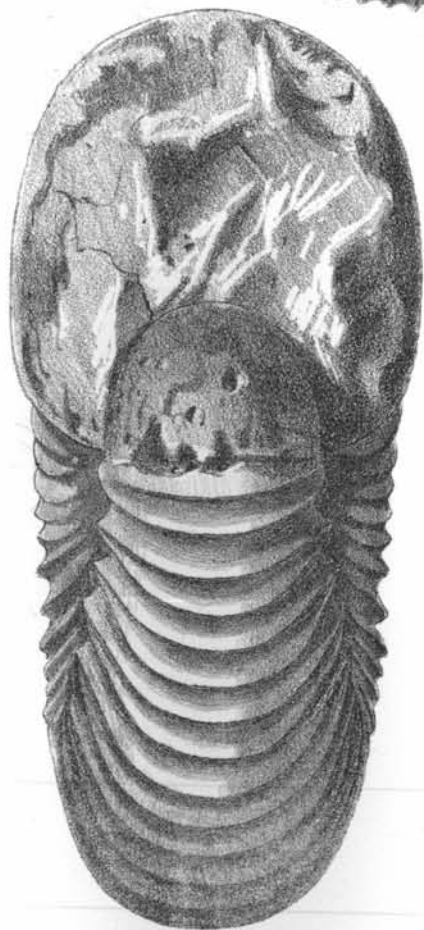
- Fig. ... 1. STEPHANOCERAS SUBCOMPRESSUM, *Waagen*, n. sp., p. 139; specimen with nearly entirely preserved body-chamber from the *Macrocephalus shales* north-west of *Soorka*; 1*a*, side-view; 1*b*, front-view.
- Fig. 2. STEPHANOCERAS MAGNUMBILICATUM, *Waagen*, n. sp., p. 133; specimen with the larger part of its body-chamber preserved from the *Macrocephalus shales* north-west of *Soorka*; 2*a*, side-view; 2*b*, front-view.



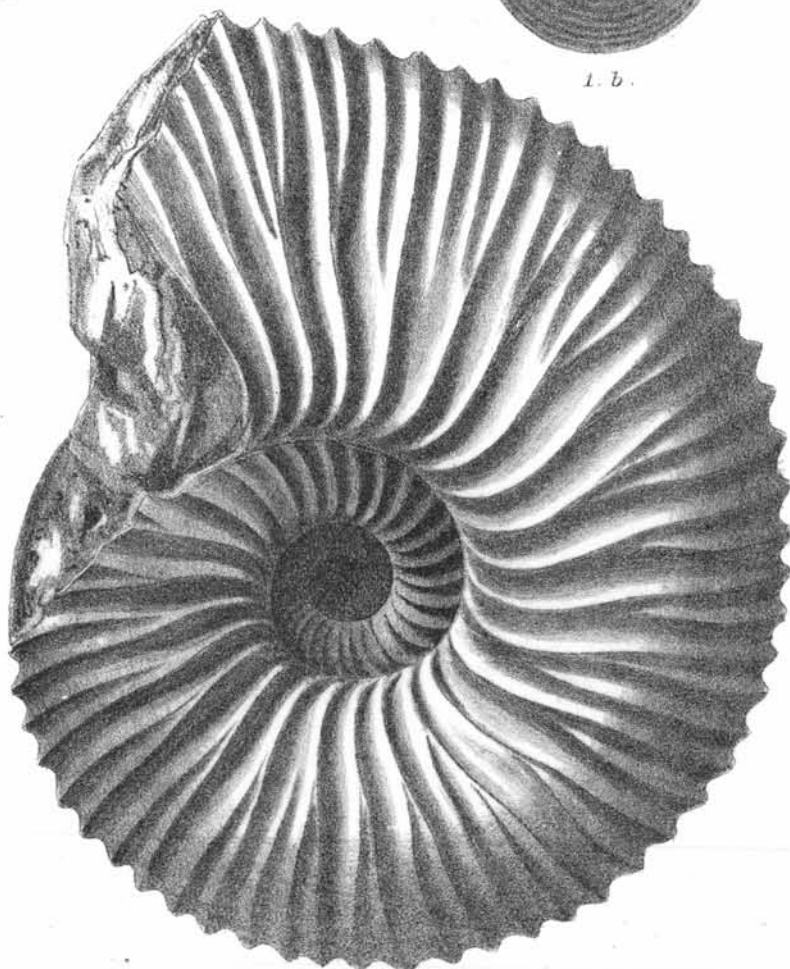
1. a.



1. b.



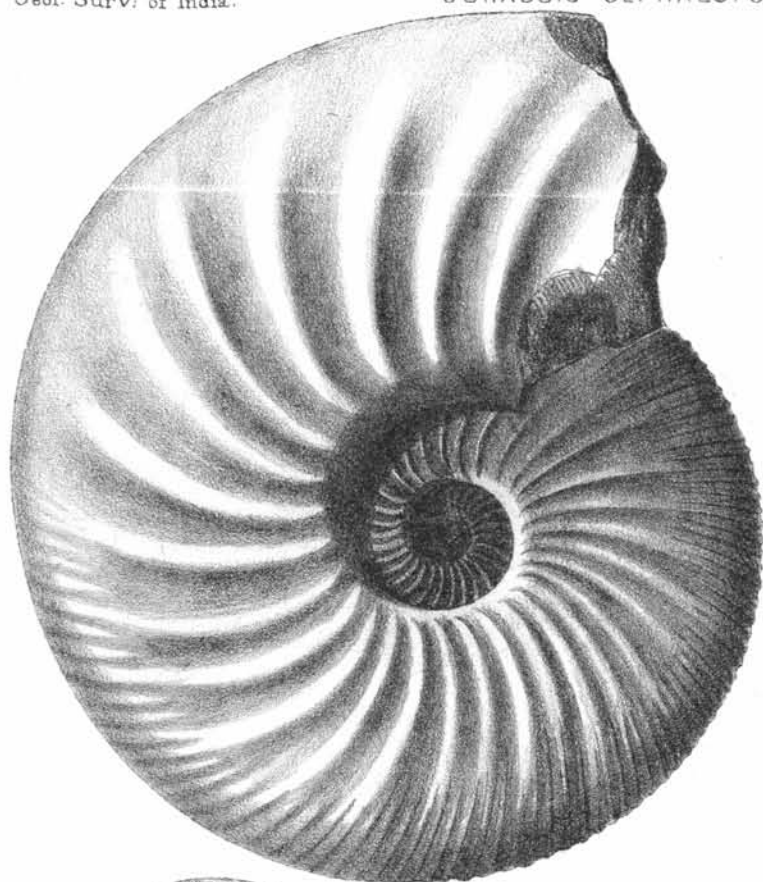
2. b.



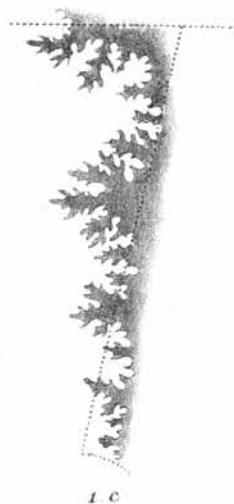
2. a.

PLATE XXXV.

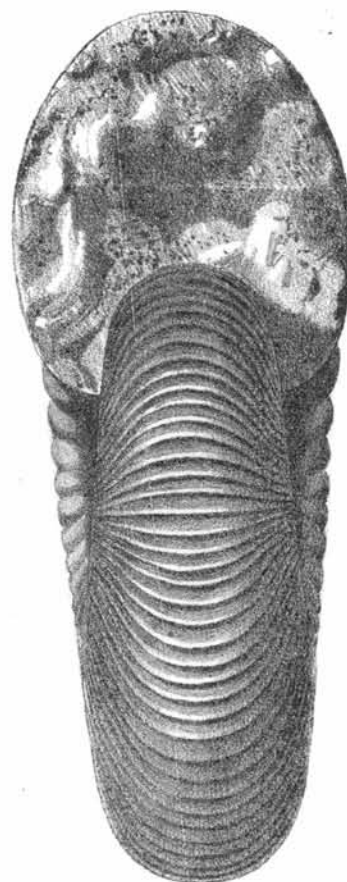
- Fig. ... 1. **STEPHANOCERAS EUCYCLUM**, *Waagen*, n. sp., p. 142 ; specimen with partly preserved body-chamber from the *golden oolite* of *Keera hill* near *Charee* ; *1a*, side-view ; *1b*, front-view ; *1c*, lobes.
- Fig. ... 2. **STEPHANOCERAS NEPALENSE**, *Gray*, p. 136 ; specimen with nearly entirely preserved body-chamber from the *red iron-sandstone* of *Kuntkote* ; *2a*, side-view ; *2b*, front-view.
- Fig. ... 3. **STEPHANOCERAS NEPALENSE**, *Gray*, p. 136 ; inner whorl of a large specimen from the same bed and locality as the preceding ; *3a*, side-view ; *3b*, back-view.



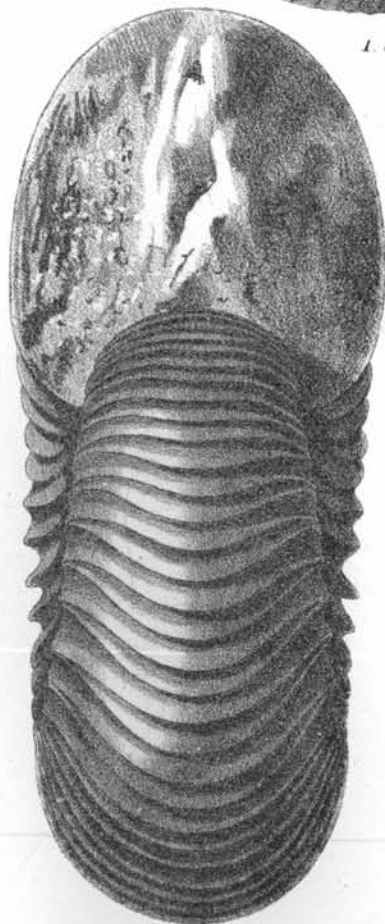
1. a.



1. c.



1. b.



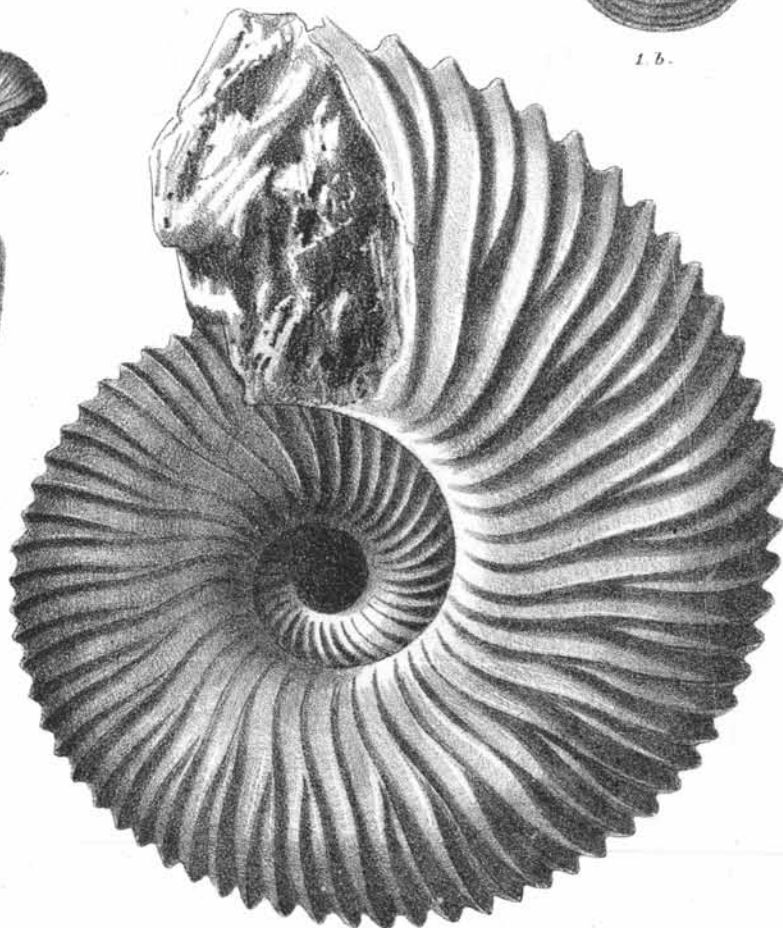
2. b.



3. a.



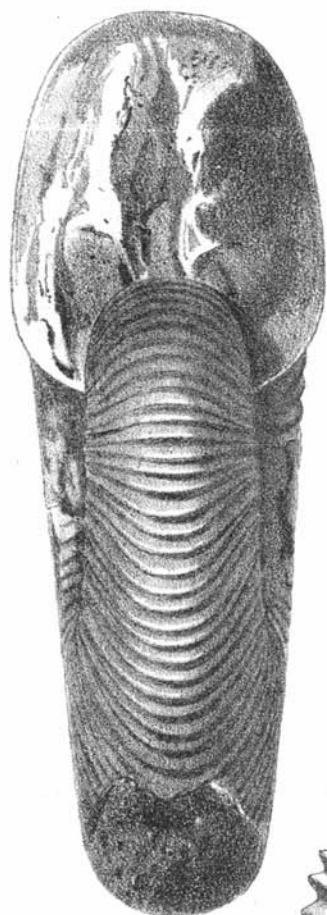
3. b.



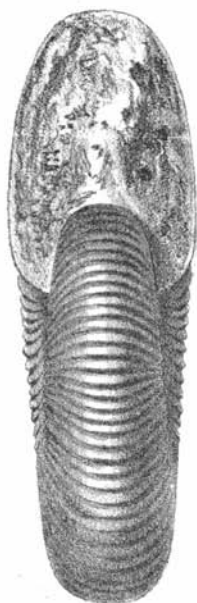
2. a.

PLATE XXXVI.

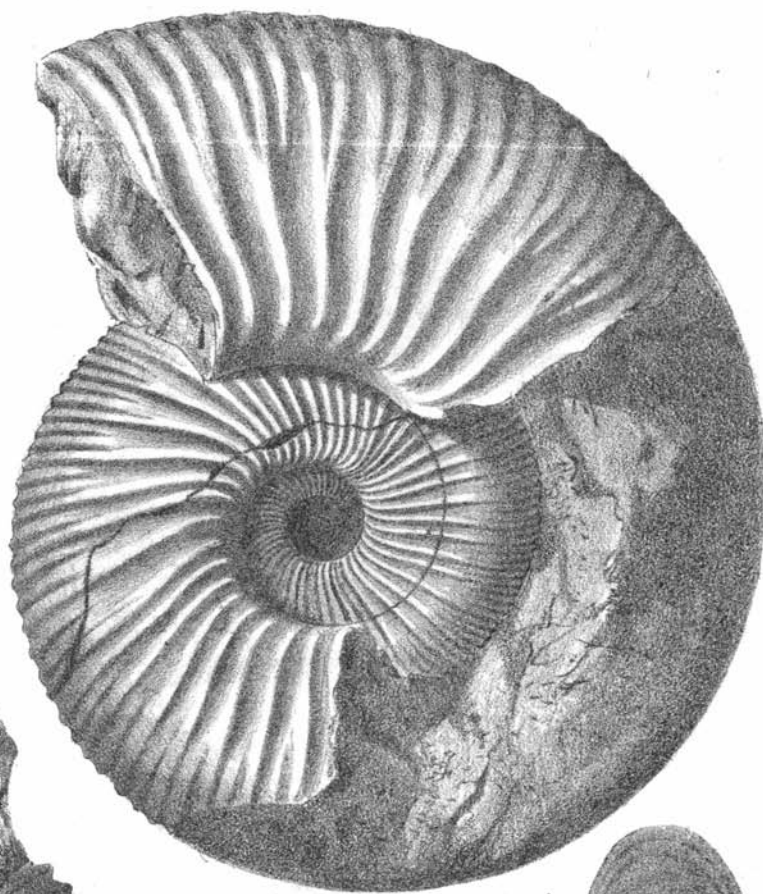
- Fig. ... 1. **STEPHANOCERAS OPIS**, *Sowerby*, p. 140 ; specimen with partly preserved body-chamber from the beds with *Perisph. anceps* of *Keera hill* near *Charee* ; 1*a*, side-view ; 1*b*, front-view.
- Fig. ... 2. **STEPHANOCERAS OPIS**, *Sowerby*, p. 140 ; small specimen from the oolites with *Per. anceps* of the *Joorra hills* ; front-view.
- Fig. ... 3. **STEPHANOCERAS OPIS**, *Sowerby*, p. 140 ; very small specimen from the same bed and locality as the preceding ; side-view.
- Fig. ... 4. **STEPHANOCEREAS FISSUM**, *Sowerby*, p. 134 ; small specimen with temporary body-chamber from the *Dhosa oolite* of *Lodai* ; 4*a*, side-view ; 4*b*, front-view.
- Fig. 5. **STEPHANOCERAS ARENOSUM**, *Waagen*, p. 121 ; specimen composed of air-chambers from the *Dhosa oolite* of *Lodai* ; 5*a*, side-view ; 5*b*, back-view ; 5*c*, lobes.
- Fig. ... 6. **STEPHANOCERAS GRANTANUM**, *Oppel*, p. 123 ; small specimen from the *golden oolite* of *Keera hill* near *Charee* ; 6*a*, side-view ; 6*b*, front-view.



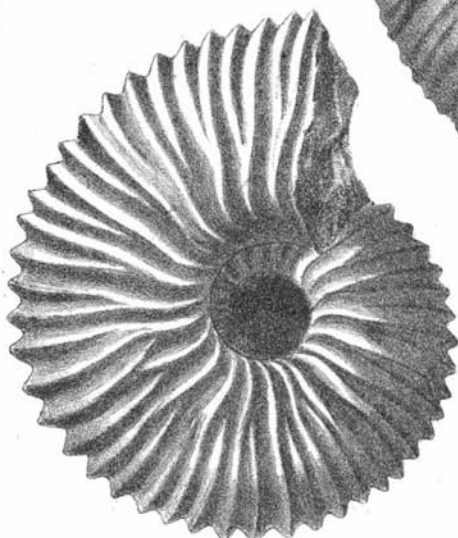
1. b.



2.



1. a.



6. a.



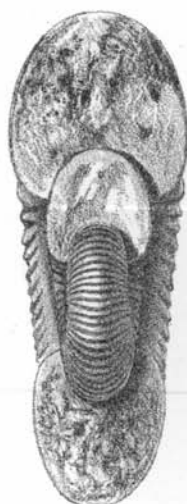
3.



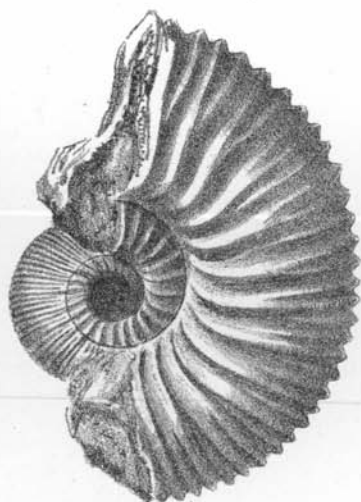
5. c.



5. b.



4. b.



4. a.



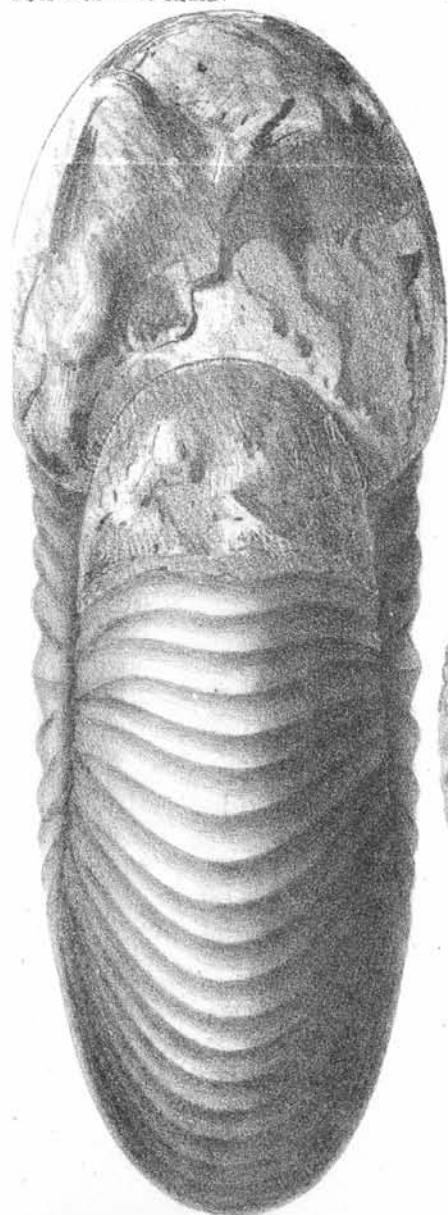
6. b.



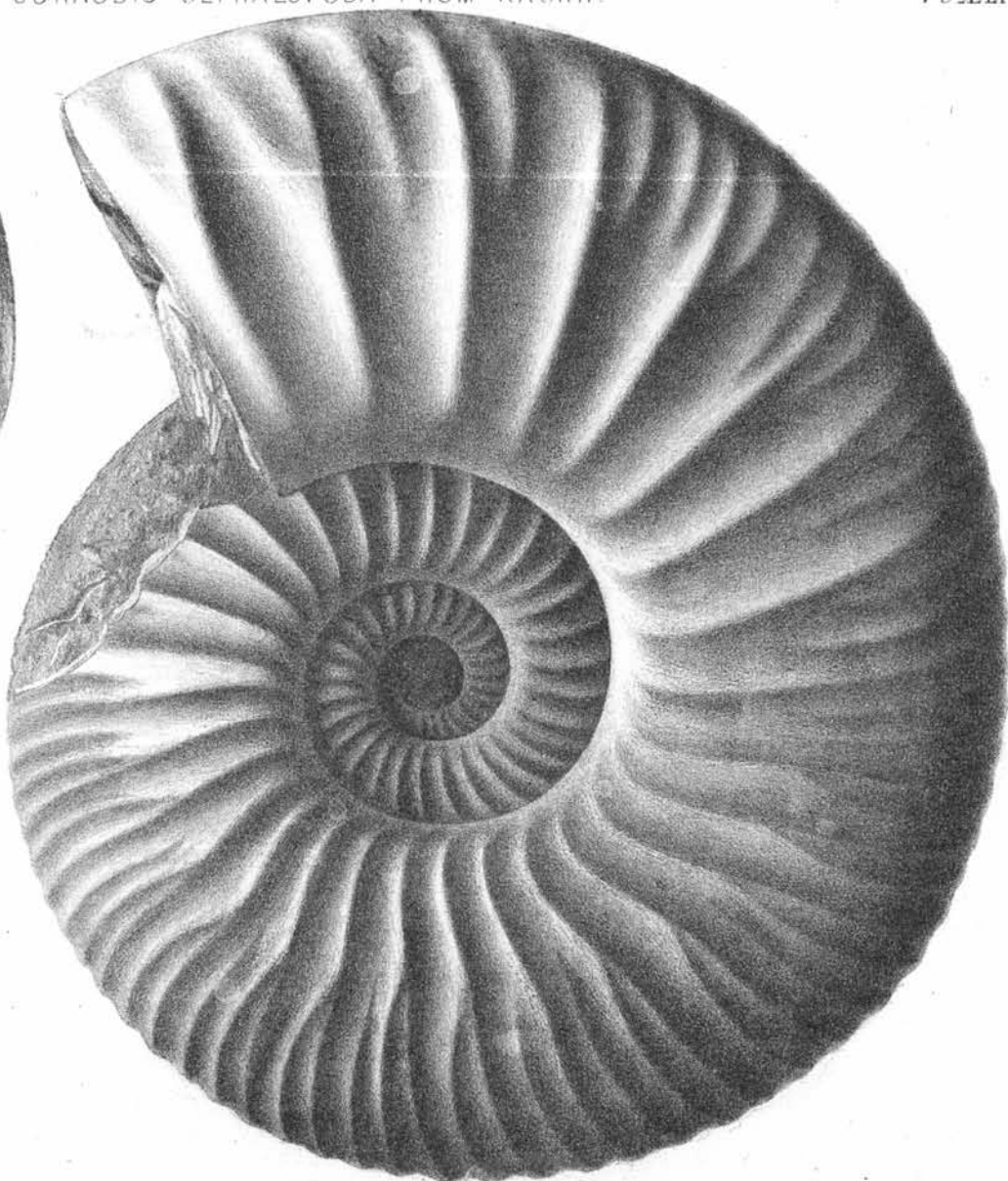
5. a.

