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MEMOIRS
OF THE
GEOLOGICAL SURVEY OF INDIA.

Palæontologia Indica.

BEING

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

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR-GENERAL OF INDIA IN COUNCIL,

UNDER THE DIRECTION OF

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SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

ser I+

Vol I

1. The Fossil Cephalopoda of the Cretaceous Rocks of Southern India,
(BELEMNITIDÆ—NAUTILIDÆ) by HENRY F. BLANFORD,
Geological Survey of India.

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THE accompanying pages are the first portion of a publication, which is intended to be supplementary to the Memoirs of the Geological Survey of India. Those memoirs and reports are more especially confined to the description of the Geological and Physical features of the several districts examined by the Geological Survey, while the present series will be limited to the description of the Organic remains obtained from those districts.

This first portion contains, in part, the Cephalopoda of the Cretaceous Rocks of Southern India, a group of great Geological importance and interest. These have been examined and described by Henry F. Blanford, Esq., who also had general charge of the party of the Geological Survey engaged in the examination of the district from which these fossils have been obtained.

The present series is confined to the Belemnitidæ and Nautilidæ. The Ammonitidæ will appear subsequently.

THOMAS OLDHAM.

Calcutta,

September, 1861.



INTRODUCTORY REMARKS.

THE fossils described in the following pages form a portion of the fauna of the Cretaceous formation of S. India. This formation, which has been recently surveyed and mapped by the officers of the Geological Survey, occupies a total area of about 300 square miles in the districts of South Arcot and Trichinopoly, extending from a point on the coast about 9 miles north of Pondicherry to within about 15 miles of the station of Trichinopoly. To the west it rests partly on the gneiss and older crystalline rocks, which form the main portion of the Peninsula, and partly on some deposits of doubtful age containing plant remains only; to the east and south it is covered by some unfossiliferous sandstones of more recent formation, which I have named the Cuddalore sandstones, and by the alluvial deposits of the Coromandel Coast and the valley of the Cauvery. The Geological features of the Cretaceous rocks will be found fully described in the Memoirs of the Geological Survey of India, Vol. IV; and an enumeration of the chief subdivisions of the series, and of their relative positions will therefore suffice to render intelligible the stratigraphical references in the following pages. For those who, following in our steps as collectors, may have occasion to refer to the lists of localities appended to each species, the Geological map of the Trichinopoly country (on the scale of half an inch to a mile) which accompanies the Memoirs, will be found the best reference.

The Sedimentary rocks of Trichinopoly and S. Arcot have been separated into six groups; four of which are of Cretaceous age and highly fossiliferous: they have been named as follows in descending order.

	TRICHINOPOLY.	S. ARCOT.
Tertiary?	Cuddalore sandstones :.....	Cuddalore Sandstones (fossil wood).
Upper Cretaceous. } ...	{ Arrialoor group	Arrialoor group.
	{ Trichinopoly group	(wanting).
Middle Cretaceous. } ...	{ Ootatoor group, including the Coral }	(wanting).
	{ Reef Limestone at its base. }	
Lower Cretaceous. }	(wanting).....	Valudayur group.
?	Ootatoor plant beds. (Plant remains only).	

In Trichinopoly, all the groups are to a certain extent unconformable on each other, the unconformity being betrayed (except in one case) chiefly by the unequal denudation that

occurred during the intervals of deposition; the greater part of the deposits are, to all appearance, undisturbed, and many physical features lead to the conclusion that they were originally formed successively as great banks of sediment around the land which, now known as the Puchamullay and Kolamullay hills, still rears itself in the immediate neighbourhood of the Cretaceous rocks to a maximum elevation of 6,000 ft.

The Ootatoor plant beds and the two lower subdivisions of the Cretaceous rocks of Trichinopoly do not extend beyond the limits of that district, being successively overlapped by the Arrialoor group; which, after being obscured by the alluvial deposits of the Vellaur river for a distance of 5 to 16 miles, re-appears near Verdachellum in South Arcot, together with the overlying Cuddalore sandstones. From Verdachellum, these groups extend northwards to the banks of the Guddalum, where another broad alluvial tract conceals them for about 12 miles, and they re-appear to the west of Pondicherry, finally wedging out on the coast 9 miles to the north of that place. At Valudayur, 10 miles to the west of Pondicherry, a group of rocks, older than any of those above enumerated (except possibly the plant beds of Ootatoor), crops out from beneath the Arrialoor group, and a single band of calcareous concretions in this formation, occurring just on the borders of the Arrialoor group, yielded the beautiful series of fossil remains which, collected by Messrs. Kaye and Cunliffe, were pronounced by Professor Edward Forbes to be of Neocomian age. The differences of opinion as to the precise age of these rocks, to which Messrs. Kaye and Cunliffe's collections have given rise, have sprung from the admixture, in their collections, of fossils from the overlying Arrialoor group, comprising *Nautilus Danicus*, *Ovulum*, *Oliva*, and the teeth of various upper-Cretaceous squaloids, with the Neocomian Ammonites, and other mollusca, which form the bulk of the collections.

To the knowledge of this Neocomian fauna we can add but little: the locality from which Messrs. Kaye and Cunliffe's beautiful collections were derived has been temporarily exhausted by our indefatigable predecessors, and it would be necessary to excavate the rock to obtain fresh fossiliferous material of value, a labour which could not be undertaken during the progress of a general field survey. Verdachellum we found to be even poorer as a fossil locality than Valudayur; a few Pectens, Trigonis and Spondyli being the chief results of 3 or 4 days' search in that neighbourhood. There is, moreover, no question that many of the specimens referred in Professor Forbes' memoirs to Verdachellum, were, in point of fact, from other localities, chiefly in the district of Trichinopoly, and from the group which I have so named; and which, as I have stated, does not occur anywhere to the north of the Vellaur river.

It is from the district of Trichinopoly, almost a virgin mine of Palæontologic wealth, that the great bulk of the collections of the Geological Survey of India has been obtained: and we are enabled to offer a fair illustration of the fauna of the three groups, two of which have hitherto been almost or quite unknown.

In addition to the Survey collections, I have had the advantage of examining a considerable series of fossils, obtained by Mr. Cunliffe from the Ootatoor group of Trichinopoly previously to the commencement of our survey, and by him most liberally placed at the disposal of the

INTRODUCTORY REMARKS.

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Survey. These fossils, which were the first specimens obtained from the Ootatoor group, were briefly catalogued in a paper read by Dr. Oldham before the Asiatic Society, and published in the proceedings of the Society for May, 1858. They were not described at any length, nor were new species specifically named, as the systematic survey of the country in question had then commenced, and it was thought desirable to defer their publication until they could appear as part of a more extensive series. A series of fossils, chiefly presented by Mr. Kaye to the Madras Museum, has also been most obligingly lent for examination by Dr. Balfour, in charge of the Government Central Museum, Madras; and this series has been of great service, containing, as it does, many species of which no specimen is possessed by the Survey. The specimens are not, I imagine, all of them *authentic* duplicates. They were labelled in Mr. Kaye's handwriting, and were some of them erroneously named. Among these latter I have detected two Nautili in a state sufficiently perfect for determination, and of distinct species, neither of which had been noticed by Professor Forbes.

HENRY F. BLANFORD.

Calcutta,

August, 1861.

confined to a restricted area, characterized by the deposition of fine silts and the comparative absence of other forms of marine life, while in neighbouring and co-extensive areas, in which the materials are coarser or more varied and the fauna richer, Belemnites are either sparingly distributed or altogether absent.

Professor Edward Forbes, in his Memoir on the Cretaceous Fossils of Southern India, notices and figures some fragments of guards and phragmocones from Pondicherry under the name of *B. ? fibula*. No such remains were met with by the Survey, whose collections from Pondicherry are very inferior to those procured by Messrs. Kaye and Cunliffe,* but some specimens of phragmocones presented by those gentlemen to the Madras Museum prove the fossils in question to be from the Valudayur limestone, the fauna of which, with slight exceptions, is distinct from that of the other groups enumerated in the foregoing introduction.

The Belemnites collected by the Geological Survey of India are all from the Ootatoor group in the Trichinopoly district, and are referrible (somewhat doubtfully) to three species, one of which is not improbably identical with the Pondicherry species of Prof. Forbes. They occur, as above remarked, in great abundance in a deposit of fine gypseous silts, covering an area of about two square miles to the east of Ootatoor, and they are also found in smaller numbers in the more fossiliferous beds to the north. In the highest beds of this formation, they are absent, and they are equally wanting in the higher groups of the series.

Of the three species described in the present Memoir, *B. seclusus*, *n. s.*, belongs to M. D'Orbigny's group *Dilatati*, all the forms of which hitherto described are Neocomian. The other two are members of the *Hastati* group, which ranges from the Lias to the Gault. They are closely related to each other, and to the well-known Gault species, *B. minimus*. Whether they are really distinct from each other, or merely definite varieties of the same species, is a point upon which it is difficult to pronounce with any confidence. Both forms exhibit a considerable range of variation, and although certain combinations of characters, which I have regarded as specific distinctions, are sufficiently marked and constant to enable me readily to refer the large majority of specimens to one or the other species, a few appear to combine the peculiarities of the two, and render it doubtful whether we have to deal with anything more than varieties of which such specimens are the connecting links. The genus is at best a difficult one, and specific distinctions founded on a structure of comparatively so little physiological importance, and exhibiting so small a range of variation, as the guard of the Belemnites, must frequently be open to more or less uncertainty.

* The reason of this, as I have explained elsewhere, is the limited supply of fossiliferous material obtainable without undertaking regular excavations. Messrs. Kaye and Cunliffe, and their native collectors, being the first in the field, have nearly exhausted the locality.

1. BELEMNITES FIBULA, *Forbes*.

1846. BELEMNITES FIBULA, *Forbes*. Trans. Geol. Soc. Lond. 2nd Ser. Vol. vii. p. 119.
Pl. 9. fig. 3.

B. testá elongatá cylindricá, vel compressá, plus minusve complanatá, posticè acutá; facie ventrali anticè brevissimè sulcatá: lateribus usque ad apicem valdè bilineatis.

DIMENSIONS.

	a		b		c	
	Ins.	lines.	Ins.	lines.	Ins.	lines.
Length of Guard,.....	2	3	—	—	—	—
Dorso-ventral diameter,	0	4	0	5½	0	5½
Thickness,.....	0	3½	0	4½	0	4

All the specimens measured are from Ootatoor; (*b*) and (*c*) are fragments wanting the upper portion; their length, therefore, cannot be given.

Guard elongated, compressed, columnar or lanceolate, acutely pointed behind on the frontal aspect. Section oval or oblong. Ventral surface evenly rounded with a very short furrow at the anterior extremity (only visible in nearly perfect specimens). Sides more or less flattened, having in some specimens a shallow sulcation, most distinct in front; marked very distinctly with a double vascular impression, which generally extends the whole length of the guard. The alveolar cavity very acute, and extending, in all the specimens examined, considerably more than half the length of the guard. It is somewhat eccentric, particularly in very compressed specimens.

This species exhibits a considerable range of variation, as may be seen on comparing the enlarged figures 5 and 7, Pl. II., which illustrate the extreme varieties. The more cylindrical specimens approach very closely to the more elongated varieties of *B. stilus*, and a few specimens in the Survey collection cannot be assigned with any confidence to either species, partaking of the characters of both. Owing to this, I long hesitated to separate the two species, but, inasmuch as the large majority of specimens is characterized by the combination of a long sulcation with a rounded form and more obtuse apex on the one hand; and a short sulcation, frequently quite wanting, with a flattened form and acute apex on the other, I have considered it most probable that these combinations of characters are an indication of specific distinction, but that the guard being a structure subject to considerable specific variation, in comparison with its narrow range of generic variation, the characteristics of two nearly allied species, are, in a few specimens, too obscure to be recognizable. The number of doubtful specimens is less than 10 per cent. of the whole.

It may, on the other hand, be doubted whether the Ootatoor Belemnite be identical with that from Pondicherry, specimens of which I have had no opportunity of comparing with it. But Professor Forbes's figure of a specimen from the latter locality

B. 1.

so well represents an average imperfect specimen from the former, that, considering the ascertained identity of a few species in the two formations, there appears to be no sufficient reason to regard these Belemnites as distinct.

Range. Valudayur? and Ootatoor groups.

Localities. Valudayur? near Pondicherry: Ootatoor, Moravatoor and Odium, in the Trichinopoly district.

2. BELEMNITES STILUS, *n. s.*

Pl. I. figs. 1—12; Pl. II. figs. 1—4.

B. testá subcylindricá vel subfusiformi, lateraliter paullulum planatá, posticè acutá; facie ventrali anticè depressá, sulcatá: lateribus obsoletè sulcatis, bilineatis.

DIMENSIONS.

Length of largest specimen,.....	2 inches.
Dorso-ventral diameter,	— „ 4 lines.
Thickness,	— „ 4½ „

Guard from 3 to 7 times as long as thick, subcylindrical or subfusiform, more or less flattened at the sides, especially in front; moderately acute and conoidal posteriorly. The ventral surface strongly furrowed anteriorly: the furrow of variable length, not exceeding $\frac{1}{3}$ the length of the guard; sides obscurely furrowed towards the front, faintly marked with a double vascular impression.

This species is rather variable in form, the guard being sometimes nearly cylindrical (Figs. 2, 3, 4, Pl. II.), sometimes swelling to its greatest diameter about half way down (Fig. 1, Pl. II.) It approaches most nearly to the Gault species *B. minimus*, Lister, among European forms.

It occurs abundantly in the gypseous clay of the Ootatoor Group to the east and north-east of Ootatoor, associated with *B. fibula* and *B. seclusus*.

Range. Ootatoor Group.

Localities. Ootatoor, Moravatoor, and Odium, in the Trichinopoly district.

3. BELEMNITES SECLUSUS, *n. s.*

Pl. I. figs. 43—51; Pl. II. fig. 8.

B. testá brevi, obtusè fusiformi, acuminatá, anticè compressá, complanatá: facie ventrali posticè tumidiori, anticè apud angulos valdè sulcatá.

DIMENSIONS.

	<i>a</i>	<i>b</i>
	Ins., lines.	Ins., lines.
Length,.....	1 —	— —
Thickness,	— 2	— 3
Dorso-ventral diameter, ...	— 2½	— 3¼

(a) A well preserved guard from Ootatoor.

(b) Fragment of large specimen, same locality.

Guard short, obtusely fusiform, acuminate, most tumid on the ventral face. Sides and dorsal surface flattened, the former specially in front, so that the section of the anterior extremity is subquadrate. The latero-dorsal angles truncated in front, and in some specimens obscurely marked with double vascular impressions towards the posterior extremity of the guard: these truncations represent the lateral furrows of such species as *B. dilatatus*, Blainv., *B. subfusiformis*, Raspail, &c. The latero-ventral angles of the anterior extremity are marked with deep irregular grooves extending about $\frac{1}{3}$ of the length of the guard. There is no trace of any dorsal groove such as characterizes other species of the Section *Dilatati* of M. D'Orbigny.

The only known species of Belemnite characterized by short lateral grooves, similar to those of the present species, is the *B. binervius* of Raspail, to which in other respects *B. seclusus* bears a general resemblance. The Indian species is however smaller and more regular in form and the lateral grooves nearer the ventral surface; while, as above remarked, it exhibits no trace of the ventral groove so marked in *B. binervius* and other allied species.

This species is common in the gypseous clays to the east of Ootatoor, but less so than the associated species previously described.

Range. Ootatoor Group.

Locality. Ootatoor.

Order, TETRABRANCHIATA.

Family, NAUTILIDÆ.

NAUTILUS, *Auctorum.*

Shell discoid, spiral, many-chambered, with simple whorls; Whorls contiguous, the last nearly or entirely covering the others: Septa transverse, concave toward the front, with a perforation for the passage of a simple siphuncle, which is never situated at the margin: margins simple.

In quoting the above diagnosis of the genus Nautilus, I omit that of the animal, inasmuch as the soft parts of only one species of the genus are known, and it is unsafe to found a generic diagnosis upon such limited data, on the assumption, our only guide in such cases, that characters of generic value in allied groups are of equal, or nearly equal, significance in that before us. Thus, while the number of arms is a character of subordinal importance in the Dibranchiata, an order in which these organs are numerically few and highly organized, it by no means follows that in the Tetrabranchiata, the only well-known species of which has numerous (40) arms of comparatively low organization, that the number or arrangement of these should be constant in all the species, even of the same genus. To determine what are the *generic* characters of the Nautilus animal, the examination of one species is manifestly insufficient, and the provisional diagnosis given by Professor Owen is of value to the classificatory Palæontologist, chiefly, in furnishing him with the differential negative characters of the order.

The discrimination of species according to the characters of the shell is, in many cases, by no means easy. The limits of differentiation exhibited in the genus being small, it becomes of special importance to ascertain, by the comparison of a large series of specimens, what are the limits of variation to which each species is subject. M. Pictet has shown, in a general review of the Cretaceous Nautili of Sainte Croix, that the characters most reliable for the determination of species are the following, enumerated in the order of their importance.

1. The position of the siphuncle.
2. The ornamentation of the shell.
3. The size of the umbilicus.
4. The proportion which the thickness of the outer whorl or the width of the aperture bears to the diameter of the shell; which proportion is usually expressed by a fraction having 100 for denominator.

To these we may add—

5. The form and number of the septa.

All these characters are, however, variable in certain species and within certain limits; and it is only by comparing the sum of the characters in each case that a satisfactory determination of the specific limits can be arrived at.

The following are the general results at which I have arrived in the case of the Indian Cretaceous Nautili.

1. The height of the siphuncle is best measured by M. Pictet's method, *viz.* by comparing the distance of the siphuncle from the base of the septum, *a b*

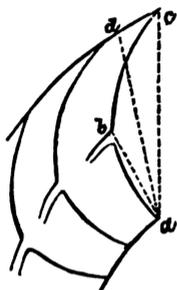


Fig. 1

Fig. 1, with the height *a c* of the septum, or (when, as frequently happens, the edge *d c* is broken, so that this becomes impossible) with the height *a d* measured to the front edge of the shell. The error of the latter measurement is, as remarked by M. Pictet, of no great amount, and the method thus becomes applicable to the great majority of specimens, in which a septum is exposed. The result is expressed by a fraction, taking the height of the septum as unity. Measured in this way, I have found that the siphuncle almost invariably ranges between $\frac{1}{4}$ and $\frac{3}{4}$ of the height

of the septum, and the limit of variation in any one species, with a single exception, does not exceed $\frac{1}{2}$ of that height. The exception I allude to, is that of *Nautilus Bouchardianus*, in the Indian specimens of which the siphuncle is sometimes dorsally,* sometimes ventrally,* eccentric, the limits being at $\frac{1}{3}$ and $\frac{2}{3}$ of the height of the septum. Including the European specimens the range of variation is even greater. The position of the siphuncle in Swiss specimens described by M. Pictet, is between $\frac{5.8}{100}$ and $\frac{6.8}{100}$, the average being therefore beyond our maximum: and in some specimens from the Swiss Alps its range is even considerably more ventral. It is indeed possible that I may be mistaken in identifying the Indian Nautilus with *N. Bouchardianus* of D'Orbigny, but amid much variation of form, &c., I can find no character, beyond this usually inferior but variable position of the siphuncle, to distinguish it from its equally variable European prototypes.

In the embryo, and in very young shells, the siphuncle is always more dorsal than in adult specimens, and does not attain its normal position usually until the completion of the 2nd or 3rd whorl. A young specimen of *N. crebricostatus* has the siphuncle at $\frac{1}{5}$ the height of the septum at the end of $1\frac{1}{2}$ whorls, while in the large adult specimens it is at $\frac{2}{3}$, or nearly central. Similarly, a young specimen of *N. Huxleyanus*, $\frac{5}{8}$ of an inch in diameter, has the siphuncle dorsally eccentric: in half a whorl, with a diameter of 1 inch, it becomes central; and in specimens between 2 and 3 inches in diameter it is at from $\frac{2}{3}$ to $\frac{3}{4}$ the height of the septum, or at its maximum ventral range.

In the above passage and throughout the following descriptions, I have employed the terms *ventral* and *dorsal* strictly with reference to the position of the animal, and therefore in an opposite sense to that in which they were used by Palæontologists before the anatomy of the animal was known. In order, however, to avoid confusion,

* See below for the meaning of those terms.

I have in describing the position of the siphuncle in the diagnosis of species, employed the synonymous terms *external* and *internal*, or *superior* and *inferior*, terms employed by M. Pictet and which have reference solely to the form of the shell: the ventral is thus synonymous with the external, and the dorsal with the internal region.

2. The ornamentation of the shell is a character of considerable palæontological importance. According to its existence or absence, and to the form it assumes, the genus has been subdivided into groups, two of which have a definite restricted range in time, and it affords characters for specific determination, scarcely second in importance to those of the siphuncle. The types of ornamentation are two; longitudinal striation, and transverse sulcation conformable to the shape of the aperture; and besides the ornamented forms, we have a large number of species with smooth shells, or those marked simply with minute striæ of growth. Of these types the Nautili of the first, or those with longitudinally striated shells, are to us of little moment: they are almost exclusively Oolitic, and only one species occurs in the Indian Cretaceous rocks. Those of the second type, on the other hand, are exclusively Cretaceous, and are largely represented in Southern India. In these Nautili, the very young shell is always smooth, and the ornament appears first as regular, sub-anular, shallow sulcations on the ventral region, the angle being directed backwards. The period at which the sulcations first appear varies in different species, and, in some species in different specimens. In *N. crebri-costatus*, the sulcation is distinct on a specimen, which, if perfect, would be $\frac{3}{4}$ of an inch in diameter, while a specimen of *N. rotæ* of $2\frac{1}{4}$ inches diameter is perfectly smooth and shows no trace of sulcation. In most species, the sulcations extend with growth to the umbilicus, the intervals between them being regular and increasing only slightly in width, so that they are much more numerous on an outer than on an inner whorl. Throughout any one species, the width of the ribbing is very constant, as also is the size of the ventral angle: these are therefore in general, reliable specific characters. In most species, the ribs that spring from the umbilicus bifurcate about the middle of the whorl, but in *N. pseudo-elegans*, and a few other species, they pass undivided across the shell. In very old specimens the sulcation becomes less regular, and sometimes almost obliterated; as in the specimen of *N. rotæ* figured at Pl. XXIV. Figs. 3, 3 a. (on the scale of $\frac{1}{2}$ its true linear dimensions), and, on the other hand, it would appear that very old specimens of smooth-shelled species occasionally become ribbed. A specimen of *N. Bouchardianus* in the Survey collection exhibits an instance of this, having broad regular sulcations ornamenting the shell within 2 or 3 inches of the aperture. In this case the specific identity of the specimen is unquestionable, but, as other specimens of equal, and even much superior magnitude, exhibit no such ornament, we must regard it as accidental, and due probably to defective or diseased growth. In all cases the form of the sulcations corresponds with that of the striæ of growth, or in other words with the form of the aperture of the shell.

The sulcation is frequently, but not always, marked on the cast. According to

M. Pictet, casts so marked are to some extent impressions of the external mould (the shell having disappeared) rather than of the interior of the shell. That this may sometimes be the case will be readily admitted. Some of our casts are, however, distinctly sulcated beneath the thin regular layer of gypsum which has replaced the shell, and there is one case, in which a portion of the shell remains on the cast with all its original sharpness of ornament; which facts lead me to believe that when the sulcation is strongly marked, as in most adult specimens, a corresponding undulation will be produced on the internal surface of the shell. The absence of sulcation on casts is, however, as remarked by M. Pictet, no proof of the smoothness of the external shell.

Among the smooth Nautili a few species possess a minute characteristic striation. The young of our *N. Bouchardianus* and the *N. Clementinus* afford instances of such ornamentation: and *N. Valudayurensis*, in what is probably its adult stage, presents a very beautiful minute decussation: (see Pl. XII. Fig. 2, 2b.). In broken specimens, which constitute the majority of all collections, the striation of the external shell is sometimes important, as indicating the form of the mouth.

3. In the majority of the Indian Cretaceous Nautili, the umbilicus is closed by the overlap of the outer whorl when the shell is perfect: in those which have the inner whorls exposed its maximum diameter is $\frac{1}{2}$ of that of the shell (*N. Forbesianus*). *N. Clementinus* has a minute perforation only, and *N. Bouchardianus* a deep funnel-shaped impression, sometimes open, sometimes closed at the bottom. Other species, such as *N. Huxleyanus*, wind round a solid shelly columella which terminates flush with the surface of the shell, and leaves a corresponding perforation in the cast. In any one species the proportional size of the umbilicus is pretty constant, except in a few Protean species, such as *N. Bouchardianus*, in which it varies with the thickness and rotundity of the shell. In some specimens of this species, it is a distinct funnel-shaped cavity with flattened sub-angulated sides: in others but a slight vorticillate impression in the side of the shell, and in others again a widely perforated umbilicus, in which the edges of the inner whorls are exposed.

The umbilicus of the cast is much less characteristic than that of the shell. A distinct perforation exists in all cases, and, as remarked by M. Pictet, its size is in general no criterion of an open or closed umbilicus, as it may or may not have been occupied by a thick shelly columella. The diameter of the umbilical perforation is, however, in general, pretty constant in the same species, so far as the Indian series enables me to judge; but a cast must be well cleaned from matrix and have its umbilical edges very perfect to allow of the width of the umbilicus being accurately ascertained. The diameter of the umbilicus may be measured directly, and the measurement expressed in terms of the diameter of the shell, but a better mode of obtaining the spiral proportions of a shell, inasmuch as it deals with larger fractions and is in general more easy of application, is to ascertain the diameter of the outer whorl, or distance between the umbilicus and the edge of the shell, and to express it as a fraction of the total diameter. In compressed shells

it is sufficient to obtain this measurement by placing the limbs of the compasses or callipers, one on the inner edge of the umbilicus, the other on the median ventral line, the greatest diameter of the shell being then measured from the latter point, but in globose specimens the outer whorl must be measured on a plane parallel to that of the spiral.

4. The form of Nautili, as regards greater or less tumidity, or, in other words, their thickness as compared with their diameter, is a character which is very constant in certain species, and as variable in others. As a general rule, the more tumid forms of Nautili are most subject to variation in this respect, as, eg. *N. Bouchardianus* and *N. pseudo-elegans*, but *N. Huxleyanus*, an equally tumid species, is very constant in form. The slight flattening of the sides and ventral regions, which is to be remarked in certain Nautili, appears by no means a specific character. *N. Bouchardianus* and *N. Clementinus* afford good instances of this (see Plates IV, and VI, VII). Even those species, in which the flatness of the shell is most characteristic tend to assume a rounded form, as they increase in size.

5. The form of the septum is a specific character of great importance, but it is only applicable to the determination of a small number of species. In the majority of the Nautili, the septum presents a simple concave surface with straight or slightly flexuous margins offering nothing very characteristic. In a few, however, both of the smooth and costulate forms, the septum is bent into lobes, the margins of which, exposed on the surface of the cast, are very constant in form and position, and characteristic of the several species. The only change that these lobes undergo during growth is, that they become more angular and decided in form. A small median dorsal impression occurs in the young shells of certain species, some of which have simple margins, but it affords no specific character, and becomes obsolete in the adult shell.

The genus *Nautilus*, as restricted by the exclusion of *Aturia*, *Discites* *Temnocheilus*, and *Cryptoceras*, is divided by M. D'Orbigny into the following three groups:—

LÆVIGATI, or Nautili with smooth shells; ranging from the Permian epoch to the present day.

RADIATI, having the shells ornamented with transverse ribs; exclusively Cretaceous.

STRIATI, having the shells ornamented with longitudinal striæ; [in Europe] exclusively Oolitic.

It is doubtful whether these subdivisions are of any physiological importance. Judging from the facts detailed at a preceding page, the transverse ribbing of the *Radiati* is nothing more than an exaggerated striation, or marking of intermittent growth corresponding to the varical ridges of several Gasteropoda and bivalves, while the longitudinal striation of the *Striati* cannot be regarded as of more physiological importance (apart from any possible correlation* with internal organs.)

* As will be obvious to every one who has read Mr. Darwin's well-known treatise, I here employ the language and ideas of that author as developed in Chap. V of his work on the Origin of Species, &c.

than the ribbing of a *Venus*, or the colour of a *Cypræa*. The fact, however, that two of these groups have definite restricted ranges in time, the one being peculiar to Oolitic, the other to Cretaceous rocks, makes this classification of great value to the Palæontologist, and lends some support to the probability that the peculiarities of external ornamentation were correlated with internal characters of more physiological importance.

Among the well defined species of *Nautilus* from the Cretaceous rocks of Southern India we have representatives of all these groups, in the proportion of 10 species of the *Lævigati*, 8 of the *Radiati*, and 1 of the *Striati*.

The abundant occurrence of the two former groups in the rocks of South Arcot and Trichinopoly is fully in accordance with the character of the entire fauna, but the occurrence of a species of the *Striati* group in rocks, the majority of the fossils of which are of Cretaceous types, proves that the range of this group, in time, is greater than had been inferred from the distribution of its European members. It is, however, to be remarked, that the single species discovered occurs in the Valudayur beds, the oldest division of our series, and the fauna of which, mainly Neocomian, affords more than one instance of the intermixture of Oolitic types. None of the *Radiati* group of *Nautili* have hitherto been discovered in these beds, and the Ootatoor beds of Trichinopoly, in which this latter group appears in great force, have a fauna almost entirely distinct, and almost as characteristically Upper Cretaceous as the Valudayur fauna is Neocomian. On the other hand, the *Radiati*, which are exclusively Cretaceous in their range, do not appear below the Ootatoor Group, the fauna of which partakes as much, if not more, of an Upper, than of a Lower Cretaceous aspect. The *Lævigati* range throughout.

The following is a classified list of the well identified species described in the following pages, together with their respective Geological ranges in the Indian beds. It is probable that the list is imperfect even as regards our present collections, since I have confined myself to the description of well preserved specimens, and have put aside a large number, which I cannot refer to any known species, but which are insufficiently characterized, or too imperfect in point of preservation, to admit of their definition as distinct forms.

NAUTILI.

