

RECORDS  
OF  
THE GEOLOGICAL SURVEY OF INDIA.

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Part 1.]

1906.

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NOTES ON SOME FOSSILS FROM THE HALORITES LIMESTONE OF THE BAMBANAG CLIFF (KUMAON), COLLECTED BY THE LATE DR. A. VON KRAFFT IN THE YEAR 1900. BY CARL DIENER, PH.D., *University of Vienna*. (With Plates 1 and 2.)

I N 1892 a Cephalopod-bearing horizon of upper Triassic age was discovered on the southern slope of the Bambanag range, towering above the Girithi valley, near Martoli E.G., by the expedition in which Griesbach, Middlemiss and myself took part. This horizon was traced by myself from Lauka and the Jandi Pass in Johar to the Shalshal Cliff in Painkhanda, but nowhere was a section found which for abundance of Cephalopoda could be compared with that of the Bambanag Cliff. The rich fauna was examined by E. v. Mojsisovics (*Denkschr. Kais. Akad.d. Wissensch. Wien*, Bd. LXIII, and *Himálayan Fossils, Palæontologia Indica*, Ser. XV, Vol. III, Pt. 1), who described 58 species belonging to the genera and sub-genera: *Halorites*, *Parajuvavites*, *Thetidites*, *Tibetites*, *Anatibetites*, *Paratibetites*, *Helicitites*, *Dittmarites*, *Dionites*, *Steinmannites*, *Clionites*, *Sandlingites*, *Sirenites*, *Arcestes*, *Pinacoceras*, *Placites*, *Bambanagites*, *Clydonautilus*, *Paranautilus*, *Indonautilus*, *Orthoceras* and *Atractites*.

*Halorites* being one of the most characteristic elements of the fauna, the name Halorites limestone was assigned to this horizon. It was correlated with the lower noric (Iacic) stage of the Hallstatt limestone by E. v. Mojsisovics, who did not, however, overlook the specific similarities of a small number of types to species of middle-noric (alaunic) age.

In 1900 the Bambanag Cliff was re-visited by the late Dr. A. von Krafft, who obtained from the Halorites beds collections which, although less rich than my own in 1892, are still very extensive. These have been entrusted to me for examination. The majority of the species are identical with forms described by E. v. Mojsisovics; they are included in the following list:—

- Atractites* sp. ind.
- Orthoceras* sp. ind. (cf. *campanile*, Mojs. ?).
- Clydonautilus biangularis*, Mojs.
- Paranautilus bambanagensis*, Mojs.
- Halorites Sapphonis*, Mojs.
- Halorites procyon*, Mojs.
- „ *Alcaci*, Mojs.
- Parajuvavites Stoliczkai*, Mojs.
- „ *buddhaicus*, Mojs.
- „ *Jacquini*, Mojs.
- „ *Feistmanteli*, Mojs.
- „ *Sternbergi*, Mojs.
- „ *Ludolfi*, Mojs.
- „ *Blanfordi*, Mojs.
- „ *Renardi*, Mojs.
- Tibetites Ryalli*, Mojs.
- „ *Murchisoni*, Mojs.
- Paratibetites Adolphi*, Mojs.
- „ *Bertrandi*, Mojs.
- „ *angustisellatus*, Mojs.
- Clionites Woodwardi*, Mojs.
- „ *Hughesii*, Mojs.
- „ *Salteri*, Mojs.
- Sandlingites Archibaldi*, Mojs.
- „ *Nicolai*, Mojs.
- Dittmarites Hindei*, Mojs.
- Thetidites Huxleyi*, Mojs.
- Steinmannites clionitoides*, Mojs.
- „ *Noetlingi*, Mojs.
- „ *undulatostriatatus*, Mojs.
- „ *Desiderii*, Mojs.
- „ *Lubbocki*, Mojs.
- Arcestes Leonardi*, Mojs.

*Pinacoceras parma*, Mojs.

*Placites Sakuntala*, Mojs.

*Bambanagites Dieneri*, Mojs.

Besides the species included in this list a small number of new forms has been recognised, which will be described in the present memoir.

Genus **PINACOCERAS** Mojs.