PLATE XXXVII.

- Fig. ... 1. STEPHANOCERAS FISSUM, *Sowerby*, p. 134; specimen with nearly entire body-chamber from the *Dhosa oolite* of *Keera hill* near *Charee*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. PERISPHINCTES OMPHALODES, *Waagen*, n. sp. p. 150; specimen with entire body-chamber and apertural margin from the beds with *Per. anceps* of *Vanda*; 2*a*, side-view; 2*b*, front-view.
- Fig. ... 3. PERISPHINCTES ORION, *Oppel*, p. 161; specimen composed of air-chambers from the beds with *Pelt. athleta* of *Vanda*; 3*a*, side-view; 3*b*, front-view.



1. b.



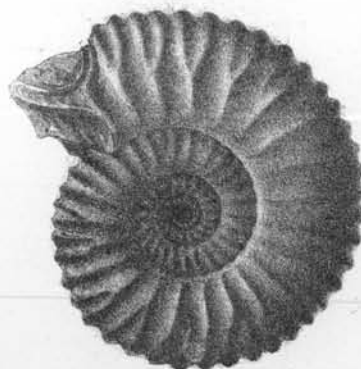
1. a.



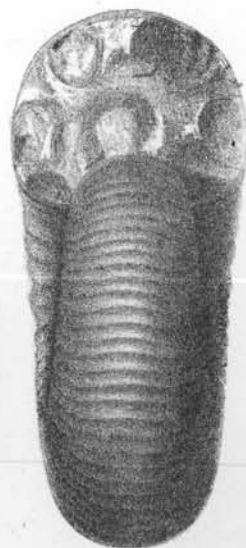
3. a.



2. b.



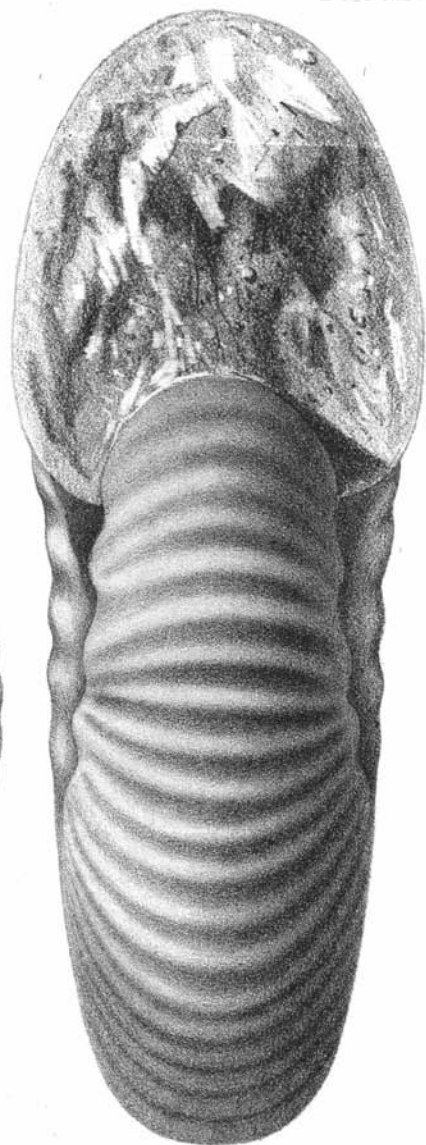
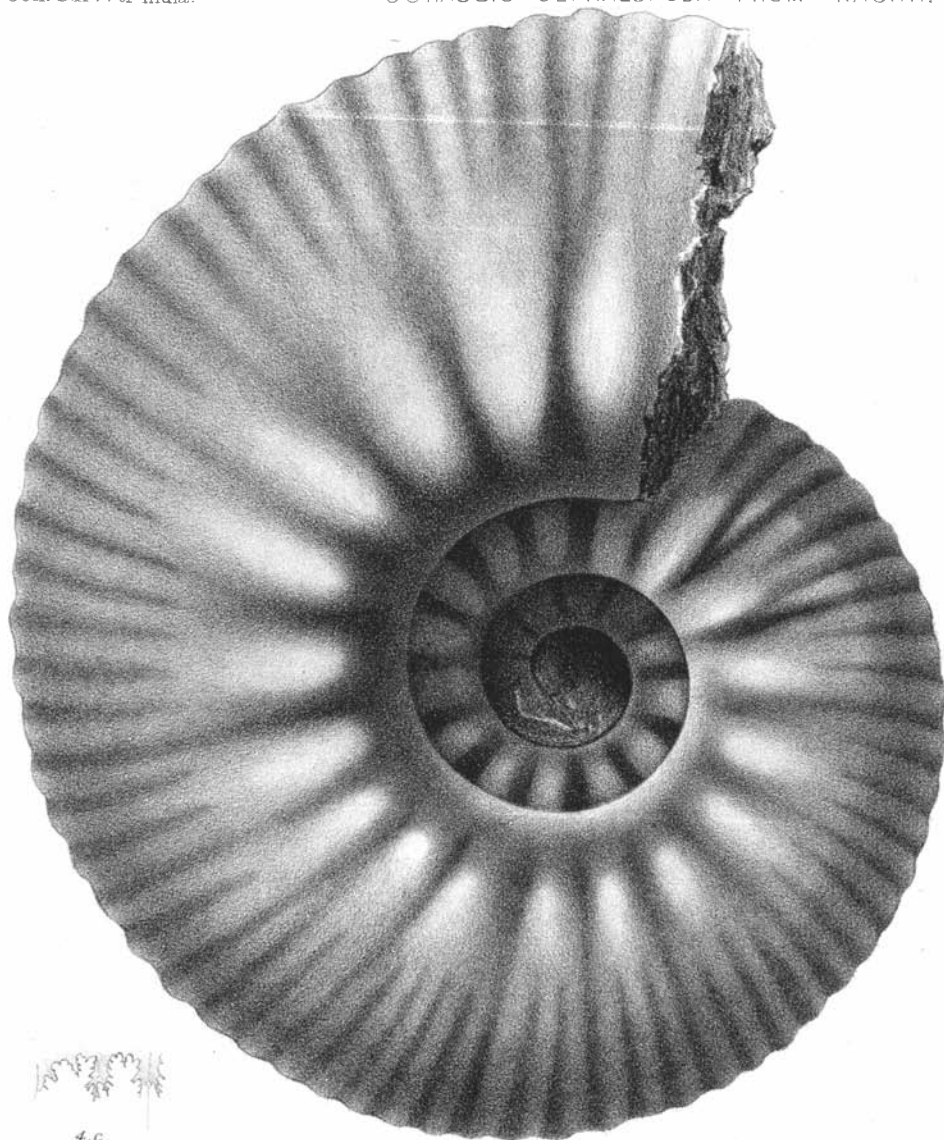
2. a.



3. b.

PLATE XXXVIII.

- Fig. ... 1. PERISPINCTES OBTUSICOSTA, *Waagen*, n. sp., p. 146; specimen composed of air-chambers from the beds with *Per. anceps* of north of *Dhosa*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. PERISPINCTES OBTUSICOSTA, *Waagen*, n. sp., p. 146; lobes of another specimen from the same beds and locality as the preceding.
- Fig. ... 3. PERISPINCTES OBTUSICOSTA, *Waagen*, n. sp., p. 146; small specimen very likely from the *Athleta* beds of north of *Gudjinsir*; 3*a*, side-view; 3*b*, front-view.
- Fig. ... 4. PERISPINCTES DHOSAENSIS, *Waagen*, n. sp., p. 149; specimen with entirely preserved body-chamber and apertural margin from the beds with *Per. anceps* of north of *Dhosa*; 4*a*, side-view; 4*b*, front-view; 4*c*, lobes.



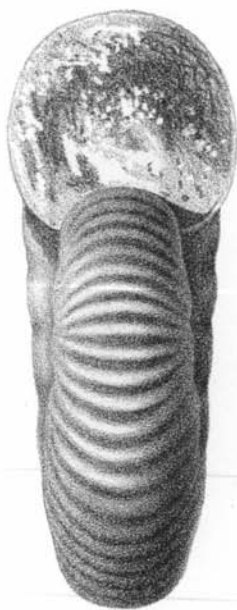
4 c.

1 a.



2

1 b.



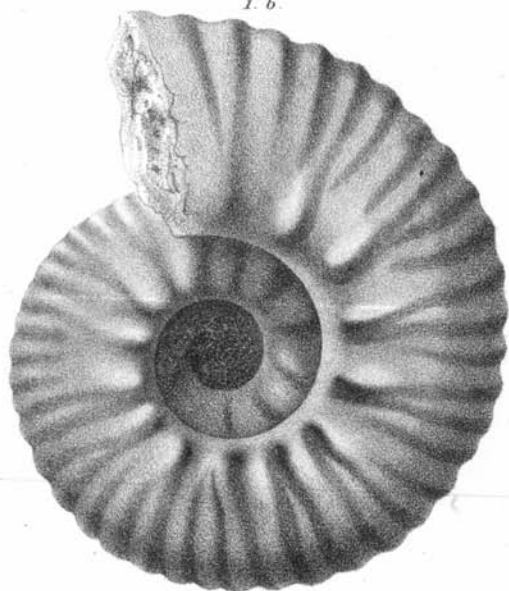
3 b.



4 b.



4 a.



3 a.

PLATE XXXIX.

- Fig. ... 1. *PERISPHINCTES MUTANS*, *Waagen*, n. sp., p. 151; specimen with nearly entirely preserved body-chamber from the base of the *Katrol group* of north of *Gudjinsir*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. *PERISPHINCTES ANGYGASTER*, *Waagen*, n. sp., p. 148; specimen composed of air-chambers from the beds with *Per. anceps* of *Keera hill* near *Charee*; 2*a*, side-view; 2*b*, front-view.
- Fig. ... 3. *PERISPHINCTES GUDJINSIRENSIS*, *Waagen*, n. sp., p. 176; specimen with preserved body-chamber from the *Athleta beds* of north of *Gudjinsir*; 3*a*, side-view; 3*b*, front-view.
- Figs. ... 4-6. *PERISPHINCTES CURVICOSTA*, *Oppel*, p. 169; 4, specimen from the *Anceps beds* of *Jumara*; 5*a, b*, from the same beds of the *Joora hills*; 6*a, b*, from the *Athleta beds* north of *Gudjinsir*.
- Fig. ... 7. *PERISPHINCTES SUBEVOLUTUS*, *Waagen*, n. sp., p. 179; small specimen from the *Dhosa oolite* of *Lodai*.

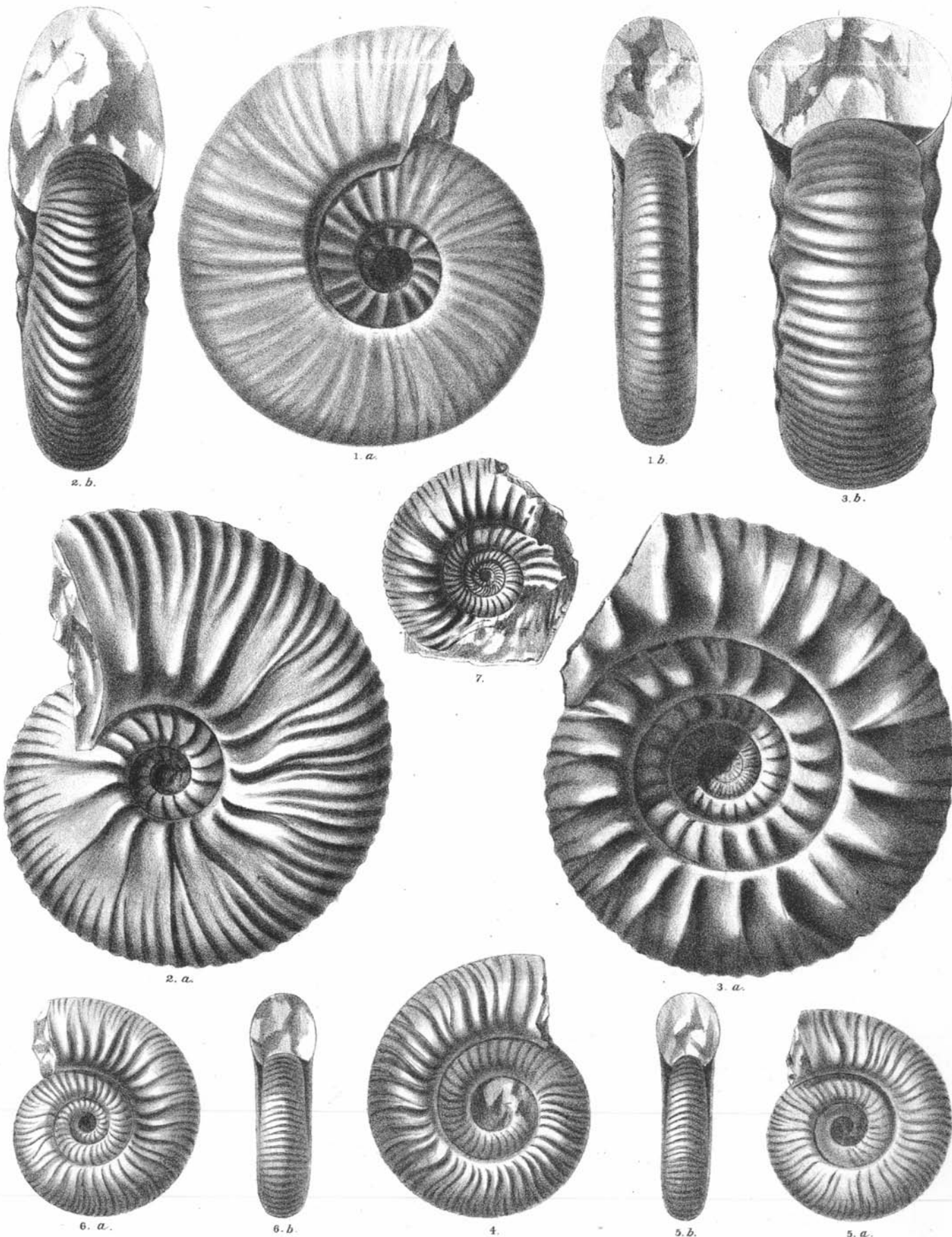
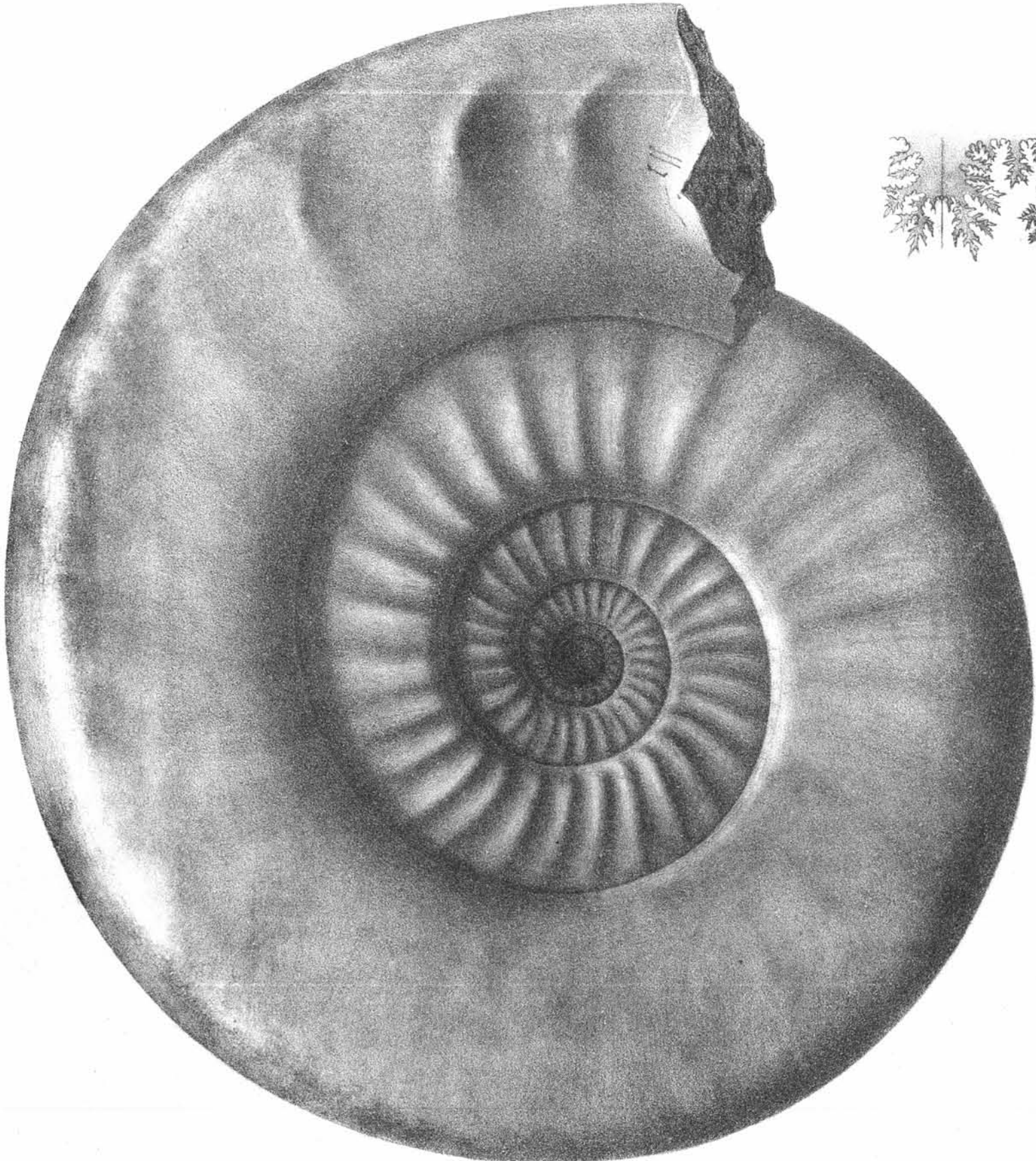


PLATE XL.

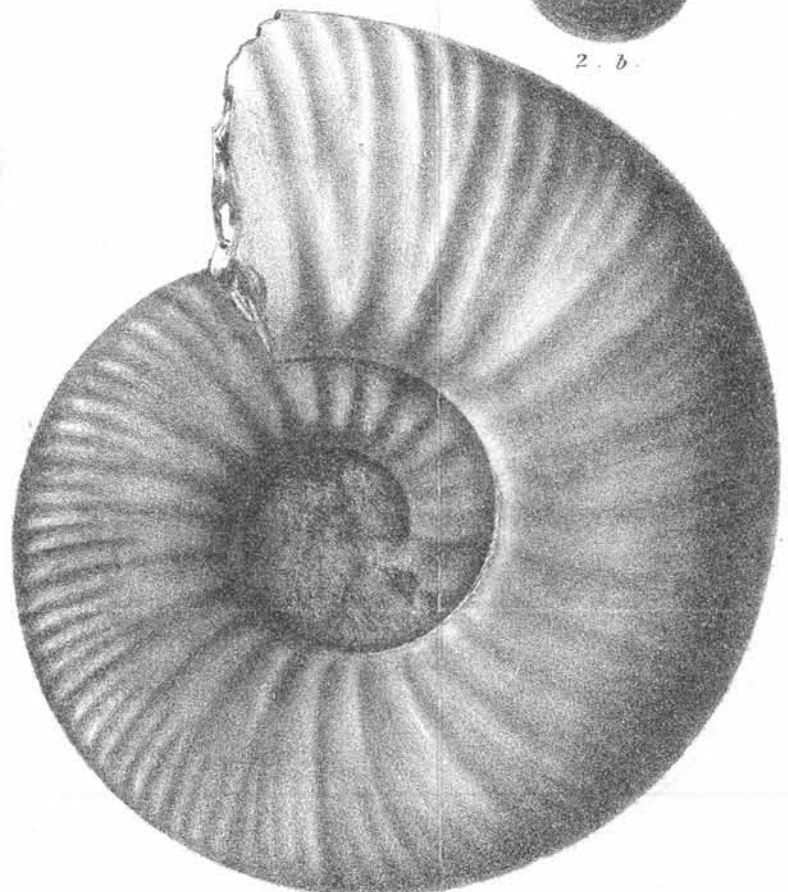
- Fig.. 1. PERISPINCTES ABERRANS, *Waagen*, n. sp., p. 175 ; specimen composed of air-chambers from the *Athleta beds* of *Keera hill* near *Charee* ; 1*a*, side-view ; 1*b*, front-view ; 1*c*, lobes.
- Fig. ... 2. PERISPINCTES ABERRANS, *Waagen*, n. sp., p. 175 ; small specimen from the same beds and locality as the preceding ; 2*a*, side-view ; 2*b*, front-view.