A. Smooth shells. *Lævigati*.1. *Septa simple*—

1. <i>N. Bouchardianus</i> .	D'Orbigny.	Arrialoor group.
2. <i>N. Clementinus</i> .	„	„ „
3. <i>N. Huxleyanus</i> .	nov. sp.	Ootatoor & Trichinopoly groups.
4. <i>N. splendens</i> .	„	Ootatoor group.
5. <i>N. justus</i> .	„	„ „
6. <i>N. Valudayurensis</i> .	„	Valudayur „

2. *Septa lobed*—

7. <i>N. Danicus.</i>	Schlotheim.	Arrialoor group.
8. <i>N. serpentinus.</i>	nov. sp.	„ „ ?
9. <i>N. Forbesianus.</i>	„	Ootatoor „
10. <i>N. angustus.</i>	„	„ „

B. Transversely ribbed. *Radiati.*1. *Septa simple*—

11. <i>N. formosus.</i>	nov. sp.	Arrialoor group.
12. <i>N. elegans.</i>	Sowerby.	Trichinopoly „
13. <i>N. Kayeanus.</i>	nov. sp.	Ootatoor „
14. <i>N. pseudo-elegans.</i>	D'Orbigny.	„ „
15. <i>N. Negama.</i>	nov. sp.	„ „
16. <i>N. crebricostatus.</i>	„	„ „

2. *Septa lobed*—

17. <i>N. Rotæ.</i>	„	Arrialoor group.
18. <i>N. Trichinopolitensis.</i>	„	„ „

C. Longitudinally striated. *Striati.*1. *Septa simple ?*

19. <i>N. Pondicherriensis.</i>	nov. sp.	Valudayur group.
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Of the Indian Cretaceous Nautili described by Professor E. Forbes and M. D'Orbigny I have been able to identify with certainty only the *N. lævigatus* and *N. sphericus* of the former author, or *N. lævigatus* and *N. Dekayi* of the latter, which species I have here included as varieties of *N. Bouchardianus*. The *N. Clementinus* of Forbes is stated to be from Verdachellum, a locality which has furnished no specimen of the genus to our collections. There is, however, in the Madras museum a specimen with decussate striation so named by Mr. Kaye, but which having a closed umbilicus and being very globose in form, cannot be the *N. Clementinus* of Forbes. It is labelled as from Verdachellum, but from its appearance and the character of the matrix, I can entertain no doubt that this reference is erroneous, and that it is really from the Valudayur beds of Pondicherry. M. D'Orbigny in the "Voyage of the Astrolabe" gives the name *N. Sowerbyanus* to a species from Pondicherry which he identifies as the *N. Clementinus* of Professor Forbes, and in the "Prodrome de Palæontologie" quotes Pondicherry and Verdachellum as its localities, renaming it *N. Indicus*. This Nautilus is, however, assuredly not the Nautilus of Mr. Kaye's collection, nor does it bear more than a general external resemblance to any species from the Indian Cretaceous beds. Its external siphuncle induces the belief that the figure is taken from a S. American specimen (Chili and the Quiriquina island being included in the list of its localities), inasmuch as no Nautilus of the form figured, and with an external siphuncle, occurs in our S. Indian collections. The same character distinguishes it also from Mr. Kaye's *N. Clementinus*, which is an undescribed species, and which I have named *N. Valu-*

dayurensis. Under these circumstances, I conclude that the *N. Clementinus* of Forbes, if not identical with that from the Arrialoor beds of Trichinopoly which I have referred to the same species, (or the young of *N. Bouchardianus*, which equally exhibits a decussate striation,) is one that has hitherto escaped our researches, while the *N. Indicus* of M. D'Orbigny is most certainly distinct from any in our collection. With reference to the former, I may remark that although none of the Kaye collection of fossils described by Professor Forbes were from the Arrialoor beds of Trichinopoly, and although I have not met with my *N. Clementinus* either at Verdachellum or Pondicherry, nevertheless the Arrialoor group occurs at both these localities, and it is possible therefore that Forbes' *N. Clementinus* may be identical with that of the present monograph.

Another species described by Professor Forbes, and which I have not met with, is *N. delphinus*. Several of our species have indeed highly sinuous septa, and *N. serpentinus*, nov. sp., bears a considerable resemblance to the figure of *N. delphinus*. The differences, however, are too great to admit of my uniting them, and we must therefore for the present regard *N. delphinus* as a distinct species, which we have not re-discovered.

We have then, in addition to the species above tabulated, the two following from the Cretaceous rocks of Southern India:—

? <i>N. Indicus</i> .	D'Orbigny.	Prodr. de Pal. Vol. II. p. 211. Pondicherry.
<i>N. delphinus</i> ,	Forbes.	Geol. Trans. Vol. VII. p. 98. Pondicherry.

DESCRIPTION OF SPECIES.

1. NAUTILUS BOUCHARDIANUS, *D'Orbigny*. Plates III. IV. V.

1840. NAUTILUS BOUCHARDIANUS, *D'Orb.* Pal. Franc. Terr. Cret. Tome 1, p. 75, pl. 13.
 1846. — LEVIGATUS, *Forbes*. Trans. Geol. Soc. 2nd Ser. Vol. VII. p. 97.
 — — SPHERICUS, ditto ditto ditto p. 98.
 1847. — LEVIGATUS *D'Orb.* Géologie du voy. de l'Astrolabe. Pal. VI. figs. 1, 2.
 1850. — DEKAYI (in part), *D'Orb.* Prodr. Tom. II. p. 211.
 1859. — BOUCHARDIANUS, *Pictet*. Matériaux pour la Pal. Suisse. Terr. Cret. de Sainte Croix. p. 142. Pl. XVIII. figs. 1-3.

N. testa globosa, perinflata, levigata, crassa, juniore decussati-striata; umbilico impresso, plerumque infundibuliformi, perforato vel aperto, absque columella; Ventre lato, rotundato: Apertura aut depressa aut orbiculari, aut reniformi; septorum marginibus lateraliter sub-sinuatis, siphunculo inter $\frac{2}{4}$ et $\frac{1}{3}$ altitudinis posito, externo, nonnundum subcentrali, vel subinterno.

DIMENSIONS.

	a.	b.	c.	d.	e.	f.	g.	h.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Diameter of shell,.....	—	7 $\frac{1}{4}$	7	6 $\frac{1}{8}$	6 $\frac{1}{2}$	5 $\frac{1}{8}$	—	4 $\frac{1}{4}$
„ outer whorl,	5	4 $\frac{1}{4}$	4 $\frac{1}{4}$	3 $\frac{7}{8}$	3 $\frac{1}{2}$	3 $\frac{5}{8}$	2 $\frac{1}{4}$	2 $\frac{7}{8}$
Thickness of ditto,	7	5 $\frac{3}{4}$	5 $\frac{1}{4}$	5	5 $\frac{1}{8}$	4 $\frac{1}{8}$	3 $\frac{1}{2}$	3 $\frac{1}{8}$
Height of aperture,.....	3 $\frac{1}{4}$	2 $\frac{1}{4}$	—	2 $\frac{7}{8}$	2 $\frac{1}{2}$	2 $\frac{7}{8}$	1 $\frac{5}{8}$	1 $\frac{3}{8}$
Thickness at return of whorl,...	—	3 $\frac{1}{8}$	2 $\frac{1}{4}$	2 $\frac{1}{8}$	—	2 $\frac{1}{8}$	1 $\frac{5}{8}$	1 $\frac{1}{8}$

(a) A fragment of a cast of the body-whorl from Olapady. Mouth wanting. Ventral region and sides much flattened.

(b) A very tumid depressed specimen from Shillagoody, shell nearly perfect, figured at Pl. III. fig. 1, 1a.

(c) A very broad depressed specimen from Olapady, figured at Pl. IV. fig. 1. $\frac{1}{2}$ size.

(d) A widely umbilicated specimen from Pondicherry. Madras Mus. Figured, Pl. IV. fig. 7. $\frac{1}{2}$ size, shell imperfect.

(e) A rounded specimen from Koloture. Pl. IV. fig. 5. $\frac{1}{2}$ size: umbilicus almost closed.

(f) A rather compressed specimen from Arrialoor. Pl. IV. fig. 2. $\frac{1}{2}$ size: shell wanting.

(g) A fragment of *N. sphericus*, var. from Pondicherry, figured at Pl. IV. fig. 8. $\frac{2}{3}$ size.

(h) A narrow whorled specimen from Arrialoor. Pl. V. figs. 1, 1a.

Diameter of outer whorl : diam. of shell = $\frac{57}{100}$ to $\frac{60}{100}$.

Height of aperture : thickness ... = $\frac{60}{100}$ to $\frac{63}{100}$.

Increase of thickness in outer whorl ... = $\frac{80}{100}$ to $\frac{90}{100}$.

Shell globose, thick, externally smooth, or, in adult specimens, marked with fine sinuous lines of growth which form a sinus in the median ventral region, and occasionally in very old specimens become exaggerated into irregular sulcations. [The young shell when of about $\frac{3}{4}$ inch diameter is marked with very regular minute transverse ridges, which are crossed by a series of minute longitudinal ridges in a manner similar to the young of *N. Clementinus*. See Pl. IV, figs. 3—3c. With the increased growth of the shell, the former become gradually sinuated, as above described, and less regularly recurrent, while the latter become obsolete first on the ventral surface and finally at the sides.] Umbilicus perforated, deeply impressed and funnel-shaped, variable in depth and in aperture in different specimens. In some specimens the umbilical edges of the whorls are almost in contact, as in the large example figured at Pl. III, while in others they leave a considerable opening, as in the specimen from Pondicherry, Pl. V. fig. 2: between these extremes we have every degree of variation. The ventral region very broad and evenly rounded. Aperture depressed, reniform, or semicircular; generally about twice as broad as high, but variable in form and dimensions. Septa very concave, moderately distant, about 18 to the whorl: the margins straight in the ventral region, more or less sinuated towards the umbilicus. Siphuncle situated between $\frac{1}{3}$ and $\frac{2}{3}$ of the height of the septum, and, therefore, either central, or ventrally or dorsally eccentric, in different specimens.

The comparison of a large series, comprising more than 100 specimens of this species, chiefly from Trichinopoly and for the most part in excellent preservation, has alone enabled me to trace out the relationship of the very variable forms which

it includes, and to identify them as varieties of the Gault species of Europe, *N. Bouchardianus*, the excellent figures and detailed descriptions of which by MM. D'Orbigny and Pictet offer reliable materials for comparison. The Pondicherry specimens of Messrs. Kaye and Cunliffe's collection were referred by Professor Forbes to two distinct species, the less globose varieties being regarded as identical with *N. lævigatus*, D'Orbigny, while the more tumid forms were described as a new species under the name *N. sphericus*. M. D'Orbigny also referred the present species, in the first instance, to *N. lævigatus*, but in summarizing the described species of Cretaceous Nautili in his Prodrôme (loc. cit.), referred the whole of the specimens in question to *N. Dekayi*, Morton, (a fossil of the upper cretaceous formation of New Jersey, U. S.), together with the *N. perlatus* of the same author and *N. Orbignyanus*, Forbes, of the cretaceous rocks of Chili. Unless, however, M. D'Orbigny had at his disposal some other data than the figures and very brief and general description of *N. Dekayi* in Mr. Morton's Synopsis, his identification of the Pondicherry specimens as *N. Dekayi* appear to be open to much doubt: the greater in proportion to the difficulty of discriminating nearly allied species of Nautili, even when good specimens are available for comparison.*

The distinctive characters upon which Professor Forbes separated the Pondicherry Nautili from *N. Bouchardianus*, viz. the greater globosity of the former, and the inferior position of the siphuncle, are subject to much variation. In the Pondicherry specimens, the siphuncle is, as stated by Professor Forbes, usually inferior, both in the *N. lævigatus* and *N. sphericus* of that author, but in the Trichinopoly specimens (which, while varying considerably in thickness, agree closely in their generally globose form their funnel-shaped umbilicus and thick shell, and which it is impossible to regard as belonging to separate species), the siphuncle is in some cases similar in position to that of the Pondicherry Nautili, while in others it is placed as much above the centre of the septum as in the average of M. Pictet's examples from the Swiss Gault. The Indian specimens are for the most part of far greater size than those described by M. Pictet, and one fragmentary specimen from Trichinopoly shows that the species occasionally attained dimensions much exceeding those most prevalent in the series. However, mere size is very unreliable as a specific character in such a genus as the Nautilus, especially as regards fossil forms; and if we find a satisfactory coincidence in form and structure, such as to warrant identification of our Indian examples with a previously described species from European deposits of about the same Geological age, a difference in average dimensions could scarcely be held to invalidate the conclusion. Moreover, that *N. Bouchardianus* did occasionally attain, in European seas, to dimensions not inferior to the majority of our Indian examples, appears from M. D'Orbigny's mention of a specimen in the Musée d'Histoire Naturelle of 300 mm. or about 1 foot in

* From the specimen of *N. Dekayi* figured at Pl. VIII. fig. 4 of Morton's "Synopsis," it would seem that *N. Dekayi* is a distinct species, inasmuch as the overlap of the whorl appears to form a solid columella, which is never present in *N. Bouchardianus*.

diameter, which is equal to the calculated dimensions of our largest fragment. The ornamentation of the young shell in some of our Indian specimens, (and which somewhat resembles that of the young *N. Clementinus*,) is a character that has not been noticed in the European species. This, however, might be expected, if very well preserved specimens of the young shall have not been examined, for the sculpturing is so fine as to be readily obliterated by any injury to the external coat of the shell.

Variation. Some of the variations in form exhibited by our specimens are illustrated on Plates IV & V. The height of the aperture* varies from $\frac{46}{100}$ to $\frac{63}{100}$ of the thickness of the whorl, the former being that which obtains in the *N. sphericus* of Forbes. The height appears to be rather greater in most of the figures, but this is due to the overlapping of the stone which fills the aperture, and covers a portion of the inner whorl. Where the septum is cleared, the proportion of the height to the thickness is rarely more than that above stated; the chief exceptions being young specimens, which are invariably less tumid. In some specimens the sides are somewhat flattened as in the typical European specimens, but in the majority the external surface is evenly rounded, the aperture being almost a perfect semicircle. The rate of increase of the thickness or the whorls during growth is also very variable, the extremes of increase in one whorl being $\frac{39}{100}$ and $\frac{60}{100}$, and thus some specimens are more square and clumsy in form than others. Fig. 1. Pl. IV. and Pl. III. show extreme cases of this. Young specimens exhibit in the above respects as much variety as adults.

The siphuncle is, in the majority of the Trichinopoly specimens, external or on the ventral side of the septum, its extreme position being at $\frac{2}{3}$ of the height measured from the dorsal edge of the septum on the inner whorl. In other specimens it is nearly central and in others again sub-dorsal in position. In some of the Pondicherry specimens it is as low as at $\frac{1}{3}$ the height of the septum. Fig. 8, Pl. IV. exhibits an extreme case of this variation, in a specimen from Pondicherry.

The variations in the umbilicus, I have noted above.

N. Bouchardianus is readily distinguished from *N. Huxleyanus*, and indeed from all the other species occurring in the Cretaceous rocks of Southern India, by its globosity, which is conspicuous even in the least tumid specimens. Its siphuncle, moreover, is less ventral than in *N. Huxleyanus*: and the inflated whorls and funnel-shaped umbilical cavity, (the latter, however, not of constant occurrence,) are also peculiar and characteristic. It occurs only in the Arrialoor group, and chiefly in the lower beds. It is most abundant in the neighbourhood of Arrialoor. The nullah to the east of Shillagoody, and the ridge to the east of Olapaudy have also furnished several fine specimens. At Pondicherry it occurs rarely, but is more abundant than any other Nautilus. Most of the Pondicherry specimens are from the neighbourhood of Ráyapoothoopákkam and Sudarampet.

* By "the height of the aperture" is here meant the vertical distance from the ventral edge of the aperture to the median ventral line of the inner whorl.

EXPLANATION OF PLATES.

- Pl. III. Figs. 1, 1a. *N. Bouchardianus*, from Shillagoody, Trichinopoly, side view, and half outline of front view.
- Pl. IV. Fig. 1. From Olapaudy. Front view, reduced to half lineal dimensions.
- " " 2. From Arrialoor. Do. do. do.
- " " 3. From Arrialoor. Side view of young specimen.
- " " 3a. Do. Front view of same.
- " " 3b, 3c. Do. Do. do. enlarged.
- " " 4. From Pondicherry. Section of specimen. Madras Museum Collection.
- " " 5. From Koloture, Trichinopoly. Front view, reduced to half dimensions.
- " " 6. From Arrialoor, Trichinopoly. Front view, reduced to half dimensions.
- " " 7. From Pondicherry. Front view, reduced to one-half dimensions. Madras Museum Collection.
- " " 8. From Pondicherry. Fragment showing septa, reduced to $\frac{1}{4}$ lineal measurements. Madras Museum Collection.
- Pl. V. Figs. 1, 1a. From Arrialoor, Trichinopoly. Fig. 1, side view; 1a, front view.
- " " 2. From Pondicherry. Side view, reduced to $\frac{1}{2}$ lineal measurement.
- " " 3. From Shillagoody, Trichinopoly. Front view.
- " " 4. From Pondicherry. Front view. Madras Museum Collection.
- " " 5 & 6. Septa of *N. Bouchardianus*.

2. NAUTILUS CLEMENTINUS, *D'Orbigny*. Plate VI. Plate VII. Figs. 1, 2.

1840. *Nautilus Clementinus*, D'Orb. Palaéont, Franç. Terr. Cret. Vol. I. p. 77. pl. 13. bis.
1846. " " Forbes. Trans. Geol. Soc. Lond. 2nd Ser. Vol. VII. p. 98.
1847. " *Sowerbianus*, D'Orbigny. Géologie du Voy. de l'Astrolabe, Pl. IV. figs. 1, 2.
1850. " *Indicus* (in part), D'Orb. Prodrome de Pal. Vol. II. p. 211.
1850. " *Clementinus*, D'Orb. Prodrome de Pal. Vol. II. p. 211.
1859. " " Pictet. Mat. pour la Pal. Suisse. 2 Ser. Terr. de Ste. Croix, p. 144, Pl. XIX. figs. 1—5.

N. testá discoideá, compressá, lævigatá: Umbilico parvo, perforato: Ventre rotundato vel sub-planato: Aperturá ovatá vel lunatá: Septis subsinuatis; Siphunculo eccentrico, interno apud $\frac{2}{3}$ altitudinis posito.

DIMENSIONS.

	a.	b.	c.
	Ins.	Ins.	Ins.
Diameter of shell,	6	$4\frac{1}{2}$	4
Ditto of outer whorl,	$3\frac{1}{2}$	$2\frac{2}{3}$	$2\frac{1}{3}$
Thickness,	—	3	$2\frac{1}{2}$

(a) Largest specimen longitudinally striated, from Coothoor near Arrialoor, surface worn.

(b) Cast from Karapaudy, near Arrialoor, Pl. VI. fig. 1, 1a.

(c) Specimen with shell, Pl. VI. Fig. 2, 2a, from Olapaudy.

Diameter of outer whorl : diameter of shell = $\frac{20}{100}$ to $\frac{60}{100}$.

Shell discoid, compressed, slightly flattened at the sides, and sometimes in the ventral region. The surface smooth or marked with striæ of growth, which are strongly angulated by the median line. Umbilicus small, consisting of a simple perforation in which the interior whorls are exposed in old specimens. Aperture

variable in form according to the greater or less compression of the shell : ovate in the more compressed specimens, lunate in the more tumid. Septa rather close, slightly sinuated ; those of the younger whorls deeply indented at the centre of the dorsal edge. Siphuncle dorsally eccentric, situated at about $\frac{2}{3}$ the height of the septum.

The specimens that I refer to *N. Clementinus* are all from the Arrialoor group. They correspond to MM. D'Orbigny's and Pictet's figures and descriptions of this species in all the important characters, so far as the state of their preservation will admit of comparison, but the existence of the decussate striation of the young shell, which is one of the most distinctive features of the type, cannot be established in the case of the Trichinopoly specimens owing to their state of preservation.

One large specimen exhibits a decided longitudinal striation of a portion of the shell, but from the thinness of the latter. I infer that in this case the shell has been in a great measure eroded, and an internal structure thus developed. Other specimens, as that figured at Plate VI. figs. 2, 2 *a.*, exhibit a perfectly smooth shell.

The Trichinopoly specimens, which are not very numerous, exhibit nevertheless some variation in form, especially in the greater or less degree of flatness of the sides and ventral region. The figures given in Plates VI. and VII. sufficiently illustrate this. Similar variations in a series of Swiss specimens are noticed by M. Pictet in his Description des foss. du terrain Cretacé de Sainte Croix.

The umbilicus in some specimens in which the shell is broken, appears to form a solid columella. As these specimens, however, are not otherwise distinguishable, I regard them mainly as a variety in which the perforation does not extend far inwards. That figured at Plate VII. fig. 2 is an instance of this. In this specimen the siphuncle and the little dorsal depression mentioned by M. D'Orbigny are well seen.

A Nautilus, said to be from Verdachellum, was referred to this species by Professor Forbes. I have not myself met with any specimen of the genus at the locality in question after repeated search, both personally, and with the aid of Mr. Cunliffe's native collector, and as I find, in the Kaye collection at the Madras Museum, numerous specimens marked as from Verdachellum which are without doubt from beds of the Trichinopoly and Valudayur groups, neither of which occur anywhere in the neighbourhood, and as it is evident a similar error of locality has pervaded the monograph of Professor Forbes, I cannot but entertain some doubts as to the real locality of Professor Forbes's specimens and consequently of their identity with those which I refer to the same species. In the Kaye collection in the Madras Museum is a specimen from the Valudayur group of Pondicherry, also marked *N. Clementinus* in Mr. Kaye's handwriting. This specimen, which resembles the species cited in the position of the siphuncle, the form and indentation of the septa, and in the surface of the shell being marked by reticulated striæ, is, however, clearly distinguished by the possession of an imperforated umbilicus. In shape also, it is more tumid than any of the Trichinopoly specimens, and the striation, which is visible only on the external layer of the shell, is finer than appears from the descriptions to obtain in the case of the typical *N. Clementinus*,

and is only clearly visible with the aid of the lens. This specimen I have figured and described as *N. Valudayurensis*.

N. Clementinus may be regarded as very nearly allied to *N. Bouchardianus*, with which it is associated. It is constantly more compressed and has always a dorsal siphuncle, but there is otherwise little to distinguish it. Like *N. Bouchardianus* it appears also to be a very variable form, although not to the same extent as that species.

Range of N. Clementinus. Lower part of Arrialoor group.

Localities. Arrialoor, Karapady, Mulloor, and Coothoor, in Trichinopoly district.

EXPLANATION OF PLATES.

Plate VI. Figs. 1, 1a. Specimen from Karapady, Trichinopoly.

Plate VII. Figs. 1, 1a. Side and front view of specimen from Ootacoil, Trichinopoly.

„ „ 2. Front view of specimen from Ootacoil, Trichinopoly.

3. NAUTILUS HUXLEYANUS, *n. sp.* Plate VII. Figs. 3, 4; Pl. VIII. Figs. 1, 2, 3; Pl. IX. Figs. 1, 2, 3, 4.

N. testâ inflatâ, lævigatâ vel striatâ, senioribus nonnullis undulatè rugatis: Aperturâ orbiculari lunatâ: Septis subflexuosis, distantibus: Siphunculo externo, circiter $\frac{3}{4}$ septorum altitudinis posito.

DIMENSIONS.

	a.	b.	c.	d.	e.
	Inches.	Inches.	Inches.	Inches.	Inches.
Diameter of shell,	7.4	7.4	6.10	5.2	3.3
Ditto of outer whorl,	4.6	4.6	4.1	3.1	1.11
Thickness of ditto,	5.9	5.0	—	3.8	2.5

Diameter of outer whorl : Diameter of shell = $\frac{6.1}{7.4}$ to $\frac{6.4}{7.4}$.

(a) A cast from Trichinopoly group, Andoor, with traces of ribbing: half size. Plate VIII. fig. 1a.

(b) Largest specimen from Ootatooor group, cast. Coonum.

(c) Another cast from Coonum, with impression of mouth perfect.

(d) Specimen from Anapady with part of shell which is striated, Trichinopoly group.

(e) Ribbed specimen figured, Plate VIII. fig. 2, from Andoor, Trichinopoly group.

Shell inflated, smooth, or striated minutely with lines of growth; in some specimens these become more strongly marked, and occasionally form ridges as in the specimen figured; Umbilicus scarcely impressed, closed by the overlap of the outer whorl; ventral surface broad, evenly rounded, marked in some well preserved casts with a fine filiform ridge. Aperture orbicular, moderate, and excavated by the interior whorl. (The casts from Coonum and Moonglepaudy have the impression of the aperture frequently perfect. There appears to have been a broad thickened band of shell near the edge, which is beveled outwards, or trumpet-shaped, in the cast. See Plate IX. Fig. 1.) Septa very concave, with slightly flexuous margins, few and distant: from 13 to 16 in one whorl. Siphuncle at about $\frac{3}{4}$ the height of the septum. It is not unfrequently laterally eccentric, viz. to the right or left of the median line.

As compared with all but *N. elegans*, which is distinguished by its flat regular ribbing and more compressed form, the fewness and distance of the septa sufficiently characterize the species.

The smooth forms predominate and occur exclusively in the Ootatoor group, but in a few specimens from the Trichinopoly beds, and which are otherwise undistinguishable, the shell where about 2 or $2\frac{1}{2}$ inches in diameter, becomes ornamented with narrow folds or ridges which coincide with the striation of growth, and are probably only an exaggeration of these striæ. They are very different in character from the flat ribs of such species as *N. elegans*. It is indeed possible that I have confounded two distinct species, inasmuch as many specimens from the Trichinopoly beds, of 3 times the diameter of the ribbed specimens, have a smooth or merely striated shell, but they are distinguished, as far as I can see, by no other character. A large cast from Andoor with traces of undulations is figured at Plate VIII. Fig. 2, half of its real size. The position of the siphuncle varies somewhat; its extremes, as marked on ten specimens, are between $\frac{63}{100}$ and $\frac{73}{100}$.

This species so nearly corresponds with the descriptions and figures of *N. lævigatus*, D'Orbigny, that it is with some hesitation I have ventured to separate it as a distinct species. In general external form, as well as in the form of the septa, and in the external position of the siphuncle, the resemblance between the two species is very great, and it is only on comparing together a large series of specimens, such as that collected by the Survey, that certain minor characters are seen to be so prevalent as to stamp the present as a distinct species. These are, the great breadth of the chambers or in other words the small number of septa in the whorl, the greater eccentricity of the siphuncle, and the tendency to form ribs or ridges of growth, manifested by some specimens, a tendency never seen in any specimens of *N. lævigatus*.

This is not the species doubtfully referred to *N. lævigatus* by Professor Forbes, in his memoir on the Cretaceous Fossils of S. India. The specimen in Mr. Kaye's collection, so referred by Professor Forbes, was from Pondicherry (where the present species does not occur) and is the same that I have referred to *N. Bouchardianus*.

N. Hurjejanus occurs both in the Ootatoor and Trichinopoly groups. It presents itself almost invariably wherever fossils occur, in the latter formation most commonly in the form of casts. It is confined to the upper portion of the former group, and to the beds to the east of Moonglepaudy and Odium.

In the broken ground south-west of Coonum, and again to the east of Odium, and to the south of Moonglepaudy, it occurs as the nucleus of septaria-nodules, on breaking which, it is found with the shell very beautifully preserved and quite perfect. It is difficult unfortunately to extract the shell without injury, as these nodules have a great tendency to break up in all directions under the blow of the hammer.

In the Madras museum are two specimens marked as from Verdachellum, but for reasons stated elsewhere I strongly doubt the correctness of this reference; they have all the appearance of specimens from the Trichinopoly group of that district.

Range. Upper part of Ootatoor group, and Trichinopoly group.

Localities. Serdamungalum, Goroodamungalum, Anapaudy, Koloture, Shutanure, Moonglepaudy, Coonum, Andoor, Pootoor, and Purawoy, in the Trichinopoly district.

EXPLANATION OF PLATES.

- Pl. VII. Fig. 3. Side view of specimen from Serdamungalum. Trichinopoly group.
 " " 4. Do. do. do. Coonum. Ootatoor group.
 Pl. VIII. Figs. 1, 1a. Ribbed cast from Andoor. Trichinopoly group. Reduced to $\frac{1}{2}$ lineal measurements.
 " Fig. 2. Ribbed specimen from Andoor.
 " " 3. Septum of *N. Huxleyanus*.
 Pl. IX. Fig. 1. Cast from Moonglepaudy, Trichinopoly. (Ootatoor group.) Side view reduced $\frac{1}{2}$.
 " " 2. Outline of Septum, from same locality. Siphuncle subcentral.
 " " 3. Outline of septum of specimen from Andoor, Trichinopoly. (Trichinopoly group.) Siphuncle median.
 " " 4. Outline of septum of specimen from Shutanure, Trichinopoly. Siphuncle ventral.

4. NAUTILUS SPLENDENS, *n. sp.* Pl. IX. Figs. 5, 5a; Pl. X. Fig. 1.

N. testá discoideá, compressá, lævigatá : umbilico impresso, imperforato : ventre rotundato, seniore subplanato : aperturá ovatá : septis subsinuatís : siphunculo interno, apud $\frac{1}{2}$ septorum altitudinis posito.

DIMENSIONS.

	a.	b.
	Inches.	Inches.
Diameter of shell,	4.75	4.2
Ditto of outer whorl,	3.0	1.6
Thickness,	2.65	1.5

The dimensions are those of the only two specimens found: for locality see below.

(a.) Pl. IX. fig. 5, 5a.

Diameter of outer whorl: diameter of shell = $\frac{2}{3}$.

Shell discoid, compressed, rounded on the sides and ventral region in the young shell, flattened slightly on the periphery when adult, surface very smooth, marked only faintly with striæ of growth, which are deeply sinuated on the ventral region. Umbilicus impressed, forming a shallow funnel-shaped hollow closed at the bottom. Aperture ovate, slightly truncated in front, the peristome probably deeply notched in front in the perfect shell. Septa slightly sinuous, pierced by the siphuncle at about $\frac{1}{2}$ of their height, measured from the base of the septum.

This nautilus, of which only two specimens have been found in the Odium beds of the Ootatoor group, is readily distinguished from most of the smooth-shelled Nautili of the Indian Cretaceous rocks by its compressed form and sub-parallel rounded sides. The Arrialoor species, which I have provisionally referred to *N. Clementinus*, offers the nearest approach to it, but, besides being more tumid in form, has a deep and perforate umbilicus. Of European species *N. Neocomiensis*, D'Orb. and *N. Sowerbianus*, D'Orb., the former a Neocomian species, the latter from the

Craie chloritée, resemble *N. splendens* in form, but the former is distinguishable by its costulate shell, the latter by its more sinuous septa, and both by the wide perforation of the umbilicus.

Both the specimens described were found by the officers of the Survey in the Cephalopoda beds of the Ootatoor group, near the village of Odium in Trichinopoly. They are figured in Plate IX. Fig. 5, 5a. and Plate X. Fig. 1. The mouth is wanting, but a large portion of the external shell of the body whorl is beautifully preserved on the larger specimen, stained with oxide of iron. It exhibits very well the smooth polished surface, faintly marked with striæ of growth, which suggested the trivial name.

Range. Middle of Ootatoor group.

Locality. Odium, Trichinopoly district.

EXPLANATION OF PLATES.

Pl. IX. Figs. 5, 5a. Side and front views. From Odium, Trichinopoly.

Pl. X. Fig. 1. Side view of cast, from Odium.

5. NAUTILUS JUSTUS, *n. sp.* Pl. X. Figs. 2, 3.

N. testâ sub-compressâ, sub-complanatâ, lævigatâ, angustè-umbilicatâ: ventre latè-rotundato: aperturâ latè-ovalâ: septis distantibus, lateraliter sub-arcuatis: siphunculo vix centrali, paullulum externo.

DIMENSIONS.

	<i>a.</i>
Diameter of shell,	3 $\frac{1}{8}$ inches.
Ditto of outer whorl,	2 $\frac{3}{8}$ "
Thickness,	2 $\frac{3}{8}$ "

(*a*) From Odium, Pl. X. fig. 2, 2a.

Diameter of outer whorl : diameter of shell = $\frac{100}{100}$.