**PINACOCERAS METTERNICHII** Hauer. Pl. 1, fig. 2.

1846. *Ammonites Metternichii* F. v. Hauer *ex-parte*, Die Cephaloden des Salzkammergutes aus der Sammlung des Fuersten von Metternich, Wien, W. Branmuller, p. 1, Taf. IV, fig. 4.  
1873. *Pinacoceras Metternichii* E. v. Mojsisovics, Die Cephaloden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-1, p. 60, Taf. XXVI, fig. 1.  
1902. *Pinacoceras Metternichii* E. v. Mojsisovics, *ibidem*, Supplement, p. 295, Taf. XIX, fig. 1.  
1906. *Pinacoceras Metternichii* Diener, The fauna of the Tropites limestone, Palæontologia Indica, Ser. XV, Himálayan Foss., Vol. V, Pt. 1, Pl. XIII, fig. 1.

A medium-sized specimen of *Pinacoceras* consisting of air-chambers only, agrees in the details of its sutural line with *Pinacoceras Metternichii* Hauer, not with *P. parma* Mojs.

*Pinacoceras Metternichii* and *P. parma* are two very nearly allied species, which can only be distinguished by a subordinate difference in their sutural lines. In *P. parma* the five adventitious saddles are of dimeroid shape, whereas in *P. Metternichii* the saddle preceding the principal lateral one is pyramidal, the inner of the two culminating branches being much more strongly developed and higher than the outer one and being shifted towards the centre of the apex of the saddle. In this character my specimen agrees exactly with F. v. Hauer's type-specimen of *Pinacoceras Metternichii* from the Steinbergkogel near Hallstatt.

There are three dimeroid adventitious saddles, following the first adventitious saddle, whose lateral branches are arranged symmetrically, four pyramidal saddles—the fifth, innermost adventitious saddle and the three main saddles—and ten dimeroid auxiliary saddles.

The first or outermost adventitious saddle is not provided with a secondary external branch, as in the variety from the Tropites limestone of Kalapani, but its ramifications are arranged symmetrically.

as in the typical form from the Hallstatt limestone. The adventitious elements of the sutural line slope more steeply from the periphery of the shell to the first main saddle than in Hauer's type, but less so than in the Himálayan example from the Tropites limestone.

The measurements of this incomplete but fairly well-preserved specimen are as follow :—

Diameter of the shell . . . . .	140 mm.
„ „ „ umbilicus . . . . .	15 „
Height of the { above the umbilical suture . . . . .	77 „
last volution { „ „ preceding whorl . . . . .	54 „
Thickness of the last volution . . . . .	17 „

*Pinacoceras Metternichii* must now be added to the list of species common to the Halorites limestone, the Tropites limestone of Byans and the Alpine Hallstatt beds.

#### PINACOCERAS POSTPARMA Mojs. Pl. 1, fig. 1.

1873. *Pinacoceras postparma* E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke : Abhandl. K. K. Geol. Reichsanst., VI-1, p. 61, Taf. XXVI, fig. 4.

1902. *P. postparma* E. v. Mojsisovics, *ibidem*, Supplement, p. 295.

A medium-sized specimen of *Pinacoceras* consisting of air-chambers only, agrees exactly with this remarkable species from the alaunic (middle noric) sub-stage of the Hallstatt limestone. The most important character of *P. postparma* is the shape of the fifth adventitious lobe and adjoining saddles. As in the type-specimen from Hallstatt four adventitious lobes are bi-partite at their base and separated by dimeroid saddles. But the fifth adventitious lobe is shorter and narrower and terminates in a median point. The two bordering saddles stand very close to each other. Although distinctly dimeroid like the rest of the adventitious saddles, they might easily be mistaken for a single adventitious saddle, whose branches divide near the very base of the stem.

In its external shape *Pinacoceras postparma* agrees exactly with *P. parma* and *P. Metternichii*.

#### Dimensions.

Diameter of the shell . . . . .	136 mm.
„ „ „ umbilicus . . . . .	12 „
Height of the { above the umbilical suture . . . . .	81 „
last volution { „ „ preceding whorl . . . . .	58 „
Thickness of the last volution . . . . .	18 „

*Pinacoceras postparma* must be added to the number of forms in the Halorites limestone exhibiting specific affinities to Alpine species of alaic age, such as *Clydonautilus biangularis* and *Sirenites elegans*.

Genus: **HALORITES** Mojs.