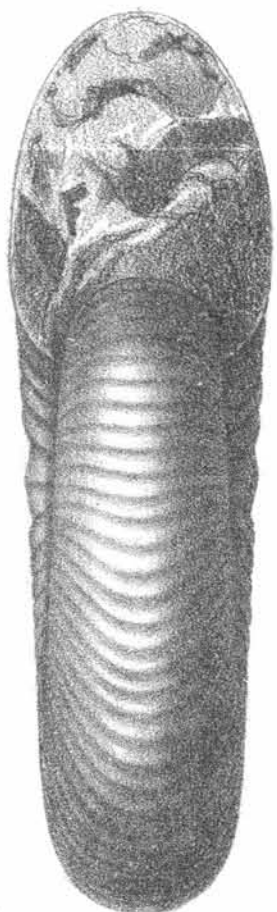
1. a



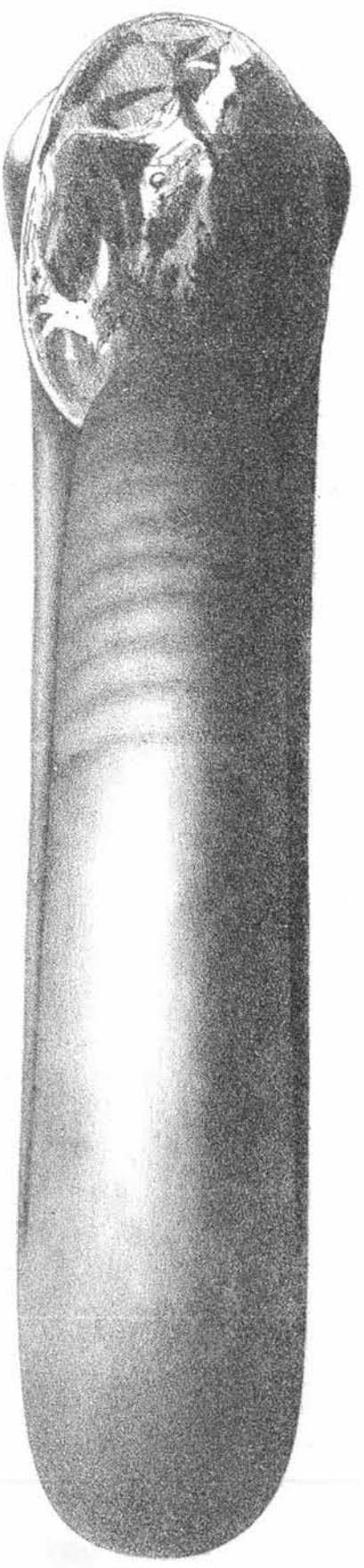
1. c



2. a



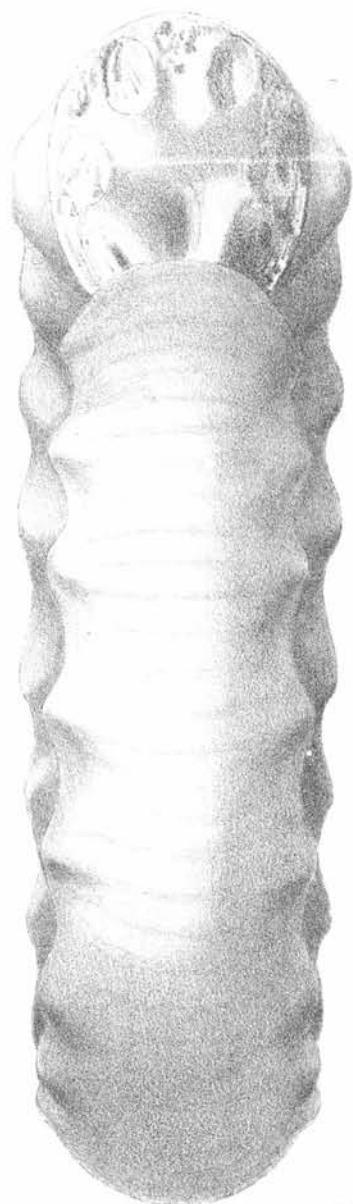
2. b



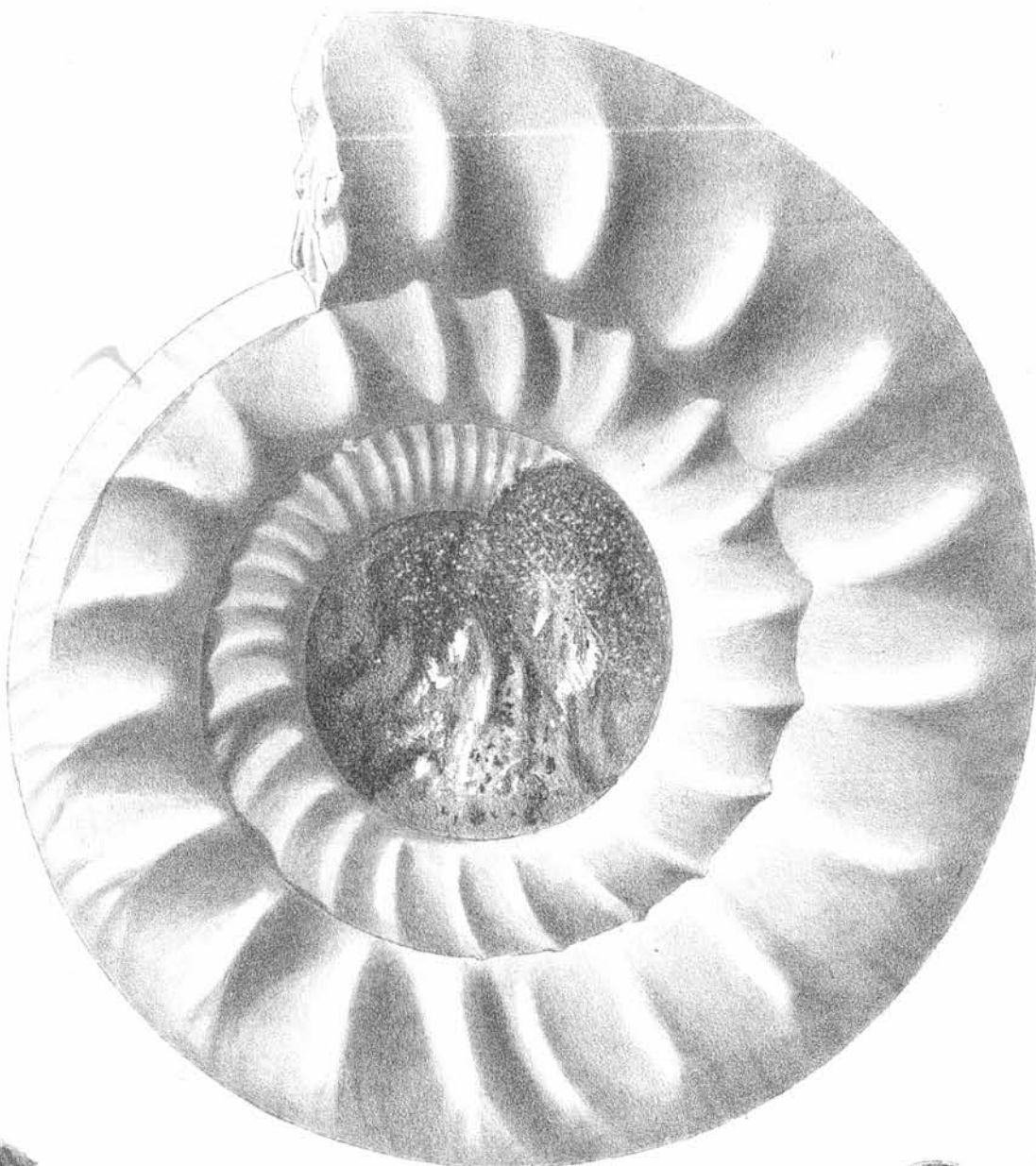
1. b.

PLATE XLI.

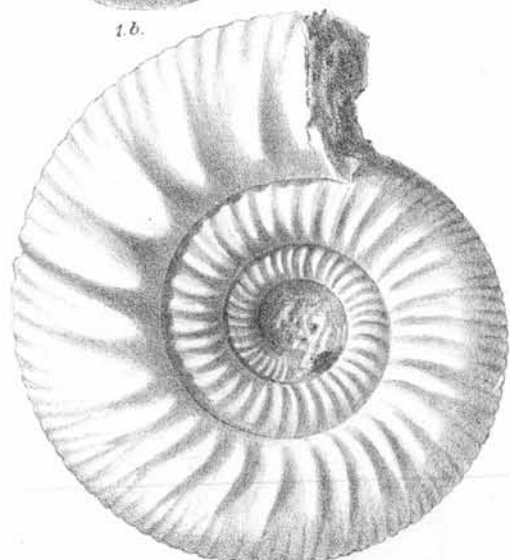
- Fig. ... 1. PERISPINCTES SPIRORBIS, *Neumayr*, p. 154; full grown specimen with nearly entire body-chamber from the *golden oolite* of *Charee*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.
- Fig. ... 2. PERISPINCTES SPIRORBIS, *Neumayr*, p. 154; inner whorls of a large specimen from *Keera hill* near *Charee*; 2*a*, side-view; 2*b*, front-view.



1.b.



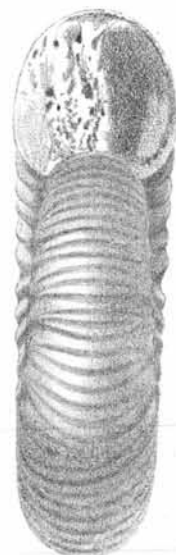
1.a.



2.a.



1.c.



2.b.

Calcutta.

PLATE XLII.

- Fig. 1. PERISPINCTES ALTIPLICATUS, *Waagen*, n. sp., p. 156; specimen composed of air-chambers from the *golden oolite* of *Keera hill* near *Charee*; 1*a*, side-view; 1*b*, section of two subsequent whorls; 1*c*, part of the inner whorl taken out; 1*d*, back-view of the same; 1*e*, section of the same; 1*f*, lobes.
- Fig. ... 2. PERISPINCTES PAGRI, *Waagen*, n. sp., p. 181; specimen with partly preserved body-chamber from the *Kuntkote sandstone* of *Kuntkote*; 2*a*, side-view; 2*b*, front-view; 2*c*, lobes.

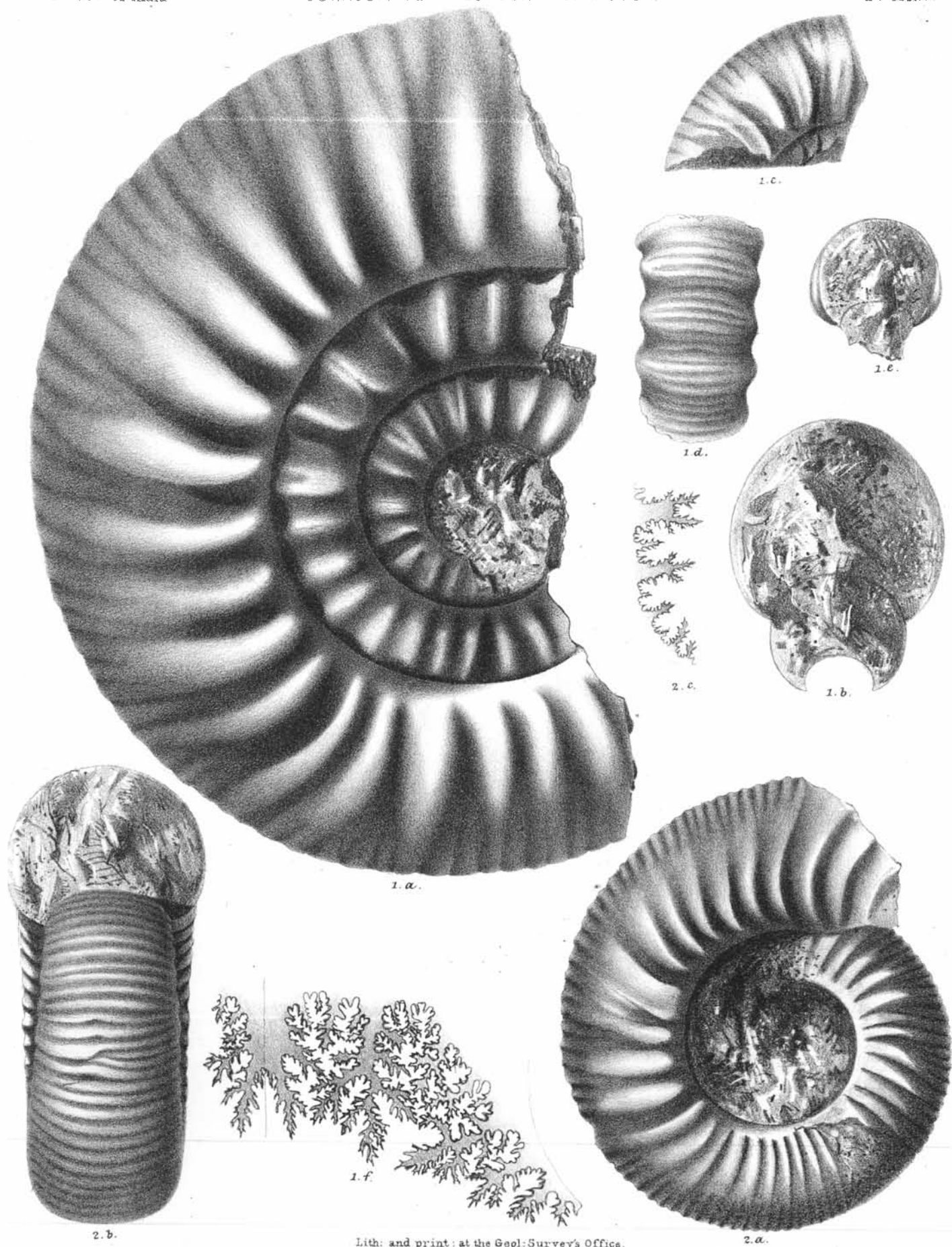
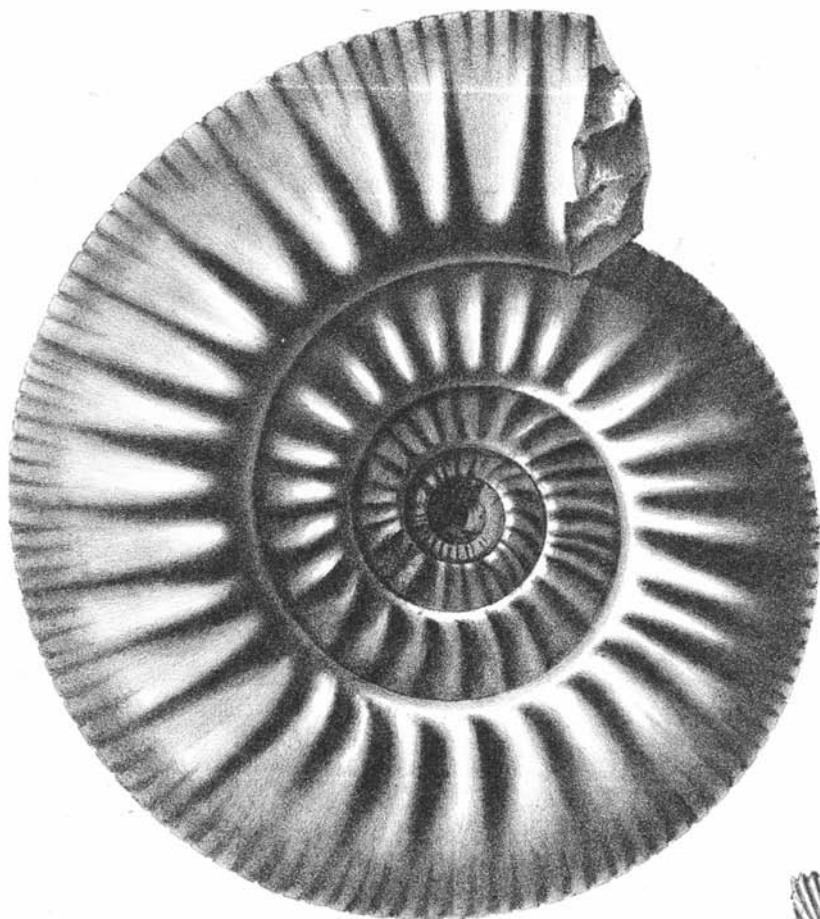
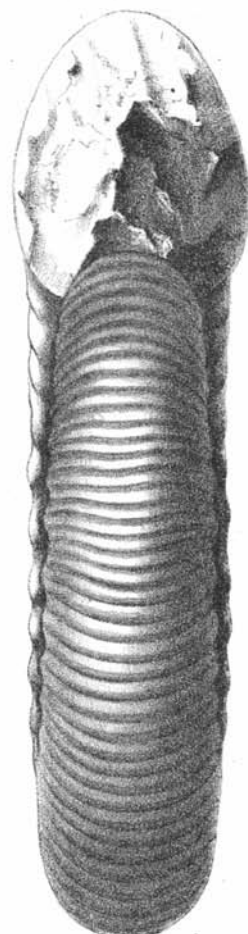


PLATE XL'IV.

- Fig. ... 1. PERISPINCTES PERDAGATUS, *Waagen*, n. sp., p. 158; specimen with partly preserved body-chamber from the beds with *Per. anceps* of *Keera hill* near *Charee*; 1a, side-view; 1b, front-view.
- Fig. ... 2. PERISPINCTES FREQUENS, *Oppel*, p. 200; middle sized specimen from the *Oomia* group west of *Soorka hill*; 2, side-view; 2a, front-view.
- Fig. ... 3. PERISPINCTES FREQUENS, *Oppel*, p. 200; small specimen from the same bed and locality as the preceding; 3, side-view; 3a, front-view.



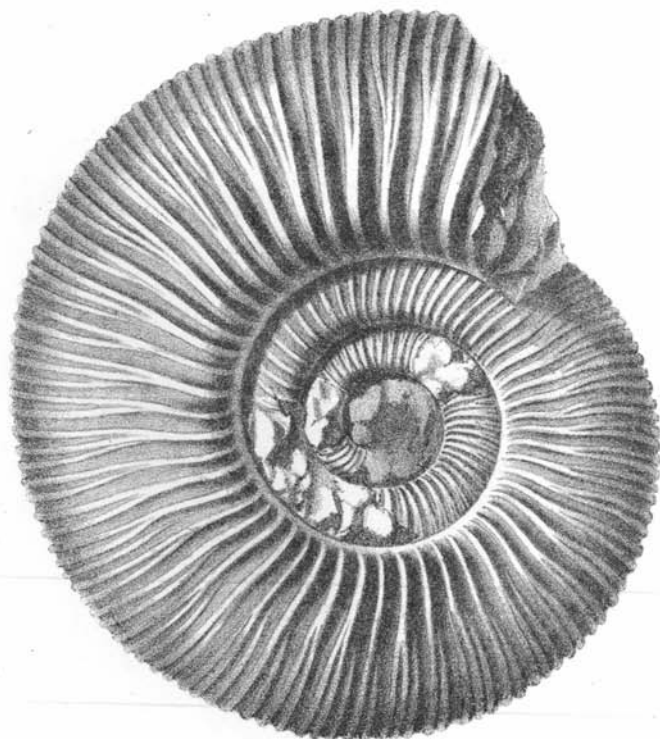
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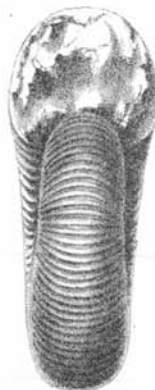
1. a.



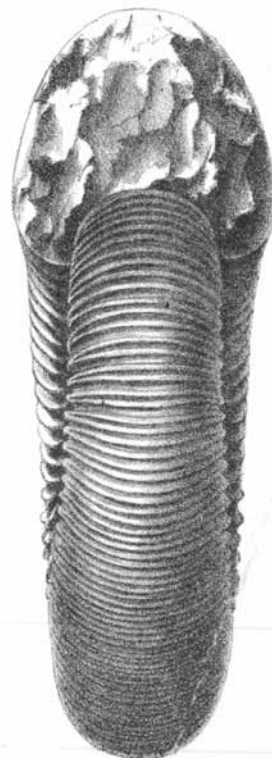
2.



3.



3. a.



2. a.

PLATE XLV.

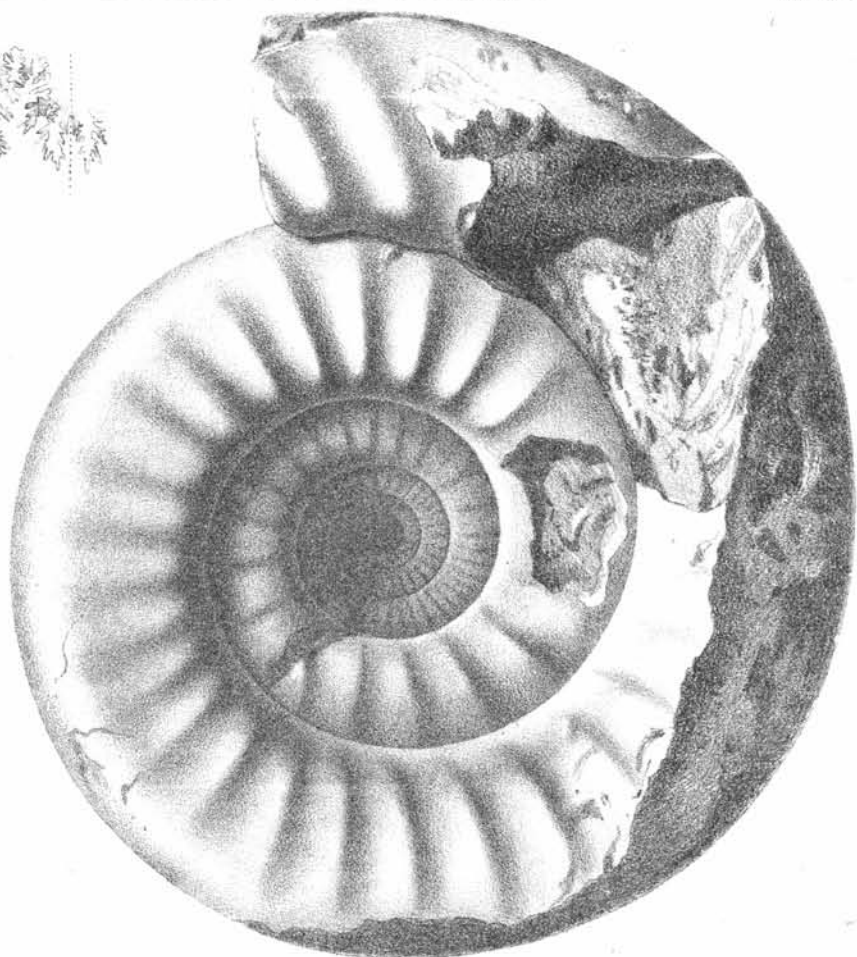
- Fig. ... 1. PERISPINCTES COBRA, *Waagen*, n. sp., p. 174; specimen with nearly entire body-chamber from the beds with *Per. anceps* south of *Bhooj*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.
- Fig. 2. PERISPINCTES BALINENSIS, *Neumayr*, p. 163; specimen with nearly entire body-chamber from the *Macrocephalus shales* north-west of *Soorka*.
- Fig. 3. PERISPINCTES SUBEVOLUTUS, *Waagen*, n. sp., p. 179; small specimen from the *Dhosa oolite* of north-west of *Soorka*; 3*a*, side-view; 3*b*, front-view.
- Fig. ... 4. PERISPINCTES OBLIQUEPLICATUS, *Waagen*, n. sp., p. 187; small specimen from the *Dhosa oolite* of *Vanda*; 4*a*, side-view; 4*b*, front-view.



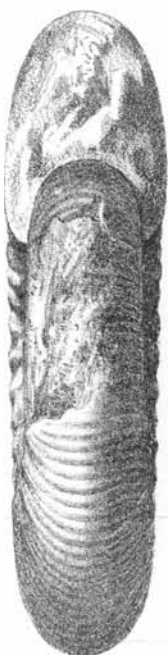
1.b.



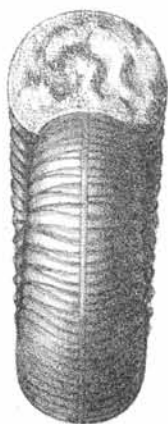
1.c.



1.a.



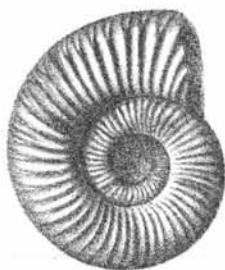
2.b.



3.b.