Shell smooth, rather compressed, and somewhat flattened at the sides, broadly rounded in the ventral region, with a small perforated umbilicus. Aperture ovate, rather depressed anteriorly. Septa few, about 13 to the whorl; the margins arcuated at the sides, straight or slightly convex ventrally. Siphuncle nearly central at $\frac{53}{100}$ to $\frac{50}{100}$ the height of the septum.

By its broad chambers, this nautilus is distinguished from all the other species here described excepting *N. Huxleyanus* and *N. elegans*, the former of which is a much more tumid form and the latter transversely sulcated. Both have, moreover, a sub-ventral siphuncle and are non-umbilicated. *N. Clementinus* and *N. splendens* are somewhat similar in form, and, being smooth shells, bear much resemblance externally to the above species, but in both the siphuncle is decidedly dorsal, and the latter is imperforated; while *N. justus* has a narrow but distinctly perforated umbilicus.

Of species exclusively European, the *N. Charpentieri*, Lam., appears to approach most closely in form to our present species, but, besides being non-umbilicate, it has closely set septa, and an internal siphuncle.

N. justus was found in the highly fossiliferous beds of Odium, where it is associated with *N. splendens*; *N. pseudo-elegans*; *N. Forbesianus*; *N. Kayeanus*; and *N. angustus*; somewhat rare however, and only two specimens are in the Survey collection.

Range. Ootatoor group.

Locality. Odium.

EXPLANATION OF PLATES.

Pl. X. Figs. 2, 2a. Side and front views of a cast from Odium, Trichinopoly.

• „ Fig. 3. Outline of septum.

6. NAUTILUS VALUDAYURENSIS, *n. sp.* Pl. XII. Figs. 2, 3.

N. testá globosá, longitudinaliter transversimque minutissimè decussatim-striatá, haud umbilicatá: ventre rotundato; aperturá semi-ellipticá: septis sub-sinuatis: siphunculo interno apud $\frac{1}{3}$ septorum altitudinis locato.

DIMENSIONS.

Diameter of shell,.....	1 inch 9 lines.
Ditto of outer whorl,.....	1 „ 0 „ approximately.
Thickness,	1 „ 5 „

The specimen has the front part broken: the measurement is taken on the internal portion. Body whorl wanting. Pl. XII. fig. 2, 2a, 2b.

Shell globose, slightly flattened towards the umbilicus, ornamented externally with minute striæ of growth, which are decussated by equally minute zigzag longitudinal striæ, only clearly visible under the lens. This ornamentation is confined to the external coat of the shell. The inner layers are perfectly smooth. The umbilicus presents no indentations, and is closed by a shelly column continuous with the edge of the aperture. Ventral region evenly rounded. Aperture semi-elliptical. Septa rather distant, deeply concave, and having a small indentation on the median dorsal line, the edges slightly sinuous at the sides. Siphuncle eccentric, at about $\frac{1}{3}$ the height of the septa.

A well-preserved specimen of this Nautilus is easily distinguished from all other species by the minute decussate striation, which ornaments the surface of the shell, and is represented on an enlarged scale in Fig. 2b. Plate XII. Specimens which have not the external shell preserved, may be distinguished from *N. Huxleyanus* and *N. vorticosus* by the dorsal position of their siphuncle, and from the *N. Clementinus* [?] of the Arrialoor group by their globose form.

The specimens described and figured are from the Kaye collection in the Madras Museum, and were labelled as *N. Clementinus*, an error founded undoubtedly

upon the character of the striation, which is, however, essentially different from that of the young *N. Clementinus*, as figured by M. D'Orbigny.

Range. Valudayur group, Pondicherry.

Locality. Valudayur, or Verdoor.

EXPLANATION OF PLATES.

- Pl. XII. Figs. 2, 2a. Back and side views of specimen from Valudayur, near Pondicherry.
 „ Fig. 2b. Do. Portion of shell, *enlarged 2 diameters.*
 „ „ 3. A septum, from same locality.

7. NAUTILUS DANICUS. *Schlotheim.* Pl. X. Fig. 4; Pl. XI.

1820. NAUTILUS DANICUS, Schlotheim. Petrefactenkunde, p. 83.

1835. „ „ „ Geol. Trans. Lond. 2nd Ser. Vol. V. p. 250.
 Pl. XVIII. fig. 4—7.

N. testá discoideá, compressá, lævigatá, sub-umbilicatá: dorso rotundato; aperturá ovatá: septis persinuatis, lateraliter in mediá profunditer unilobatis: lobo apertè rotundato: siphunculo subcentrali, paulo externo.

DIMENSIONS.

Diameter of largest fragment,.....	a.	13 inches.
Ditto, outer whorl of ditto,.....	8	„
Thickness,	7	„

Diameter of outer whorl : diameter of shell = $\frac{11}{100}$ to $\frac{12}{100}$.

(a) A fragment from Mooticoorchy in the north of Trichinopoly: mouth broken: Plate XI.

Shell discoid, slightly compressed, smooth, sub-umbilicated; inner whorls entirely concealed. Back rounded; aperture elliptical, narrow, and rounded in front with prominent rounded lateral angles: septa deeply situated, forming an obtuse rounded lobe in the middle of the sides. The basal angles of the lobe also rounded; the dorsal edge straight or slightly convex towards the front; siphuncle a little above the centre of the septum.

On a careful comparison of the specimens of this Nautilus with the figures of *Nautilus Danicus* in the Transactions of the Geological Society (loc. cit.), I am unable to elicit any other difference than a somewhat greater compression of form in some of the former, a character which varies in the series of specimens now before me. The very large size to which the Trichinopoly specimens occasionally have attained can scarcely be regarded as a specific character. In two young specimens from Plaunthoray there is a tendency to form a small median ventral lobe, which disappears in older specimens.

This species is abundant in the highest part of the Arrialoor group. The largest specimens were obtained at Mooticoorchy, on the bank of the Vellaur, where they were very numerous. Other localities were in the bed of the Vellaur, opposite Plaunthoray and in the nullahs to the east of Ninnyoor. These localities

are all on the same stratigraphical horizon. One or two specimens have also been found in beds near the base of the Arrialoor group, at Sudarampet, near Pondicherry.

Range. Upper part of Arrialoor group.

Localities. Ninnyoor, Mooticoorchy, and Plaunthoray, in Trichinopoly district: Sudarampet, near Pondicherry.

EXPLANATION OF PLATES.

Pl. X. Figs. 4, 4a. Side and front views of cast from Ninnyoor, Trichinopoly.

Pl. XI. Figs. 1, 1a. Side and front views. From Ninnyoor. Trichinopoly.

„ Fig. 2. Outline of septum.

8. NAUTILUS SERPENTINUS, *n. sp.* Pl. XII. Fig. 1.

N. testá discoideá, compressá, lævigatá, (?) sub-umbilicatá; lateribus complanatis, ventre rotundato: aperturá ovatá; septis persinuatis, lateraliter et supra medium anfractus valdè uni-lobatis; lobo compresso, rotundato: siphunculo prope marginem internam septa perforante.

DIMENSIONS.

Diameter of whorl,.....	3 ins. 10 lines.
Thickness,	3 „ 5 „
Specimen figured, Plate XII. figs. 1, 1a.	

Shell discoid, compressed, sub-umbilicated. Inner whorls concealed, probably smooth, sides flattened, approximating towards the exterior. Ventral area evenly rounded. Section of whorls elliptical; angles rounded. Septa deeply lobed laterally, a little above the centre of the whorl. The lobe is of compressed form, the dorsal side longest, rounded off abruptly at its ventral base, whence the septal margin crosses the ventral area with a gentle convexity towards the front. The dorsal margin of the septa is also lobed. The siphuncle very near the internal margin, $\frac{1}{5}$ the height of the whorl.

This Nautilus bears much resemblance to *N. Danicus* in its general form and aspect, but is undoubtedly a distinct species. The dorsal position of the siphuncle, and the more sinuated form of the septa clearly establish this. In some respects the present species corresponds to the description of *N. delphinus*, Forbes, but it shows no tendency to the peculiar angulation at the superior flexure of the lobe, which is so strongly insisted on by the describer of that species.

The above description of *N. serpentinus* is taken from a single fragmentary specimen from Rayapoothapakkam, near Pondicherry. It wants the shell, but is otherwise in good preservation.

Range. Arrialoor group.

Locality. Rayapoothapakkam, near Pondicherry.

EXPLANATION OF PLATES.

Pl. XII. Figs. 1, 1a. Side and front views of a cast from Rayapoothapakkam, Pondicherry.

9. NAUTILUS FORBESIANUS, *n. sp.* Pl. XIII.

N. testá discoideá, compressá, lævigatá, latè umbilicatá: ventre rotundato: aperturá trigono-ovatá, peristomate anticè latissimè excavato: septis persinuatis, lateraliter in medio valde uni-lobatis; lobo compresso: siphunculo ad marginem externam approximato.

DIMENSIONS.

Diameter of largest specimen,	4 ins. 10 lines.
Ditto of outer whorl of ditto,	2 „ 10 „
Thickness of ditto,	2 „ 6 „
Diameter of outer whorl : diameter of shell =	$\frac{5}{100}$ to $\frac{5}{100}$.

Specimen from Odium.

Shell discoid, compressed, smooth; or (in the young specimen?) marked with fine spiral and transverse striæ, broadly and deeply umbilicated, the inner whorls being well exposed in the umbilicus, and beneath the overlap of the outer whorls; ventral area evenly rounded, sides flattened, approximating towards the back. Aperture triangular, ovate, rounded in front, broadest near the umbilicus; posterior angles rounded, septa deeply sinuated, forming a compressed lobe nearly in the middle of the whorl, the lobe is of compressed form, subacute in well-preserved specimens, deepest on the inferior side, where the septal margin forms a subacute saddle, and then curves backwards to the umbilicus. On the superior side, the lobe is abruptly rounded off, the dorsal portion of the septum being slightly convex towards the front. A small median dorsal lobe is seen in young specimens, which frequently becomes obsolete with age. The siphuncle is situated near the external dorsal margin at about $\frac{3}{4}$ the height of the septum.

This species, which I have named after the late eminent naturalist to whose labours the first detailed knowledge of the Indian Cretaceous fauna is due, is peculiar to the Ootatoor group, in the northern part of which it is not uncommon; none of the specimens before me have more than a few fragments of the external shell preserved, and most of them are in the state of casts only, more or less crushed. One specimen, being accidentally broken, shows the internal part of the shell in beautiful preservation, exhibiting cross systems of longitudinal and transverse striæ similar to *N. Clementinus*, D'Orb. The unribbed shell and wide umbilicus, and the peculiar form of the septal margins, clearly distinguish this from the numerous allied species.

All the specimens collected by the Survey are from the neighbourhood of Maravattoor, Odium, and Purawoy. Three specimens, undoubtedly from the same locality, are from Mr. Cunliffe's collection.

Range. Ootatoor group.

Localities. Odium, Maravattoor, and Purawoy, northern part of Trichinopoly district.

EXPLANATION OF PLATES.

- Pl. XIII. Fig. 1. Side view of cast from Maravattoor, Trichinopoly : from Brooke Cunliffe, Esq.
 „ Figs. 2, 3. Specimen from same locality.
 „ Fig. 4. Septum of *N. Forbesianus* from Odium, Trichinopoly.
 „ „ 5. Side view of cast from Odium, Trichinopoly.
 „ „ 6. Outline of Septum.

10. NAUTILUS ANGUSTUS, *n. sp.* Pl. XIV. Figs. 1, 2.

N. testá compressá, complanatá, lævigatá, haud umbilicatá : Ventre rotundato, lateribus planatis, sub-obliquis : Aperturá sagittatá, anticè rotundatè-truncatá ; septis lateraliter perexcavatis, apud umbilicum valde flexuosis. Siphunculo sub-centrali, paullulum ventrali, apud $\frac{2}{3}$ septorum altitudinis posito.

DIMENSIONS.

	a.	
	Ins. lines.	
Diameter of shell,.....	2	5
Ditto of outer whorl,.....	1	5
Thickness of ditto,	1	3
Diameter of outer whorl : diameter of shell = $\frac{1}{100}$.		
(a) A cast from Odium. Pl. XIV. Figs. 1, 1a, 1b, 2.		

Shell compressed, smooth ; sides oblique and flattened ; ventral area rounded ; umbilicus very small in cast, probably closed in the shell. Aperture sagittate, rounded in front ; septa very concave, the margins flexuous, convex in the ventral region, deeply excavated at the sides, and convex again near the umbilicus. Siphuncle nearly central at $\frac{2}{3}$ the height of the septa.

This Nautilus is nearly allied to *N. Fittoni*, Sharpe, of the Upper Greensand, which species it resembles in the compression of its whorls, and the peculiar flexure of its septa. It differs in having a very narrow umbilicus in the cast, probably closed in the shell, and in the external position of its siphuncle. The umbilical flexure of the septa is also broader in *N. angustus* and the ventral region less compressed. Still greater is its resemblance to the Indian Nummulitic species *N. Forbesi*, D'Archiac, the form and septa of which are, so far as I can judge from the author's figures, almost identical with those of *N. angustus*, except perhaps that the former species is somewhat more tumid. The position of the siphuncle in the two species is, however, very different, that of *N. Forbesi* being very close to the internal (dorsal) margin of the septa, while in *N. angustus* it is sub-central, and rather external ; possibly the comparison of specimens might lead to the detection of other differences.

Only one specimen has been met with, near Odium, in the Trichinopoly district.

Range. Ootatoor group.

Locality. Odium, Trichinopoly district.

EXPLANATION OF PLATES.

- Pl. XIV. Figs. 1, 1a, 1b. Side, back, and front views of cast, with part of matrix : from Odium, Trichinopoly.
 „ Fig. 2. Outline of septum.

11. NAUTILUS FORMOSUS, *n. sp.* Pl. XIV. Figs. 3, 4; Pl. XV.

N. testá discoideá, umbilicatá; areá ventrali latè-rotundatá, seniori angustè planatá, sulcis angulatis, distantibus, ornatá; areá umbilicali juniori lævigatá: Aperturá orbiculari-lunatá: Septorum marginibus sub-rectis, distantibus: Siphunculo eccentrico, ad septorum marginem externam approximato.

DIMENSIONS.

	a.		b.		c.	
	Ins.	lines.	Ins.	lines.	Ins.	lines.
Diameter of shell,	2	0	4	3	?	?
Ditto outer whorl,	1	4	2	10	3	6
Thickness,	1	6	2	11	3	6

Diameter of outer whorl : diameter of shell = $\frac{6}{100}$.

(a) Specimen from Karapady, Pl. XIV. figs. 4, 4a.

(b) From Kurriem, Pl. XIV. figs. 3, 3a.

(c) Fragment, with mouth, from Veraghoor, Pl. XV.

Shell discoid, somewhat inflated; the whorls embracing so as to leave a very small or no umbilical depression; the ventral area evenly rounded, except in old specimens, which are somewhat flattened, and ornamented with broad shallow sulci, forming an obtuse sinus on the median ventral line. The posterior edge of the sulcus is most abrupt, and the exterior of the shell thus presents the appearance of a series of overlapping plates like the greaves of a coat of armour. In old shells some of the sulci bifurcate in the middle of the whorl: in the young shell the furrows become obsolete about the middle of the whorl, but in adult specimens they continue to the umbilicus, being rather flattened in the middle of the whorl, and more crowded than on smaller individuals. Aperture nearly orbicular and lunate, slightly compressed. The edges of the septa nearly straight: chambers large, resembling those of *Nautilus Huxleyanus*. Siphuncle very near the ventral margin.

At first sight this elegant species might be confounded with the ribbed varieties of *N. Huxleyanus*, which it resembles, not only in the width of its chambers, but also in the absence of any marked umbilical depression, and in the ventral position of its siphuncle. A comparison of the young shells however indicates differences which have a specific value. The broad, distinct, evenly sculptured sulci which ornament the young shell of *N. formosus*, and which are present on all the young specimens before me, bear no resemblance to the narrow crowded ribbing seen in a few speci-

mens of *N. Huxleyanus*, and the form of the sulcus, when continued to the umbilicus, differs entirely as may be seen on comparing the figures Pl. XV. 1b and Plate VIII. 2. This difference is important, as the curvature of the sulcus is that of the aperture of the shell. *N. formosus* is moreover less tumid than the *N. Huxleyanus* and in old specimens the flattening of the sides and ventral region are very characteristic. It is more nearly allied to *N. elegans*, but is more tumid than that species, and the sulci are broader, especially in young specimens. Contrary to the prevalent rule in the Nautili, young specimens are comparatively more tumid than adults. It is of rare occurrence, and has only been found in the lower part of the Arrialoor group, associated with *N. Bouchardianus* and *N. Clementinus*, &c.

Range. Lower part of Arrialoor group.

Localities. Karapaudy, Mulloor, Kurribiem, Veraghoor, and Olapaudy, in the Trichinopoly district.

EXPLANATION OF PLATES.

- Pl. XIV. Figs. 3, 3a. Front and side views of adult specimen from Kurribiem, Trichinopoly.
 " " 4, 4a. Do. do. young shell from Karapaudy, Trichinopoly.
 Pl. XV. " 1, 1a, 1b. Front, back, and side views of fragment from Andoor, Trichinopoly.

12. NAUTILUS ELEGANS, *D'Orbigny*, non *Sowerby*. Pl. VIII. Fig. 4.; Pl. XVI. Figs. 1, 2, 3, 4.

1840. *Nautilus elegans*, D'Orbigny. Paléont. Franç. Terr. Cret. Tom. 1, p. 87, pl. 19.
 1850. " " " Prôdrome de Pal. Tom. 11, p. 145.
 1853. " " Sharpe, Brit. Cret. Moll. Palæont. Soc. Lond. p. 12.
 1859. " " Pictet. Mat. pour la Paléont. Suisse 2 Ser. Terr. de Ste. Croix. p. 12.

N. testâ sub-inflatâ, haud umbilicatâ, costis numerosis, regularibus, apud medium ventris perobtusè-angulatis, notatâ : Ventre rotundato ; Aperturâ semi-lumatâ, septis distantibus circa quatuordecem, marginibus lateraliter sub-rectis : Siphunculo externo, apud $\frac{3}{4}$ septorum altitudinis posito.

DIMENSIONS.

	a.	b.	c.
	Ins.	Ins.	Ins.
Diameter of shell,.....	$3\frac{5}{8}$	$3\frac{1}{2}$	$2\frac{1}{4}$
Ditto of outer whorl,.....	$2\frac{2}{16}$	$2\frac{1}{16}$	$1\frac{1}{4}$
Thickness of ditto,	$2\frac{1}{2}$	$2\frac{3}{8}$	$1\frac{3}{8}$

(a) A specimen from Anapaudy, Pl. XVI. fig. 2.

(b) From Anapaudy, Pl. XVI. fig. 3.

(c) From Andoor, Pl. XVI. fig. 4.

N. B.—These measurements are all made on casts

Diameter of outer whorl : Diameter of shell = $\frac{55}{100}$ to $\frac{50}{100}$.

Shell somewhat inflated, rounded, ornamented with numerous narrow and regular sulcations and striæ of growth, which, springing from the umbilicus, form a very obtuse

angle on the median ventral line. Ventral area rounded, umbilicus closed in the perfect shell by a columella, which leaves a small perforation in the cast, of about $\frac{1}{5}$ the diameter of the entire cast. Aperture semi-lunar; septa distant, about 14 to the whorl, the margins very slightly arcuated at the sides, straight in the ventral region. Siphuncle ventrally eccentric at $\frac{2}{3}$ the height of the septum.

M. Pictet in his admirable review of the costated Nautili pointed out very clearly the error into which M. D'Orbigny and many of his successors had fallen in referring the *N. elegans* of Sowerby and Mantell to the non-umbilicate species of the Paléontologie Française. While, however, exposing this error M. Pictet, on what I cannot but think insufficient grounds, has declined to rectify it, a duty for which his own high position and his claims as the unraveller of pre-existing confusion especially fitted him, and he has perpetuated the *N. elegans* of D'Orbigny, in preference to that of the earlier authors. I do not feel myself in a position to oppose M. Pictet's decision, however much I may regret that that decision is at variance with the recognized law of priority, and I have, therefore, applied the name of *N. elegans* to a species which appears to me to be identical with that of MM. D'Orbigny and Pictet, and have rejected from my list of quotations all those which appear to refer to other than this species.

It differs from the ribbed Nautili of the Ootatoor group (*N. Kayeanus*; *N. pseudo-elegans*; *N. Negama*; and *N. crebricostatus*) in its distant septa, and the absence of any umbilical perforation or depression. To *N. Huxleyanus* it bears much resemblance; but is less tumid, and has a costulation of very different character from the ribbed varieties of that species. Casts entirely denuded of shell may, however, be mistaken for that species, except in so far as they are characterized by greater compression. As compared with *N. formosus*, the present species has a much narrower sulcation, and a more rounded form. There are many points of resemblance between the two species, but the marked difference in the above-mentioned characters, indicates specific diversity sufficiently strongly.

N. elegans is confined to the Trichinopoly group, where, moreover, it is by no means common. Few of the specimens are other than casts.

Range. Trichinopoly group.

Localities. Serdamungalum, Anapaudy, Shutanure, Andoor, in the Trichinopoly district.

EXPLANATION OF PLATES.

Pl. VIII. Figs. 4, 4a.	Side and front views of specimen from Shutanure, Trichinopoly.
Pl. XVI. Fig. 1.	Side view of cast from Kannanore, Trichinopoly.
" " 2.	Cast, with fragment of shell, from Anapaudy, Trichinopoly
" " 3.	Cast from Anapaudy.
" " 4.	Cast from Andoor, Trichinopoly.

13. NAUTILUS KAYEANUS, *n. sp.* Pl. XVI. Figs. 5, 6; Pl. XVII. Figs. 1, 2.
Pl. XVIII. Figs. 1, 2; Pl. XXI. Fig. 2.

N. testá discoideá, sub-compressá, undulatè sulcatá, angustè-umbilicatá; Ventre rotundato, seniori nonnunquam planato, sulcis acutè-angulatis ornato: Aperturá ovatá; Septis lateraliter sub-arcuatis, approximatis; Siphunculo interno, apud $\frac{1}{3}$ septorum altitudinis posito.

DIMENSIONS.

	a.		b.		c.	
	ins.	lines.	ins.	lines.	ins.	lines.
Diameter of Shell,.....	7	10	8	8	4	4
Ditto of outer whorl,	4	10	5	1	2	6
Thickness of ditto,	4	2	5	6	2	5

(a.) From Ootatoor, Pl. XVIII. Figs. 1, 1a.

(b.) From Ootatoor, Pl. XVIII. fig. 2.

(c.) From Ootatoor, Pl. XVII. figs. 2, 2a.

Diameter of outer whorl : diameter of shell = $\frac{5}{10}$ to $\frac{4}{10}$.

Shell discoid, compressed, ornamented with broad undulating ribs, forming an angle on the ventral axis, which is rather acute on the young shell and becomes somewhat more obtuse with age. The ribs do not appear to increase much in width with the growth of the shell, so that in a space equal to the semi-diameter, measured on the median ventral line of the shell, they are more numerous in adult than in young specimens: they are visible on the cast of adult specimens as regular sinuous undulations. Umbilicus perforated, but not exposing the inner whorls in the perfect shell. Ventral area evenly rounded, becoming flattened in the adult shell. Aperture ovate. Margins of septa moderately concave, slightly sinuous near the umbilicus, arcuated on the sides and straight or convex in the ventral region. Siphuncle large, eccentric, dorsal, at about one-third the height of the septum.

There is some difficulty in ascertaining the limits of this species and the amount of variation to which it is liable, owing to the bad state of preservation of most of the adult specimens. The large majority of these are argillaceous casts, the shell having entirely disappeared, or having been replaced by crystallized gypsum, which readily breaks off the cast and being strongly attached to the matrix, rarely exhibits the external ornamentation of the original shell. The casts are further frequently crushed and the shelly septa having disappeared, the position of the siphuncle cannot be determined, except in a single specimen.

The size of the umbilicus in uncrushed specimens is tolerably constant, but the most striking character and one by which this species may be readily recognized is the number and approximation of the septa, of which there are more than 24 in the whorl.

It is closely related to the three associated species *N. Negama*, *N. pseudo-elegans*, and *N. crebricostatus*; indeed *N. crebricostatus* may possibly be merely a variety of the above. As, however, the position of the siphuncle in the only specimen of *N. Kayeanus* which exhibits it clearly, is more dorsal than in *N. crebricostatus*, and this difference is accompanied by a more compressed form and more acutely angulated ribs, I have provisionally separated the latter as a distinct species. From *N. pseudo-elegans* the present species is distinguished in a greater degree by the same characters, and also by a larger umbilicus; and from *N. Negama*, by its compressed form, the more acute angulation and greater breadth of its ribs, and by its smaller umbilicus.

Among European species *N. pseudo-elegans*, D'Orb. and *N. Neocomiensis*, both of them from beds of the Neocomian age, bear many points of affinity to *N. Kayeanus*, which may be regarded as intermediate between them. It possesses the numerous and closely approximated septa, the small umbilicus, and internal siphuncle of the former, and the compressed form and undulating ribs of the latter species, to which the present species is most closely allied. From *N. Neocomiensis* it is distinguished by its small umbilicus, and as a secondary character of less importance, the more acute angulation of the ribbing. *N. Neckerianus*, Pictet, is also related to the present species, but the distant septa and sub-central siphuncle clearly distinguish it as a separate species. In the former there are about 4 ribs to the septum, in the latter only 2. The cast of a young shell resembles *N. Fleuriausianus* in form. In its range *N. Kayeanus* is confined to the lower part of the Ootatoor group. The gypseous shales east of Ootatoor have furnished most of the specimens, and others have been obtained from the neighbourhood of Odium and Purawoy.

This species is named in honour of Mr. Kaye, the first explorer of the south Indian Cretaceous rocks.

Range. Lower and middle beds of Ootatoor group.

Localities. Ootatoor, south-east of Kauray, Penangoor, Odium and Purawoy, in the Trichinopoly district.

EXPLANATION OF PLATES.

Pl. XVI.	Fig. 5.	Side view of cast from Ootatoor.
"	" 6.	Cast with undulations, from Purawoy, Trichinopoly.
Pl. XVII.	" 1.	Cast with part of shell, from Ootatoor.
"	Figs. 2, 2a.	Front and back view of cast from Ootatoor.
Pl. XVIII.	" 1, 1a.	Side and front view of cast from Ootatoor: reduced to $\frac{1}{2}$ lineal dimensions.
"	Fig. 2.	Back view of cast from Ootatoor: reduced to $\frac{1}{2}$ lineal dimensions.
Pl. XXI.	Figs. 2, 2a.	Cast from Ootatoor. Fig. 2. Back view full size; 2a. Side view reduced to $\frac{1}{2}$ lineal dimensions.

14. NAUTILUS PSEUDO-ELEGANS, *D'Orbigny*. Pl. XVII. fig. 3; Pl. XVIII. fig. 3; Pl. XIX.; Pl. XX. fig. 1.

1840. *Nautilus pseudo-elegans*, *D'Orbigny*, Paléont. Franç. Terr. Cret. Tome I. p. 70, Pl. 8, 9.
 1850. " " " Prod. de Paléont. Tome II. p. 63.
 1851. " " Cornuel, Bull. de la Soc. Geol. de France, Tome VIII. 2nd Ser. pp. 434 and 442.
 1858. " " Bailey, Quart. Jour. Geol. Soc. London, Vol. XIV. pp. 139, 156.
 1859. " " Pictet, Paléont. Suisse, 2nd Ser. Terr. Cret. de Ste. Croix, pp. 121, 123, Pl. XIV—XIV bis.

N. testá discoideá inflatá, sulcatá, angustè umbilicatá : Ventre late-rotundato : sulcis medio ventris obtusè sub-angulatis, apud latera sub-flexuosis : Aperturá orbiculari : Septis approximatis, (22), lateraliter sub-flexuosis : Siphunculo ?

DIMENSIONS.

	a.	b.
	ins. lines.	ins. lines.
Diameter of shell,	5 3	4 4
Ditto of outer whorl,	3 2	2 7
Thickness of ditto,	3 8	2 11
Both specimens from Odium: (a.) Pl. XIX. figs. 1, 1a; (b.) Pl. XX. figs. 1, 1a.		
Diameter of outer whorl: diameter of shell = $\frac{2}{3}$.		

Shell inflated, evenly rounded, ornamented with numerous sulcations generally visible on the cast. Ventral area broad and rounded. Umbilicus impressed and very small in the cast; the perforation not exceeding $\frac{1}{30}$ of the diameter of the shell. The sulcations rather variable in width, narrow on most specimens, forming a very obtuse angulation on the median ventral line, whence the sulci curve forward towards the umbilicus, (generally becoming obsolete on the sides of the cast,) and forming a very slight flexure towards the umbilicus. Aperture orbicular; septa numerous, about 22 to the whorl, the margins slightly flexuous at the sides, straight or slightly convex in the ventral region. The siphuncle not visible in any of the specimens described.

The majority of the specimens in the Survey collection, all of them well preserved casts, are either smooth or have a narrow close-set sulcation as shown in figs. 3, 3b. Pl. XVIII. One specimen only, that represented in figures 1, 1a. Pl. XX. while agreeing in all other points with the other specimens is characterized by a broad well-marked sulcation on the body whorl, and a more acute angulation on the median ventral line than is seen in other costulate specimens: I do not, however, hesitate to regard it as a mere variety of the species to which the majority of the specimens belong. So also there appears no good reason for separating the smooth from the sulcated specimens, all being in the state of casts; and the form, number, and shape of the septa, and other important characters, being similar throughout the series.

Although the identity of this Nautilus with the European species of M. D'Orbigny must be open to some doubt so long as the position of the siphuncle is unascertained, the numerous points of coincidence of character which it affords appear to me fully to warrant its provisional union with *N. pseudo-elegans*.

The Indian specimens are on the whole less tumid than the majority of the European specimens, and in some of them the cast shows indications of ribbing at a younger age than those described by MM. D'Orbigny and Pictet. In both these respects, however, both our own and the type specimens exhibit considerable variation, and some of those from Haute Rive, figured by M. Pictet, (and therefore from a locality the specimens of which were identified by M. D'Orbigny, the first describer of the species, as authentic) are not more tumid than the least tumid of our specimens. The extension of *N. pseudo-elegans* to India becomes less surprising when we consider that it ranges through the Neocomians of England, France, and Switzerland, and was recognized by M. D'Orbigny and Mr. Bailey in collections of lower Cretaceous Nautili from the Crimea. Indeed the only point which appears anomalous is its association, in the Ootatoor beds, with fossils which in Europe are confined to the Upper Cretaceous group, such as *Ammonites Mantelli* and *Ammonites inflatus*: but on the other hand it affords by no means a singular instance of the kind. *Ammonites Bouyanus*, a no less characteristic species in Europe, occurs associated with all the *above* species in the Ootatoor beds, and also occurs in the Valudayur group of Pondicherry, in a fauna the general *facies* of which is decidedly Neocomian with an intermixture of Oolitic forms; and many other similar instances will appear in the course of these memoirs. It appears, therefore, that in this case, as in many others, we have an illustration of the rule pointed out by Professor Forbes that those species which have a wide range in space are also those which have the longest range in time, and that the discovery of identical species in localities far apart by no means proves the contemporaneousness of the respective formations. The general consideration of the geological position of the Ootatoor beds as deduced from a review of its entire fauna, will be reserved for subsequent investigation.