**HALORITES TROTTERI**, nov. sp. Pl. 2, fig. 4.

This is a species of *Halorites* belonging to the group of *acatenati*, as do all Himálayan representatives of this genus hitherto known. The chambered portions of its shell agree almost entirely with *Halorites Sapphonis* Mojs. (Palæontol. Indica, ser. XV, Himál. Foss., Vol. III, Pt. 1, p. 13, Pl. IV, figs. 1—4). Their ornamentation consists of numerous zig-zag bent ribs, bifurcating both on the lower half of the lateral parts and near the siphonal margin.

The body-chamber differs in its sculpture considerably from *H. Sapphonis* by the absence of any marginal knobs and by the gradual weakening of the ribs. A deep constriction, which is situated nearly one entire volution in front of the last sutural line, marks the immediate vicinity of the peristome, of which, however, only traces have been preserved.

The egression of the umbilicus is also considerably inferior to that in *H. Sapphonis*. Where the shell has been preserved, the umbilicus is entirely closed by a callosity.

The modifications in the shape of the body-chamber are rather insignificant. The siphonal part, which is broadly rounded near the beginning of the last volution, becomes more compressed in the middle of the body-chamber whorl, whereas towards the mouth there occur again a slight widening of the external region and a corresponding inflation of the lateral parts.

*Dimensions.*

Diameter of the shell . . . . .	68.5 mm.
"    "    " umbilicus . . . . .	0    "
Height of the { above the umbilical suture . . . . .	37    "
last volution {    "    preceding whorl . . . . .	15    "
Thickness of the last volution . . . . .	29    "

*Sutures.*—Agreeing in their details with those of *Halorites Sapphonis*.

## HALORITES ALTERNANS nov. sp. Pl. I, fig. 3.

This species, represented only by the figured specimen, is to be regarded as a form closely allied to *Halorites Alcaci* Mojs. (l. c. p. 17, Pl. III, fig. 3). It is distinguished from this species and from all other Indian *Halorites* by two characters of importance.

The first character of importance is the absence of any egression of the umbilicus. The second is the sharp separation of the sculpture in the anterior and posterior portions of the last volution. Near its beginning the last volution, corresponding entirely to the body-chamber, is considerably inflated and covered by very numerous and delicate, sharp ribs, which cross the broadly rounded siphonal area with many bifurcations. These delicate and densely crowded ribs are suddenly replaced by flattened, irregularly bending folds, which stand more widely apart and are elevated into marginal knobs.

The sharp boundary between those two patterns of ornamentation corresponds to the region of the body-chamber, where the compression of the whorl begins. On the anterior portion of the body-chamber a considerable weakening of the sculpture is coincident with the increase of the inflation in the apertural region.

*Dimensions.*

Diameter of the shell	.	.	.	.	.	.	40 mm.
" " " umbilicus	.	.	.	.	.	.	0 "
Height of the last volution	.	.	.	.	.	.	22 "
Thickness of the { at the point of greatest inflation	.	.	.	.	.	.	20 "
last volution { " " " " " " compression	.	.	.	.	.	.	16 "

*Sutures*.—Not known in detail.

## MARTOLITES nov. gen.

To this genus belong evolute shells with numerous whorls and a widely open umbilicus recalling in their shape *Japonites* or *Gymnites*. The sculpture is interrupted along the narrow external part, as in *Florianites* or *Danubites*. It consists of simple ribs, of which two or three originate from umbilical tubercles. To this plicate ornamentation paucostome-furrows are added, as in *Cycloceltites* Mojs.

The sutures are very simple. It is merely a matter of convenience, whether one regards the small umbilical saddle as second lateral or as auxiliary saddle, the projection of the periphery of the preceding volution just touching the broad lobe which follows the principal lateral saddle.

It is rather difficult to assign to this genus its proper systematic position. I have not succeeded in finding out the exact length of the body-chamber, the sutural line being only accessible to examination at one single place in the penultimate whorl of my largest specimen of *Martolites Krafti*. Thus whether *Martolites* belongs to the *Tropitidæ* or to the *Ceratitidæ* cannot be decided on the strength of the main character on which the separation of those two groups of Triassic *Ammonea trachyostraca* has been based by E. v. Mojsisovics. My personal opinion is, that *Martolites* should be placed in the sub-family *Celtitinae*, near *Celtites* Mojs. The affinity of *Martolites* to *Celtites* appears to me to be stronger than to any other Alpine genus of upper Triassic ammonites. An inspection of the illustration of *Celtites Neumayri* as given by E. v. Mojsisovics (Abhandl. K. K. Geol. Reichsanst. VI-2, Taf. CC., fig. 6) and of *Cycloceltites annulatus* Mojs. (*ibid.* Taf. CXXII, figs. 8—14) will convince the reader of the remarkable similarity of the two genera in their external shape and involution. With *Cycloceltites* my new genus agrees in the combination of normal ribs with paulostome-ribs and furrows. A difference is, however, marked by the presence of umbilical tubercles and by interruption of the sculpture along the siphonal part. The latter feature is noticed in the group of *Celtites multispirati*, but not in *Cycloceltites*.