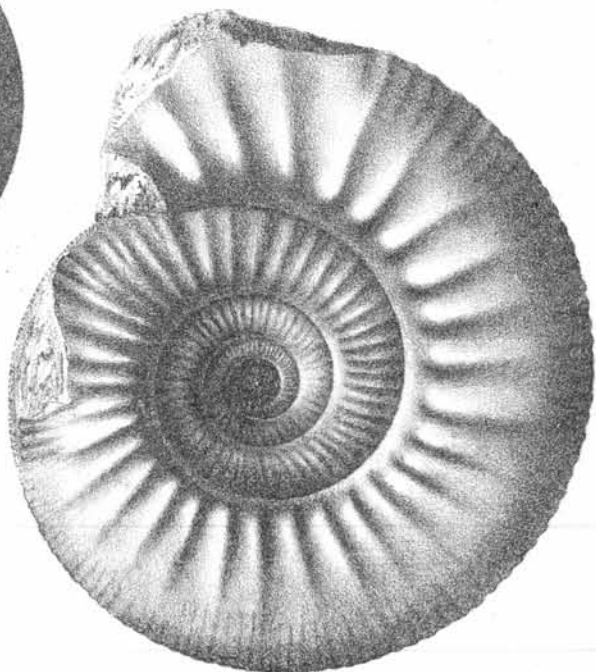
3.a.



4.a.



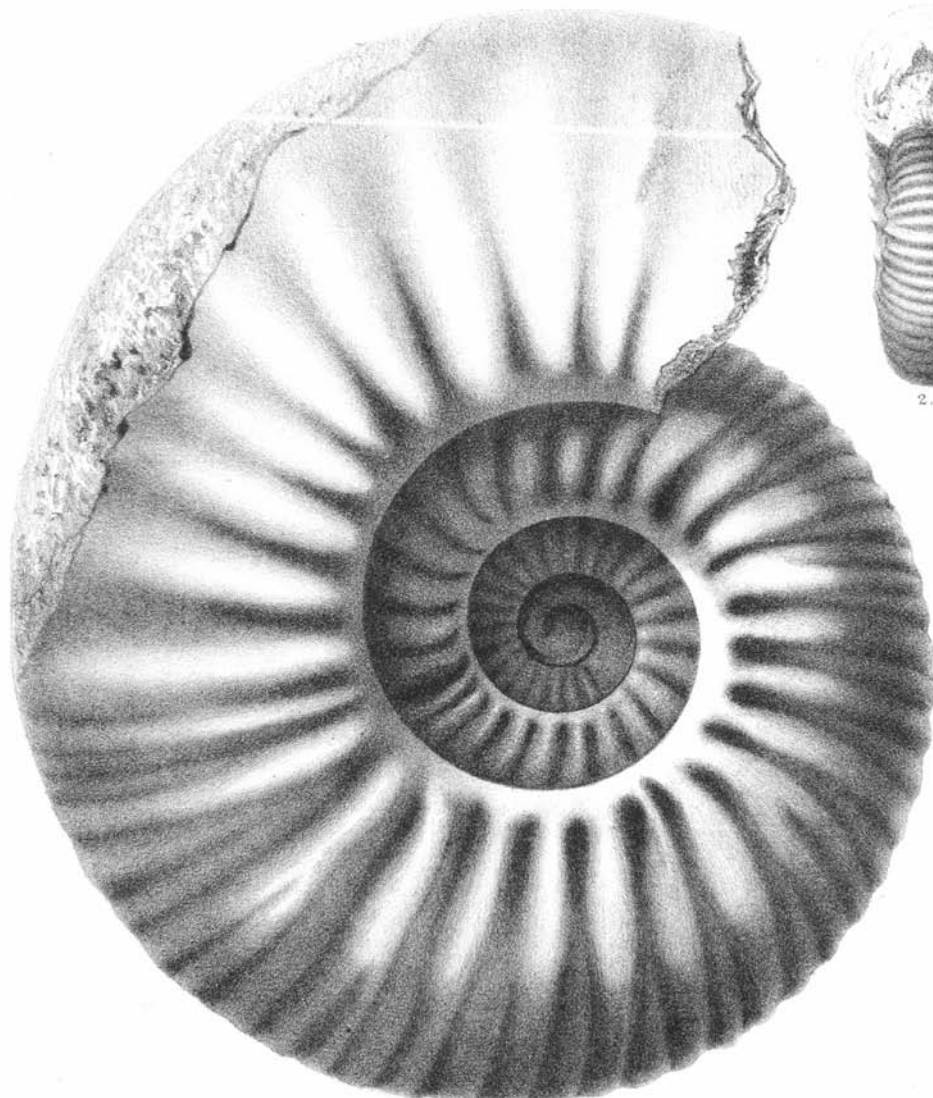
4.b.



2.a.

PLATE XLVI.

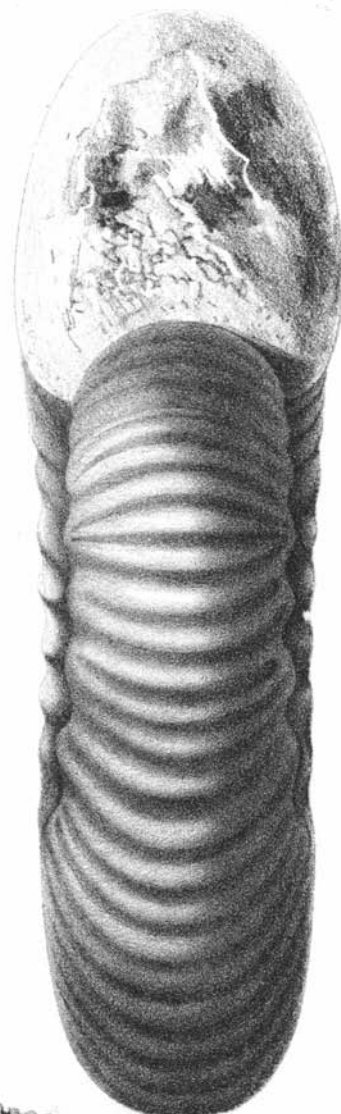
- Fig. ... 1. **PERISPHINCTES PARAMORPHUS**, *Waagen*, n. sp., p. 162; specimen composed of air-chambers from the *golden oolite* of *Keera hill* near *Charee*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. **PERISPHINCTES PARAMORPHUS**, *Waagen*, n. sp., p. 162; inner whorls of a large specimen from the *golden oolite* of *Keera hill* near *Charee*; 2*a*, side-view; 2*b*, front-view.
- Fig. ... 3. **PERISPHINCTES DENSEPLICATUS**, *Waagen*, n. sp., p. 201; middle-sized specimen from the *Oomia group* of west of *Soorka hill*; 3*a*, side-view; 3*b*, front-view.



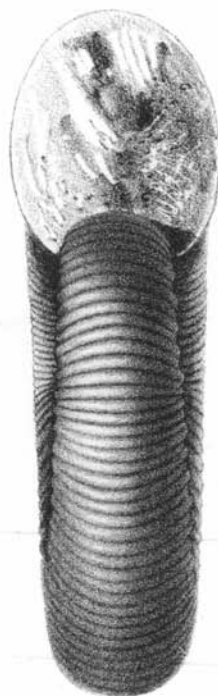
1. a.



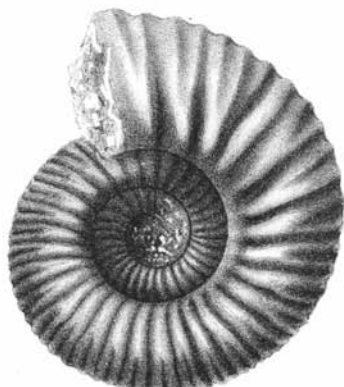
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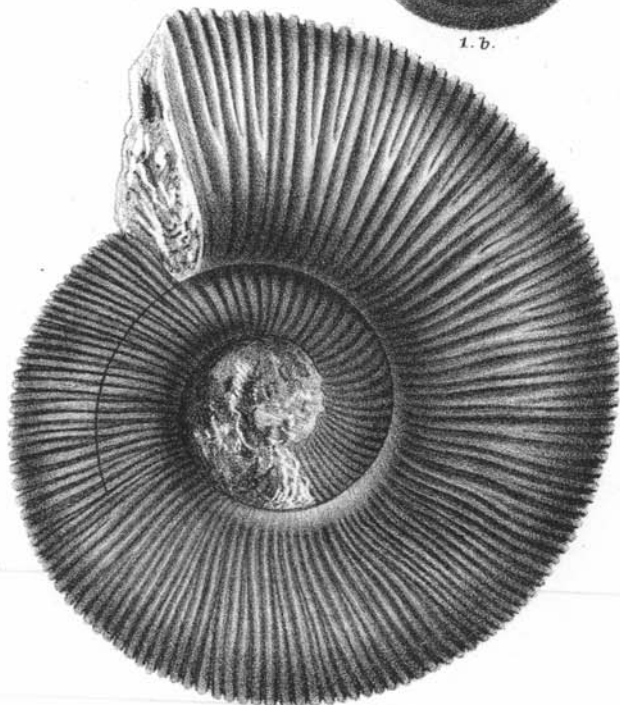
1. b.



3. b.



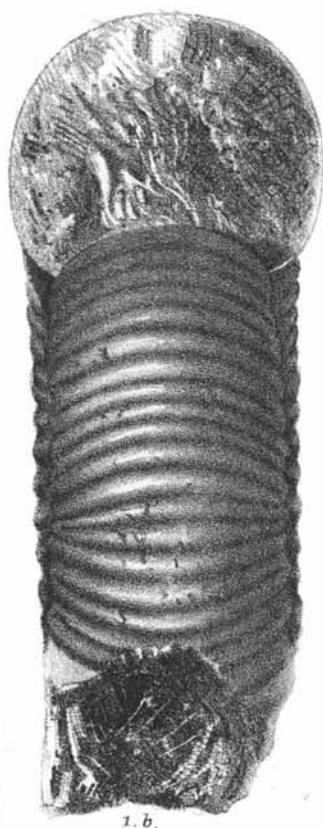
2. a.



3. a.

PLATE XLVII.

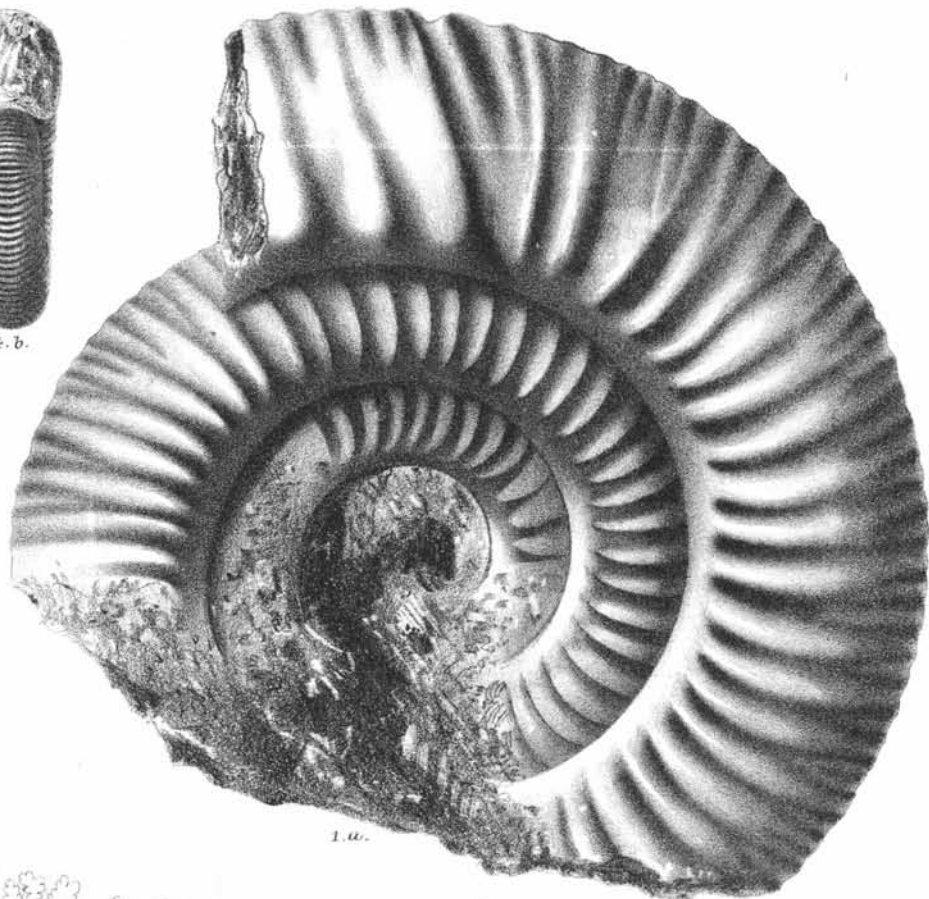
- Fig. 1. **PERISPHINCTES INDOGERMANUS**, *Waagen*, n. sp., p. 185; specimen composed of air-chambers with preserved shell from the *Dhosa oolite* of *Joorun*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.
- Fig. 2. **PERISPHINCTES** *cf.* **FUNATUS**, *Oppel*, p. 155; specimen composed of air-chambers from the *golden oolite* of *Keera hill* near *Charee*; 2*a*, side-view, 2*b*, front-view.
- Fig. 3. **PERISPHINCTES PARAMORPHUS**, *Waagen*, n. sp., p. 162; lobes of a specimen from the *Golden oolite* of *Keera hill*.
- Fig. 4. **PERISPHINCTES VIRGULOIDES**, *Waagen*, n. sp., p. 203; small specimen from the *Kuntkote sandstone* of *Kuntkote*; 4*a*, side-view; 4*b*, front-view.



1. b.



4. b.



1. a.



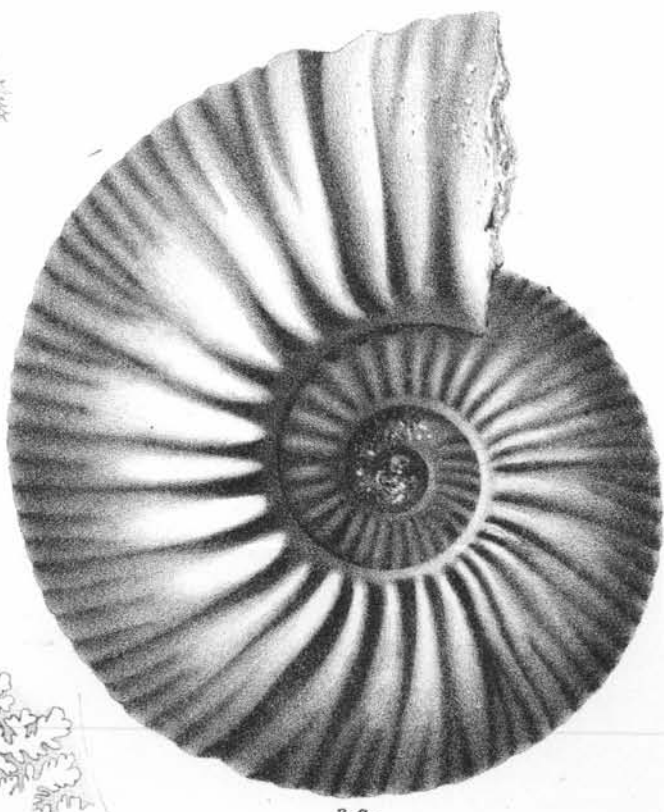
2. c.



2. b.



4. a.



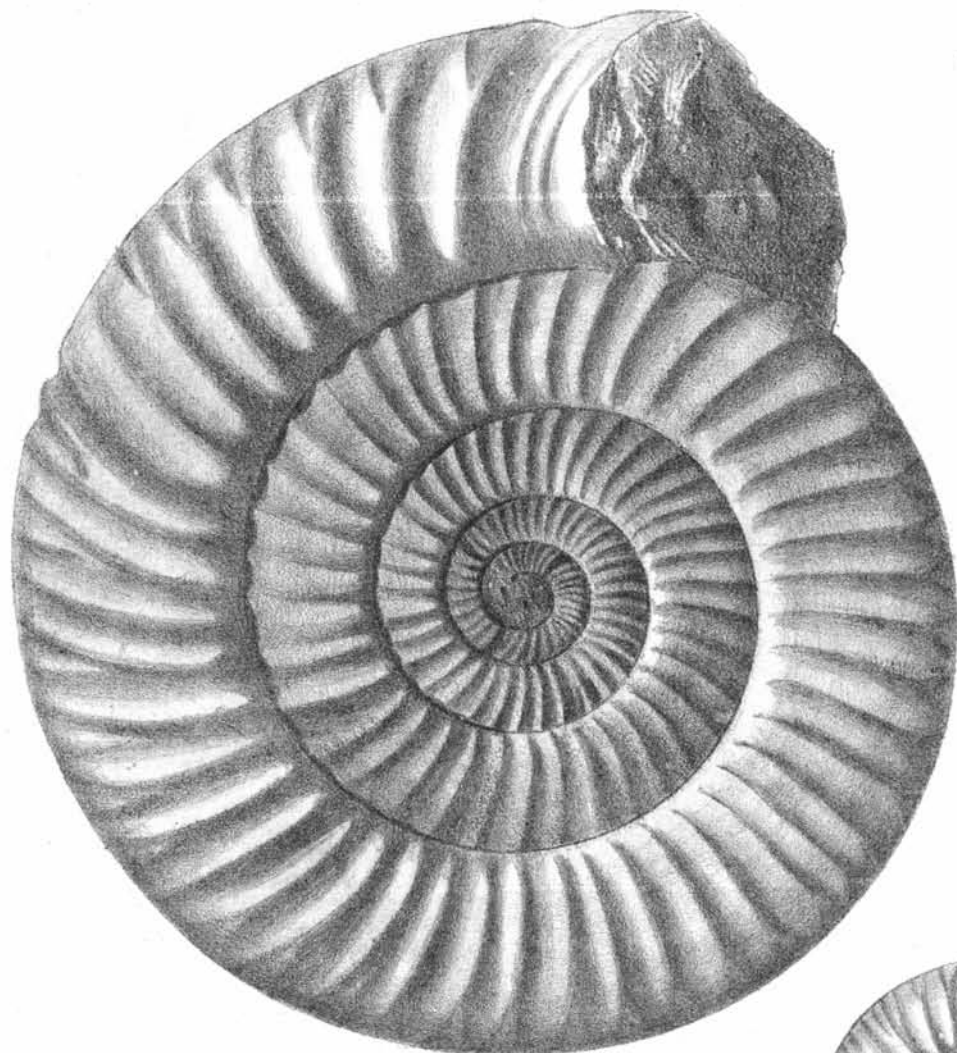
2. a.



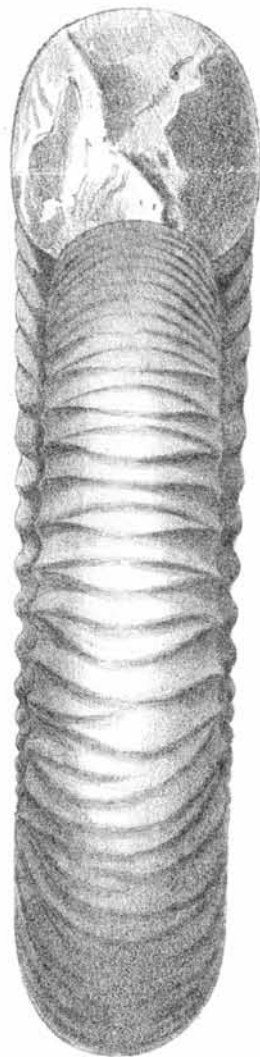
3.

PLATE XLVIII.

- Fig. ... 1. *PERISPHINCTES ROTA*, *Waagen*, n. sp., p. 186; specimen with nearly entire body-chamber from the *Dhosa oolite* of *Vanda*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. *PERISPHINCTES OBLIQUEPLICATUS*, *Waagen*, n. sp., p. 187; specimen with nearly entire body-chamber from the *Dhosa oolite* of *Vanda*; 2*a*, side-view; 2*b*, front-view.
- Fig. ... 3. *PERISPHINCTES INDOGERMANUS*, *Waagen*, n. sp., p. 185; small specimen (cast) from the *Dhosa oolite* of *Vanda*; 3*a*, side-view; 3*b*, front-view.
- Fig. ... 4. *PERISPHINCTES INDOGERMANUS*, *Waagen*, n. sp., p. 185; small specimen without shell from the *Dhosa oolite* of *Keera hill* near *Charee*; 4*a*, side-view; 4*b*, front-view.



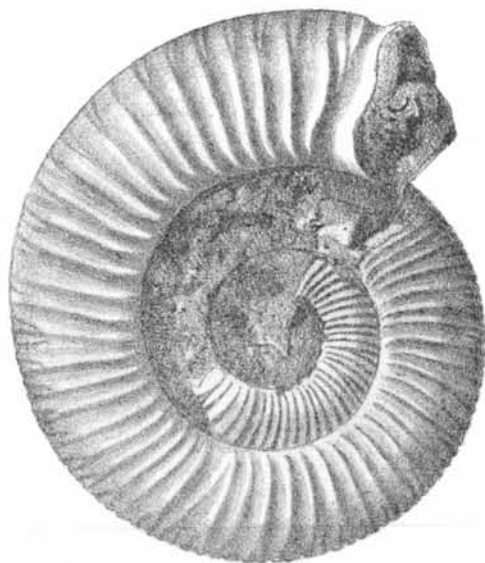
1. a.



1. b.



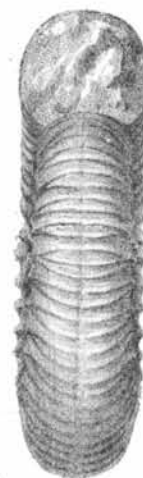
3. a.



2. a.



4. a.



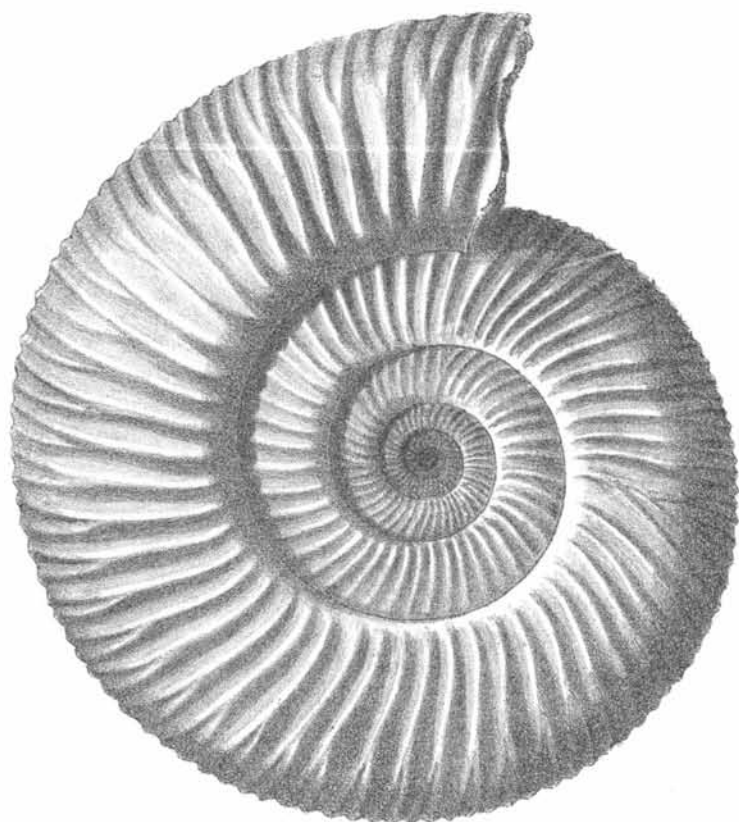
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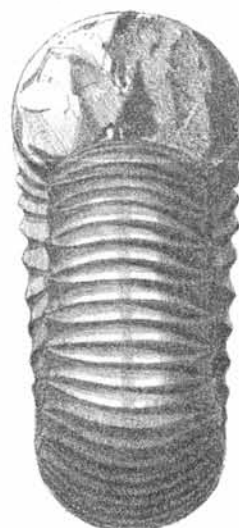
2. b.