N. pseudo-elegans occurs most abundantly in the neighbourhood of Odium and appears to range throughout the greater part of the Ootatoor group.

Range. Ootatoor group.

Localities. Ootatoor, and Odium, in the Trichinopoly district.

EXPLANATION OF PLATES.

- | | | |
|------------|------------------|---|
| Pl. XVII. | Fig. 3. | Back view of cast from Odium, Trichinopoly. |
| Pl. XVIII. | Figs. 3, 3a. 3b. | Small cast wanting body whorl. From Odium, Trichinopoly. Side, front, and back views. |
| Pl. XIX. | Fig. 1. | Side view of cast from Odium: Ootatoor Group. |
| " | " 2. | Front view of cast from same locality. |
| Pl. XX. | Figs. 1, 1a. | Cast from Odium, Ootatoor Group. |

15. NAUTILUS NEGAMA, n. sp. Pl. XX. Fig. 2. Pl. XXI. Fig. 1.

*N. testá discoideá inflatá, undulatè sulcatá, abruptè profunditerque umbilicatá :
Ventre compresso, rotundato, sulcis numerosis, angustis, obtusè-angulatis ornato :
lateribus sub-planatis, flexuosi-sulcatis. Aperturá semi-ovatá ; septis numerosis
lateraliter arcuatis. Siphunculo?*

DIMENSIONS.

	a.	
	ins.	lines.
Diameter of shell,	7	3
Ditto of outer whorl,.....	4	0
Thickness of ditto,	5	0

(a). From Sirgumpore, Pl. XX. fig, 2, 2a.
Diameter of outer whorl : diameter of shell = $\frac{4}{7}$.

Shell discoid, expanded, widest at the umbilical angles, abruptly umbilicated, closely sulcated : sulci narrow and numerous, forming a somewhat obtuse angle on the median ventral line, and a sigmoid flexure on the sides of the shell, radiating from the umbilicus. Ventral region compressed, rounded, becoming broader with age ; sides somewhat flattened ; umbilicus large, deep, and abruptly angulated, exposing the inner whorls. Aperture semi-oval, septal margins strongly arcuated at the sides, approximated, about 22 to the whorl : Siphuncle ?

This Nautilus is the broadest of all the sulcated species of the Indian Cretaceous rocks, and is especially characterized as a distinct species by its wide umbilicus and angular form, and by its rapid increase in thickness during growth. Its close-set and more angulated ribs further distinguish it from *N. Kayeanus*.

Only one specimen of this Nautilus has been found by the Survey ; it occurred in the lowest beds of the Ootatoor group, in the neighbourhood of Sirgumpore.

Range. [Lower beds] ? of Ootatoor group.

Locality. Sirgumpore, Trichinopoly district.

EXPLANATION OF PLATES.

- Pl. XX. Figs. 2, 2a. Side and front views of cast from Sirgumpore, Trichinopoly. (Ootatoor group). Half lineal dimensions.
Pl. XXI. Fig. 1. A portion of the same specimen, full size, showing the ribbing.

16. NAUTILUS CREBRICOSTATUS, *n. sp.* Pl. XXI. Fig. 3; Pl. XXII.

N. testá discoideá, sub-compressá, sulcis numerosis notatá, angustè umbilicatá : Ventre latè-rotundato : Umbilico perforato : Sulcis medio ventre perobtusè sub-angulatis, lateribus flexuosis, nucleo leviter impressis : Aperturá ovatá : Septis lateraliter valdè-arcuatis, apud ventrem sub-rectis : Siphunculo sub-centrali, apud $\frac{2}{3}$ altitudinis locato.

DIMENSIONS.

	a.	
	ins.	lines.
Diameter of shell,.....	6	6
Ditto of outer whorl,.....	4	0
Thickness,.....	4	0

(a.) From Ootatoor, Pl. XXII.

Diameter of outer whorl : diameter of shell = $\frac{2}{3}$.

Shell discoid, moderately compressed, rounded, externally ornamented with numerous sulcations (5 or 6 to the septum in adult specimens), which are obtusely sub-angulated on the median ventral line, and thence come forward towards the umbilicus, forming a sigmoid flexure on the sides. The sulcations are very distinctly marked on the ventral portion of the cast. Ventral area broadly rounded; umbilicus perforated, sulcated. Aperture ovate, septa very concave, the margins strongly arcuated, straight or slightly concave in the ventral region. Siphuncle nearly central, somewhat nearer to the dorsal margin.

N. crebricostatus is very closely allied to *N. Kayeanus*, but appears to be specifically distinguished by its more concave septa, its obtusely angulated and narrow sulcation, and, especially, by the more central position of its siphuncle, which is very large in this species. As compared with any but large and adult specimens of *N. Kayeanus*, it is also more tumid and the umbilical perforation is wider, exposing, although to a small extent, the edges of the inner whorls. The umbilicus is, however, narrower than that of *N. Negama* and the costulation broader, while the form of the shell differs in being more compressed towards the umbilicus, and less so in the ventral region. From *N. pseudo-elegans*, it is distinguished by being less tumid and having an ovate instead of an orbicular aperture; also by a larger umbilicus and more concave septa. Like *N. Kayeanus* this species may be regarded as to a certain extent intermediate between *N. pseudo-elegans*, D'Orb., and *N. Neocomiensis*, D'Orb. It is more tumid than the latter species and less so than the former, while its umbilicus is wider than in the former and narrower than in the latter. The ribs and septa are narrower and more numerous than in *N. Neckerianus*, Pictet, which, in form and the position of its siphuncle, this species resembles very closely. Moreover, M. Pictet's species is characterized by a closed umbilicus.

Of this species only two well characterized specimens have been found, both in the gypseous clays near Ootatoor, in company with *N. Kayeanus*, which is much more common.

Range. Lowest beds of Ootatoor group.

Locality. Ootatoor, Trichinopoly district.

EXPLANATION OF PLATES.

Pl. XXI. Fig. 3. Side view of small cast from Ootatoor, Trichinopoly.

Pl. XXII. Figs. 1, 1a. Side and front views of cast from Ootatoor, Trichinopoly.

17. NAUTILUS TRICHINOPOLITENSIS, n. sp. Pl. XXIII; Pl. XXIV. Figs. 1, 2.

N. testá discoideá compressá, valdè flexuosi-costatá, umbilicatá: Aréá ventrali rotundatá angulatè costatá: Aperturá ovatá nonnunquam compressá: Septis persinuatis lateraliter supra medium rotundate-lobatis: siphunculo externo, apud $\frac{3}{4}$ altitudinis septorum.

DIMENSIONS.

	a.		b.	
	ins.	lines.	ins.	lines.
Diameter of shell,	7	3	5	7
Ditto of outer whorl,	4	3	3	3
Thickness,	3	2	2	8

Both specimens from Arrialoor: (a) figured at Plate XXIII. figs. 1, 1a.

Diameter of outer whorl: diameter of shell = $\frac{4}{10}$.

Shell discoid, compressed, ornamented with strong flexuous ribs, continuous to the umbilicus, acutely angulated on the back, and separated by narrow deeply cut grooves, which are faintly impressed on the cast. Umbilicus moderate, with sloping sides; inner whorls concealed. Ventral area evenly rounded. Aperture ovate, narrower in front, sometimes flattened at the sides. Septa deeply sinuated, forming a rounded compressed lobe above the middle of whorl. The base of the lobe is evenly rounded on both sides. On the ventral surface the edges of the septa are either straight or slightly concave, the latter generally in old specimens. Siphuncle rather large, situated at three-fourths the height of the septum.

This well-marked species is confined to the Arrialoor group, and appears to be of very local occurrence. The specimens are principally casts, but in good preservation.

Range. Lower part of Arrialoor group.

Localities. Koloture, Arrialoor, and Mulloor, in the Trichinopoly district.

EXPLANATION OF PLATES.

Pl. XXIII. Figs. 1, 1a. Nautilus Trichinopolitensis. Side and back views of old specimen from Arrialoor, Trichinopoly.

Pl. XXIV. „ 1, 1a. Side and back views of cast from Arrialoor, Trichinopoly.

„ Fig. 2. Outline of septum.



18. NAUTILUS ROTA, *n. sp.* Pl. XXIV. Fig. 3; Pl. XXV. Figs. 1, 2, 3.

N. testâ discoidâ, compressâ, complanatâ, juniore lævigatâ, seniore lateraliter lævigatâ, ventraliter angulatè-sulcatâ; Umbilico clauso; Aperturâ hastatâ anticè truncatâ: Marginibus septorum persinuatis, lateraliter concavis, apud regionem umbilicalem valdè refractis; Siphunculo ad marginem ventralem approximato, apud $\frac{2}{3}$ septorum altitudinis posito.

DIMENSIONS.

	a.		b.		c.	
	ins.	lines.	ins.	lines.	ins.	lines.
Diameter of shell,.....	10	9	7	7	7	4
Ditto of outer whorl,.....	6	8	4	7	4	6
Thickness of ditto,	5	9	3	5	3	10

(a.) Very old specimen, with shell from Karapaudy, Pl. XXIV. figs. 3, 3a.

(b.) Fragment, with shell, Pl. XXV. fig. 1.

(c.) Cast from Arrialoor, somewhat broken at edges.

Diameter of outer whorl : diameter of shell = $\frac{6}{10}$.

Shell discoid, compressed, flattened and smooth at the sides. Ventral region narrow, flattened in old specimens, and ornamented with deeply angular furrows, which are not prolonged beyond the ventral region. Umbilicus closed, somewhat impressed in adult shell. Aperture hastate, truncated in front, sometimes wider in old specimens (see measurement [a] above.) Septa, very concave, the edges describing a broad concave curve on the side of the shell, and bending back abruptly near the umbilicus, so as to form a compressed saddle rounded at the apex. Siphuncle nearest to the ventral margin.

Nearly allied to *Nautilus Fittoni*, of Sharpe, the present species is distinguished by its narrow umbilicus, its deep ventral grooving, and the greater size and prominence of its umbilico-lateral saddles, which in the present species occur at about $\frac{1}{4}$ the diameter of the whorl. *N. Forbesi*, D'Archiac, from the Nummulitic formation of Scinde, has septa exactly resembling those of *N. rota*, but has a more dorsal (internal) siphuncle and is more tumid in form.

Four specimens have been found in the Trichinopoly district; all from the lower beds of the Arrialoor group. One only has a large portion of the shell preserved, exhibiting the regular and deep grooving of the back, which is more regular and deeply excavated than that of any of the associated species. The grooving is quite apparent on the cast.

In one very large specimen, Pl. XXIV. figs. 3, 3a, the umbilical region is irregularly ribbed, owing to the strong development of the lines of growth. The

ventral ribbing is also irregular, and, near the aperture, becomes obsolete. A similar obliteration of the normal characters may be frequently seen in very old specimens of other species.

A young specimen, 2 inches in diameter, is perfectly smooth, and has a closed and nearly smooth umbilicus. It is figured at Plate XXV. figs. 3, 3a.

Range. Lower part of Arrialoor group.

Localities. Arrialoor, Karapady, and Mulloor, in the Trichinopoly district.

EXPLANATION OF PLATES.

- Pl. XXIV. Figs. 3, 3a. Old specimens from Karapady, Trichinopoly. Side and front views : half lineal dimensions.
 Pl. XXV. „ 1, 1a. Fragment, with shell, from Karapady. Half lineal dimensions.
 „ Fig. 2. Side view of cast from Mulloor, Trichinopoly.
 „ Figs. 3, 3a. Young and smooth shell, from Arrialoor, Trichinopoly. Side and back views.

19. NAUTILUS PONDICHERRIENSIS, *n. sp.* Pl. XXV. Fig. 4.

N. testá compressá, complanatá, longitudinaliter striatá, umbilicatá; Areá ventrali, subplanatá; Aperturá, compressá tetragoná; Septis? Siphunculo interno, apud $\frac{1}{4}$ altitudinis posito.

DIMENSIONS.

		ins.	lines.
Diameter of fragment,	. . . . .	3	6
Ditto of last whorl,	. . . . .	2	0
Thickness,	. . . . .	1	$7\frac{1}{2}$

Shell much compressed, flattened at the sides, and ventral region, marked with longitudinal striæ. Umbilicus open, deep and abruptly angulated. Aperture tetragonal, as wide as high, narrowing towards the ventral region. Siphuncle at about $\frac{1}{4}$ the height of the septum.

The only specimen of this species before me is a fragment from the Madras Museum collection. It is marked as from Pondicherry, and from its appearance, and the character of its matrix, I have no doubt that it is from the Neocomian or Valudayur beds of that locality. The specimen is a cast exhibiting traces of the shell, which is distinctly marked with longitudinal striæ in a manner resembling many Jurassic Nautili. The edges of the septa are not very distinct, but they appear to form a deep concave curve on the ventral portion of the shell and to be slightly sinuous at the sides.

Both in form and ornamentation, this Nautilus bears a strong resemblance to certain characteristic Oolitic species, such as *N. semi-striatus*, D'Orb. of the Upper Lias, and *N. sinuatus*, D'Orb. of the Inferior Oolite, Caen.

No Nautilus having the same peculiar marking has hitherto been found in the Cretaceous rocks of Europe.

Range. Valudayur group.

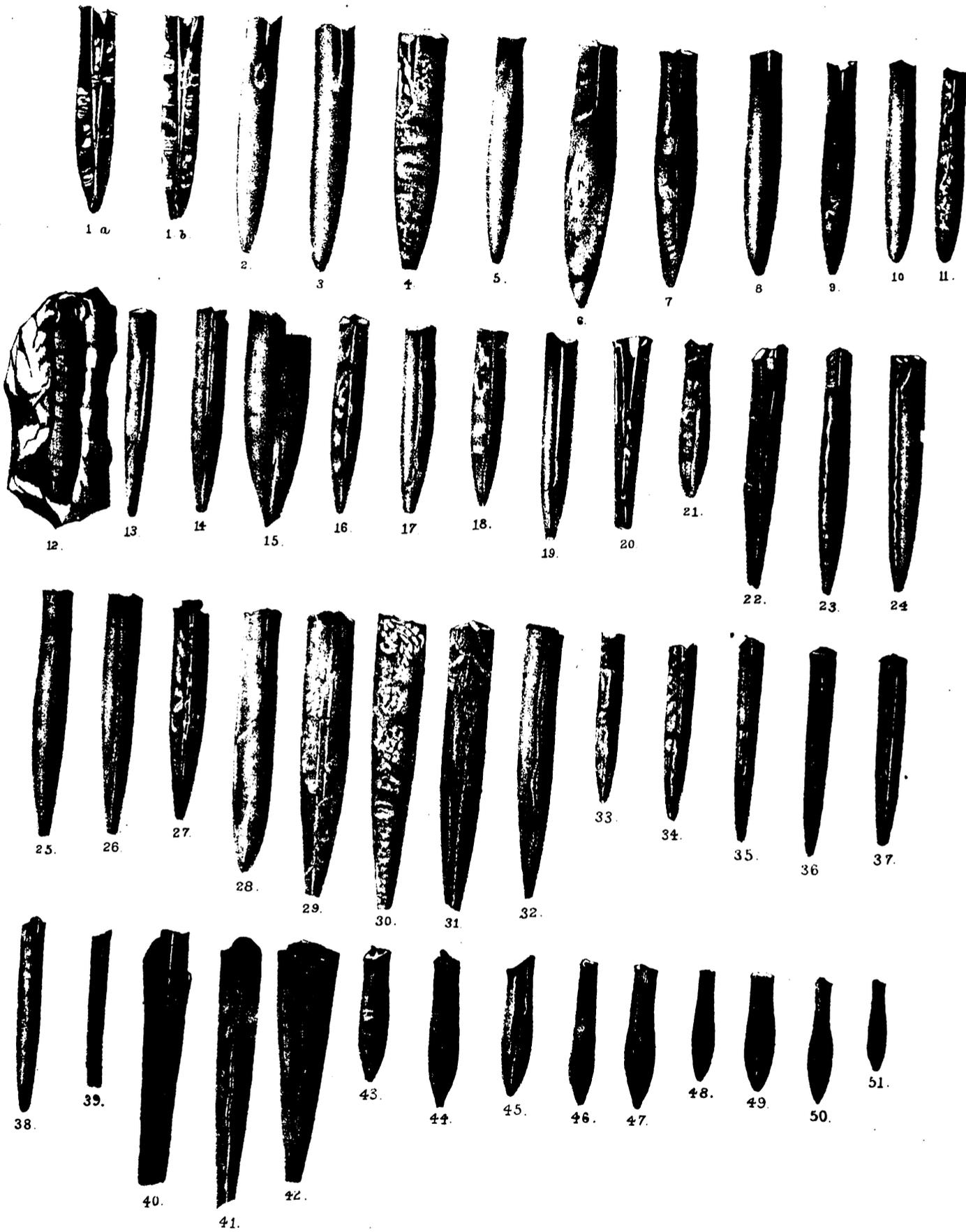
Locality. Valudayur, near Pondicherry.

EXPLANATION OF PLATES.

Pl. XXV. Figs. 4, 4a, 4b. Front, side, and back views of a fragment from the Valudayur limestone, Madras Museum.

PLATE I.

- Figs. 1a—b. **BELEMNITES STILUS, nov. sp.:** From Ootatoor. Trichinopoly. Ootatoor Group.
(Longitudinal Sections.)
- Figs. 2—11. **BELEMNITES STILUS, nov. sp.:** Same loc. and formation. (Ventral aspect.)
- Fig. 12. **BELEMNITES STILUS, nov. sp.:** From Odium, Trichinopoly. Ootatoor Group.
- Figs. 14—19, 21, 26, **BELEMNITES FIBULA,? Forbes.:** From Ootatoor. Ootatoor Group. (Various
27, 29—34, 37, 40, 42. Forms. Side view.)
- Figs. 20, 22. **BELEMNITES FIBULA,? Forbes.:** Same locality and formation. (Sectional views.)
- Figs. 23, 35, 38. **BELEMNITES FIBULA,? Forbes.:** Same loc. &c. (Ventral aspect.)
- Figs. 13, 24, 26, 28. Same species, but more or less neither front nor side views.
- Figs. 36, 39. Doubtful specimens.
- Figs. 43, 46. **BELEMNITES SECLUSUS, nov. sp.:** Ootatoor, Trichinopoly. Ootatoor Group.
(Ventral aspect.)
- Figs. 44, 45, 47, 49, 51. **BELEMNITES SECLUSUS, nov. sp.:** Same locality and formation. (Side view.)
- Fig. 50. Same species. (Ventral aspect, but exaggerated in form.)



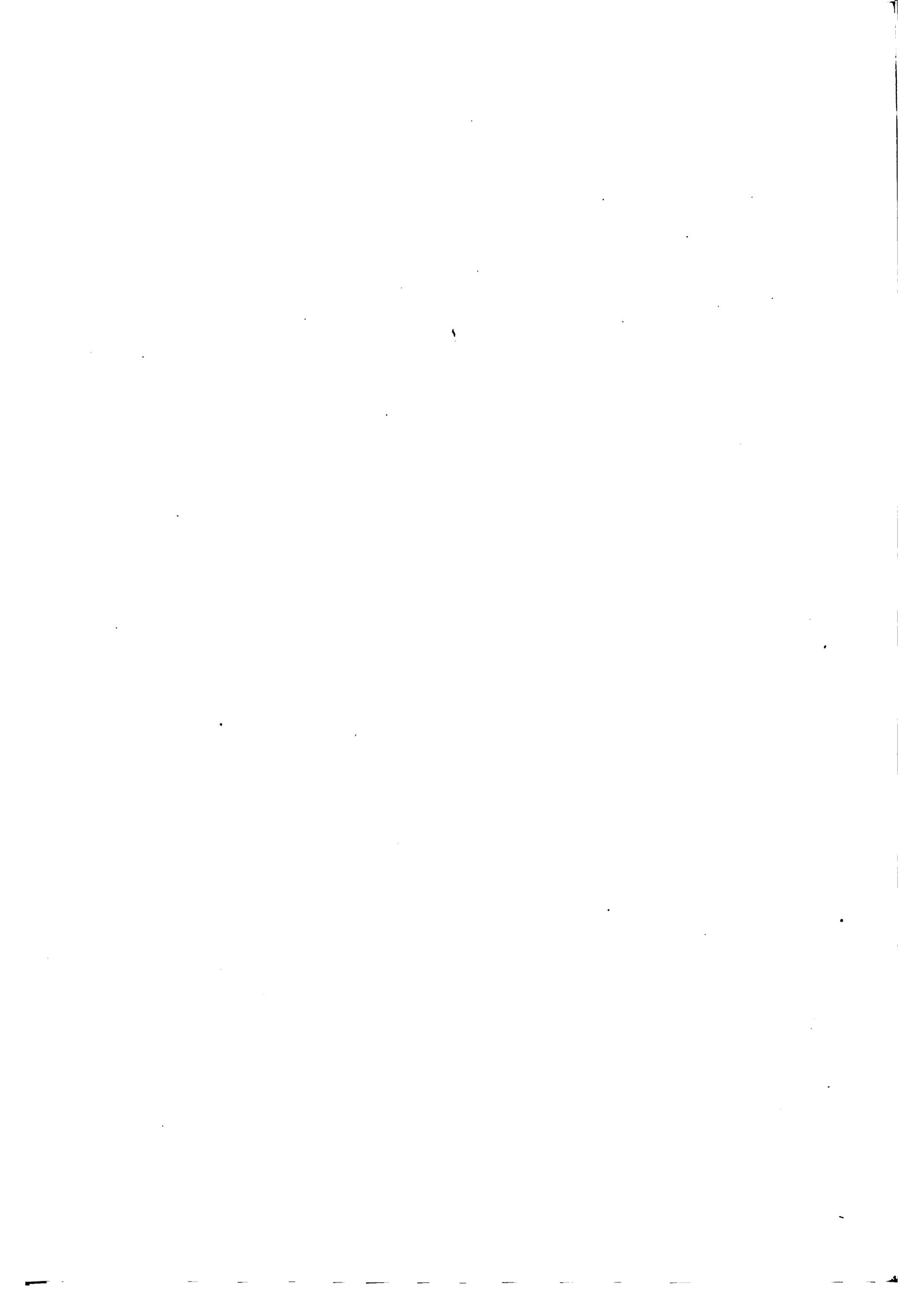




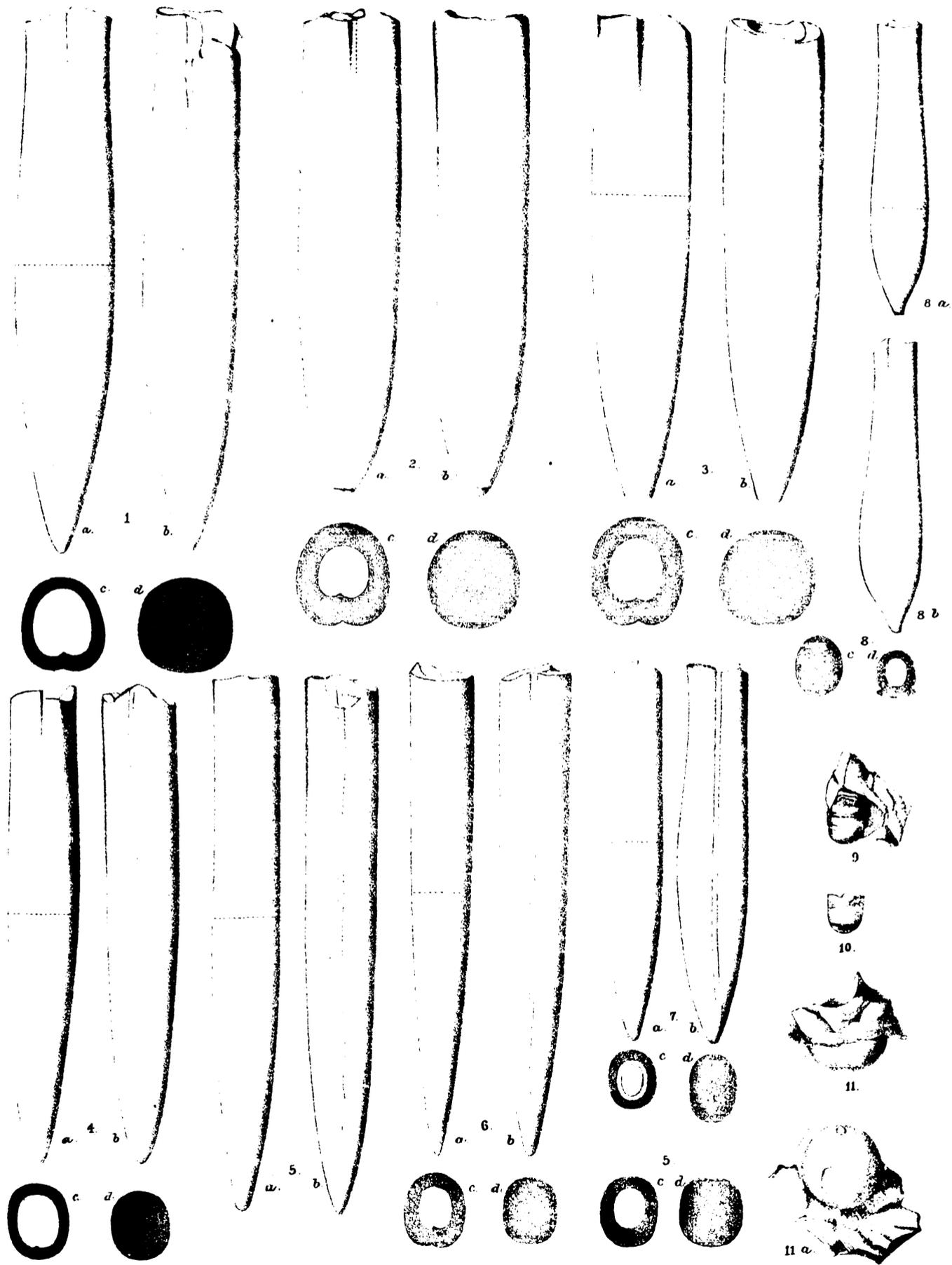
PLATE II.

- Fig. 1, *a—d.* BELEMNITES STILUS, *nov. sp.* : Fusiform variety (enlarged to twice its lineal dimensions : figured nat. size at Pl. I. fig. 6).
a. b. ventral and lateral aspects. *c.* anterior end. *d.* section at widest part.
- Figs. 2, 3, 4, *a—d.* BELEMNITES STILUS, *nov. sp.* : Cylindrical varieties (enlarged as above).
a. b. c. d. as above. Fig. 4. *d.* is rather too compressed.
- Fig. 5, *a—d.* BELEMNITES FIBULA, ? *Forbes.* : Sub-cylindrical variety (enlarged as above).
a. b. c. d. as above.
- Fig. 6, *a—d.* BELEMNITES FIBULA, ? *Forbes.* : Sub-cylindrical, compressed variety (enlarged as above). *a. b. c. d.* as above.
- Fig. 7, *a—d.* BELEMNITES FIBULA, ? *Forbes.* : Compressed laterally, ventrally dilated (enlarged as above). *a. b. c. d.* as above.
- Fig. 8, *a—d.* BELEMNITES SECLUSUS, *nov. sp.* : (Enlarged as above). *a. b.* as above, *c.* section at thickest part, *d.* anterior end views.
- Figs. 9. 10 ? BELEMNITES FIBULA, *Forbes.* : Phragmocones from the Valudayur limestone, Pondicherry.
- Figs. 11, 11. *a.* BELEMNITES, *sp.?* Septum of Phragmocone from Odium, Ootatoor. Ootatoor Group. Fig. 11, side view: 11 *a.* posterior view.

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Pl. II.



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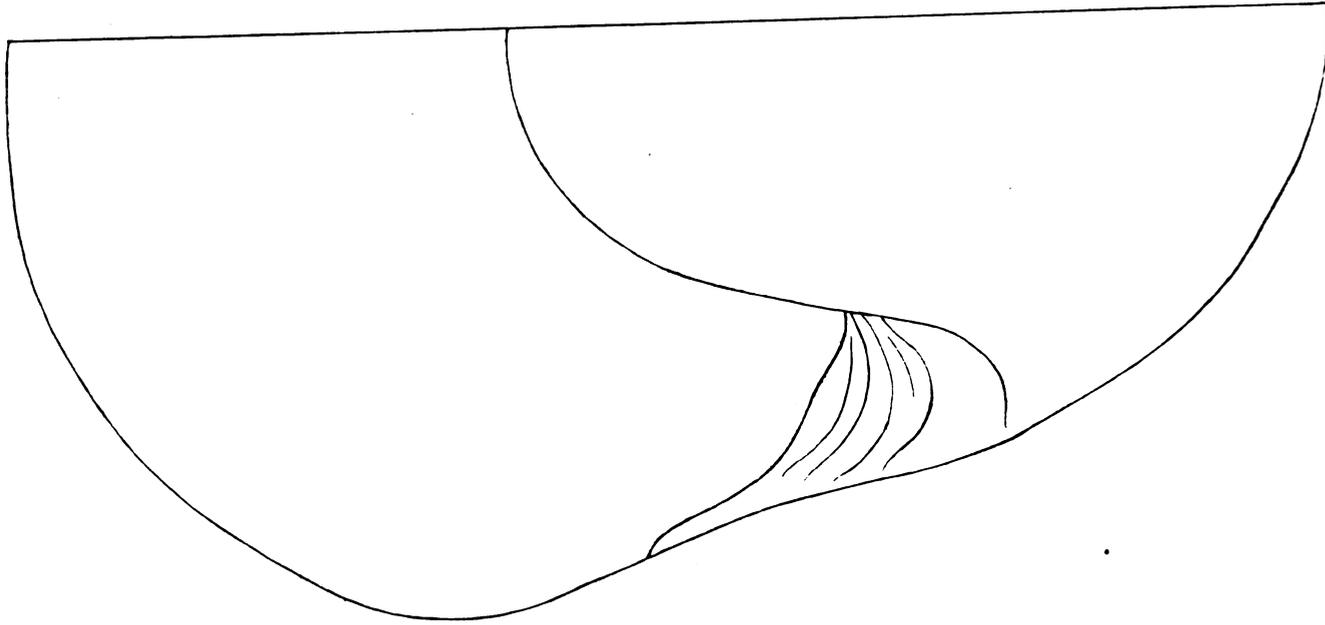
PLATE III.

Fig. 1. NAUTILUS BOUCHARDIANUS, *D'Orbigny*: Side view of specimen from Shillagoody,
Trichinopoly.

Fig. 1a. „ „ „ Half outline of front view of same specimen.



1.



1. a.