*Martolites* is so far only known from the Halorites limestone of the Himálayas, where it is represented by a single species, *M. Krafti*.

MARTOLITES KRAFFTII nov. sp. Pl. 2, figs. 1, 2, 3.

Of the three specimens figured the largest, illustrated in fig. 1, may stand as the type of this species. It possesses an obliquely elliptical outline, which is, however, acquired only in later stages of growth. The inner nucleus is of normal shape and agrees exactly with the smaller example illustrated in fig. 3. The elliptical outline of the full-grown specimen is confined to the last volution and is probably caused by an acceleration of growth in front of the beginning of the last whorl and in front of the anterior half of it.

The whorls of the inner nucleus are strongly inflated and thicker than high, but in the cross-section of the last whorl the width is inferior to the height. The transverse section is cordiform, the sides converging into a narrowly rounded siphonal part. The whorls overlap each other scarcely to the fourth part of their height. Thus a wide and shallow umbilicus is left open.

The ornamentation consists of very numerous straight and sharp ribs, which are turned forward but do not cross the siphonal part, which remains smooth. In the inner nucleus single ribs occur occasionally, but are rare. Most of the ribs rise in pairs from the umbilical edge, which separates the flat lateral parts from a steep but very low umbilical wall. Bifurcation of the ribs outside the umbilical region is also frequently noticed. In the inner nuclei the points of bifurcation along the umbilical edge are not marked by tubercles. It is only in the last volution of the two larger specimens illustrated, that umbilical tubercles play an important part in the ornamentation of the shell. In the meantime the ribs become more densely crowded and more than two often rise from a single umbilical tubercle.

The second element of sculpture is paulostome-furrows, which are as a rule connected with strong paulostome-ribs. They appear at an earlier stage of development than the umbilical tubercles. In the small specimen illustrated in fig. 3 a deep paulostome-furrow is noticed corresponding to a diameter of the shell of 13 mm. It is directed forward more noticeably than the lateral ribs and is accompanied by a sharp paulostome-rib, cutting off two adjoining ribs and thus forming with them a sort of chain-rib, recalling the chain ribs in the group of *Anatomites scissi*.

In the last volution of my type-specimen two deep paulostome-furrows are noticed. But the paulostome-ribs preceding them do not cut off any adjoining ribs, deviating but slightly from their direction. From the normal ribs the paulostome ribs differ not only in their greater strength but also by crossing the external part without any interruption.

<i>Dimensions.</i>		Fig. 1.	Fig. 3.
Diameter of the shell	. . .	37 mm.	18 mm.
Height	} of the last volution . . .	12 "	6.5 "
Thickness		9 "	7 "
Diameter of the umbilicus	. . .	16	6.5 "
Height	} of the volution at the place of its greatest aplanation.	10 "	
Thickness		8.5 "	
Corresponding diameter of the shell	. . .	28 "	
" " " umbilicus	. . .	13 "	



*Sutures*.—There is only a single place near the beginning of the penultimate whorl, where the sutural line of two air-chambers is accessible for examination. The siphonal lobe is deep, bicuspidate and divided by a high siphonal prominence. Siphonal saddle high and elongated, with its apex shifted towards the external part. Lateral lobe faintly serrated at its base, but serration visible only by means of a magnifying glass. Lateral saddle shorter than the siphonal saddle and followed by a broad, faintly serrated lobe, which might be termed either lateral or auxiliary with equal reason. The inner margin of the small adjoining saddle is touched by the umbilical suture.

Genus **JUVAVITES** Mojs.

Sub-genus *ANATOMITES* Mojsisovics.

*ANATOMITES* sp. ind. Pl. 1, fig. 4.