PLATE XLIX.

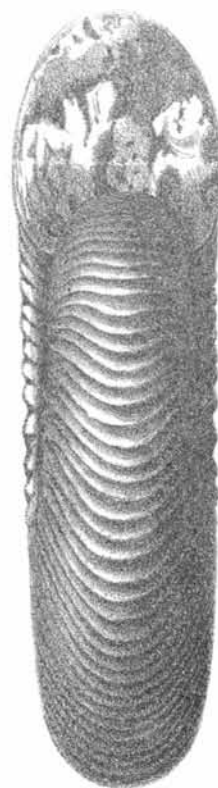
- Fig. ... 1. *PERISPINCTES VIRGULOIDES*, *Waagen*, n. sp., p. 203 ; specimen with partly preserved body-chamber from the *Kuntkote sandstone* of *Gangta Bét* ; 1*a*, side-view ; 1*b*, front-view.
- Fig. ... 2. *PERISPINCTES SPARSIPLICATUS*, *Waagen*, n. sp., p. 204 ; specimen without body-chamber from the lowest beds of the *Katrol group* north of *Gudjinsir* ; 2*a*, side-view ; 2*b*, front-view.
- Fig. ... 3. *PERISPINCTES PRAECURSOR*, *Waagen*, n. sp., p. 178 ; specimen with preserved body-chamber from the *Dhosa oolite* of *Vanda* ; 3*a*, side-view ; 3*b*, front-view.
- Fig. ... 4. *PERISPINCTES PRAECURSOR*, *Waagen*, n. sp., p. 178 ; specimen with preserved body-chamber from the *Dhosa oolite* of *Vanda* ; 4*a*, side-view ; 4*b*, front-view.



1. a.



2. b.



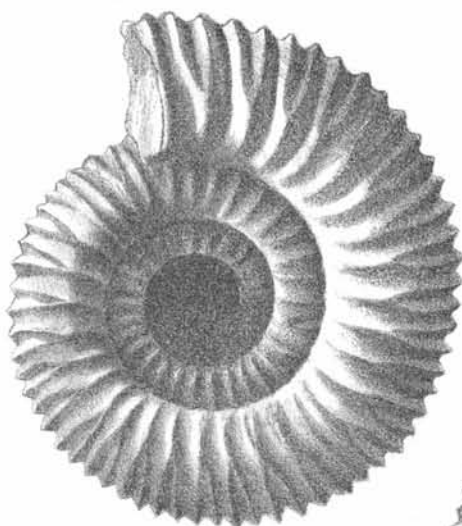
1. b.



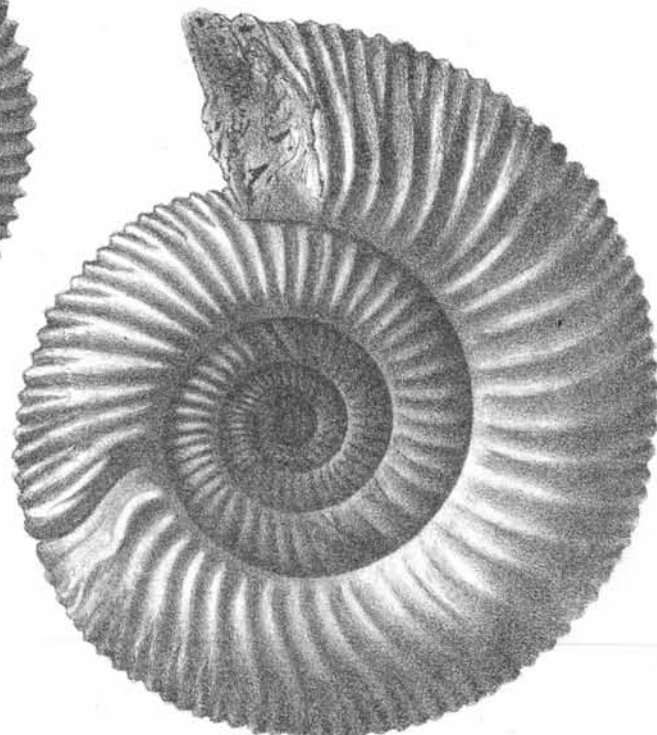
4. a.



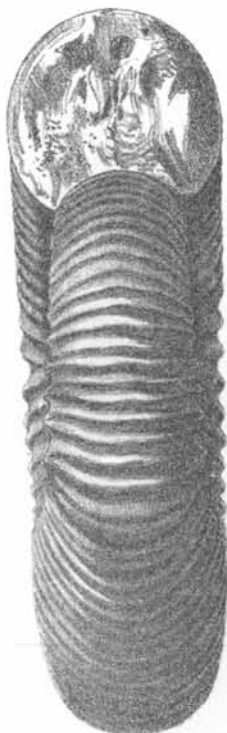
4. b.



2. a.



3. a.



3. b.



5. a.



5. b.

PLATE L.

- Fig. ... 1. PERISPINCTES BATHYPLOCUS, *Waagen*, n. sp., p. 192; small specimen from the *Katrol sandstone* of the *Katrol range*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. PERISPINCTES ALTERNEPLICATUS, *Waagen*, n. sp., p. 199; middle-sized specimen from the *Katrol sandstone* south of *Joorun*; 2*a*, side-view; 2*b*, front-view.
- Fig. ... 3. PERISPINCTES CHLOROOOLITHICUS, *Guembel*, p. 198; small specimen from the *Dhosa oolite* of north-west of *Soorka*; 3*a*, side-view; 3*b*, front-view.
- Fig. ... 4. PERISPINCTES OCCULTEFURCATUS, *Waagen*, n. sp., p. 195; specimen composed of air-chambers from the *Oomia beds* of the *Idler scarp*; 4*a*, side-view; 4*b*, front-view.

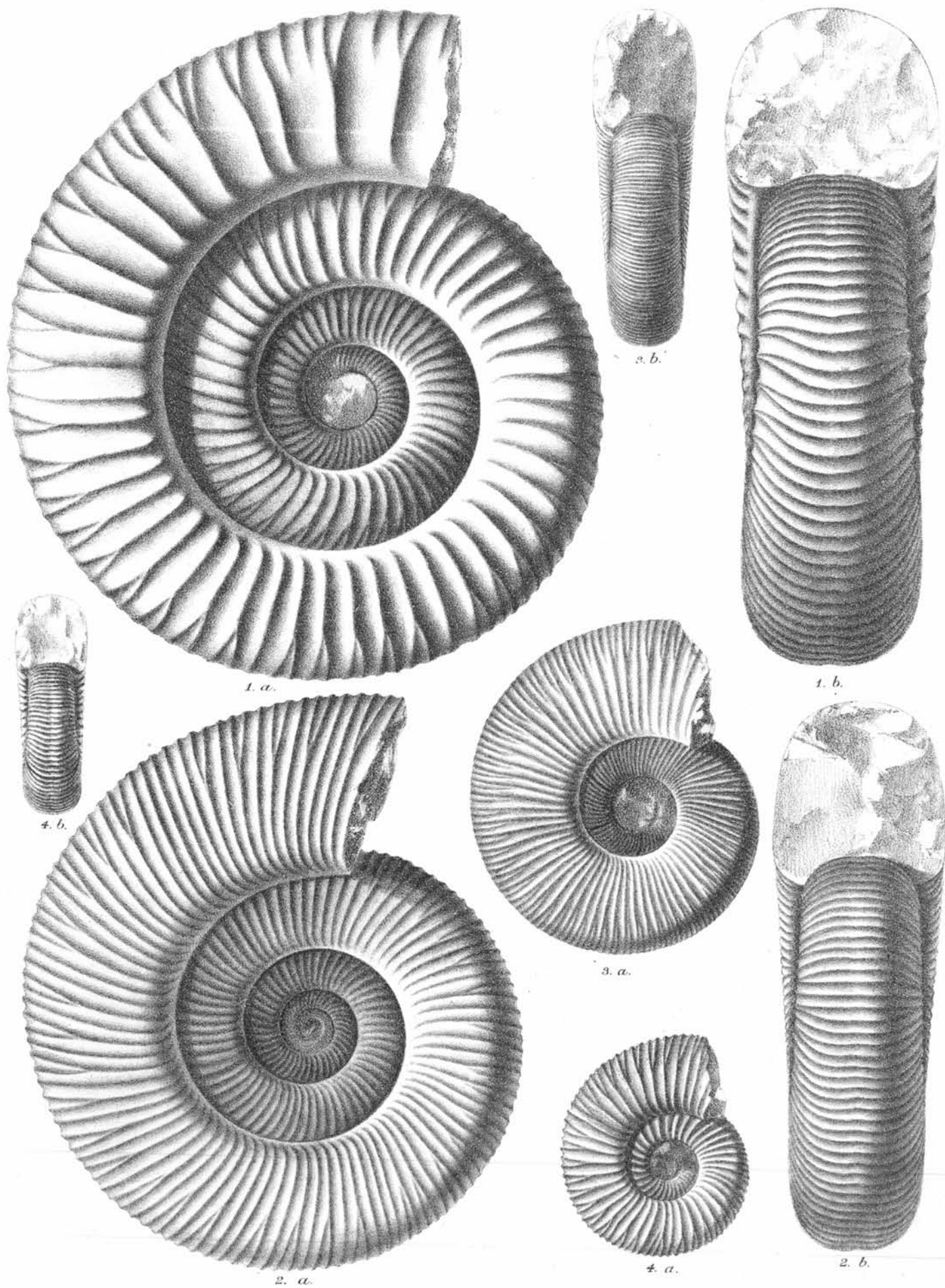
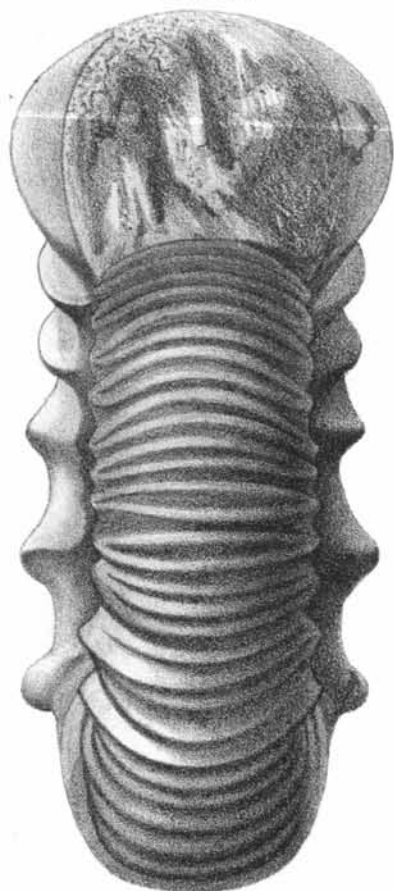
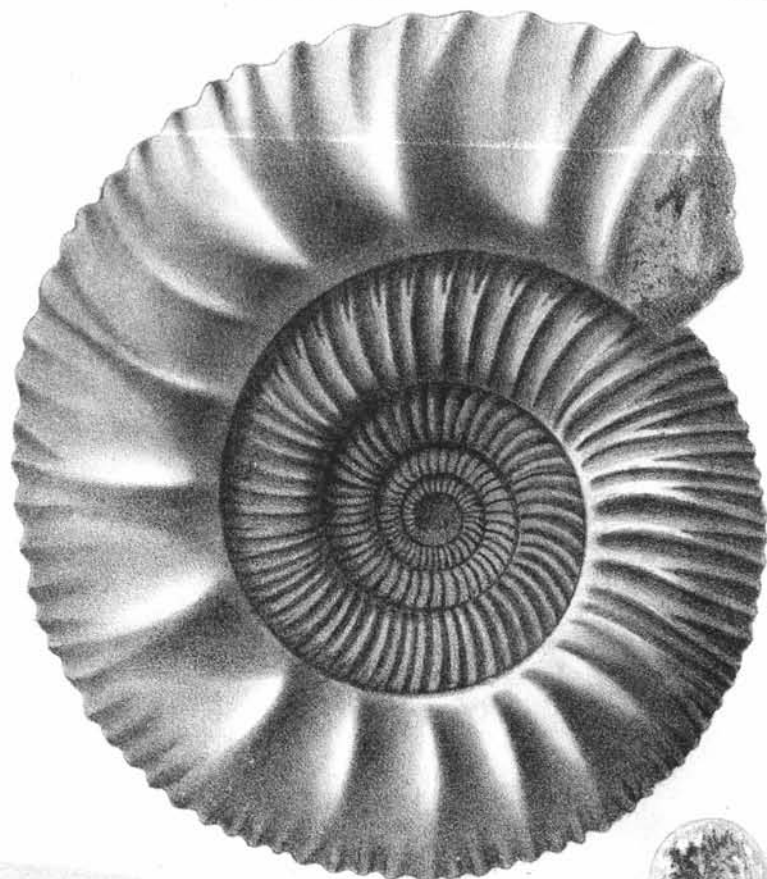


PLATE LI.

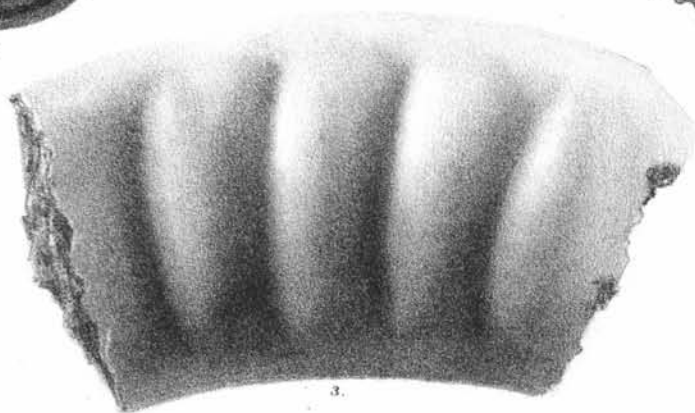
- Fig. 1. **PERISPHINCTES POTTINGERI**, *Sowerby*, p. 183; specimen with nearly entire body-chamber from the *Katrol sandstone* of the *Katrol range*; 1*a*, side-view; 1*b*, front-view.
- Fig. 2. **PERISPHINCTES PLICATILIS**, *Sowerby*, p. 189; small specimen from the *Kunthkote sandstone* of *Kunthkote*; 2*a*, side-view; 2*b*, front-view.
- Fig. 3. **PERISPHINCTES PLICATILIS**, *Sowerby*, p. 189; part of the outer whorl of a full grown specimen from the same bed and locality as the preceding; side-view.
- Fig. ... 4. **PERISPHINCTES JOORAENSIS**, *Waagen*, n. sp., p. 211; specimen with part of the body-chamber probably from the beds with *Per. anceps* of the *Joora hills*; 4*a*, side-view; 4*b*, front-view.



1. b.



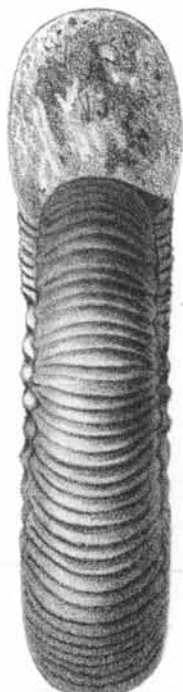
1. a.



3.



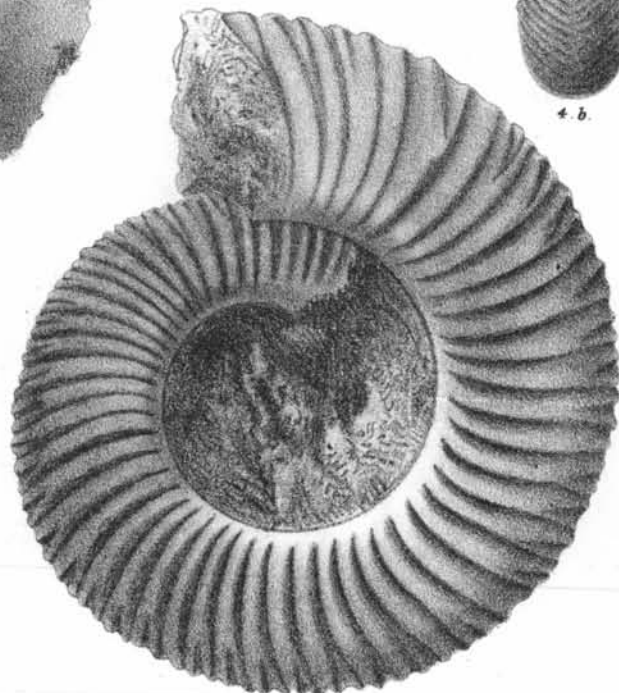
4. b.



2. b.



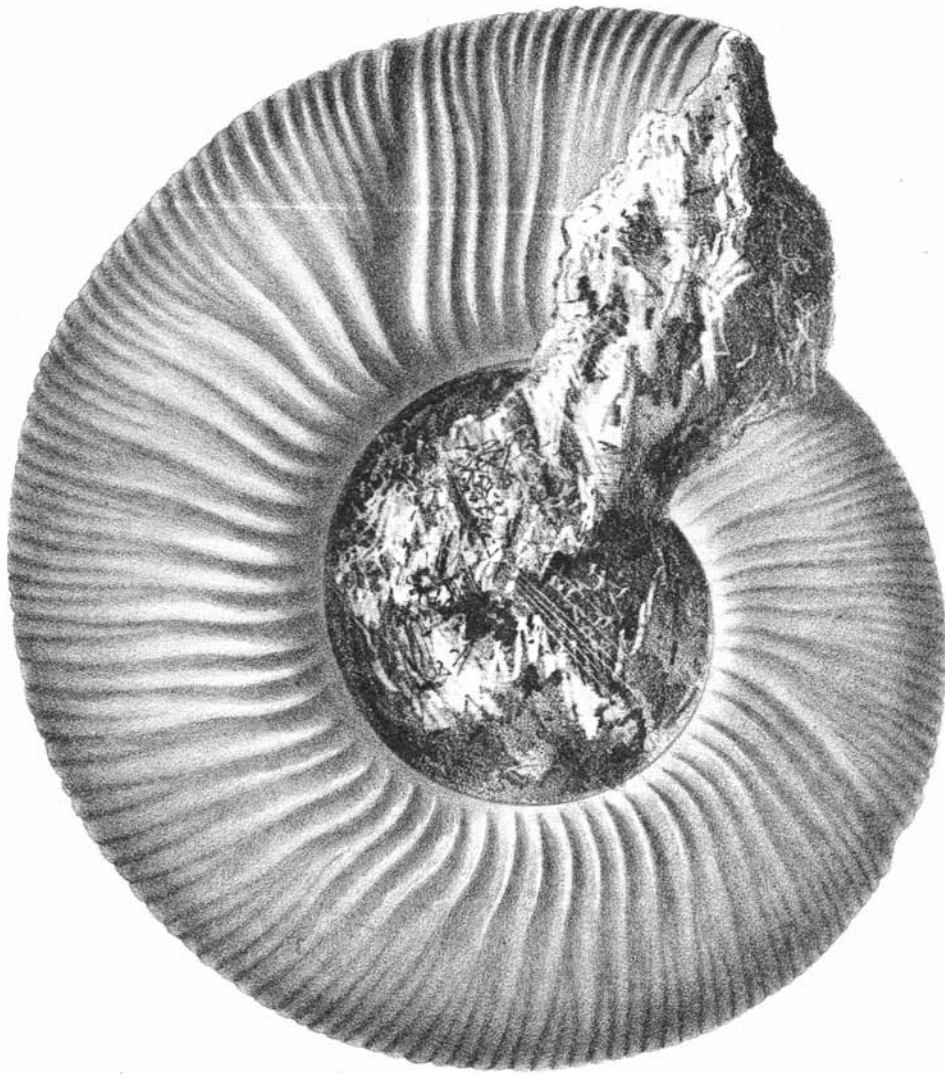
4. a.



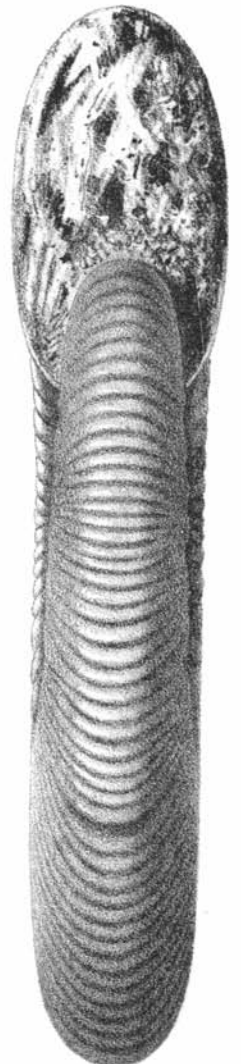
2. a.

PLATE LII.

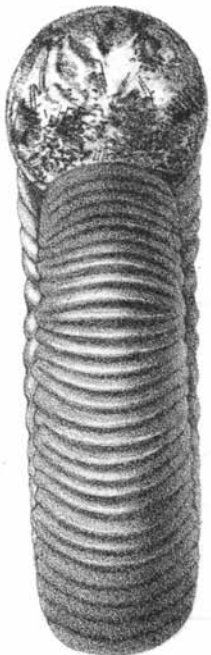
- Fig. 1. **PERISPHINCTES LEIOCYMON**, *Waagen*, n. sp., p. 205 ; specimen with partly preserved body-chamber from the *Kuntkote sandstone* of *Kuntkote* ; 1, side-view ; 1a, front-view.
- Fig. ... 2. **PERISPHINCTES EUPLOCUS**, *Waagen*, n. sp., p. 182 ; specimen with nearly entire body-chamber from the *Katrol sandstone* of the *Katrol range* ; 2, side-view ; 2a, front-view.
- Fig. 3. **PERISPHINCTES PLICATILIS**, *Sowerby*, p. 189 ; part of the outer whorl of the full-grown specimen figured on Pl. LI ; back-view.