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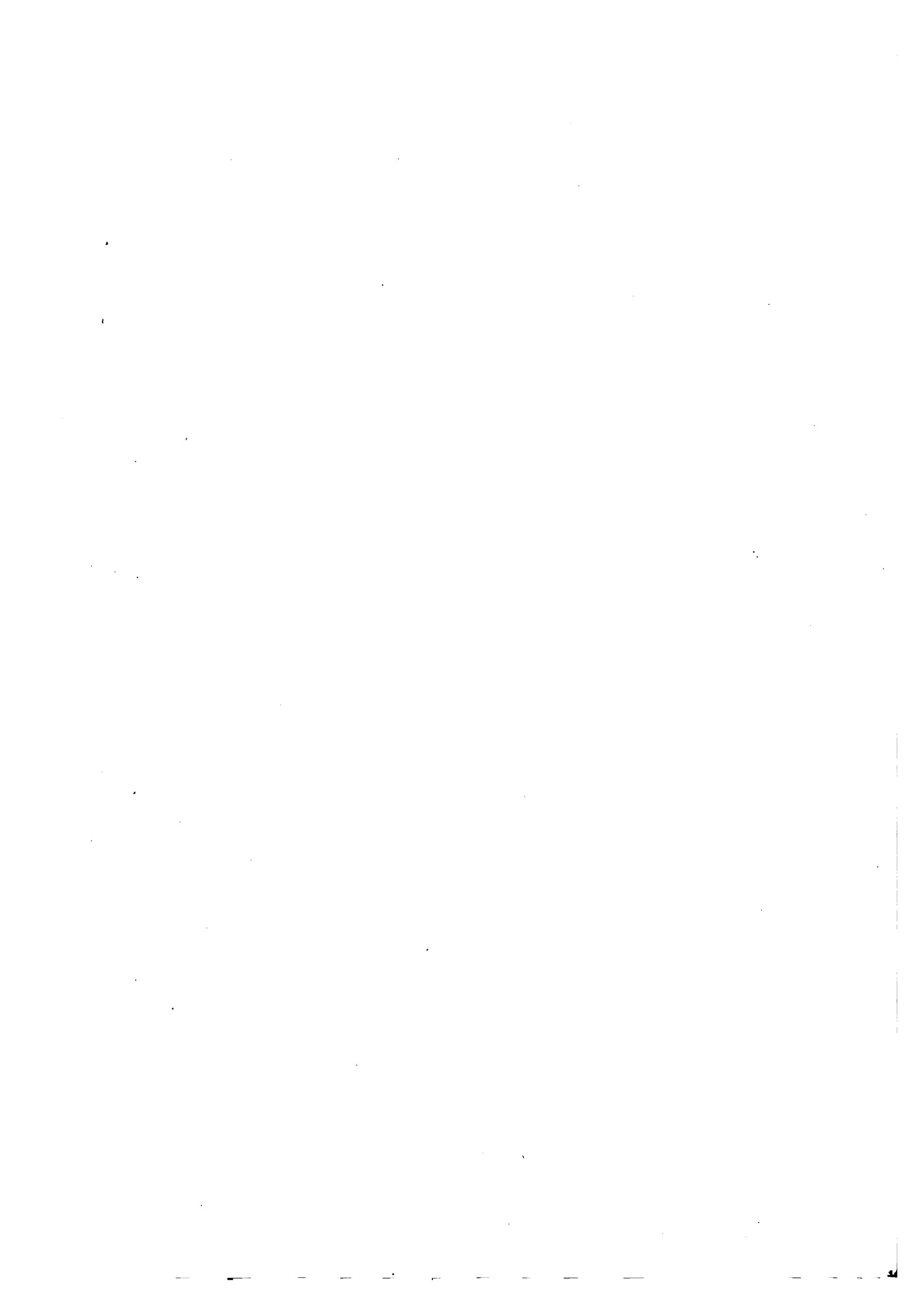




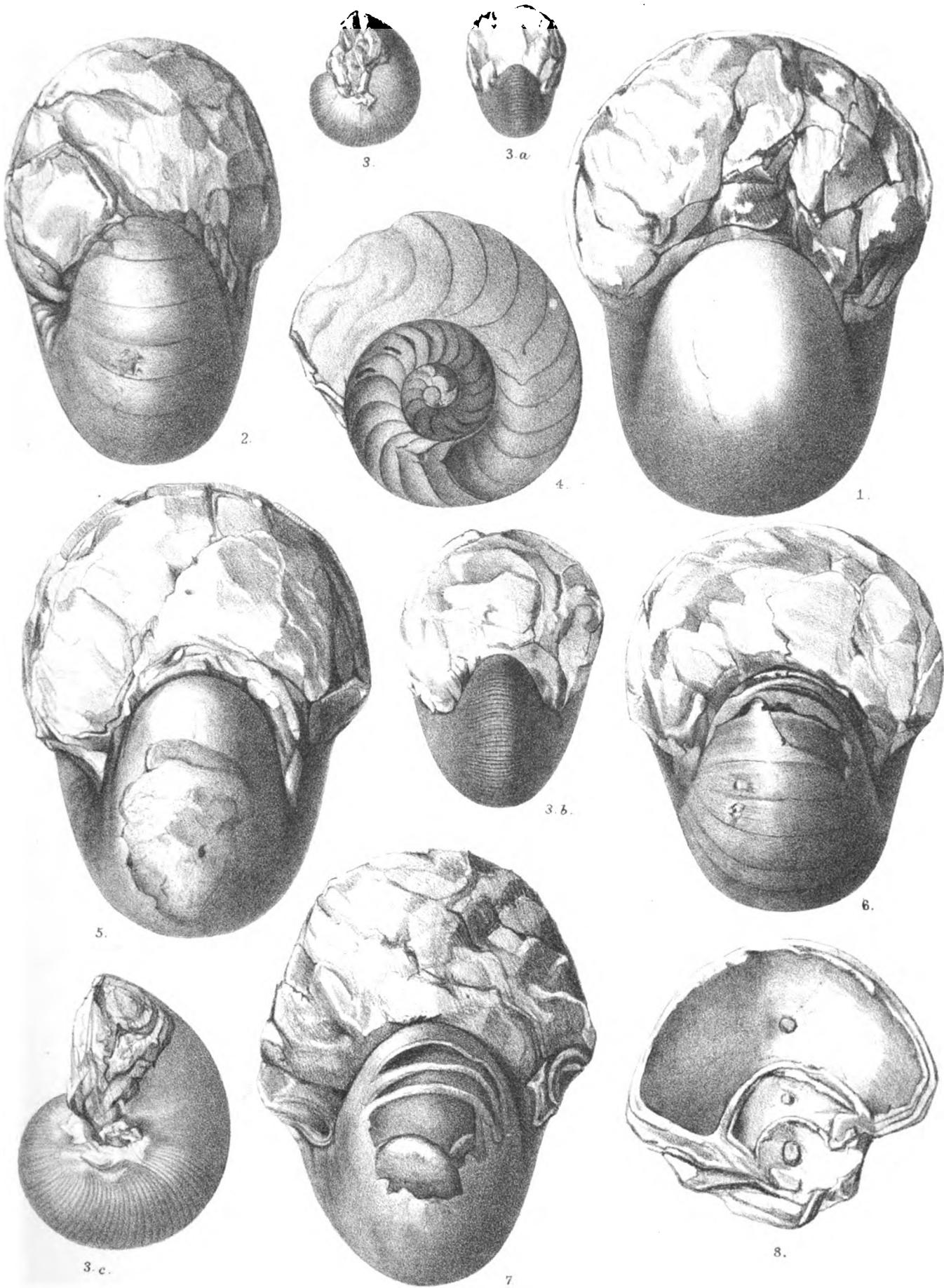
PLATE IV.

- Fig. 1. NAUTILUS BOUCHARDIANUS, *D'Orbigny*: From Olapaudy, Trichinopoly. Front view, *reduced to half the lineal dimensions.*
- Fig. 2. " " " From Arrialoor, Trichinopoly. Front view, *reduced to half the lineal dimensions.*
- Fig. 3. " " " From Arrialoor, Trichinopoly. Young specimen: Side view.
- Fig. 3a. " " " Ditto. Front view.
- Figs. 3b. 3c. " " " Ditto. Front and side views *enlarged.*
- Fig. 4. " " " From Pondicherry. (Madras Museum.) Sectional view.
- Fig. 5. " " " From Koloture, Trichinopoly. Front view, *reduced to half the lineal dimensions.*
- Fig. 6. " " " From Arrialoor, Trichinopoly. Front view, *reduced to half the lineal dimensions.*
- Fig. 7. " " " From Pondicherry. (Madras Museum.) Front view, *reduced to half the lineal dimensions.*
- Fig. 8. " " " From Pondicherry. (Madras Museum.) Fragment showing septa. Front view, *reduced to two-third lineal dimensions.*

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PL. IV.



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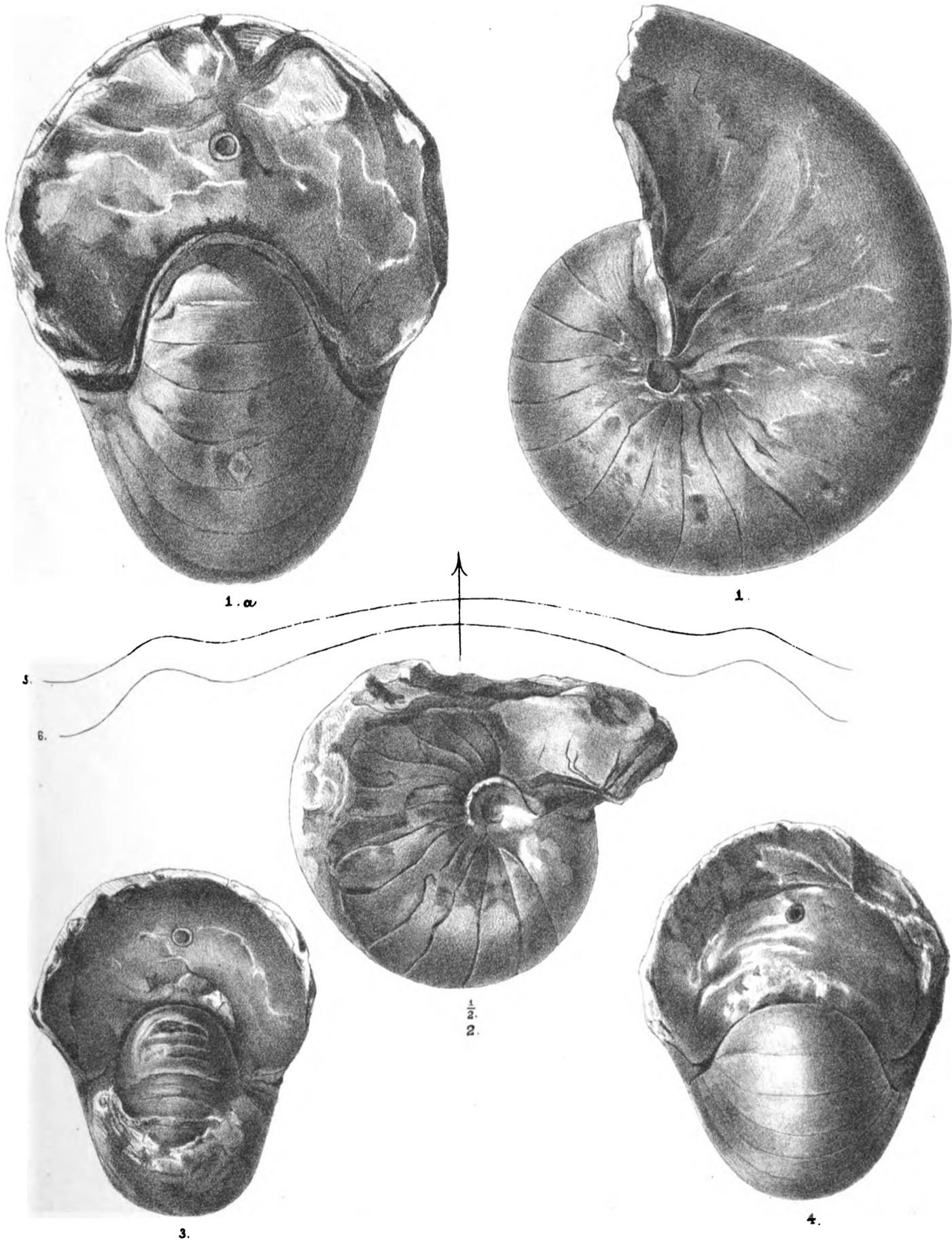
PLATE V.

- Figs. 1, 1a. NAUTILUS BOUCHARDIANUS, *D'Orbigny* : From Arrialoor, Trichinopoly. Front and side views.
- Fig. 2. " " " From Pondicherry. Side view. *Reduced to half the lineal dimensions.*
- Fig. 3. " " " From Shillagoody, Trichinopoly. Front view.
- Fig. 4. " " " From Pondicherry. (Madras Museum.) Front view.
- Figs. 5 & 6. " " " Septa of *N. Bouchardianus*.

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Pl. V.



R. S. Aodhikary, Lith.

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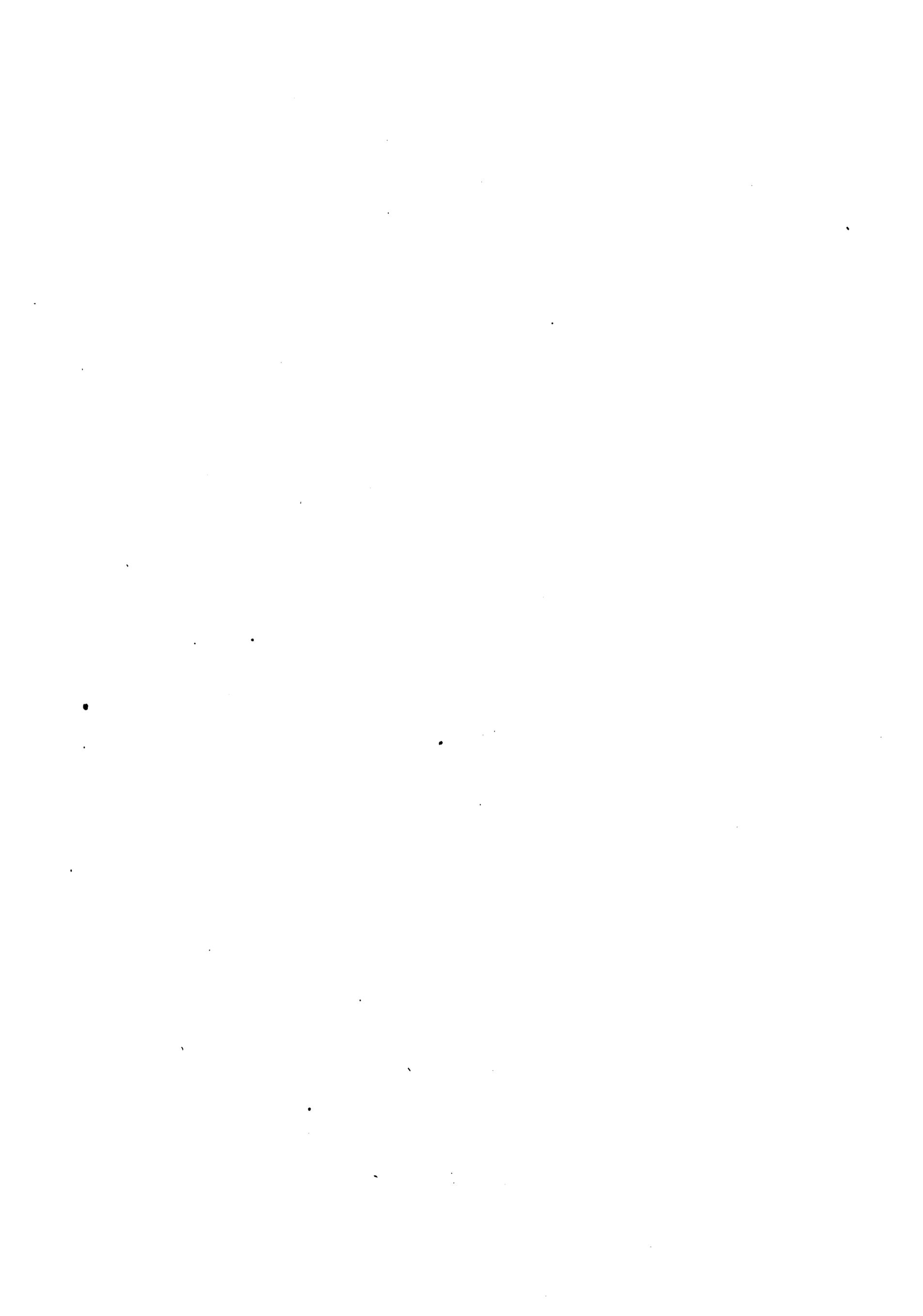


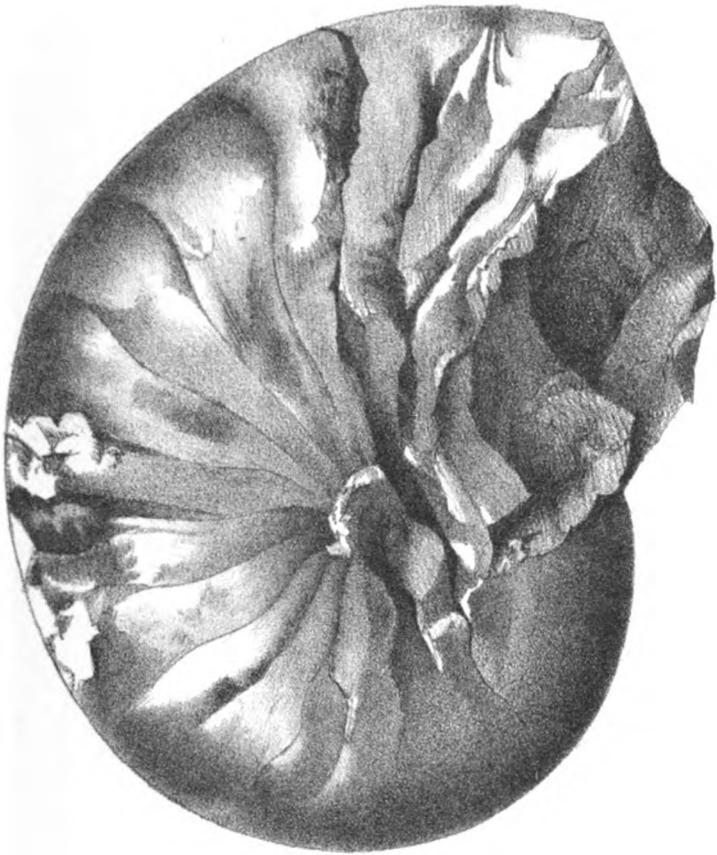
PLATE VI.

Figs. 1, 1*a*. NAUTILUS CLEMENTINUS, *D'Orbigny*: From Karapady, Trichinopoly.
Figs. 2, 2*a*. " " " " From Olapady, Trichinopoly.

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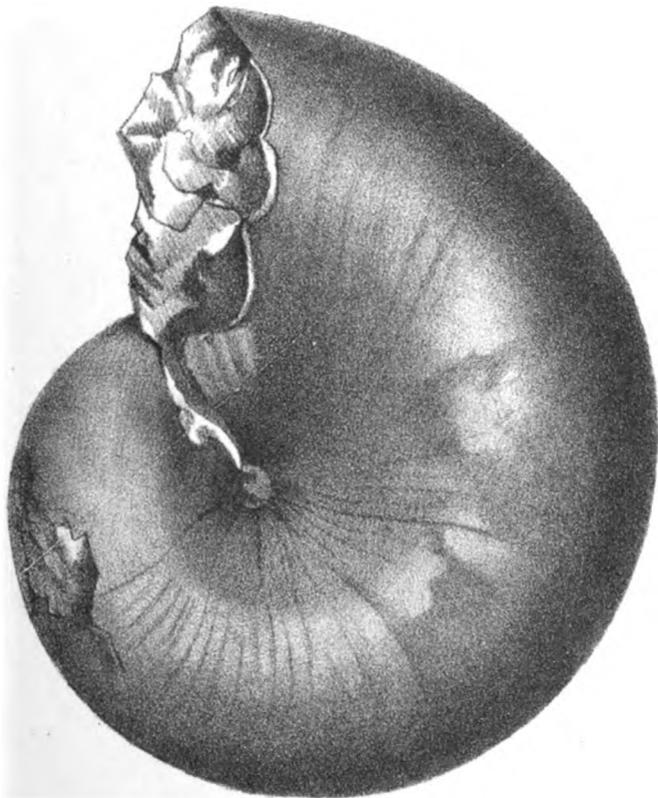
PL. VI.



1.



1 a.



2.



2 a.

Nilcanto Das, lith.

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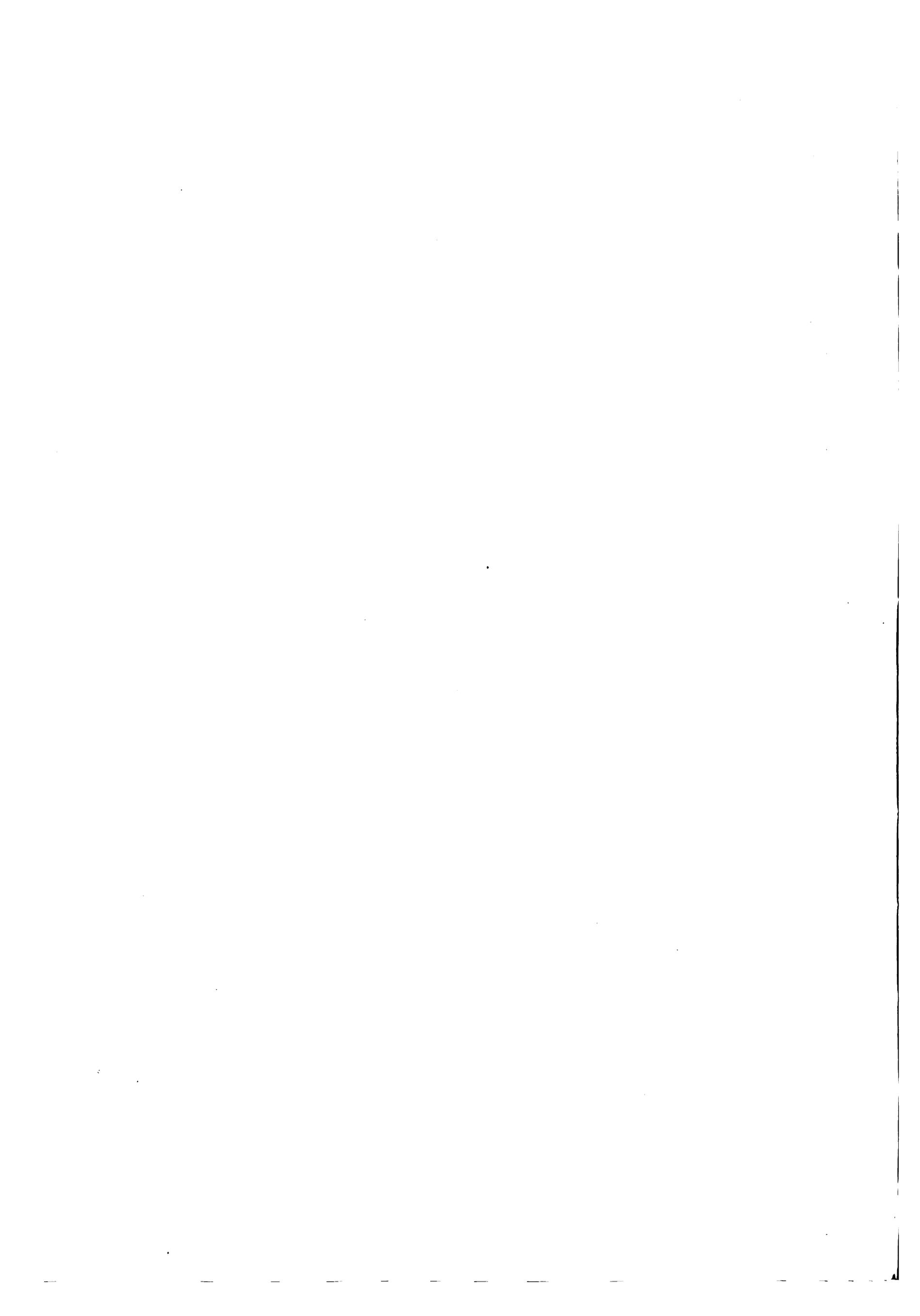




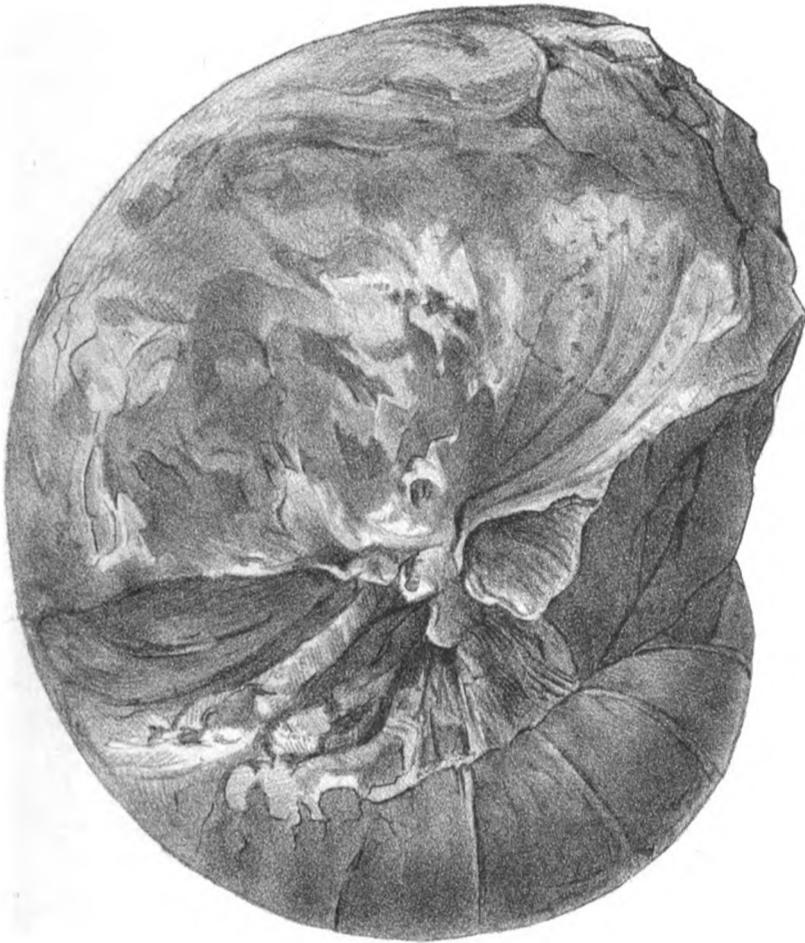
PLATE VII.

- Figs. 1, 1a. NAUTILUS CLEMENTINUS, *D'Orbigny*: From Ootacoil, Trichinopoly. Side and front view.
- Fig. 2. " " " From Ootacoil, Trichinopoly. Front view.
- Fig. 3. NAUTILUS HUXLEYANUS, *n. sp.* From Serdamungalum, Trichinopoly. (Trichinopoly group.) Side view.
- Fig. 4. " " " From Coonum, Trichinopoly. (Ootatoor group.) Side view.

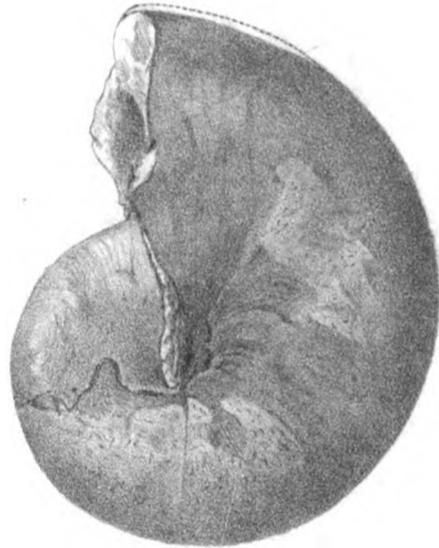
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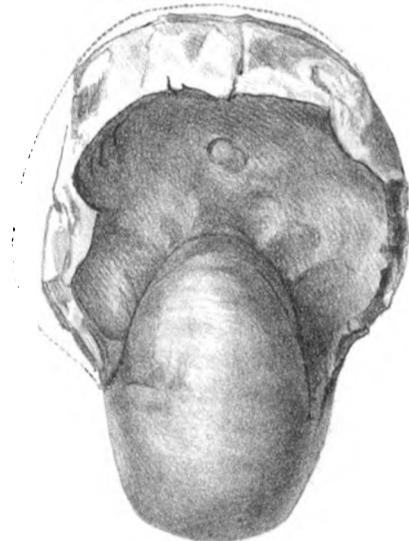
Pl. VII.



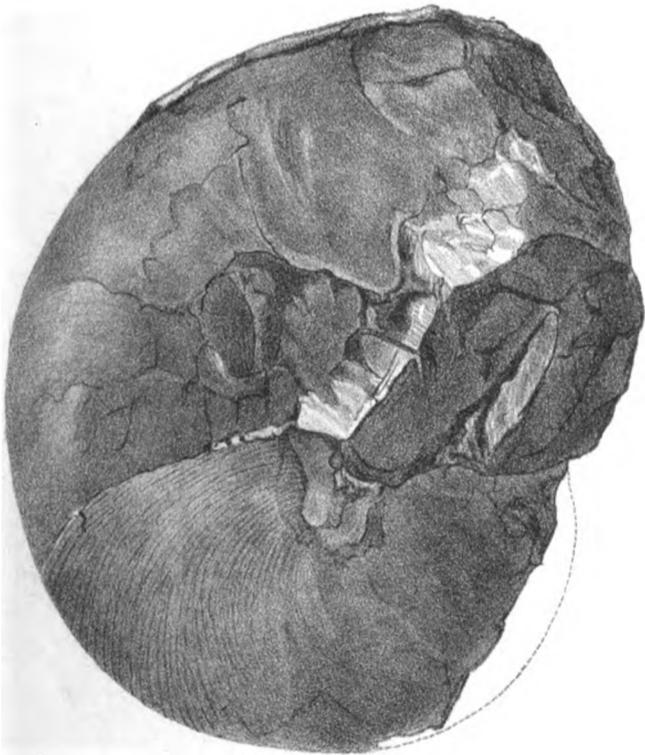
3.



1.



1. a.



4.



2.