The figured specimen is the chambered nucleus of a large-sized example, which in its dimensions can scarcely have been inferior to *Anatomites Camilli* Mojsisovics (Cephalopoden der Hallstätter Kalke, Abhandl. K. K. Geol. Reichsanst., VI-2, p. 103, Taf. XCI, fig. 3), to which it exhibits a distant resemblance. It deserves special mention, since the sub-genus *Anatomites* is chiefly restricted to beds of carnic age and is very rare in the noric stage of the Hallstatt limestone. The present nucleus belongs to the group of *Anatomites scissi*. On account of its incompleteness it is preferable to refrain from the imposition of a new specific name.

There are two paulostome-furrows present in the last volution, both of them being accompanied by strong ribs on either side. The lateral ribs, which are broad, irregularly bent, and frequently dichotomous, meet alternately along the middle line of the siphonal part, where the sculpture is interrupted.

The direction of the paulostome-furrows is inclined obliquely forward. The bundle of ribs preceding the last paulostome has a chain-like appearance, but in the rib preceding the first paulostome this is not the case.

*Dimensions.*

Diameter of the shell	.	.	.	.	.	24 mm.
" " umbilicus	.	.	.	.	.	2 "
Height	} of the last volution	.	.	.	.	{ 13 "
Thickness		.	.	.	.	{ 12.5 "

*Sutures*.—Saddles provided with dolichophyllic denticulations, as in *Anatomites rotundus* Mojs. but more slender. Sutures narrow and deep. The siphonal and principal lateral lobe standing at an equal level. Siphonal lobe divided by a broad and simple median prominence.

### Genus **SIRENITES** Mojs.

#### **SIRENITES ELEGANTIFORMIS** nov. sp. Pl. 2, fig. 5.

This species is very nearly allied to *Sirenites elegans* v. Mojsisovics (Himálayan Foss., *op. cit.* Vol. III, Pt. 1, p. 94, Pl. XVII, figs. 8, 9). The resemblance is so great, that I should not have separated the two species, had not the differences in their sutures have demanded this separation. Not having the type-specimen of *S. elegans* at hand for comparison, I must take the illustration of its sutural line for granted on the authority of E. v. Mojsisovics, although the remarkable difference in the dimensions of the siphonal and principal lateral saddles puzzles me considerably.

In its external shape and ornamentation *Sirenites elegantiformis* agrees with *S. elegans* with the exception of some minor details. But none of those slight differences is of specific importance, if we allow for the difference in the dimensions of the two type-specimens. The ornamentation is very delicate. Traces of ribs are but faintly marked. The principal element of sculpture is spirally arranged rows of tubercles, of which fourteen are counted from the umbilical margin to the crenulated keels. The rows of tubercles succeed one another at irregular distances and the shape and size of the tubercles themselves varies considerably in different rows. In most of the rows the tubercles show rounded outlines. In some rows they are extended longitudinally and frequently fused together so as to form a continuous elevated spiral band. In the row situated next to the crenulated keels, they are arranged in short lines, which are directed obliquely forward.

#### *Dimensions.*

Diameter of the shell	. . . . .	92 mm.
"    "    " umbilicus	. . . . .	4 "
Height of the { above the umbilical suture	. . . . .	54 "
last volution { "    " preceding whorl	. . . . .	33 "
Thickness of the last volution	. . . . .	19 "

*Sutures*.—Agreeing with those of *Sirenites elegans* in the development of an adventitious saddle in the siphonal lobe. The striking disproportion in the height of the siphonal and principal lateral saddles, which is the most remarkable character in the sutural line of *S. elegans*, is not noticed in the present species, the two saddles being of nearly equal dimensions.

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#### EXPLANATION OF PLATES.

##### PLATE 1.

- Fig. 1*a, b.* *Pinacoceras postparma* Mojs.  
,, 2 *Pinacoceras Metternichii* v. Hauer. Sutural line.  
,, 3*a, b.* *Halorites alternans* Dien.  
,, 4*a, b.* *Anatomites* sp. ind.