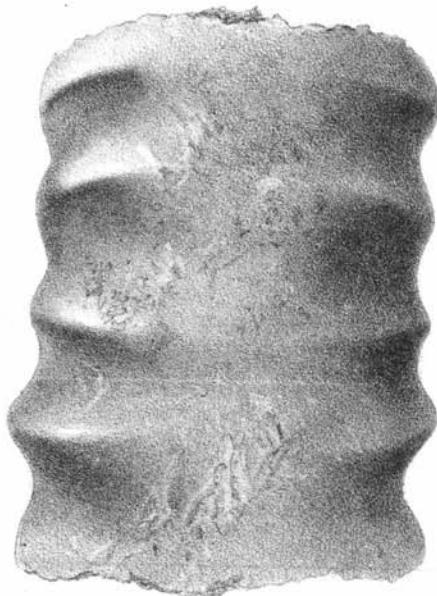
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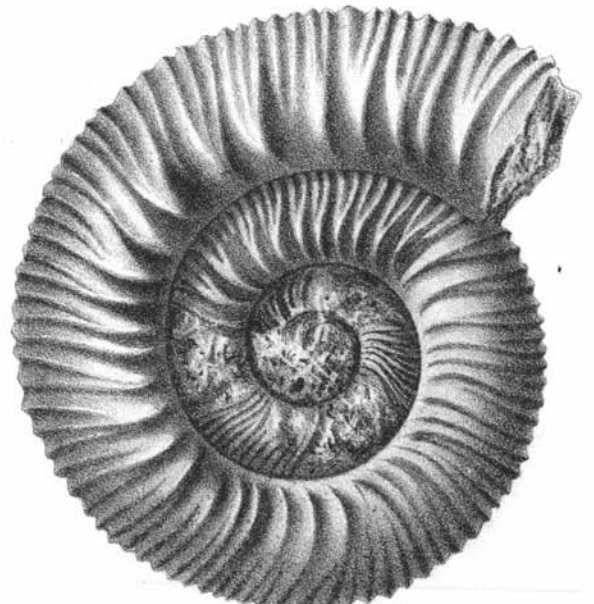
1. a.



2. a.



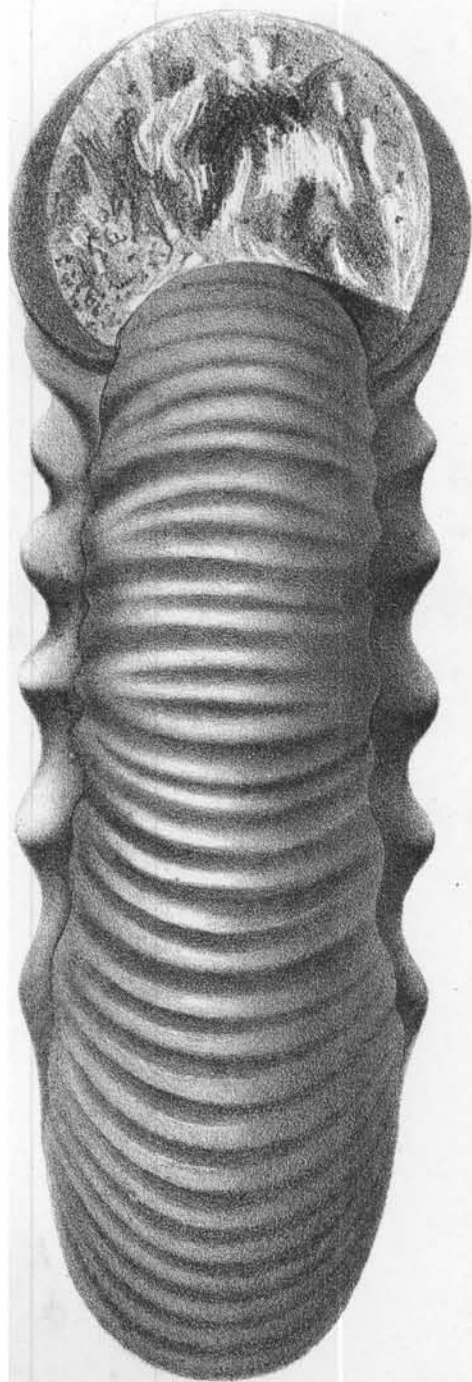
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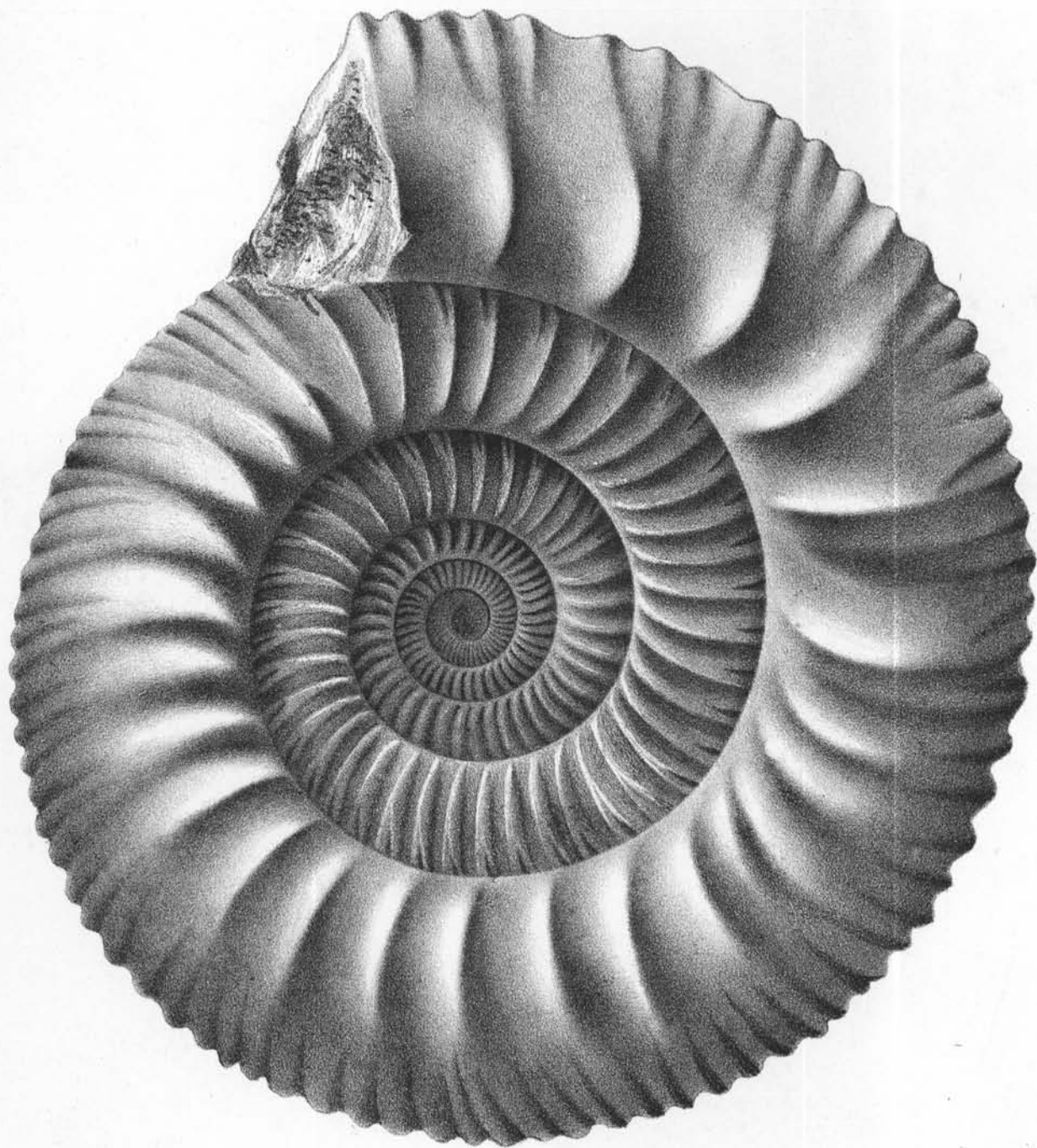
2.

PLATE LIII.

Fig. ... 1. PERISPINCTES KATROLensis, *Waagen*, n. sp., p. 184; specimen with partly preserved body-chamber from the *Katrol group* of the *Katrol range*; 1, side-view; 1a, front-view.



1. a.



1.

PLATE LIV.

Fig. ... 1. **PERISPHINCTES TORQUATUS**, *Sowerby*, p. 191 ; specimen composed of air-chambers from the *Katrol group* of the *Katrol range* ; 1, side-view ; 1*a*, front-view.

•

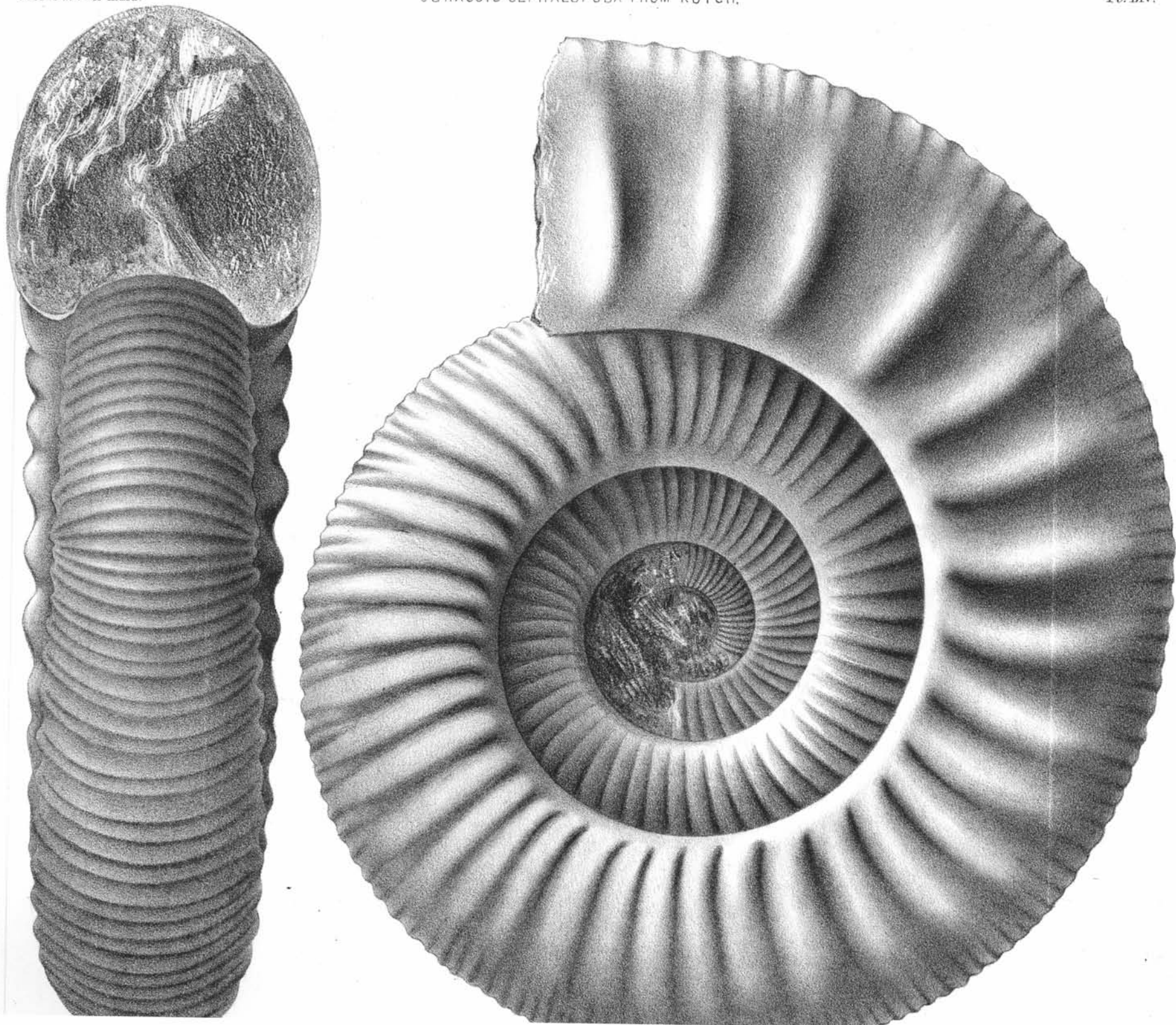
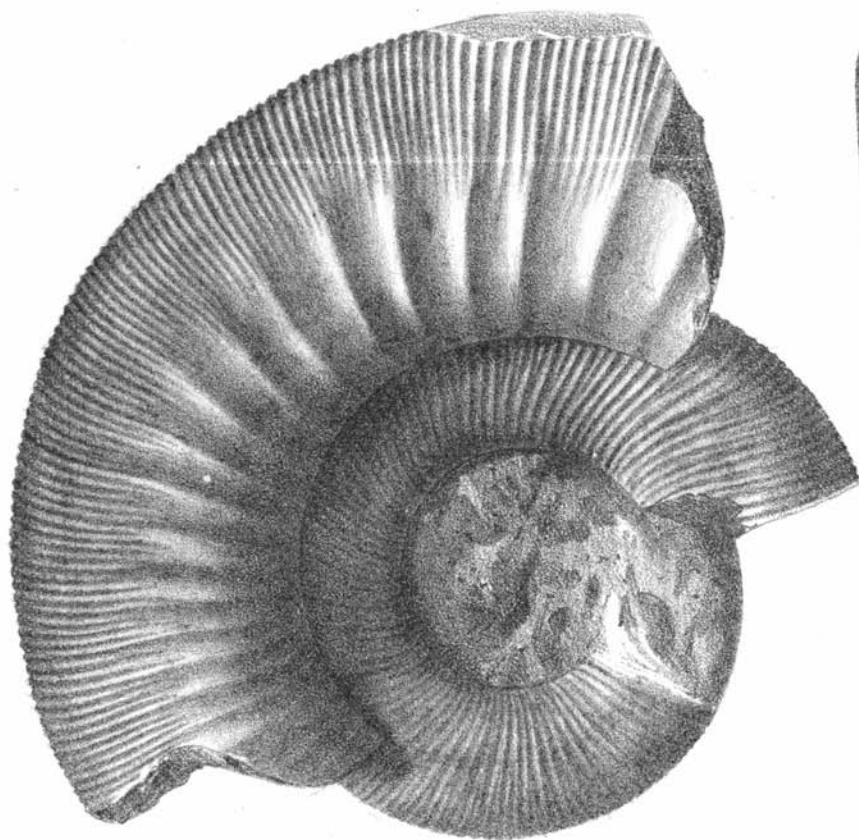
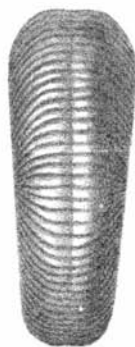


PLATE LV.

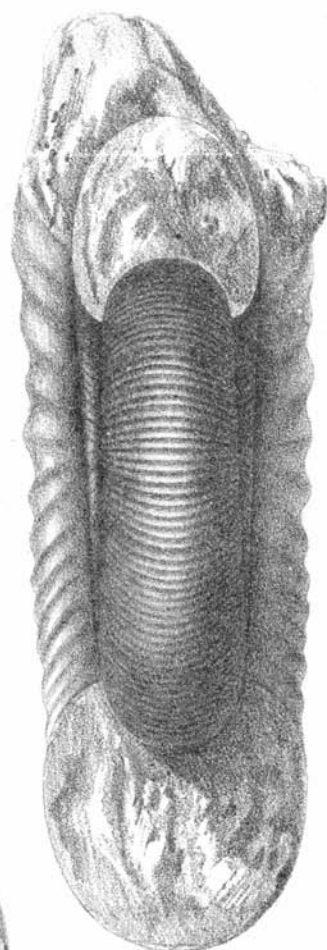
- Fig. ... 1. **PERISPHINCTES DENSEPLICATUS**, *Waagen*, n. sp., p. 201; fragmentary specimen with the beginning of the body-chamber preserved from the *Oomia group* north of *Moondan*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. **PERISPHINCTES DENSEPLICATUS**, *Waagen*, n. sp., p. 201; lobes of a specimen from the same bed and locality as the preceding.
- Fig. ... 3. **PERISPHINCTES MARTELLI**, *Oppel*, p. 190; small specimen from the *Kuntkote sandstone* of *Gangta Bét*; 3*a*, side-view; 3*b*, front-view.
- Fig. ... 4. **PERISPHINCTES BLEICHERI**, *P. de Loriol*, p. 194; specimen with temporary body-chamber from the *Oomia group* of *Goorpoor*; 4*a*, side-view; 4*b*, front-view.
- Fig. ... 5. **PERISPHINCTES EUDICHOTOMUS**, *Zittel*, p. 197; small specimen with preserved shell from the *Oomia group* of *Moondan*; 5*a*, side-view; 5*b*, front-view; 5*c*, back-view.



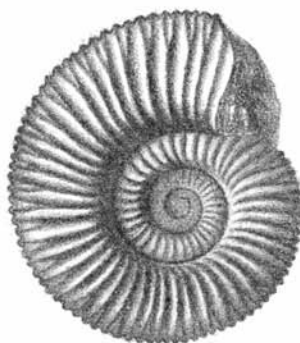
1. a.



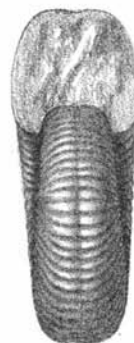
5. c.



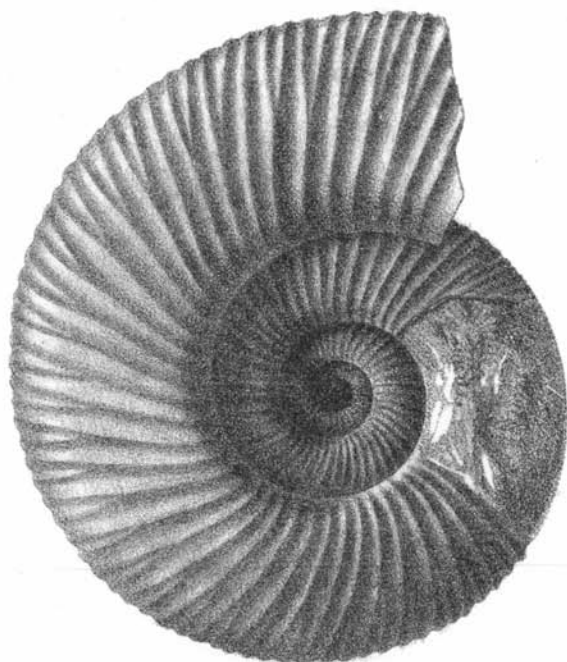
1. b.



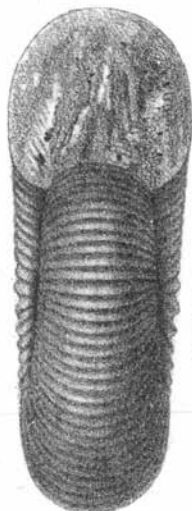
5. a.



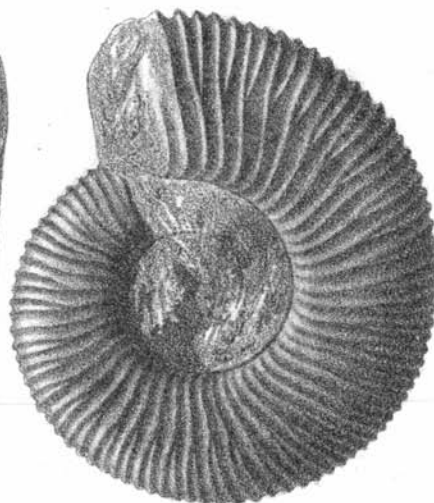
5. b.



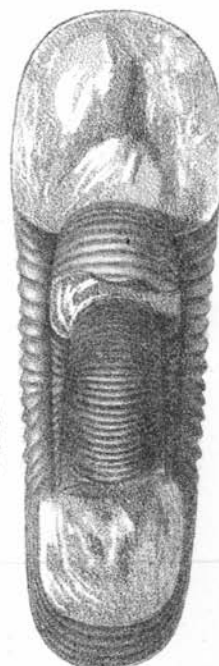
3. a.



4. b.



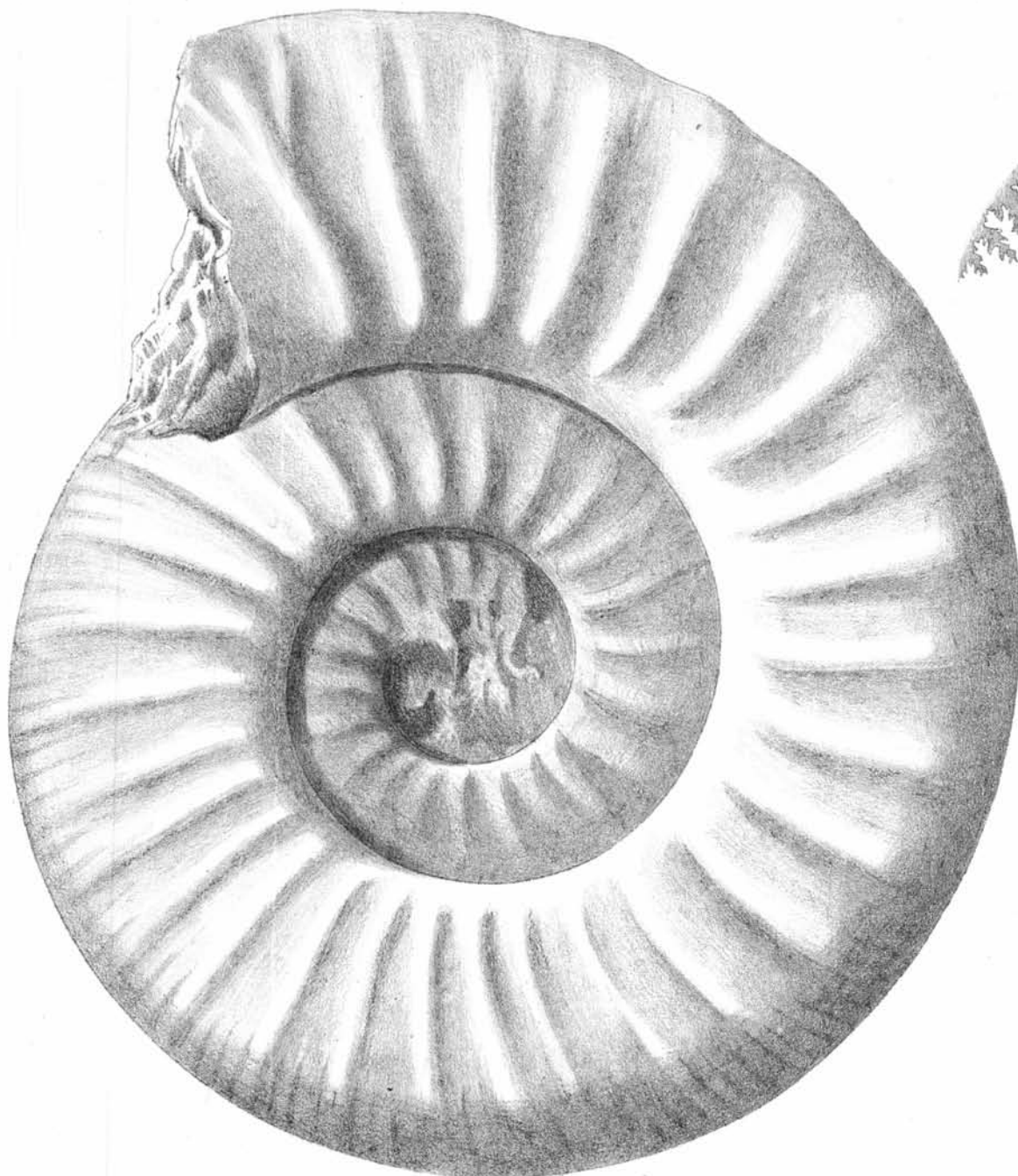
4. a.



3. b.

PLATE LVI.