R. S. Audhikary, Lith^d

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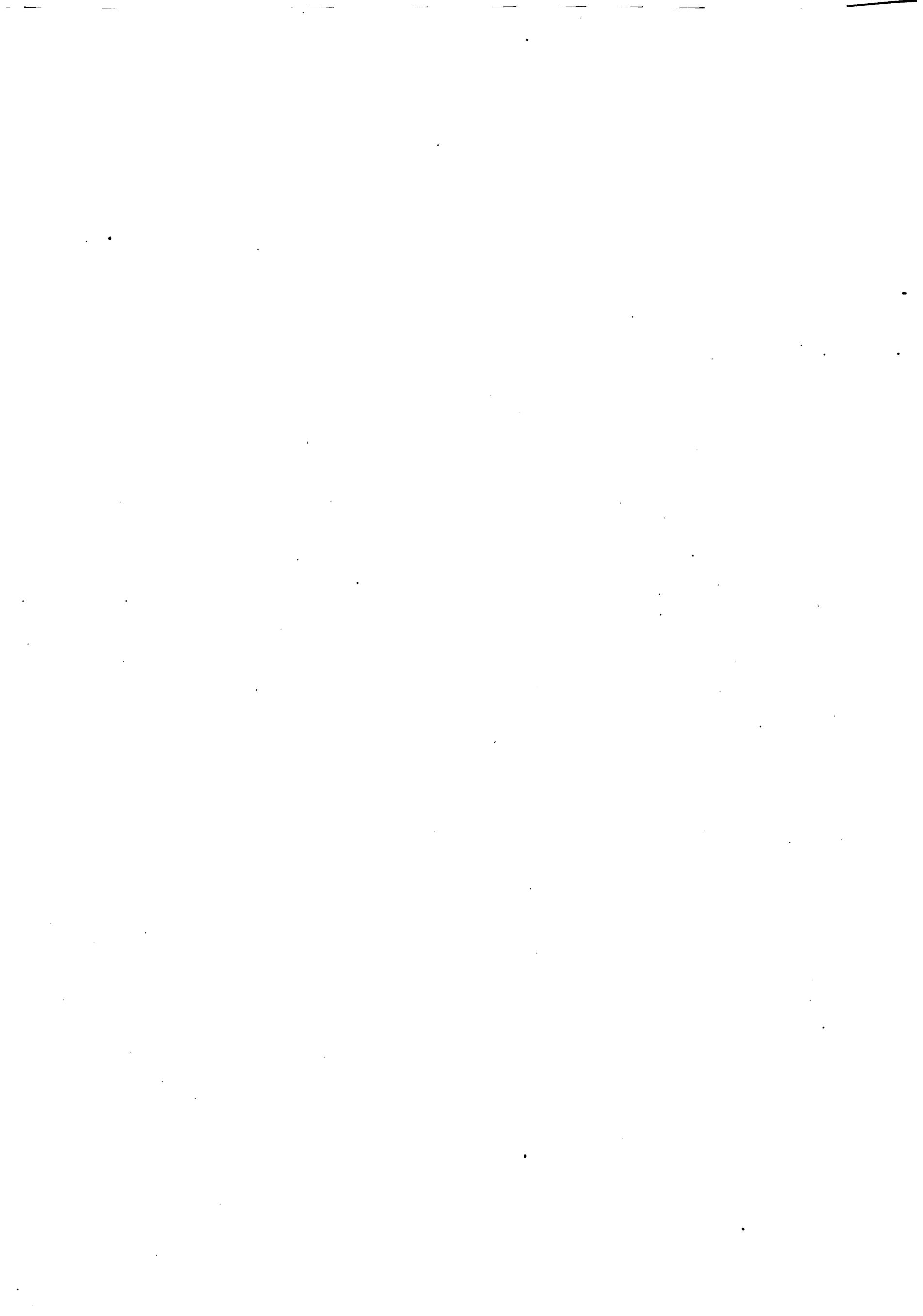


PLATE VIII.

- Figs. 1, 1a. NAUTILUS HUXLEYANUS, *n. sp.*: Ribbed cast from Andoor, Trichinopoly. (Trichinopoly group.) Side and front views, *reduced to half the lineal dimensions.*
- Fig. 2. " " " " Ribbed specimen from Andoor, Trichinopoly. (Trichinopoly group.) Side view.
- Fig. 3. " " " " Septum of *N. Huxleyanus*.
- Figs. 4, 4a. NAUTILUS ELEGANS, *D'Orbigny*: Side and front views of specimen from Shutanure, Trichinopoly.

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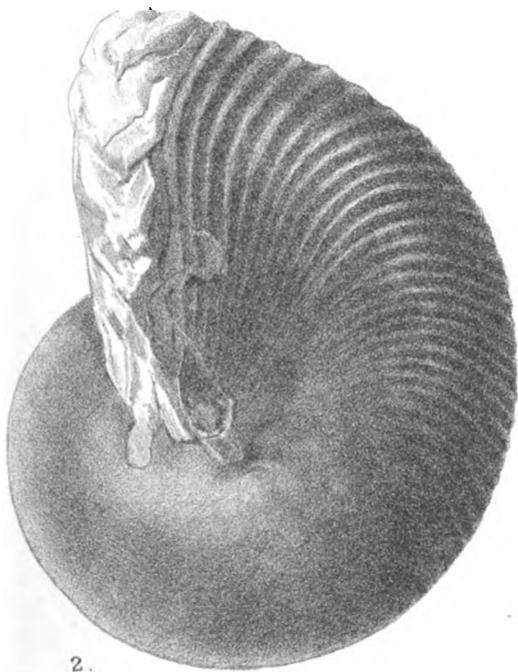
PL. VIII.



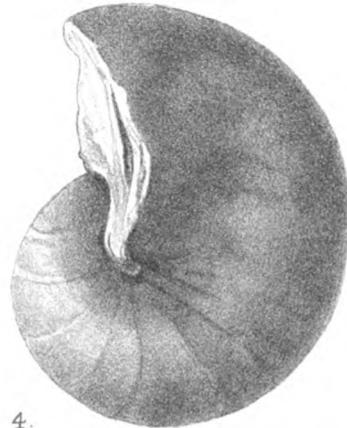
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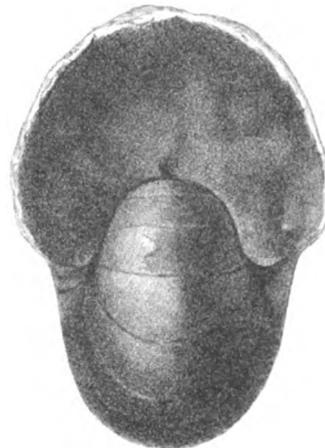
1. a.



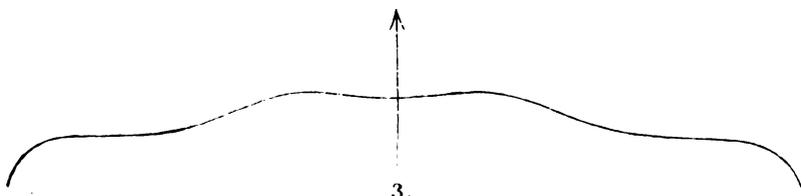
2.



4.



4. a.



3.

R. S. Audhikary. Lithd.

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PLATE IX.

- Fig. 1. NAUTILUS HUXLEYANUS, *n. sp.*: Cast from Moonglepaudy, Trichinopoly. (Ootatoor group.) Side view, *reduced to half the lineal dimensions.*
- Fig. 2. " " " Outline of septum of specimen from Moonglepaudy (Ootatoor group). Siphuncle sub-central.
- Fig. 3. " " " Outline of septum of specimen from Shutanure, Trichinopoly. (Trichinopoly group). Siphuncle ventral.
- Fig. 4. " " " Outline of septum of specimen from Andoor, Trichinopoly. (Trichinopoly group.) Siphuncle median in position.
- Figs. 5, 5a. NAUTILUS SPLENDENS, *n. sp.*: From Odium, Trichinopoly. Side and front views.

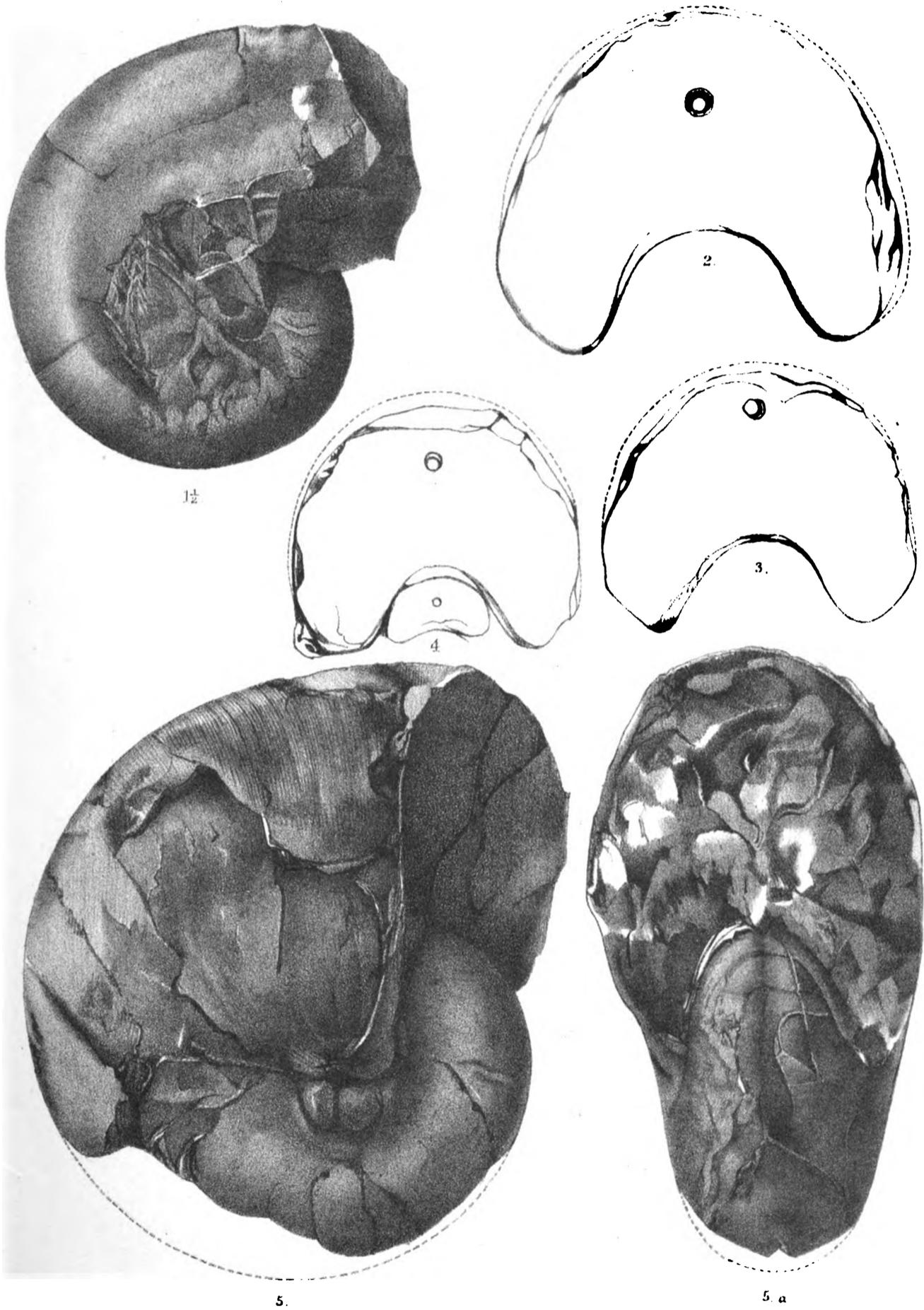






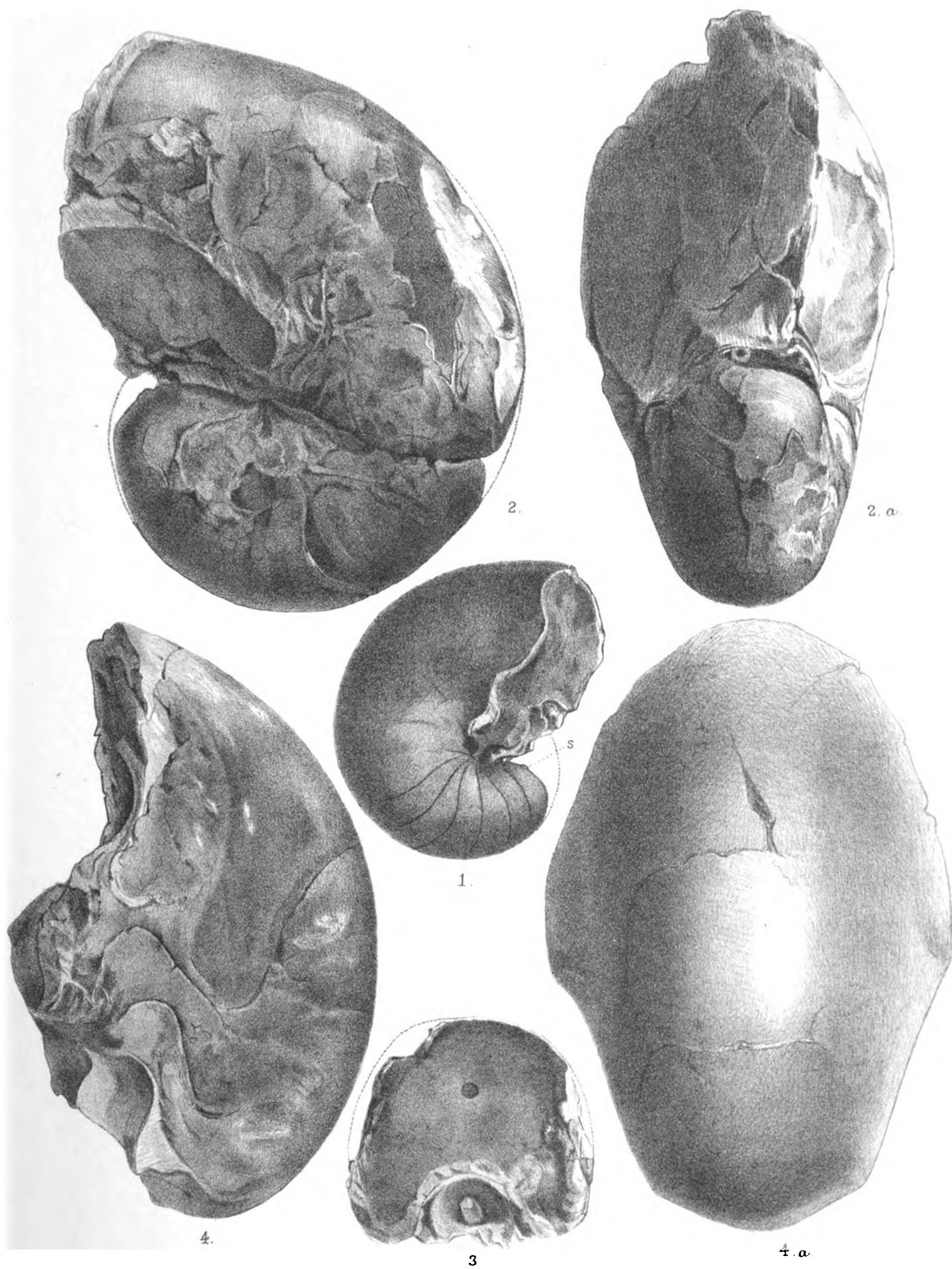
PLATE X.

- Fig. 1. NAUTILUS SPLENDENS, *n. sp.*: Side view of cast, from Odium, Trichinopoly.
- Figs. 2. 2a. „ JUSTUS, *n. sp.*: Side and front views of cast from Odium, Trichinopoly.
- Fig. 3. „ „ „ Septum of specimen from Odium, Trichinopoly.
(Front view.)
- Figs. 4. 4a. NAUTILUS DANICUS, *Schlotheim*: Fragment of cast from Ninnyoor, Trichinopoly.
Side and front views.

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Pl. X.



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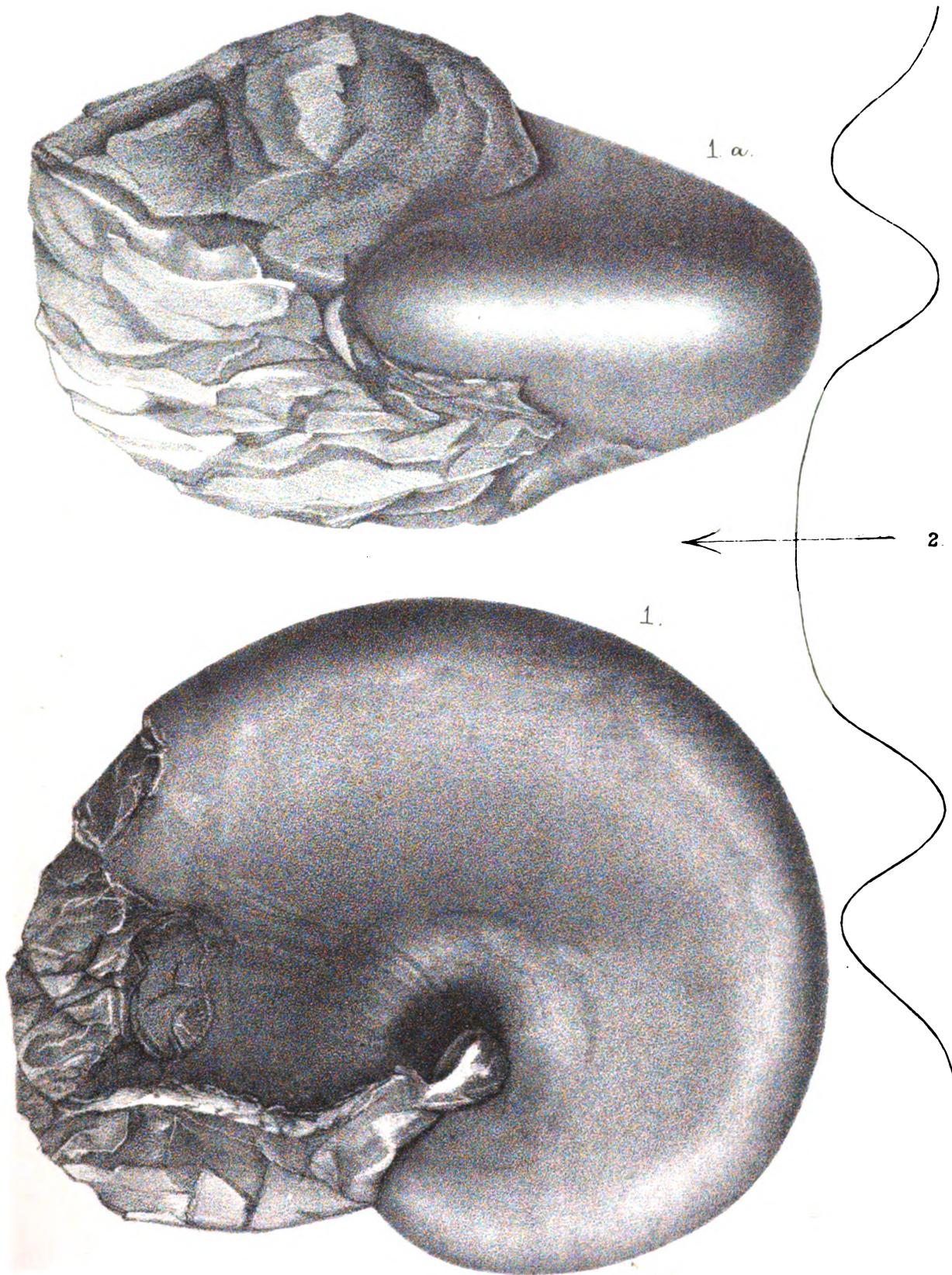
PLATE XI.

Figs. 1, 1a. NAUTILUS DANICUS, *Schlotheim*: Side and front views. From Ninnyoor, Trichinopoly.
Fig. 2. " " " Outline of septum.

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Pl. XI.



Nilcanto Das, Lith.

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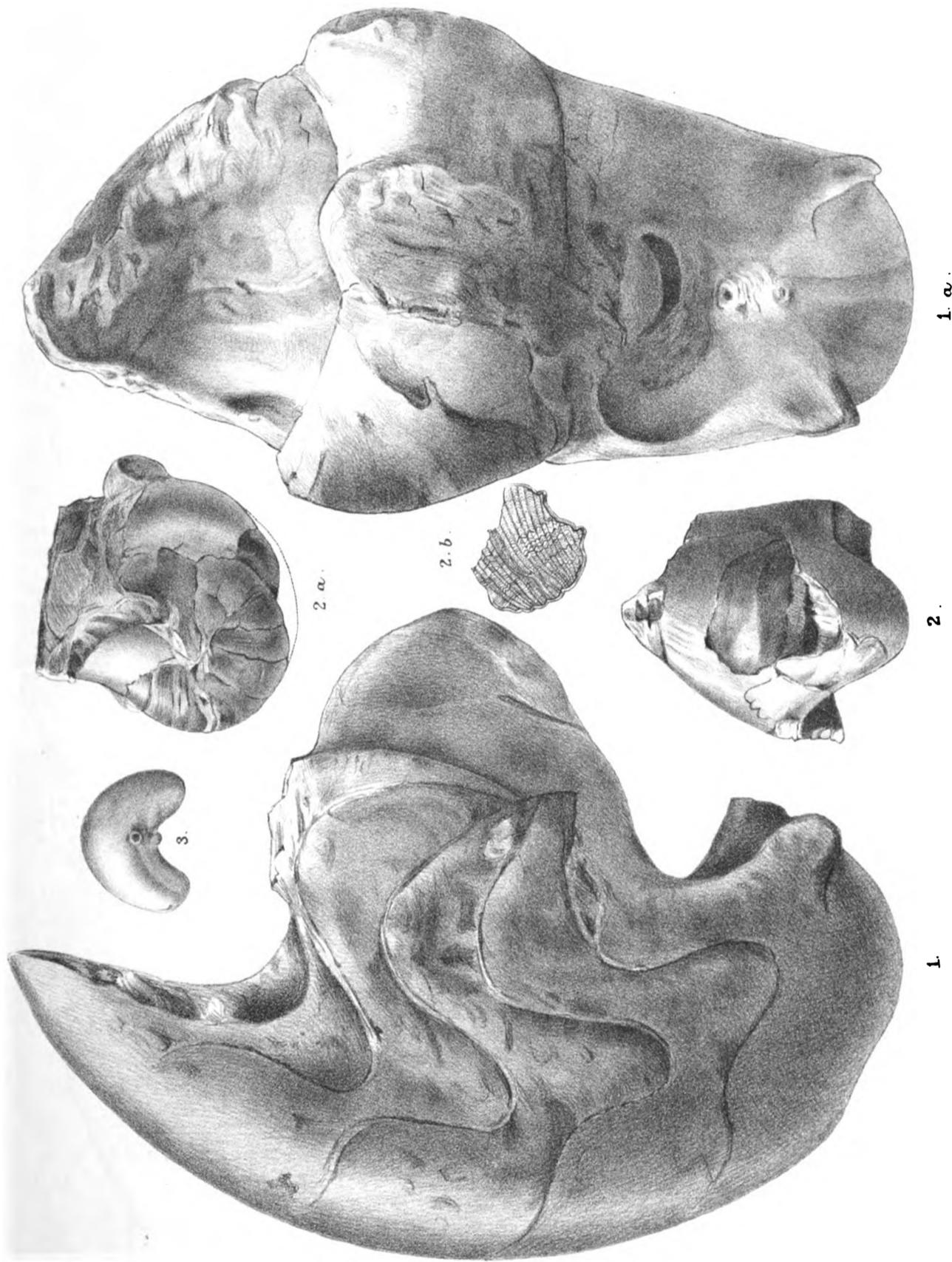




PLATE XII.

- Figs. 1, 1a. NAUTILUS SERPENTINUS, Fragment of a cast from Rayapoothapakkam,
Pondicherry. From the Arrialoor? group.
(Side and front views.)
- Figs. 2, 2a. NAUTILUS VALUDAYURENSIS, n. sp.: From the Valudayur limestone near Pondi-
cherry. Madras Museum. (Back and side
views.)
- Fig. 2b. " " " Fragment of shell enlarged 2 diameters.
- Fig. 3. " " " A septum in the Madras Museum Collection.
From the same formation and locality.

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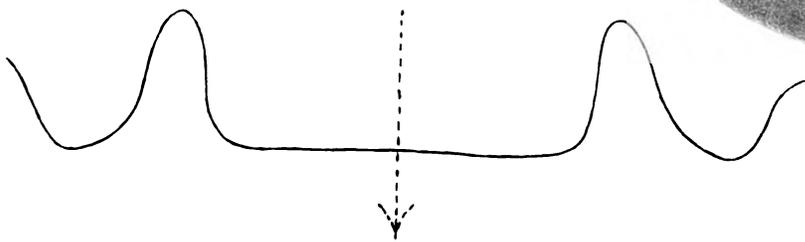
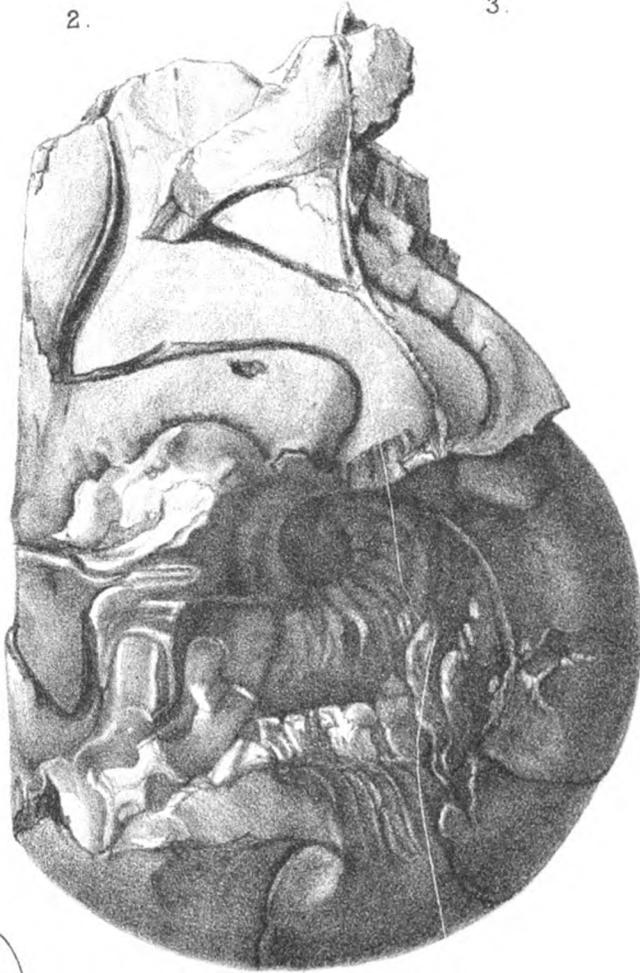
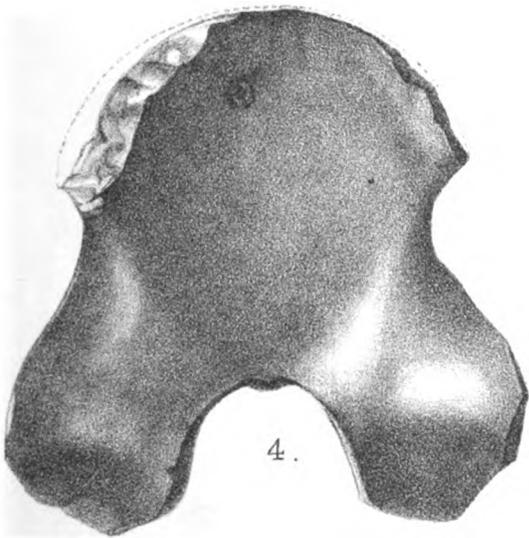
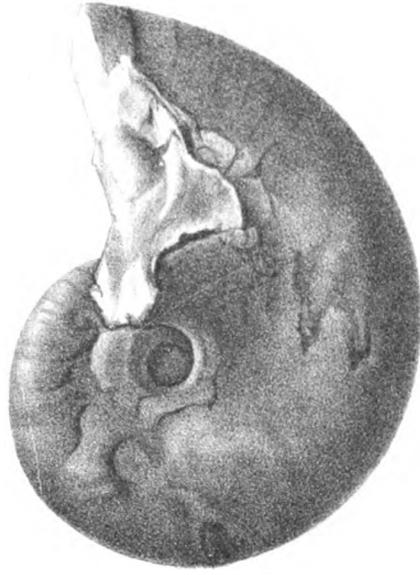
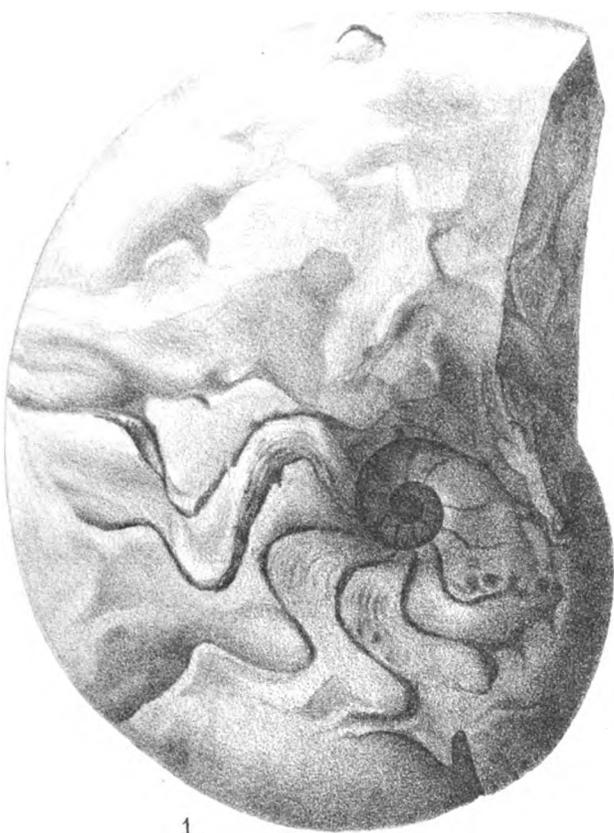
PLATE XIII.

- Fig. 1. NAUTILUS FORBESIANUS, *n. sp.*: Cast from Maravuttoor, Trichinopoly. From Brooke
Cunliffe, Esq. Side view.
- Figs. 2, 3. „ „ „ Cast from Maravuttoor, Trichinopoly, from B: Cunliffe,
Esq. (Side and front views.)
- Fig. 4. „ „ „ Septum from Odium, Trichinopoly. Front view.
- Fig. 5. „ „ „ Cast from Odium, Trichinopoly. Side view.
- Fig. 6. „ „ „ Outline of septum.

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Pl. XII.



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PLATE XIV.

Figs. 1, 1a. 1b. NAUTILUS ANGUSTUS, *n. sp.*: Cast with part of the matrix, from Odium, Trichinopoly.

Fig. 1. Side view; 1a. back view; 1b. front view of detached portion showing septum.

Fig. 2. " " " Outline of septum.