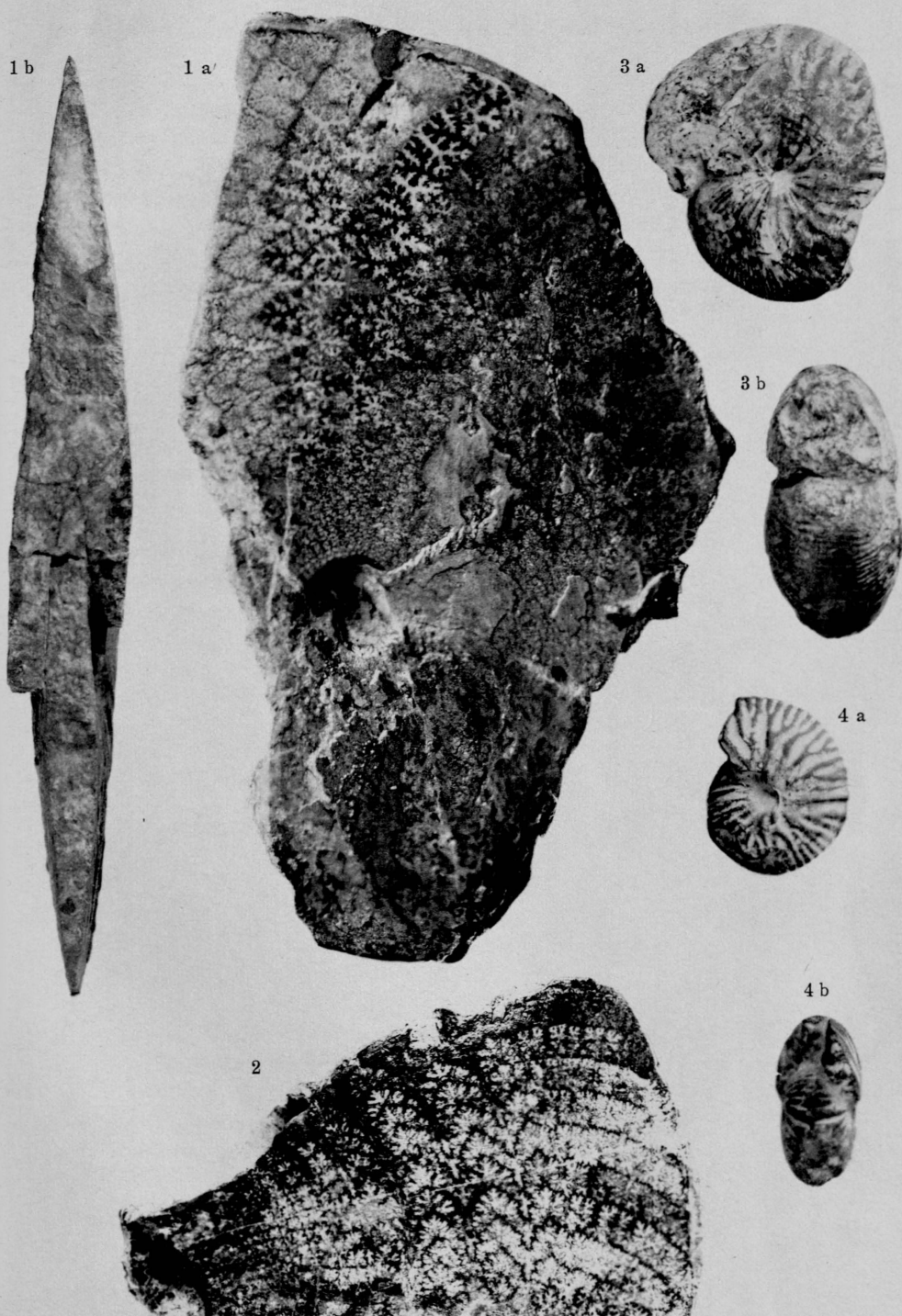
##### PLATE 2.

- Fig. 1*a, b, c.* }  
,, 2*a, b.* } *Martolites Krafftii* Dien.  
,, 3*a, b.* }  
,, 4*a, b.* *Halorites Trotteri* Dien.  
,, 5*a, b.* *Sirenites elegantiformis* Dien.
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Unfortunately, the fossils yielded by the boring are generally undeterminable. The limestone at 142 feet from the surface is crowded with *Amphistegina*. Mr. Pilgrim of the Geological Survey of India who determined the genus observes : "Although it is true that *Amphistegina* was very much more abundant in the miocene, still it is found in the seas of to-day, most commonly up to a depth of 30 fathoms. But added to the testimony of the *Ostrea*,<sup>1</sup> it strengthens the probability that we are dealing with a marine deposit which is at all events as old as miocene."