- Fig. ... 1. PERISPINCTES CALVUS, *Sowerby*, p. 166; figure of a cast of *Sowerby's* original specimen in the collection of the *Geological Society of London*, very likely from the *Dhosa oolite* on the road from *Bhoj* to *Rahpoor*; 1*a*, side-view; 1*b*, front-view.
- Fig. ... 2. PERISPINCTES CONGENER, *Waagen*, n. sp., p. 171; lobes of the specimen figured on Pl. LVII.
- Fig. ... 3. ANCYLOCERAS CALLOVIENSE, *Morris*, p. 212; small specimen with preserved shell from the *Anceps-beds* of *Nurrha*; 3*a*, side-view; 3*b*, back-view.



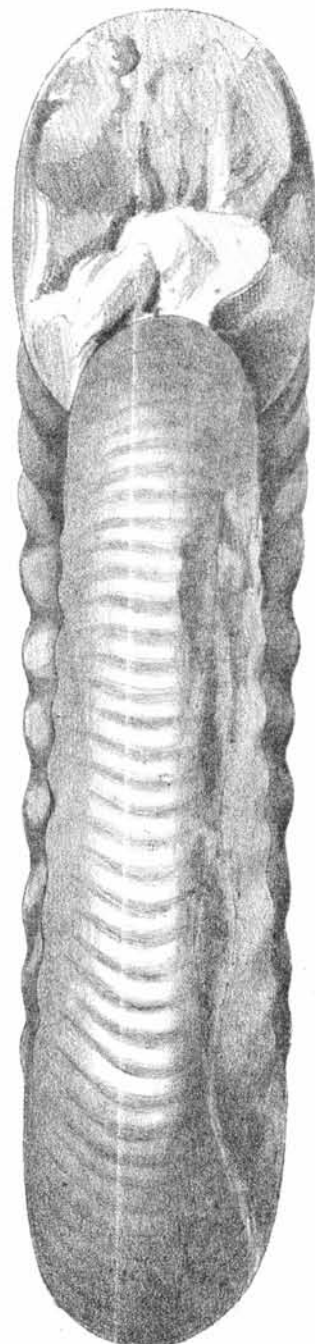
1. a.



2.



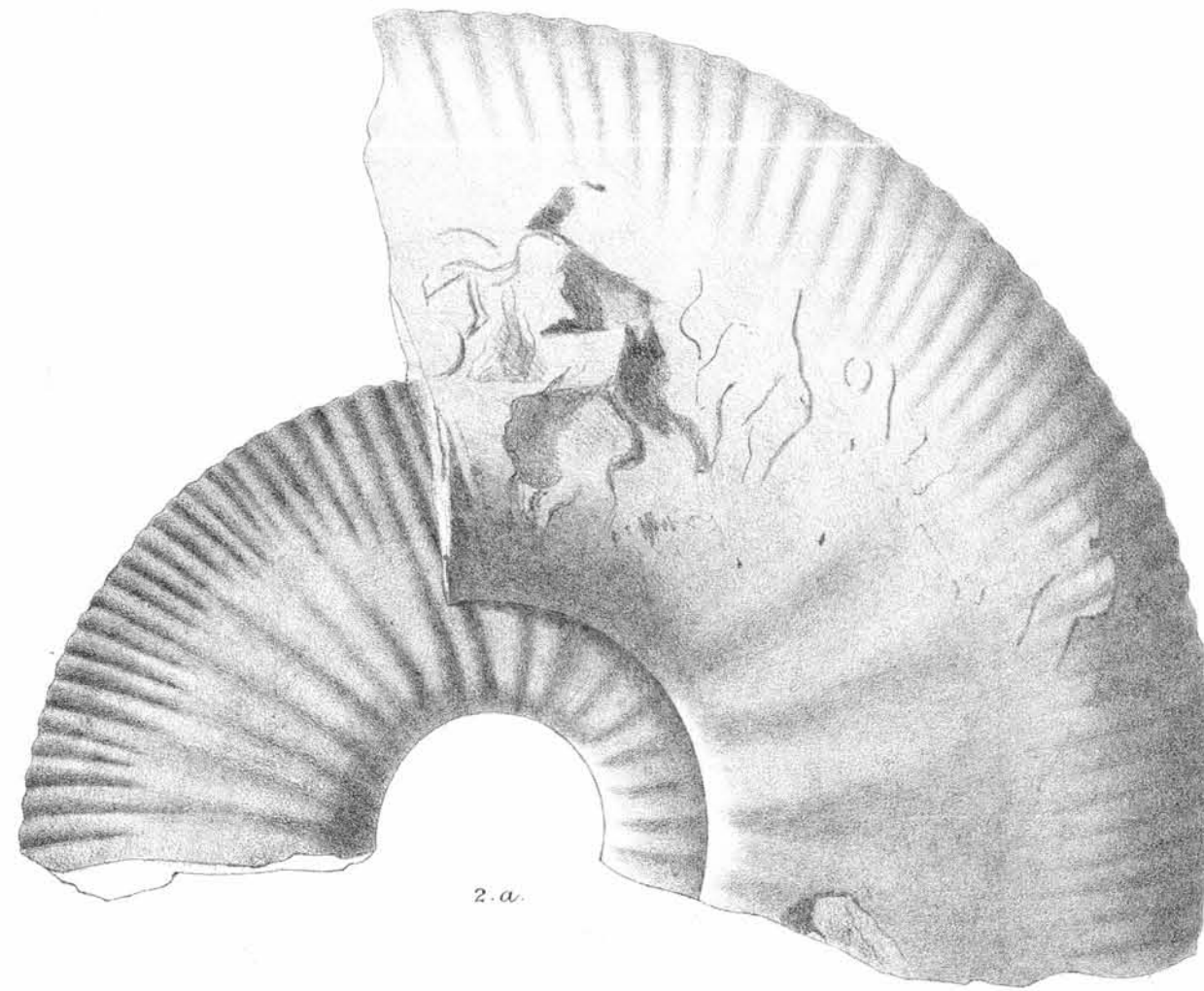
3.



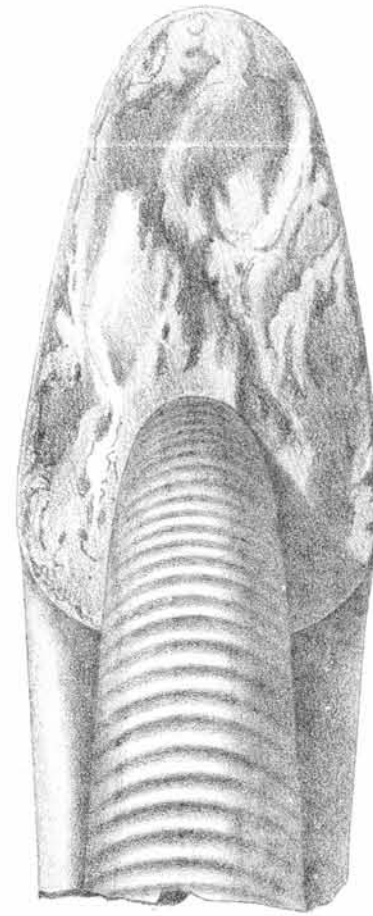
1. b.

PLATE LVII.

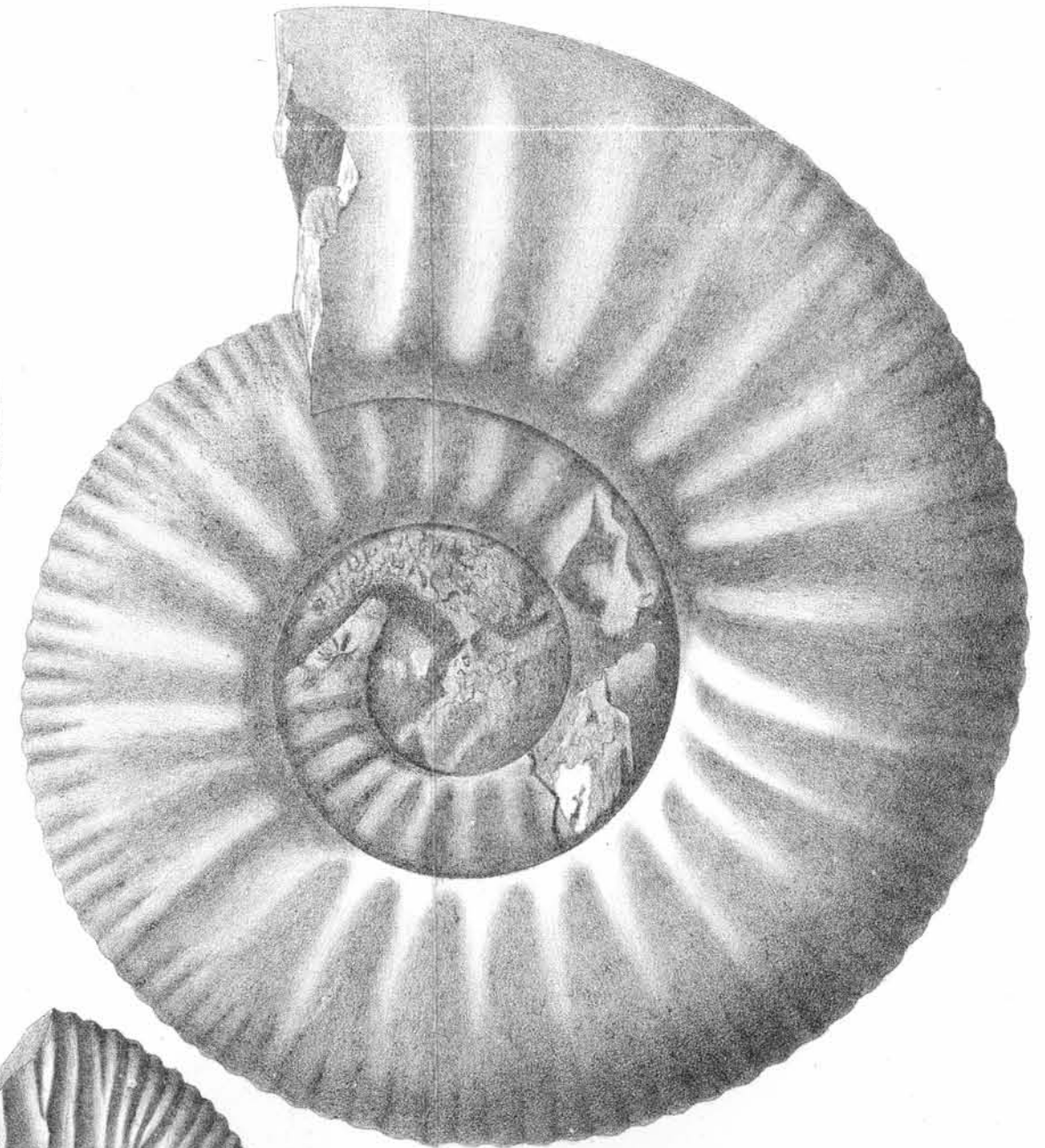
- Fig. ... 1. *PERISPHINCTES CONGENER*, *Waagen*, n. sp., p. 171; specimen composed of air-chambers from the uppermost beds of the *Putchum group* of north-west of *Jumara*; 1*a*, side-view; 1*b*, section of the last whorl.
- Fig. ... 2. *PERISPHINCTES HIAN*s, *Waagen*, n. sp., p. 153; fragmentary specimen composed of air-chambers from the highest beds of the *Putchum group* of north-west of *Jumara*, 2*a*, side-view; 2*b*, front-view; 2*c*, lobes.
- Fig. ... 3. *PERISPHINCTES DECORUS*, *Waagen*, n. sp., p. 208; fragmentary specimen composed of air-chambers from the highest beds of the *Putchum group* of *Jumara*; 3*a*, side-view; 3*b*, front-view; 3*c*, back-view; 3*d*, lobes.
- Fig. ... 4. *PERISPHINCTES ANCEPS*, *Reinecke*, p. 207; fragmentary specimen with partly preserved body-chamber from the beds between the *golden oolite* and the shales with *Pelt. athleta* of *Keera hill* near *Charee*; 4*a*, side-view; 4*b*, back-view.



2.a.



2.b.



1.a.



3.b.



3.a.



3.c.



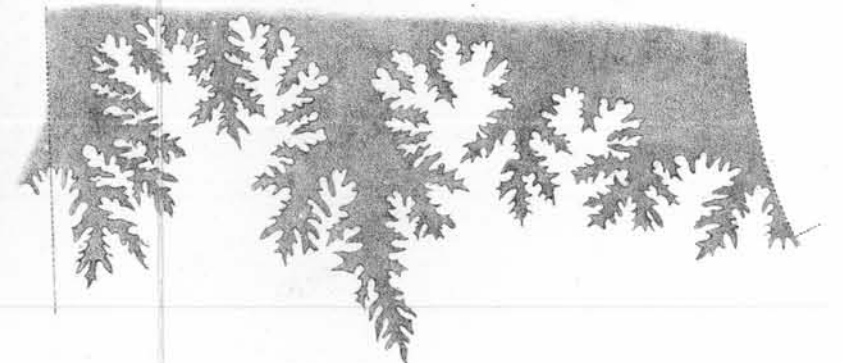
1.b.



4.b.



4.a.



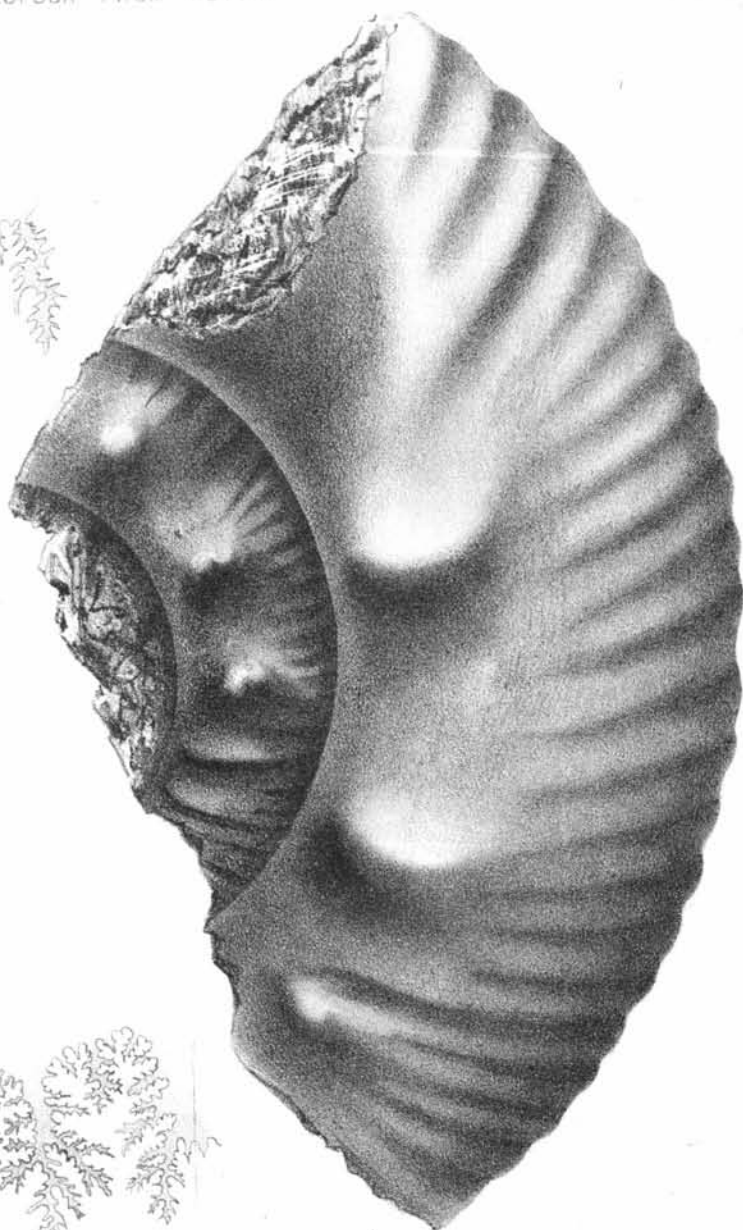
2.c.

PLATE LVIII.

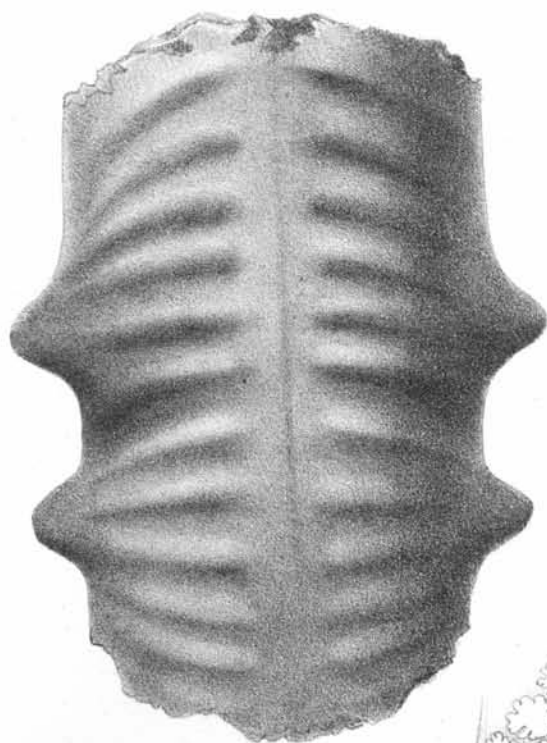
- Fig. ... 1. PERISPHINCTES REHMANNI, *Oppel*, p. 206 ; fragment of a specimen composed of air-chambers from the *golden oolite* of *Keera hill* near *Charee* ; 1, side-view ; 1*a*, back-view ; 1*b*, lobes.
- Fig. ... 2. PERISPHINCTES ARCICOSTA, *Waagen*, n. sp., p. 167 ; specimen with entirely preserved body-chamber from the *golden oolite* of *Keera hill* near *Charee* ; 2, side-view ; 2*a*, front-view.
- Fig. ... 3. PERISPHINCTES LATERALIS, *Waagen*, n. sp., p. 165 ; specimen with part of the body-chamber from the beds with *Per. anceps* of *Keera hill* near *Charee* ; 3, side-view ; 3*a*, front-view.
- Fig. ... 4. PERISPHINCTES ARTHRITICUS, *Sowerby*, p. 210 ; lobes of the specimen figured on Pl. LIX.



1. b.



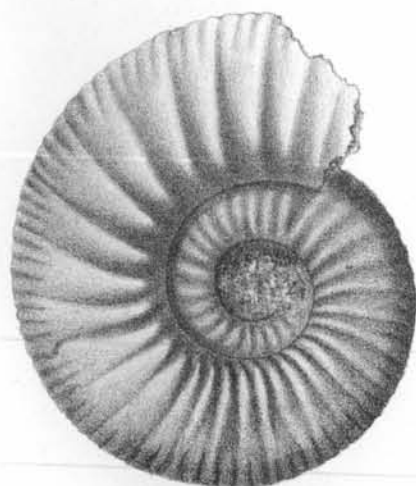
1.



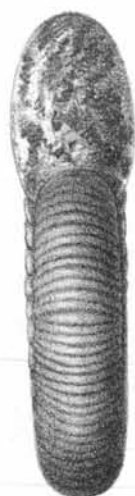
1. a.



4.



3.



3. a.



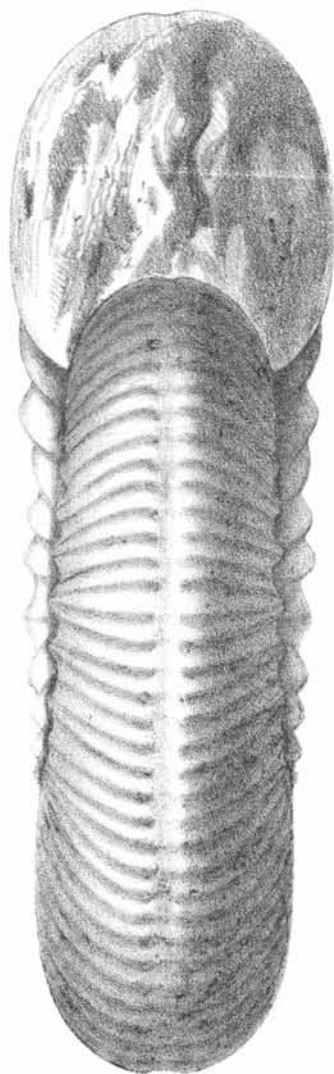
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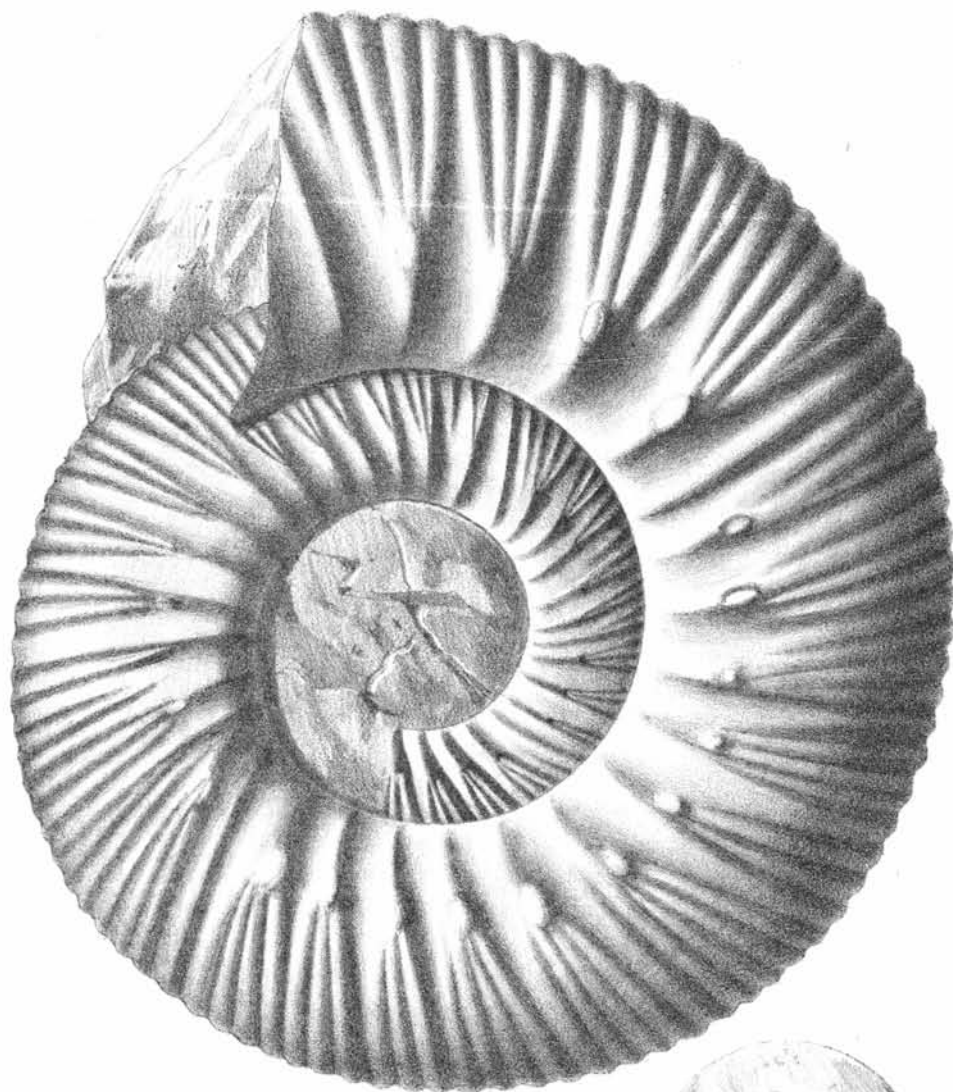
2.