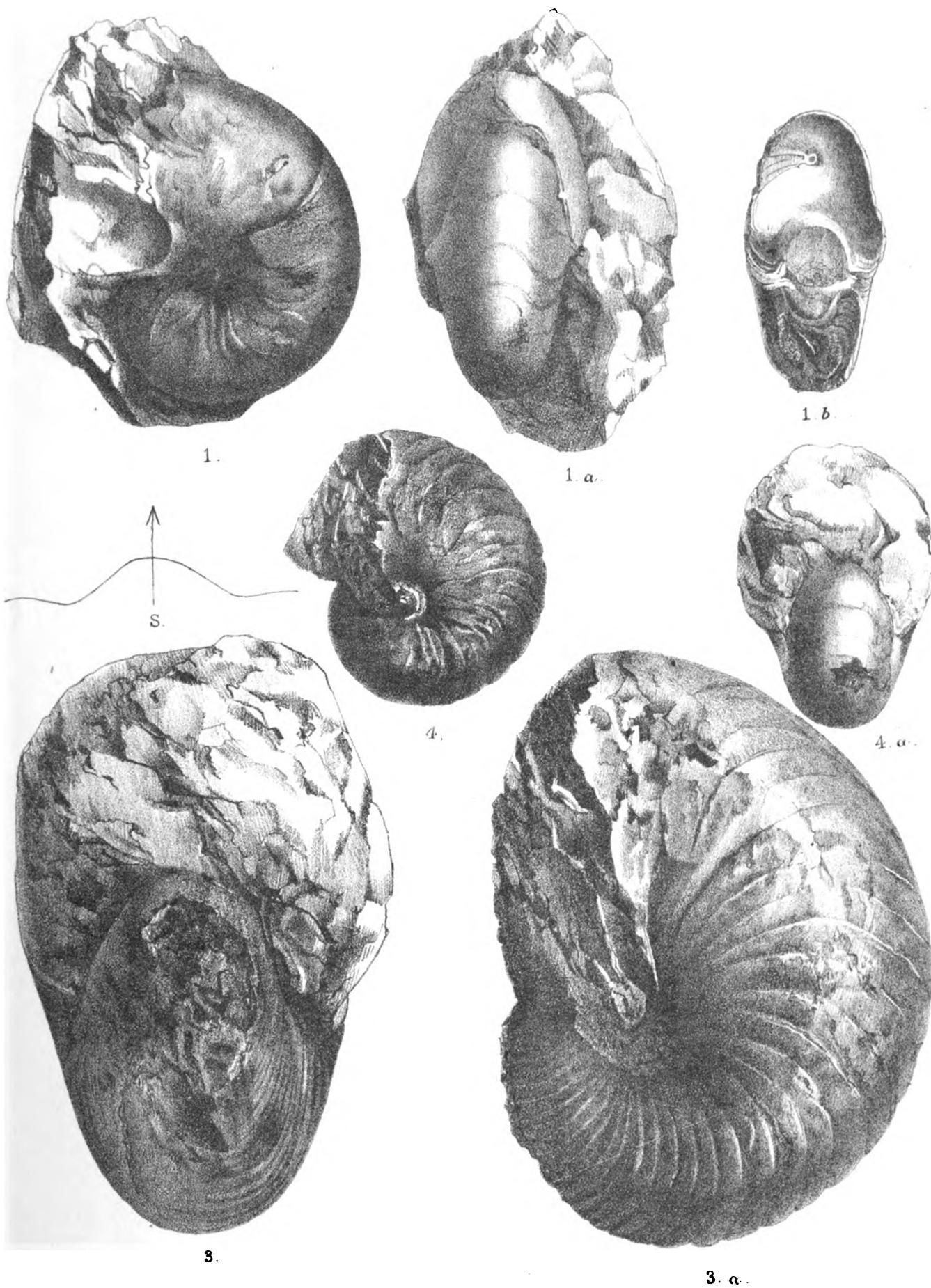
Figs. 3, 3a. NAUTILUS FORMOSUS, *n. sp.*: Adult specimen from Kurribiem, Trichinopoly. Front and side views.

Figs. 4, 4a. " " " Young shell from Karapady, Trichinopoly. Side and front views.

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Pl. XIV.



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PLATE XV.

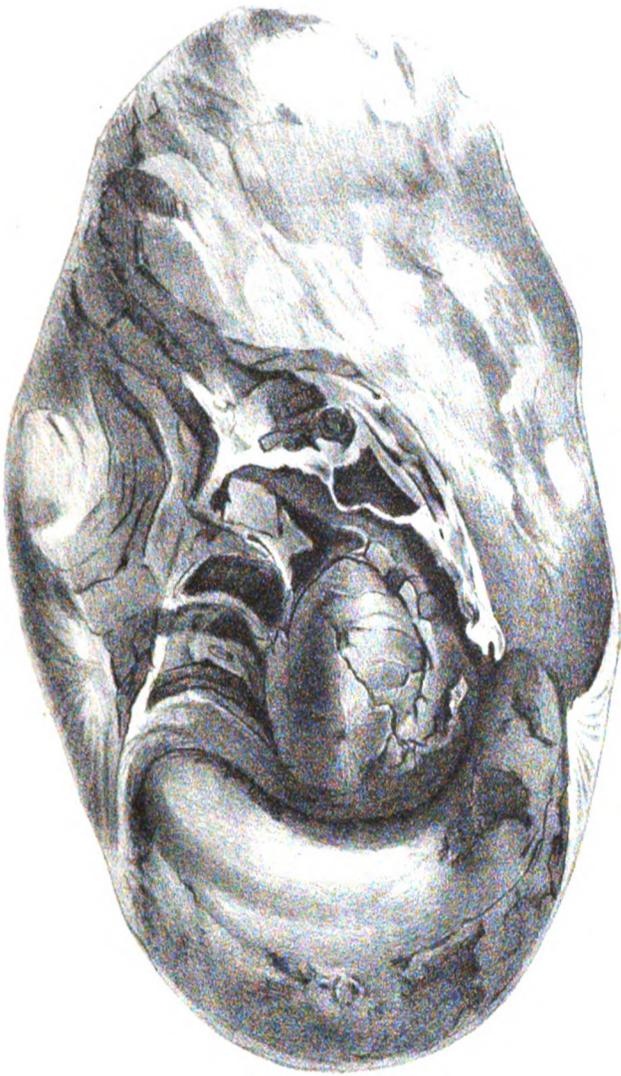
Fig. 1. *1a. 1b.* NAUTILUS FORMOSUS, *n. sp.*: Fragment from Andoor, Trichinopoly.

Fig. 1, front view: Fig. *1a.* back view; Fig. *1b.*
side view.

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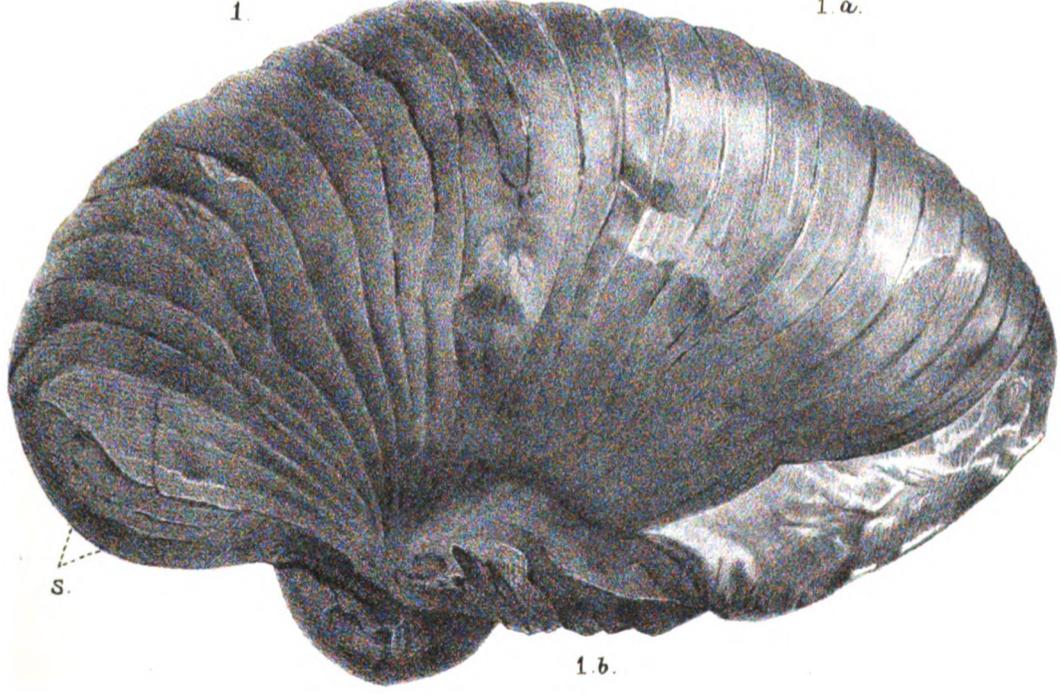
Pl. XV.



1



1.a.



1.b.

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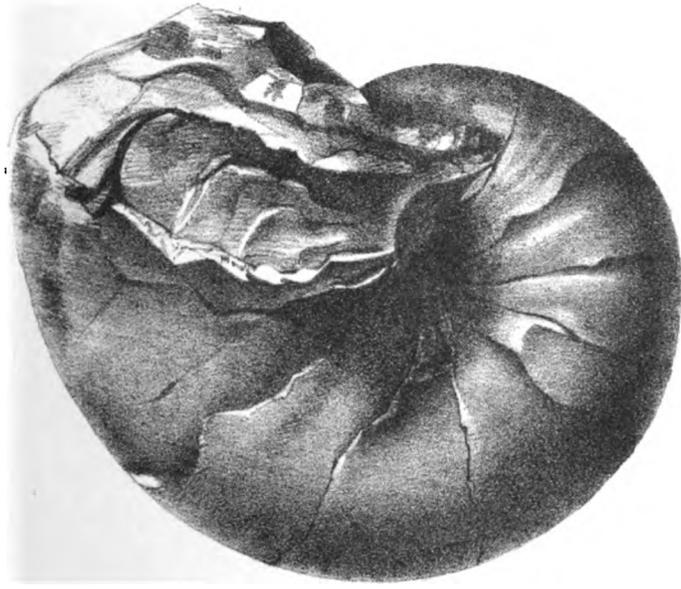




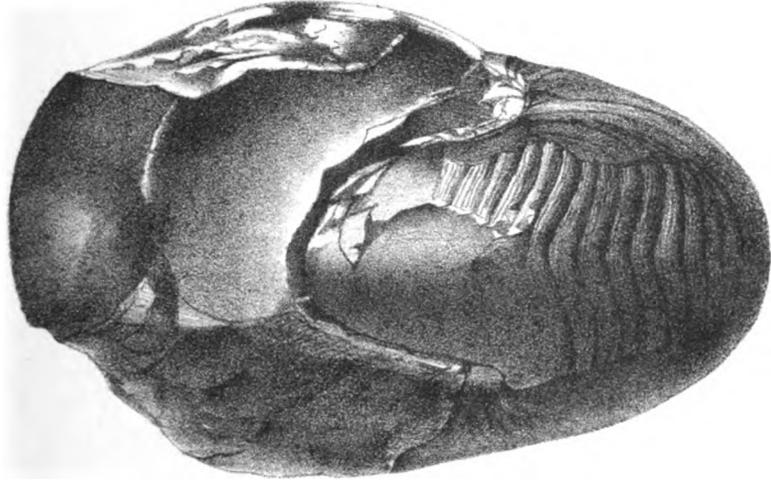


PLATE XVI.

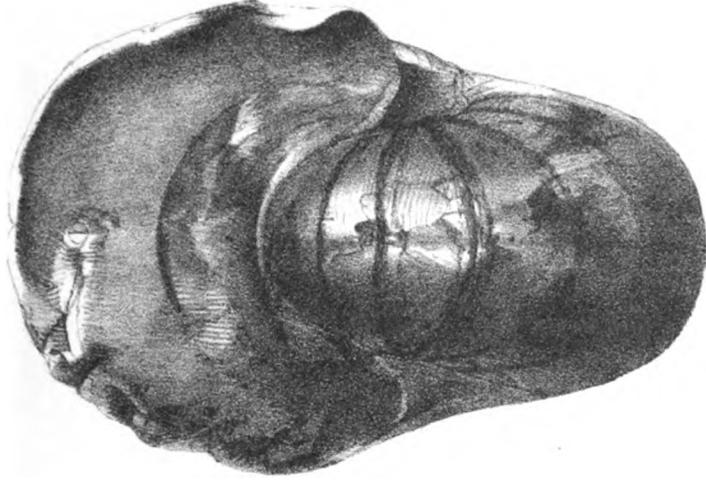
- Fig. 1. NAUTILUS ELEGANS, *D'Orbigny*. : Cast from Kunnanore, Trichinopoly. Side view.
Fig. 2. " " " Cast with fragment of shell from Annapaudy, Trichinopoly. Front view.
Fig. 3. " " " Cast from Annapaudy, Trichinopoly. Front view.
Fig. 4. " " " Cast from Andoor, Trichinopoly. Front view.
Fig. 5. NAUTILUS KAYEANUS, *n. sp.* : Cast from Ootatoor, Trichinopoly, side view.
Fig. 6. " " " Cast with undulations, from Purawoy, Trichinopoly. Side view.



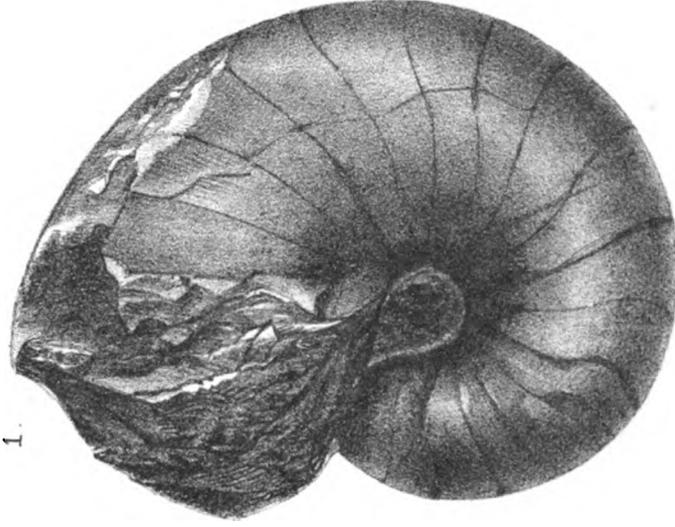
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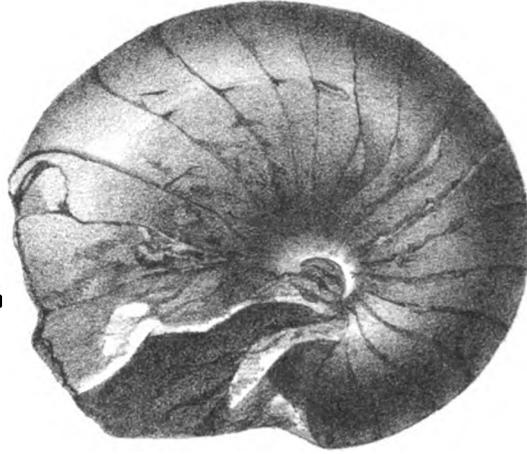
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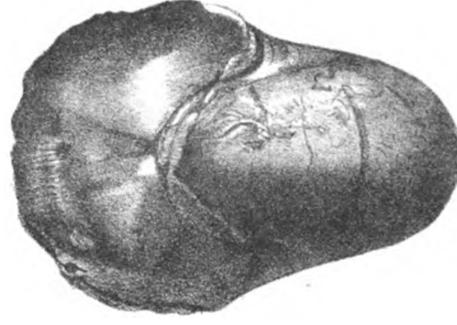
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6.



5.



4.





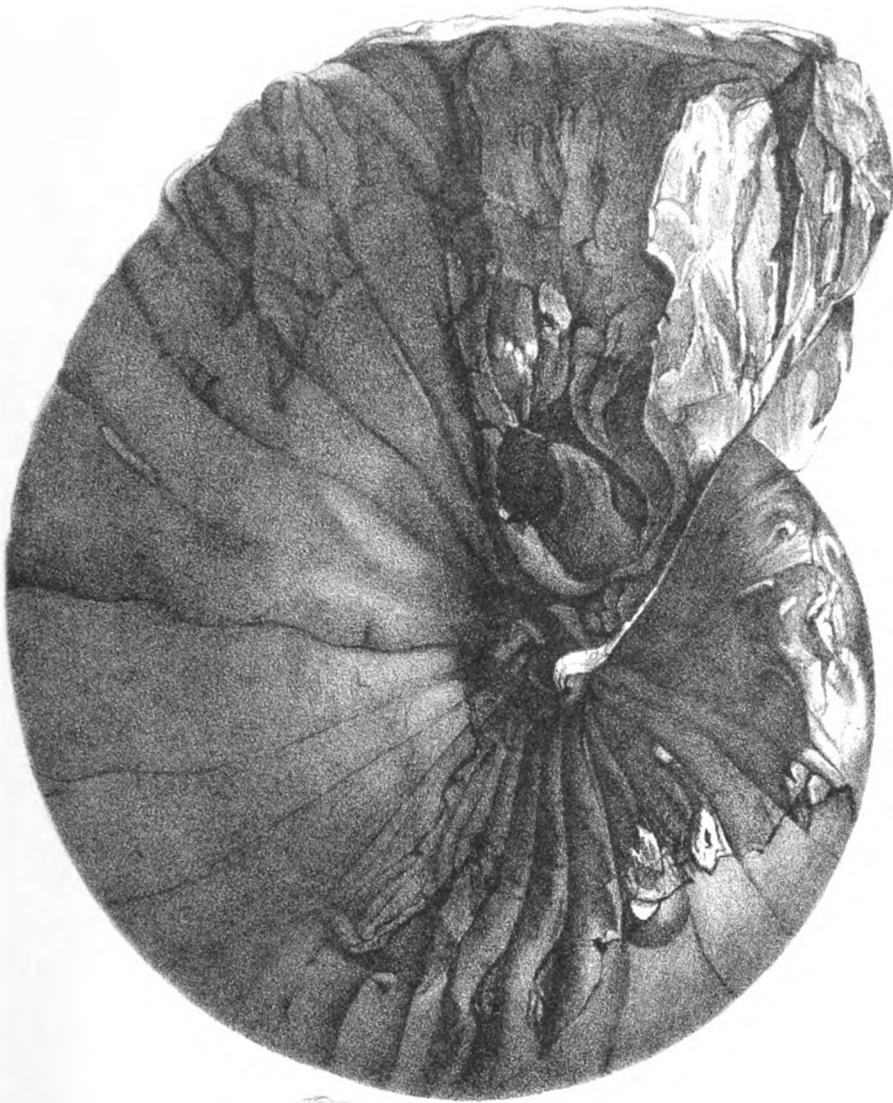
PLATE XVII.

- Fig. 1. NAUTILUS KAYEANUS, *n. sp.*: Cast with part of shell from Ootatoor, Trichinopoly. Side view.
- Figs. 2, 2a. „ „ „ Cast from Ootatoor, Trichinopoly. Front and back views.
- Fig. 3. NAUTILUS PSEUDO-ELEGANS, *D'Orbigny*: Cast from Odium, Trichinopoly. Back view.

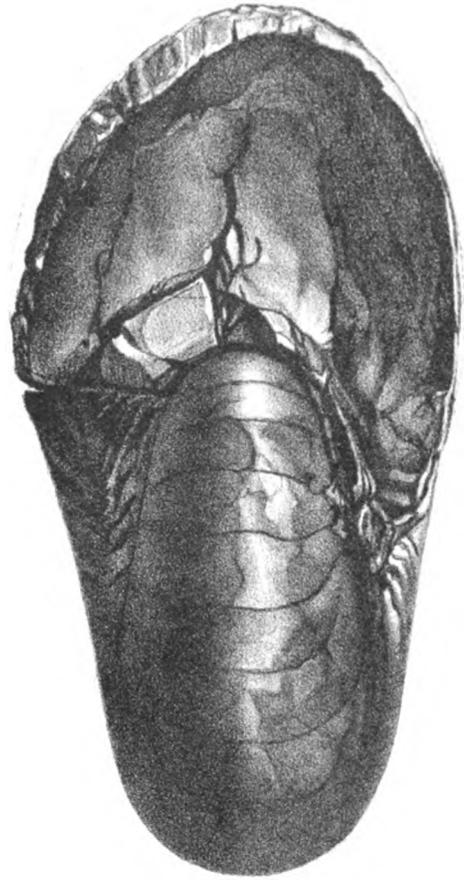
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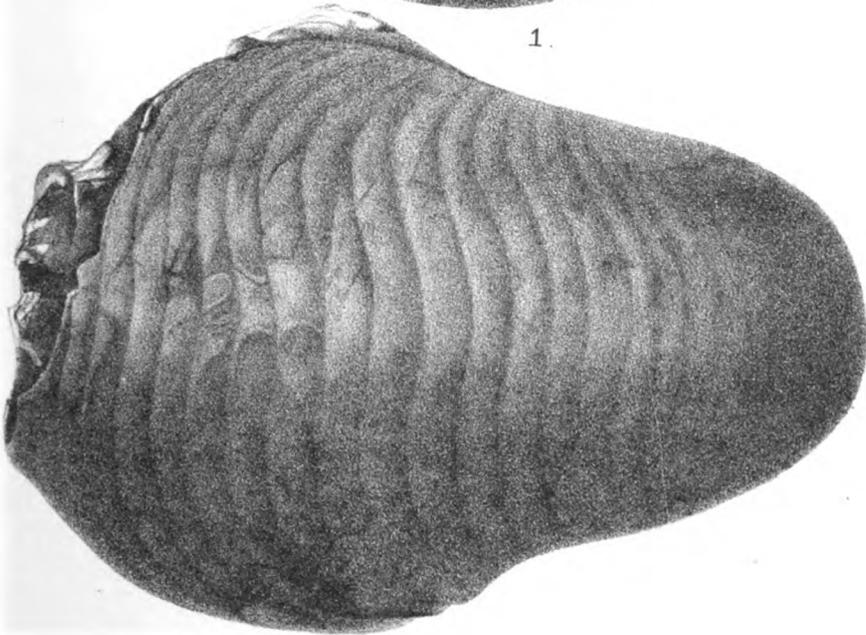
Pl. XVII.



1.



2.



3



2 a

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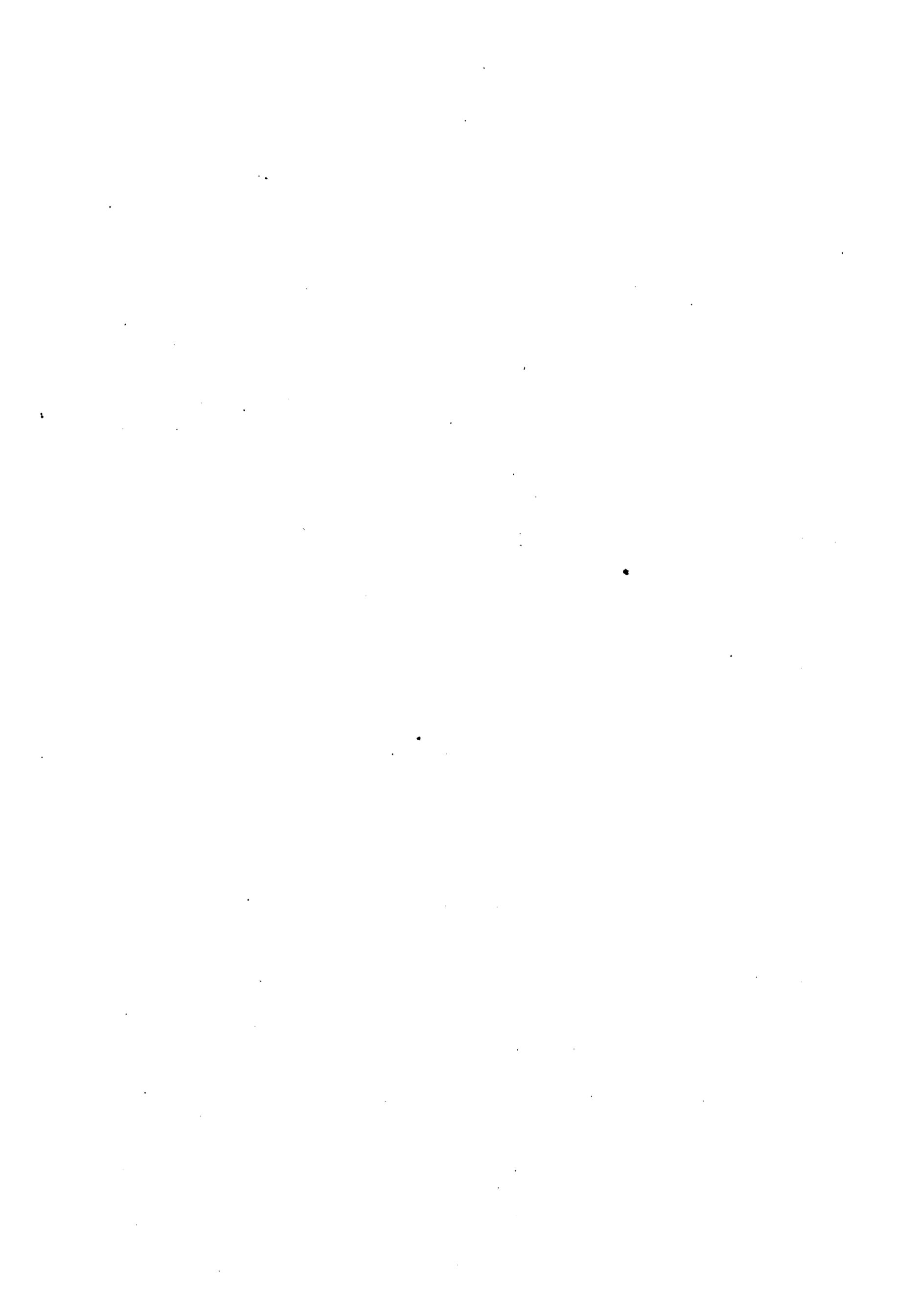


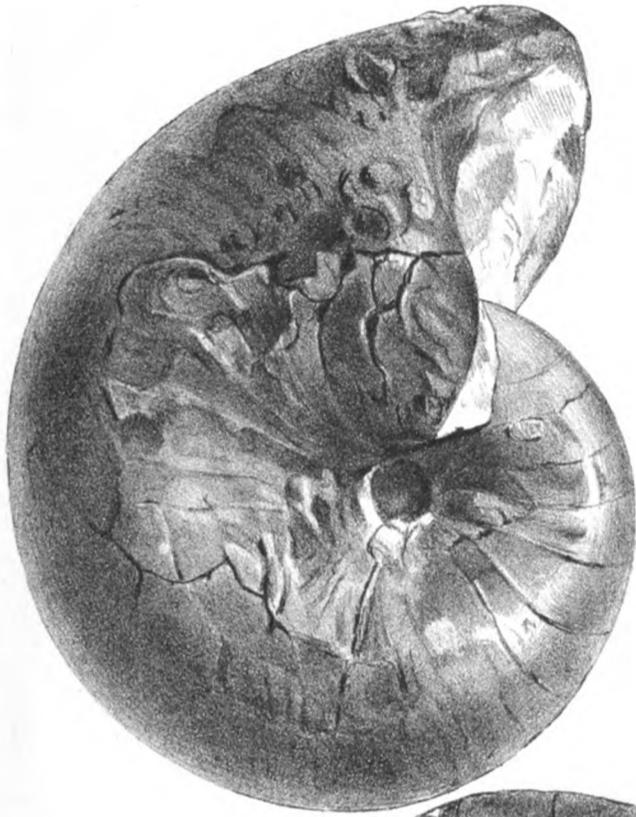
PLATE XVIII.

- Figs. 1, 1a. NAUTILUS KAYEANUS, *nov. sp.* : Cast from Ootatoor, Trichinopoly; (side and front views,) *reduced to one-half lineal dimensions.*
- Fig. 2. " " " Cast from Ootatoor. Back view, *reduced to one-half lineal dimensions.*
- Figs. 3, 3a., 3b. NAUTILUS PSEUDO-ELEGANS, *D'Orbigny* : Small cast, wanting body whorl. From Odium, Trichinopoly. Side, front, and back views.

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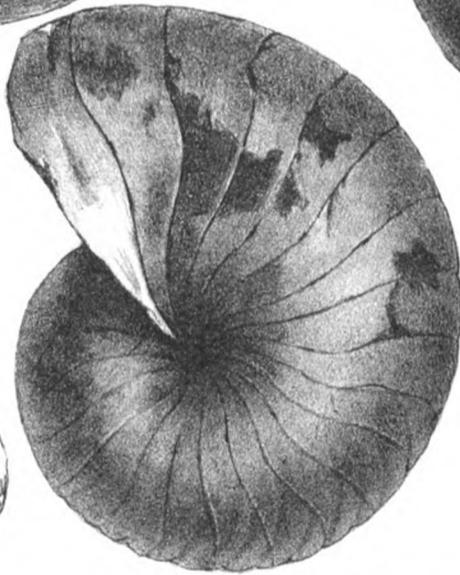
Pl. XVIII.



1.



2.



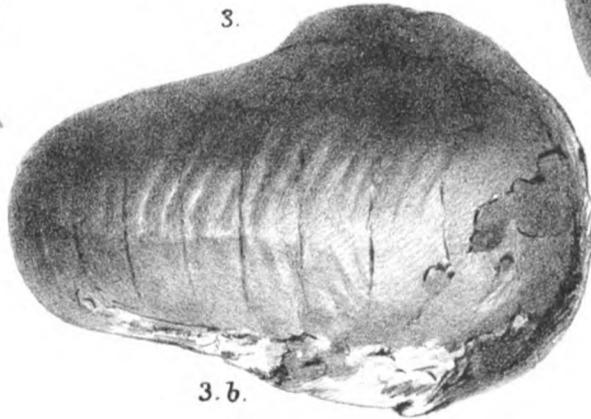
3.



1.a.



3.a.



3.b.