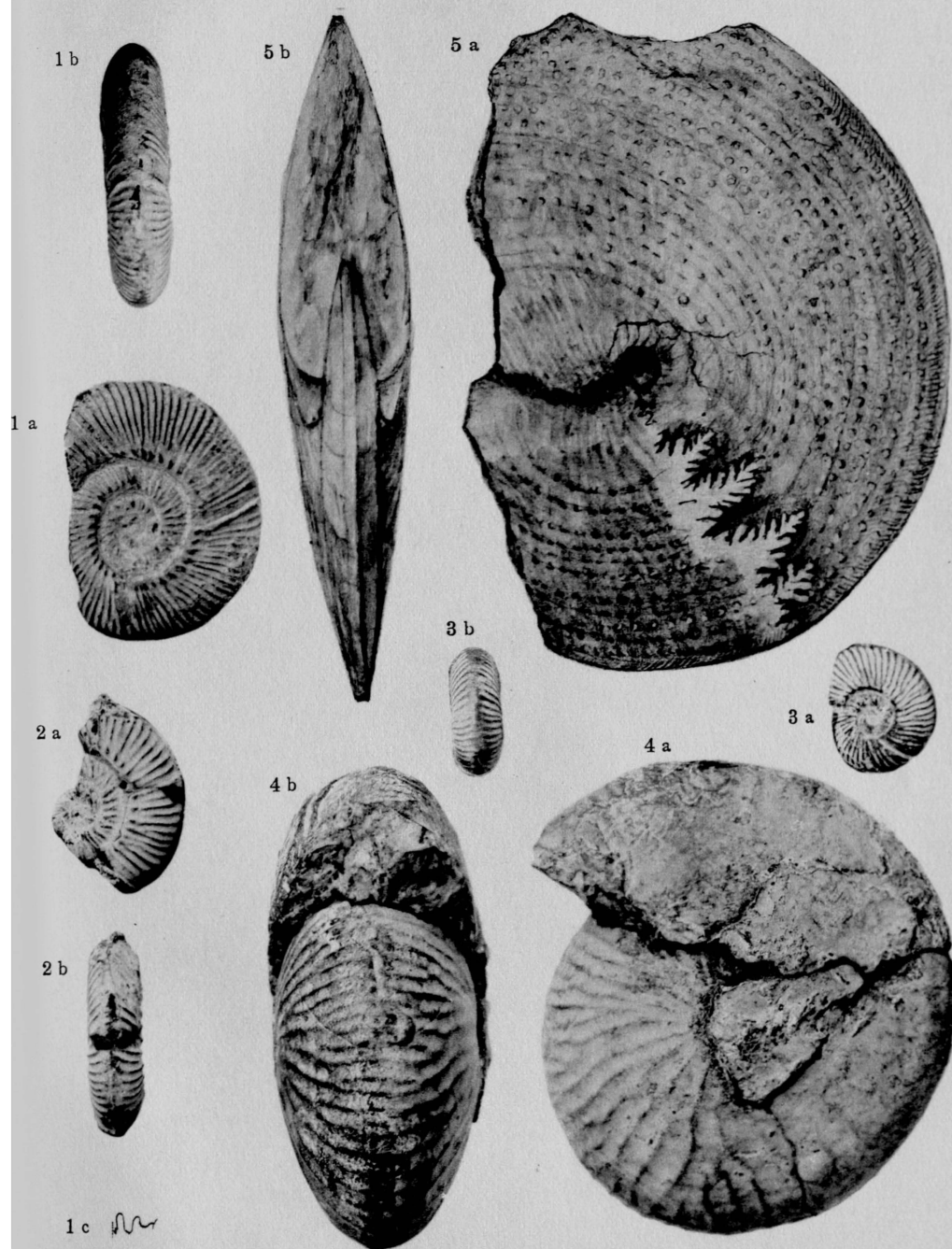
[P. N. BOSE.]

<sup>1</sup> See "Notes on the Geology and Mineral Resources of Mayurbhanj." *Rec., Geol. Surv. Ind.*, Vol. XXXI, pt. 3.



Collotype Max Jaffé, Vienna.

Fossils from the Halorites limestone.



Collotype Max Jaffé, Vienna.

Fossils from the Halorites limestone.