PLATE LIX.

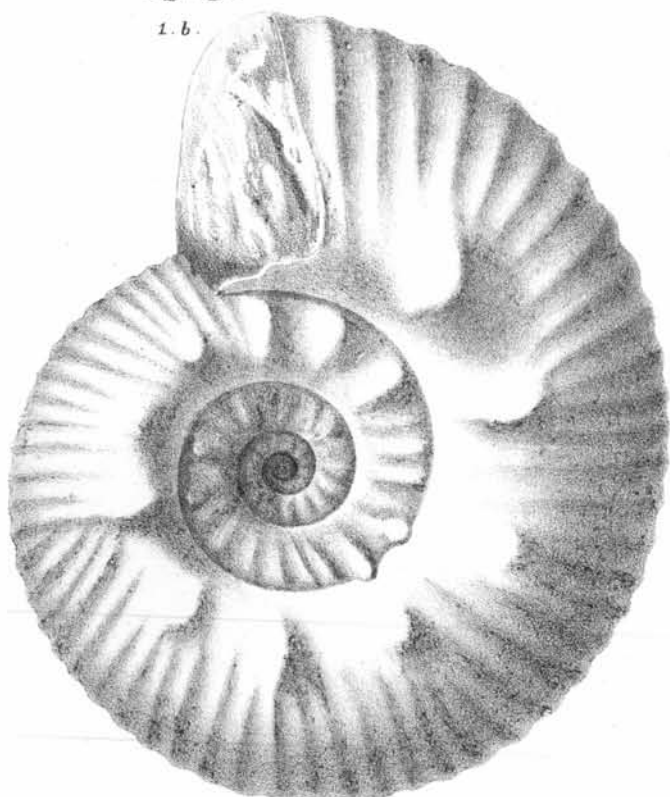
- Fig. 1. PERISPINCTES ANCEPS, *Reinecke*, p. 207; specimen with partly preserved body-chamber from the *beds between the Macrocephalus and the Athleta beds of the Joora hills*; 1*a*, side-view; 1*b*, front-view.
- Fig. 2. PERISPINCTES ARTHRITICUS, *Sowerby*, p. 210; specimen composed nearly entirely of air-chambers from the beds with *Per. anceps* of *Keera hill near Charee*; 2*a*, side-view; 2*b*, front-view; 2*c*, section and front-view of the inner whorls of the same specimen.



1. b.



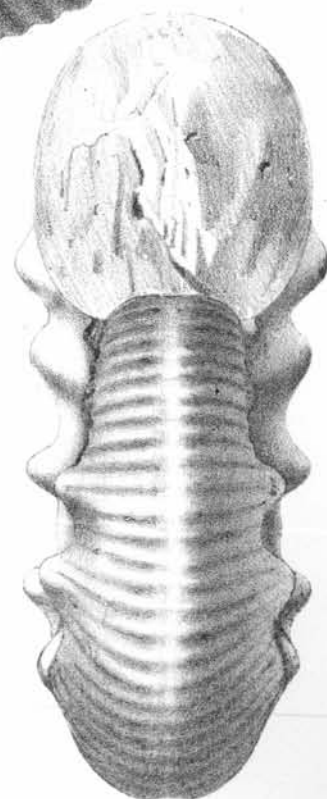
1 a



2 a



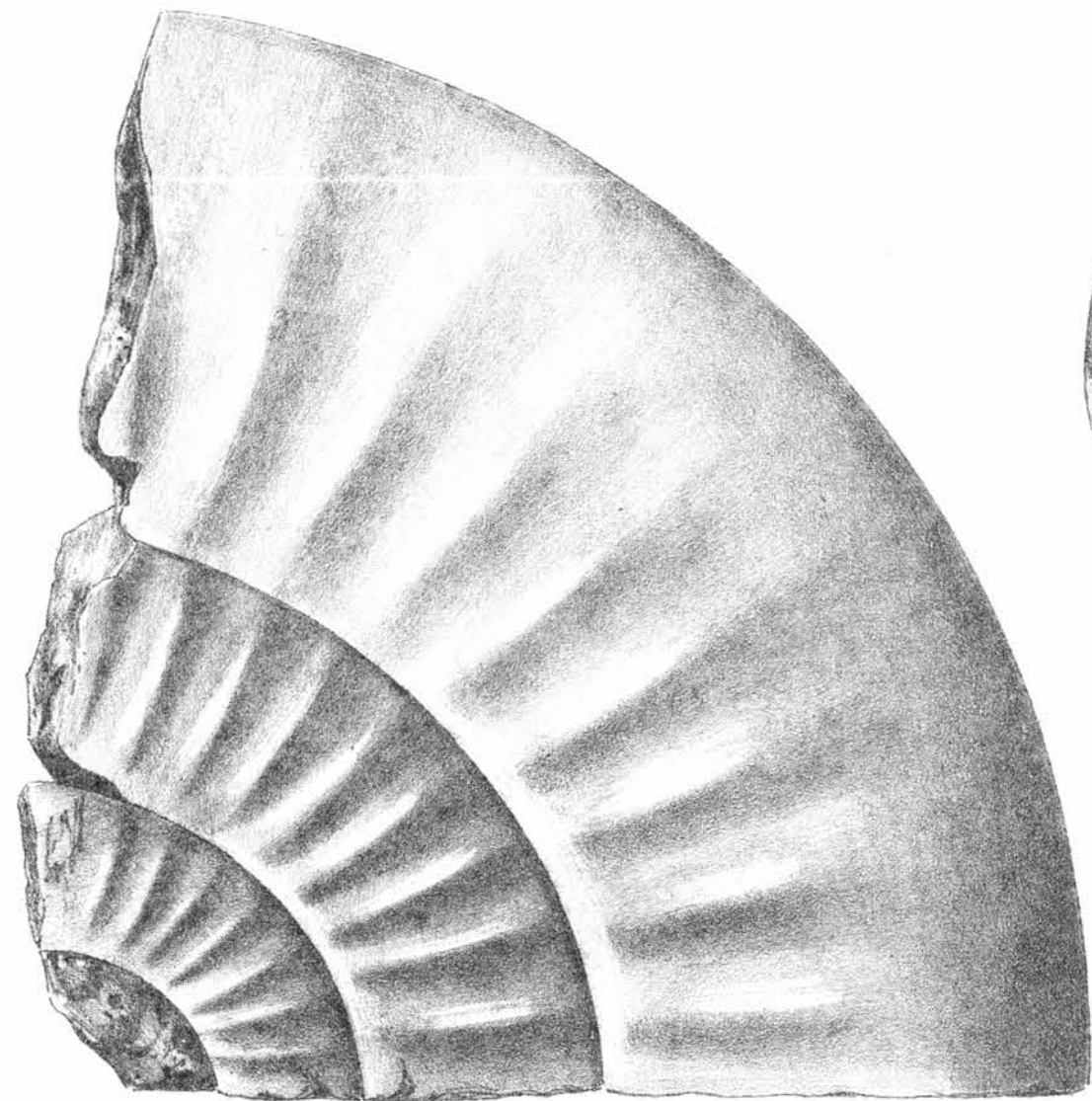
2 c



2. b

PLATE LX.

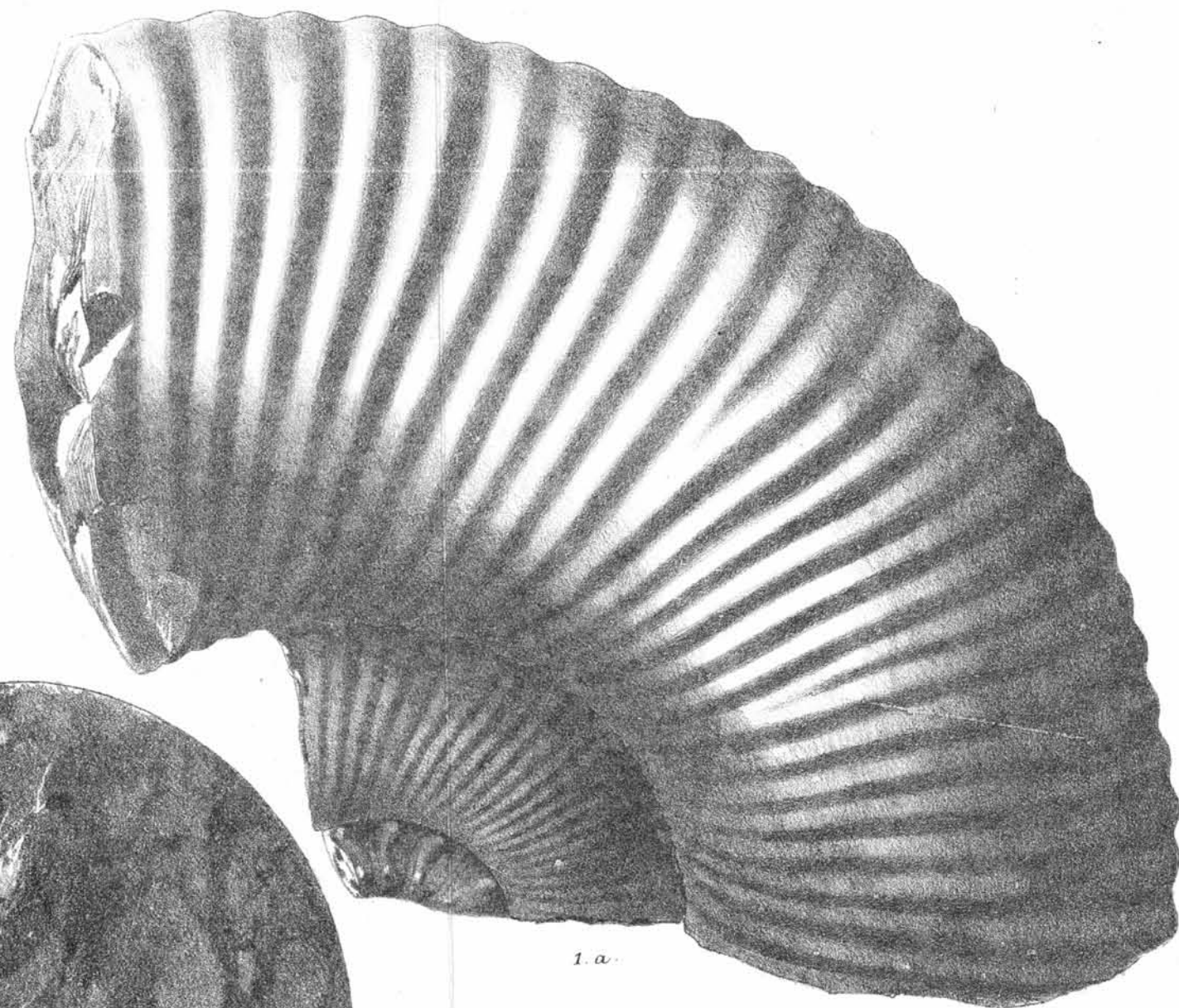
- Fig. ... 1. *CRIOCERAS LATERALE*, *Moore* ; 1*a*, specimen with portions of three whorls *in situ* ; 1*b*, section of same, natural size ; 1*c*, portion of outer whorl of a much larger specimen reduced to half measurements. All from *Ukra Hill*.
- Fig. ... 2. *AMMONITES DESHAYESI*, *Leymerie* ; 2*a*, side-view, and 2*b*, back-view of same specimen ; natural size. From *Ukra Hill*.
- Fig. ... 3. *AMMONITES MARTINI*, *Orbigny* ; 3*a*, side-view of specimen showing portions of four whorls *in situ*, natural size ; 3*b*, section of the same. From *Ukra Hill*.



3. a.



3. b.



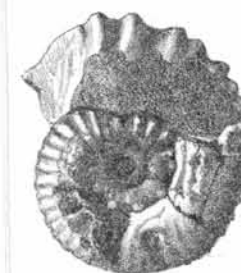
1. a.



1. c.



1. b.



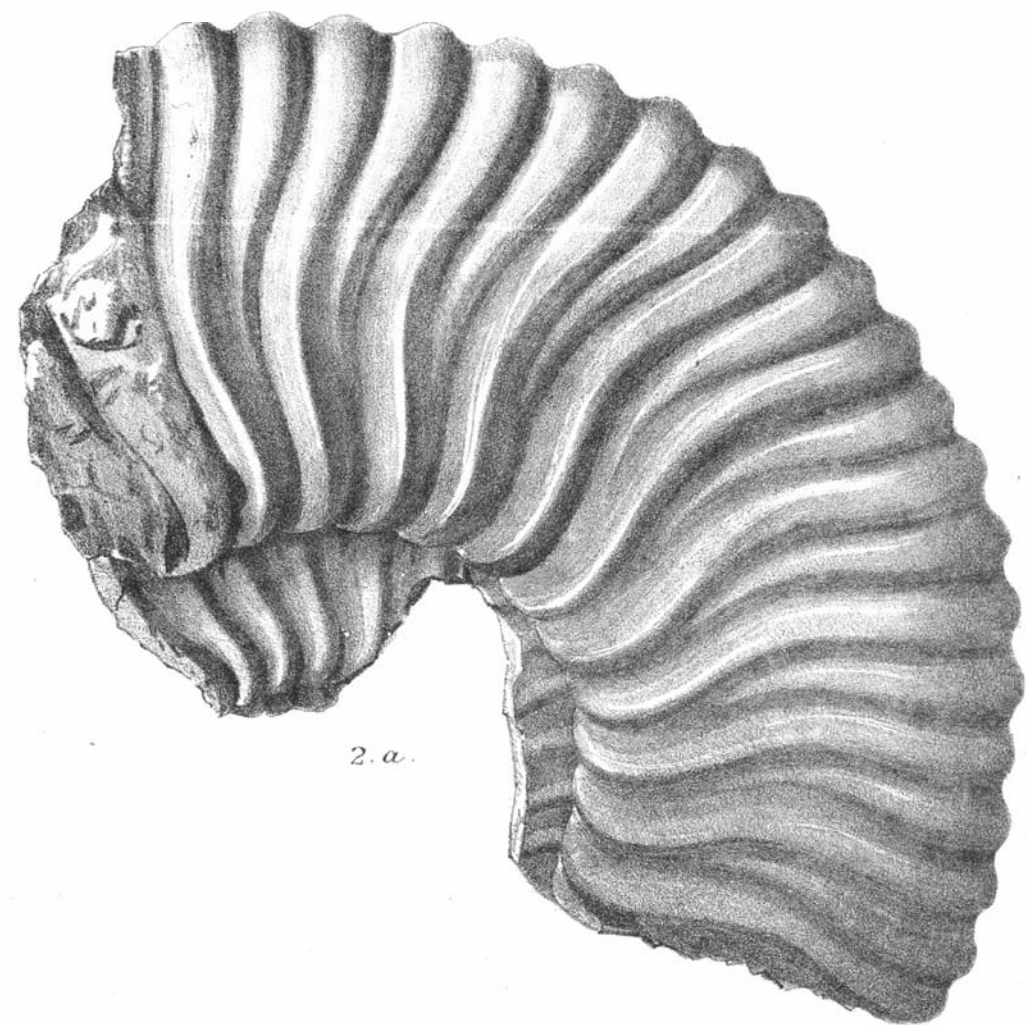
2. a.



2. b.

PLATE LX.

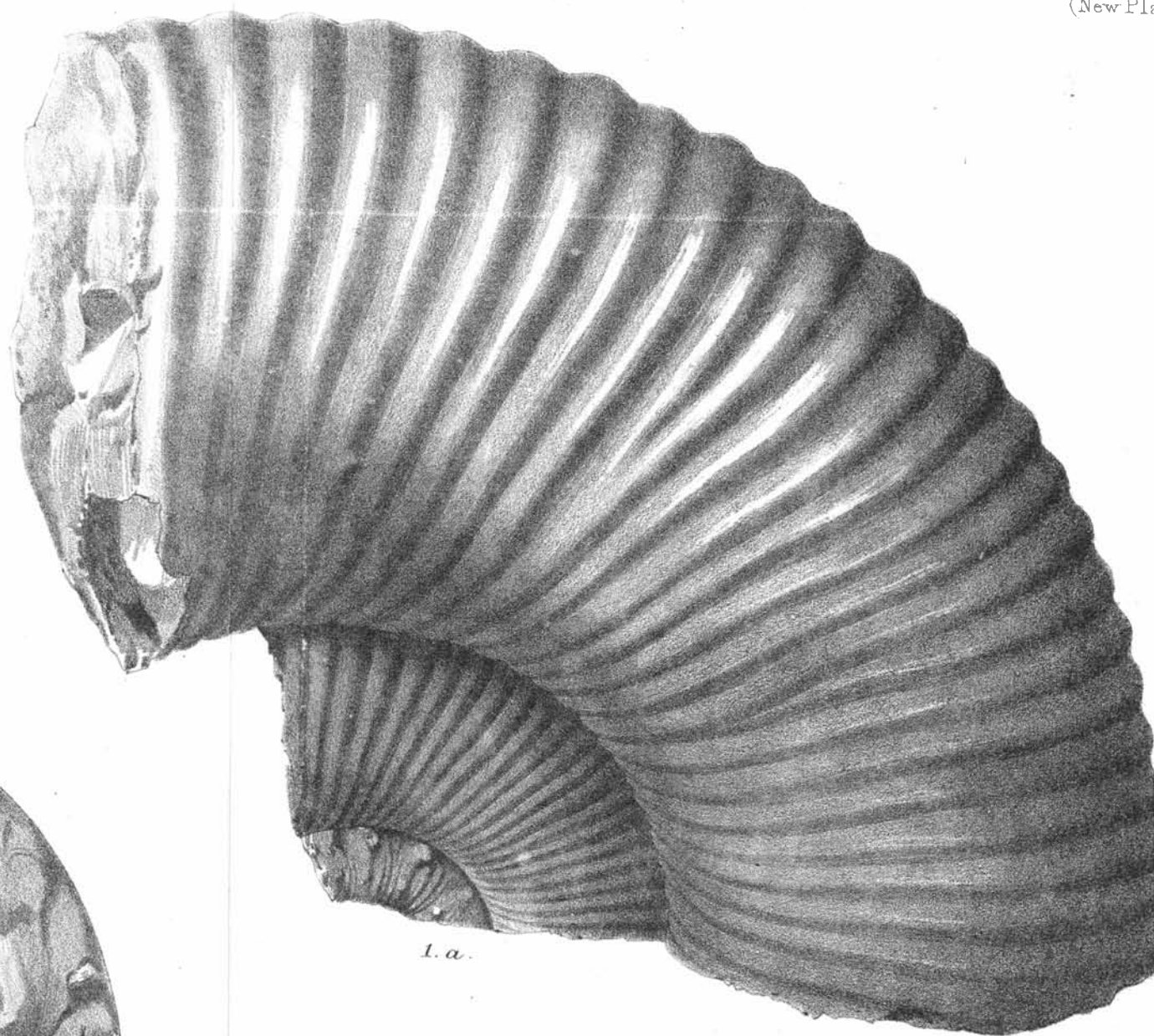
- Fig. 1. CRIOCERAS AUSTRALE, *Moore* ; 1*a*, specimen with portions of three whorls *in situ* ; 1*b*, section of same, natural size ; 1*c*, portion of outer whorl of a much larger specimen reduced to half measurements. All from *Ukra Hill*.
- Fig. ... 2. AMMONITES DESHAYESI, *Leymerie* ; 2*a*, side-view, and 2*b*, section of same specimen ; natural size. From *Ukra Hill*.
- Fig. ... 3. AMMONITES MARTINI, *Orbigny* ; 3*a*, side-view, natural size ; 3*b*, front-view of the same. From *Ukra Hill*.



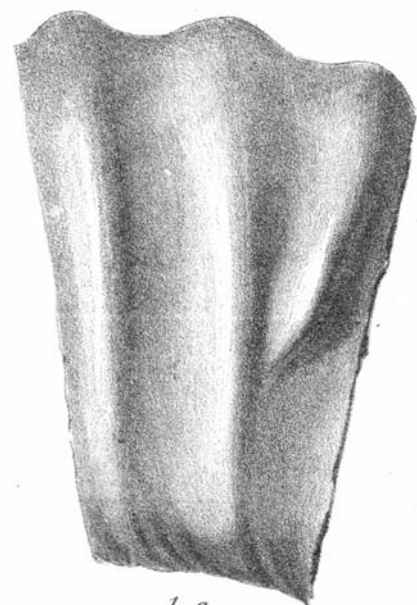
2. a.



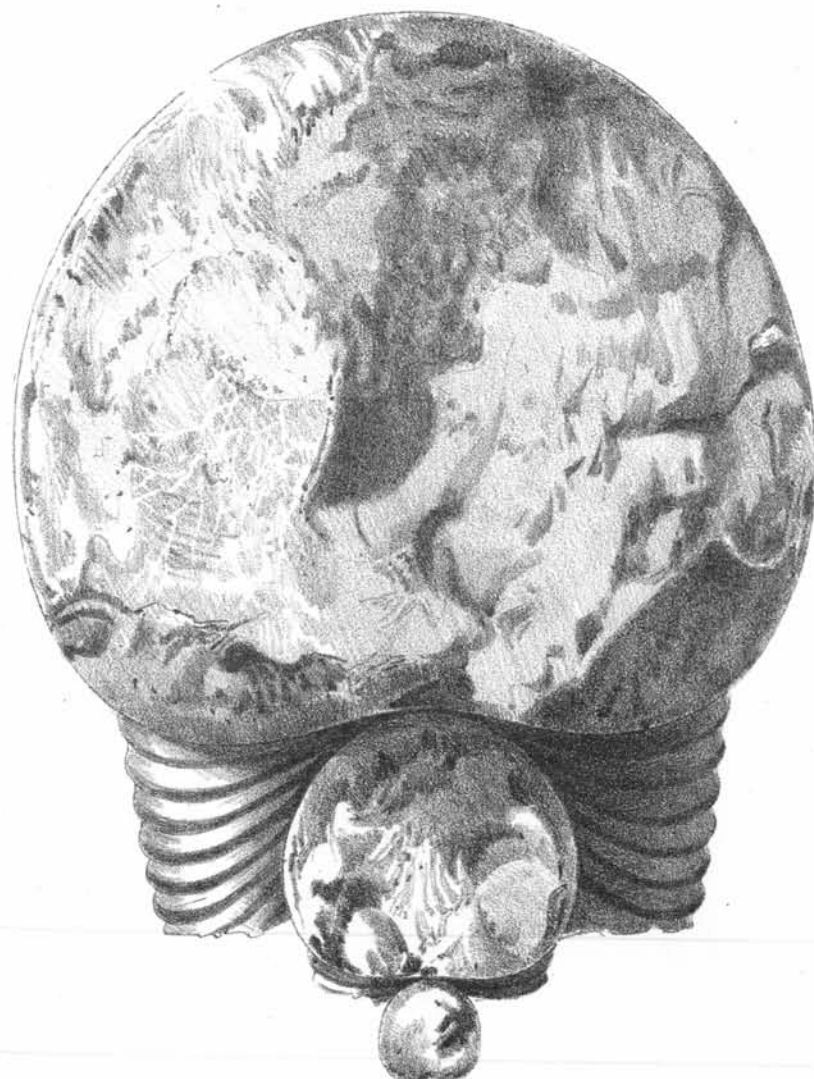
2. b.



1. a.



1. c.



1. b.



3. a.



3. b.