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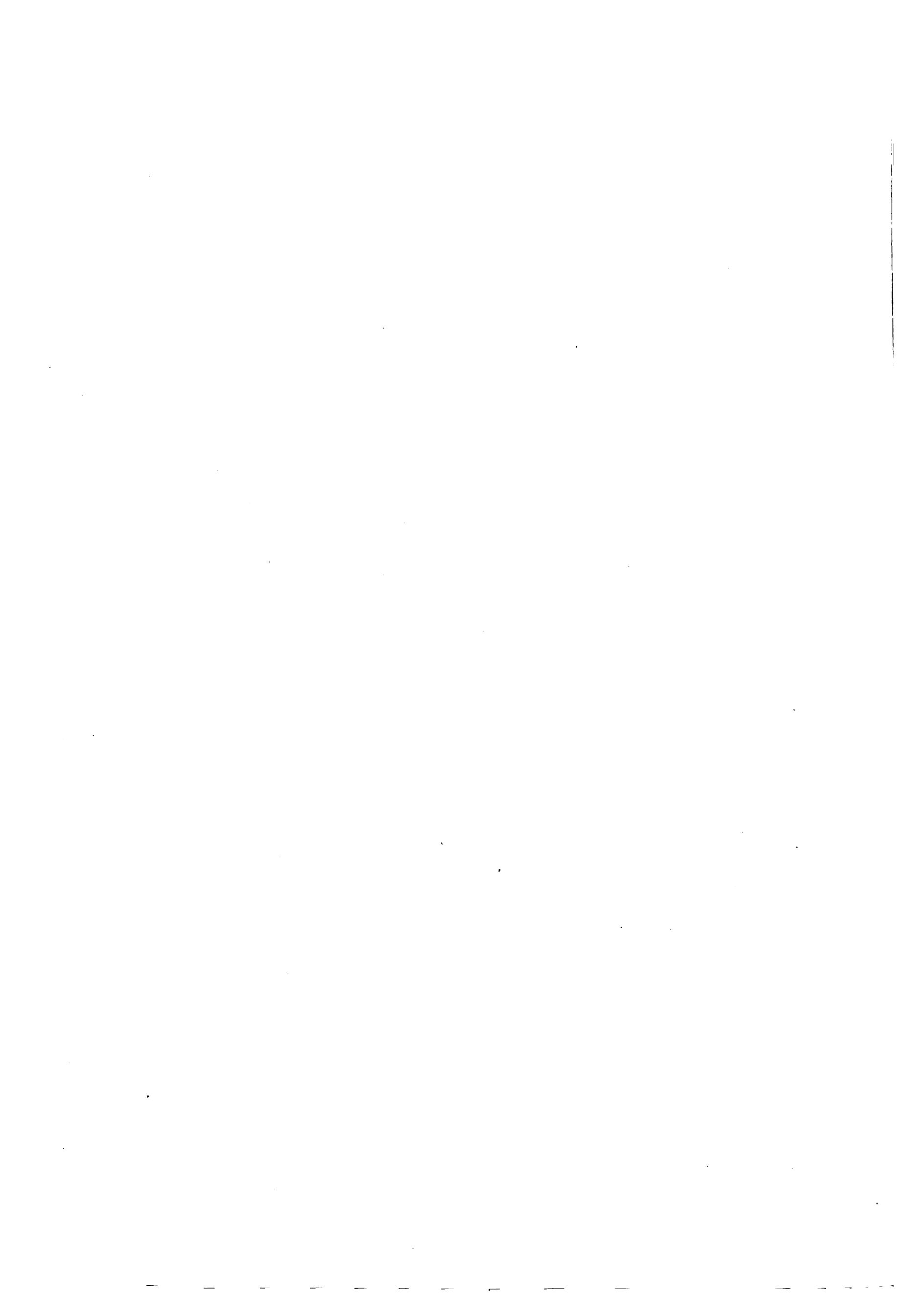


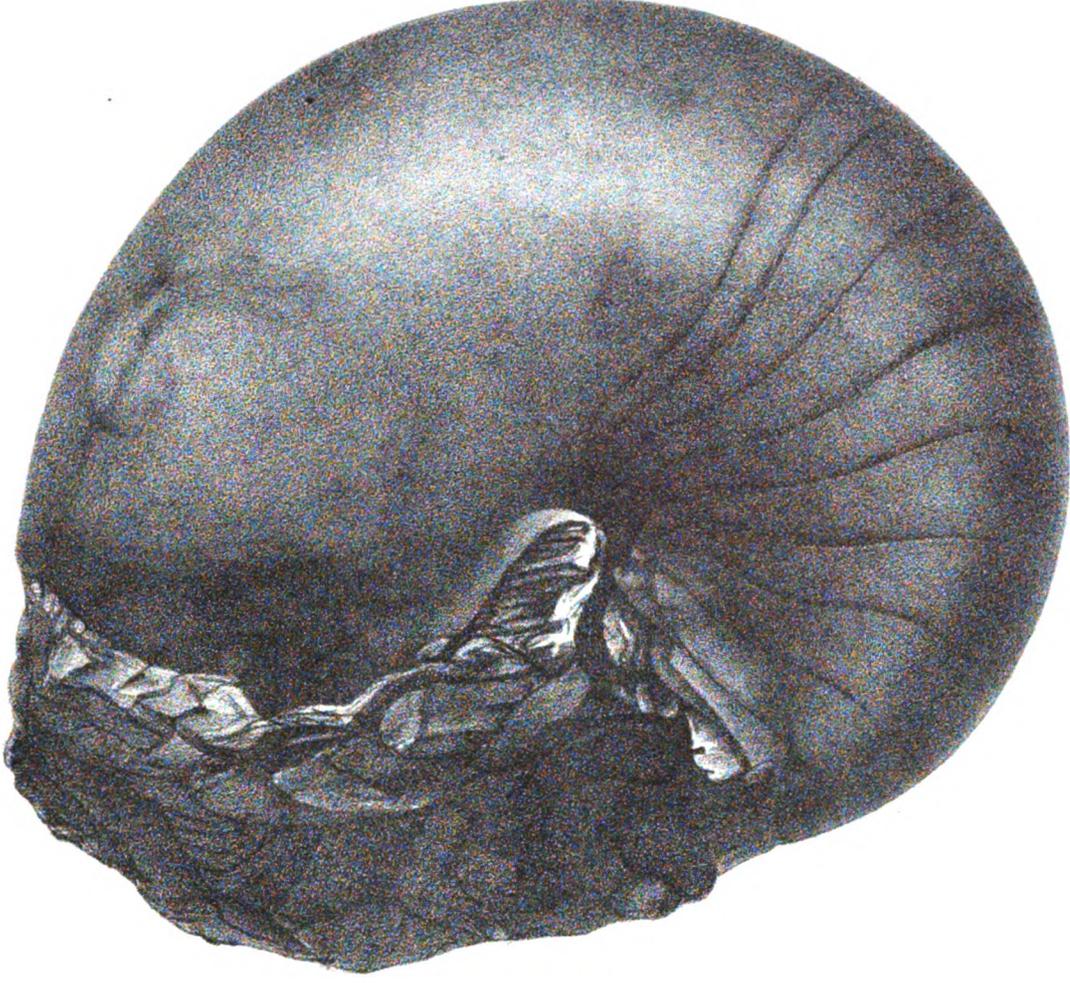


PLATE XIX.

- Fig. 1. NAUTILUS PSEUDO-ELEGANS, *D'Orbigny*. Side view of a cast from Odium, Trichinopoly.
Ootatoor group.
- Fig. 2. " " " Front view of another cast from the same locality.
Ootatoor group.



2.



1.





PLATE XX.

- Figs. 1, 1a. NAUTILUS PSEUDO-ELEGANS, *D'Orbigny*. A cast from Odium, Trichinopoly, Ootatoor group. Side and front views.
- Figs. 2, 2a. NAUTILUS NEGAMA, *nov. sp.* A cast from Sirgumpore, Trichinopoly. Ootatoor group. Side and front views. *Half lineal dimensions.*

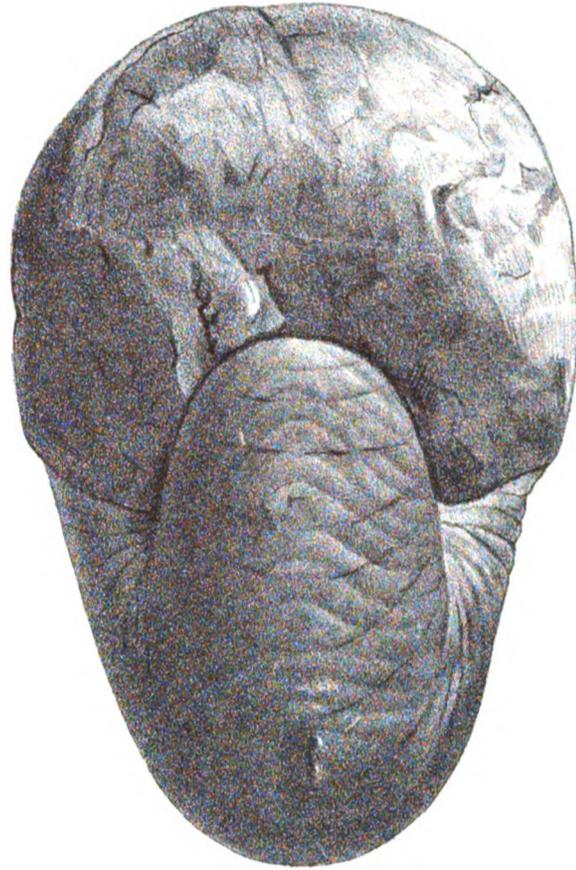
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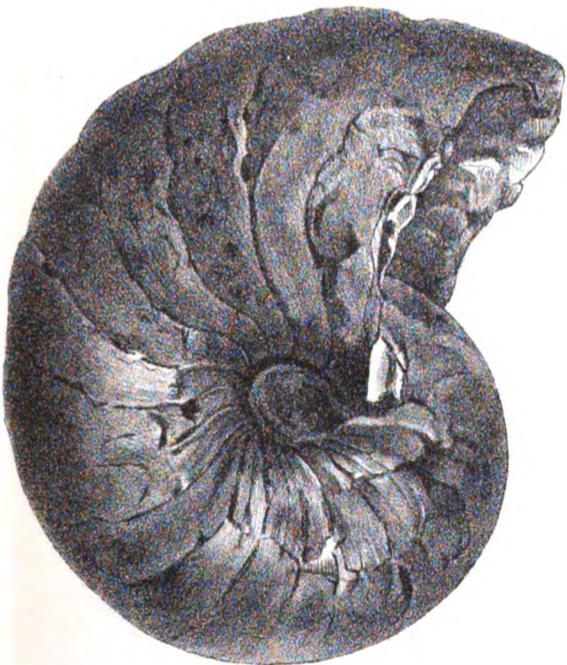
PL. XX.



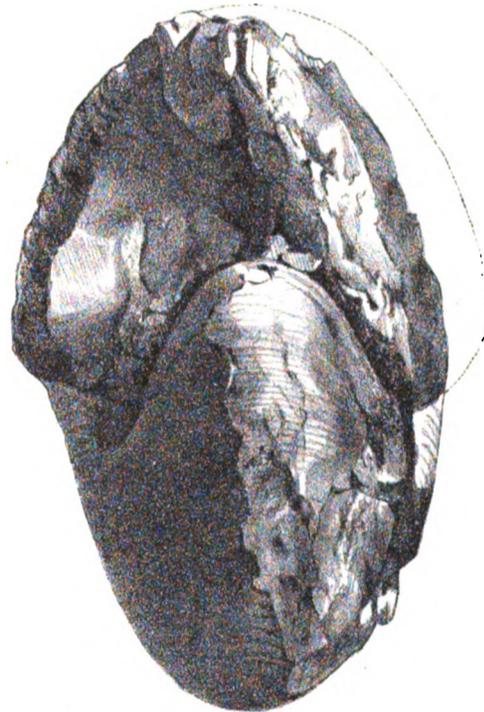
1.



1. a.



2.



2. a.

R. S. Audhikary, Lithd.

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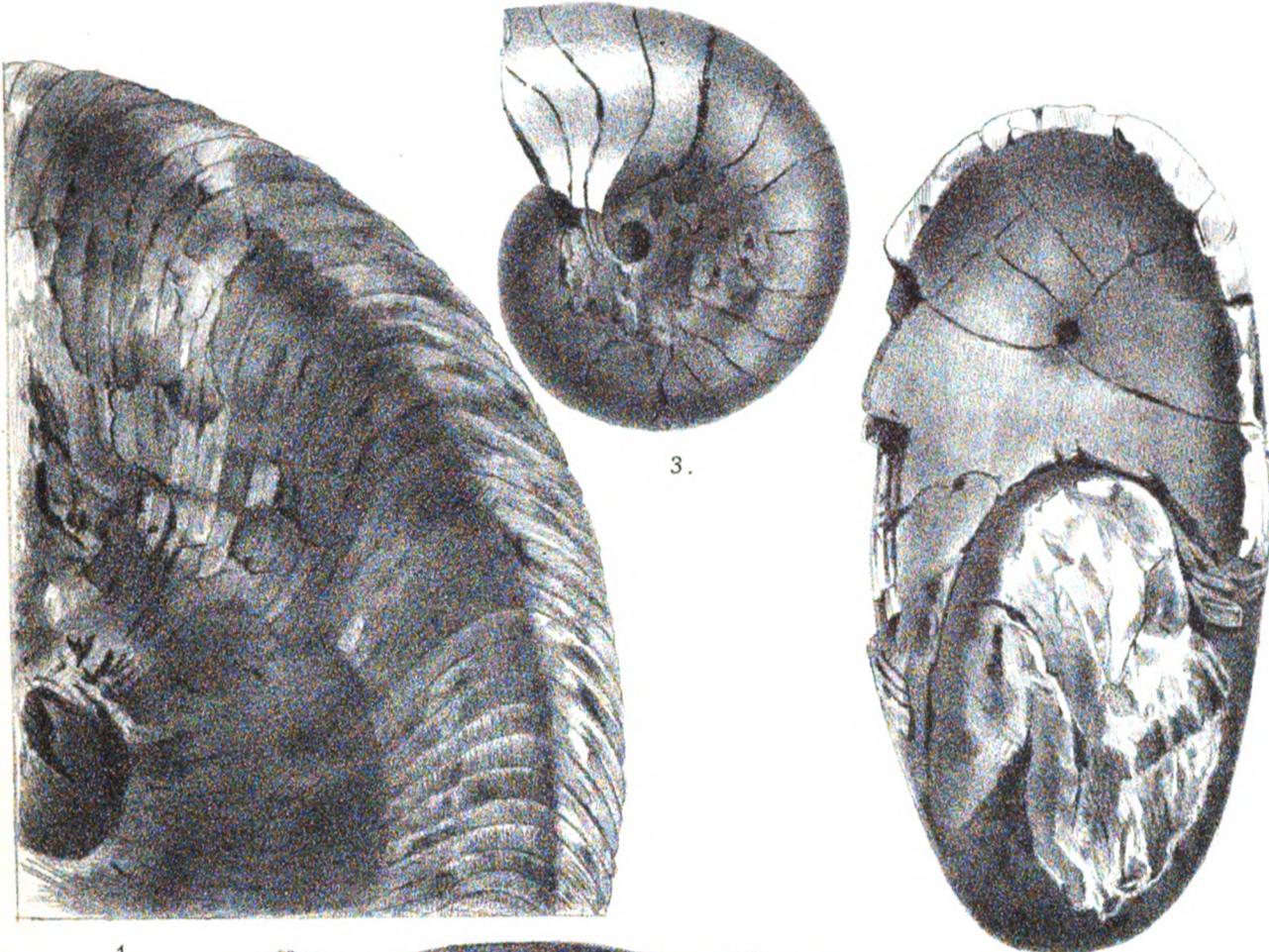
PLATE XXI.

- Fig. 1. NAUTILUS NEGAMA, *nov. sp.* A portion of the specimen figured on Plate XX, showing the ribbing : full size. Side view.
- Figs. 2, 2a. NAUTILUS KAYEANUS, *nov. sp.* Cast from Ootatoor, Trichinopoly. Back view : full size.
2a. Front view, *reduced to one-half lineal dimensions.*
- Fig. 3. NAUTILUS CREBRICOSTATUS, *nov. sp.* Small cast from Ootatoor, Trichinopoly. Side view.

CRETACEOUS ROCKS S. INDIA.

Geol. Surv. of India.

Pl. XXI.



1.

3.

2. a.



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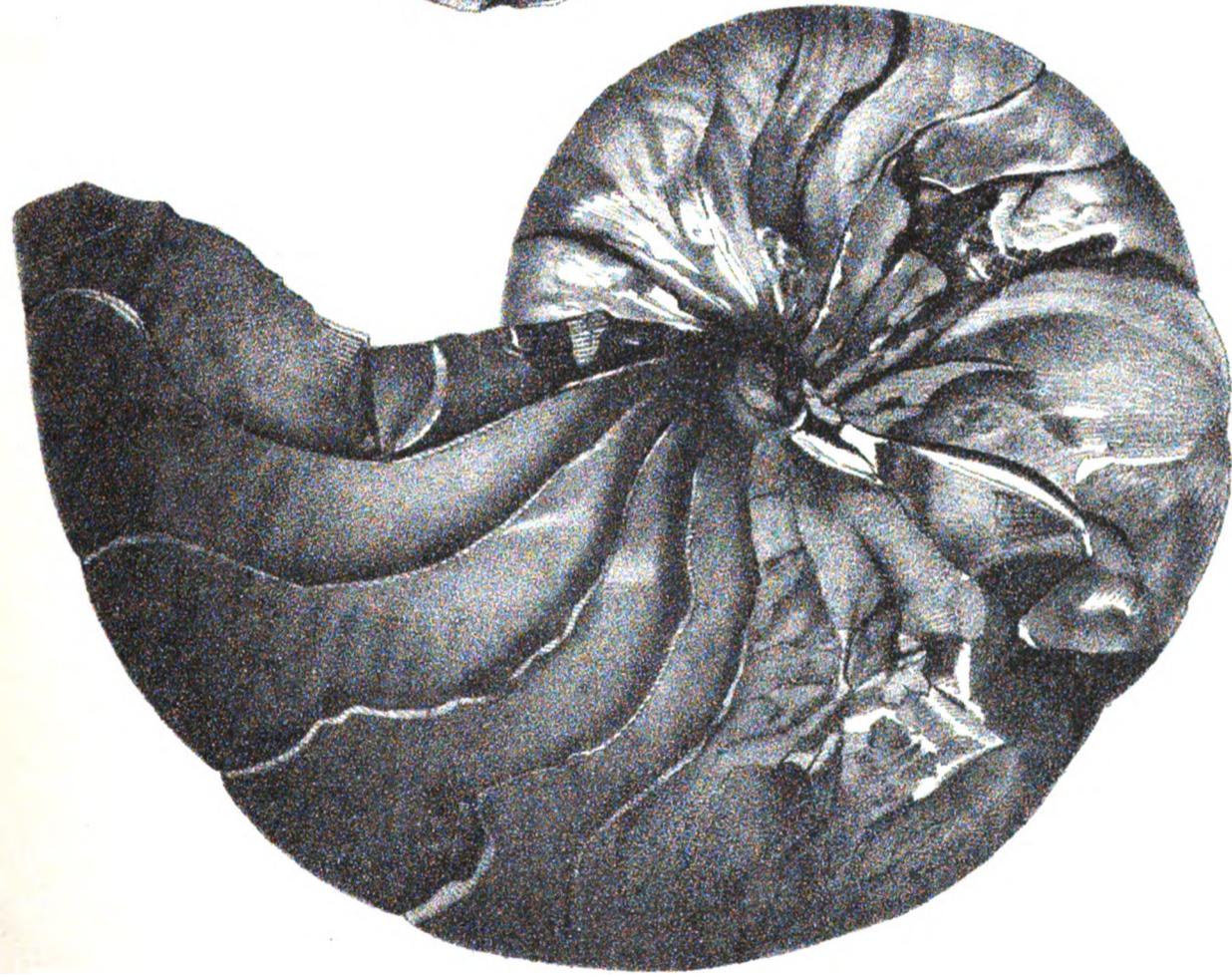




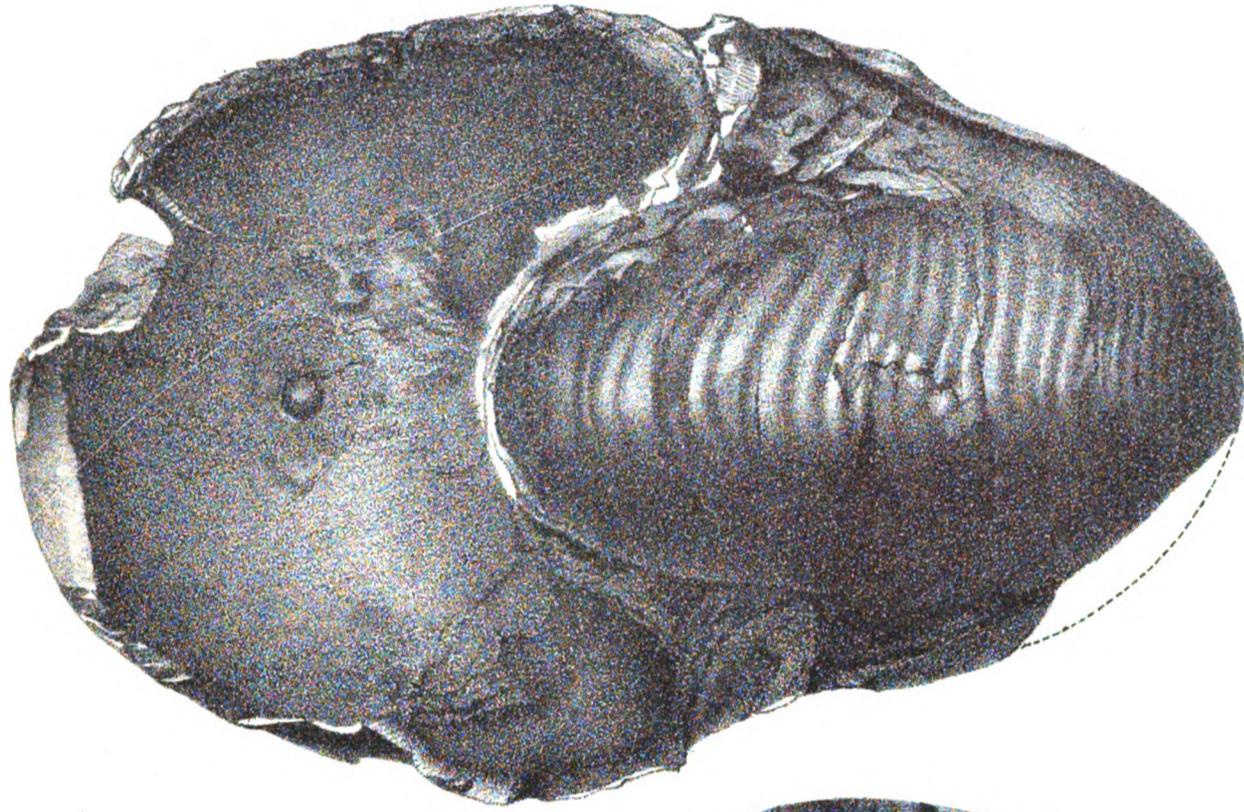


PLATE XXII.

Figs. 1, 1a. NAUTILUS CREBRICOSTATUS, *nov. sp.* Cast from Ootatoor, Trichinopoly. Ootatoor group. (Side and front views.)



1.



1. a.

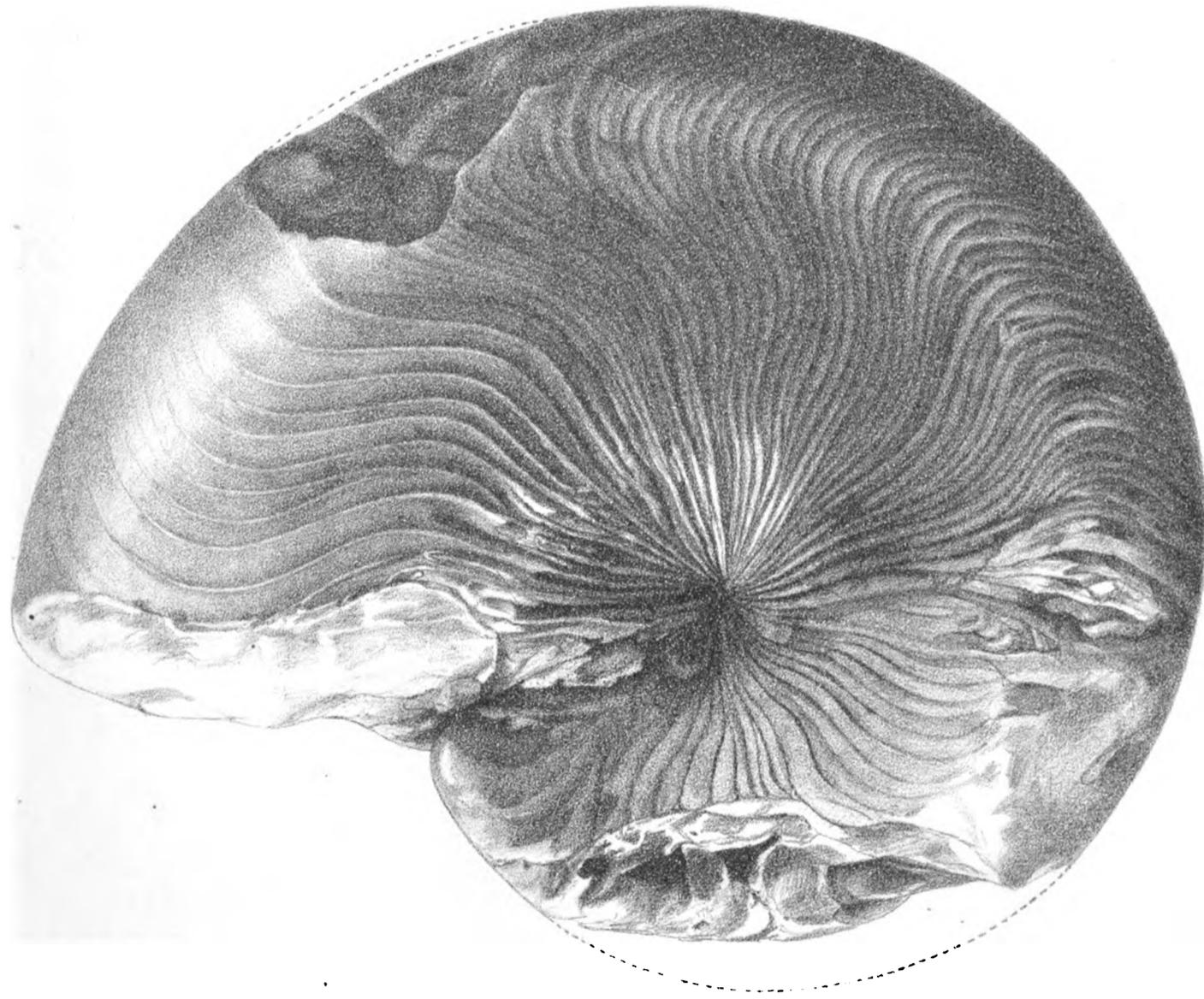
Nil Kanth Das, Lithd.

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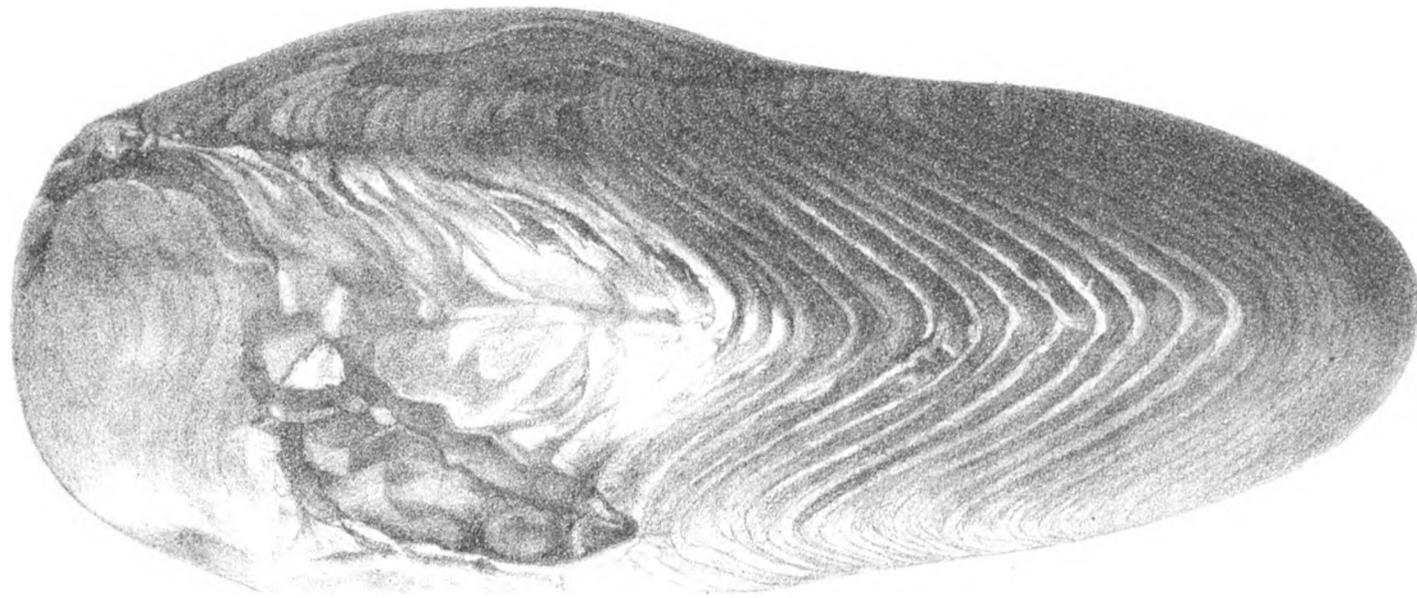


PLATE XXIII.

Figs. 1, 1a. NAUTILUS TRICHINOPOLITENSIS, *nov. sp.* Old specimen from Arrialoor, Trichinopoly
Arrialoor group. Side and back views.



1.



1. a.

Jodunath Das, Lithd.

Printed at Geol. Survey Office.

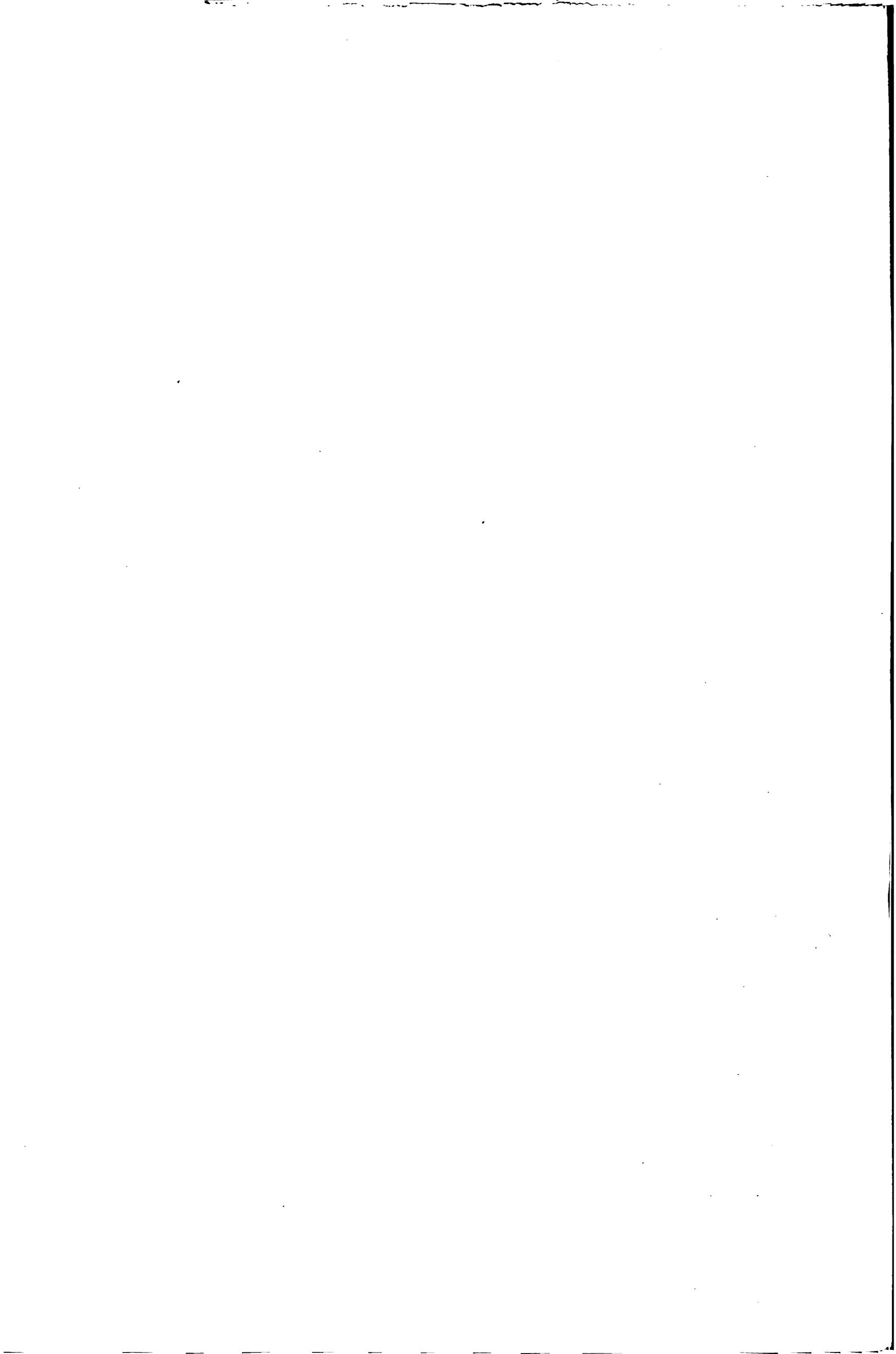
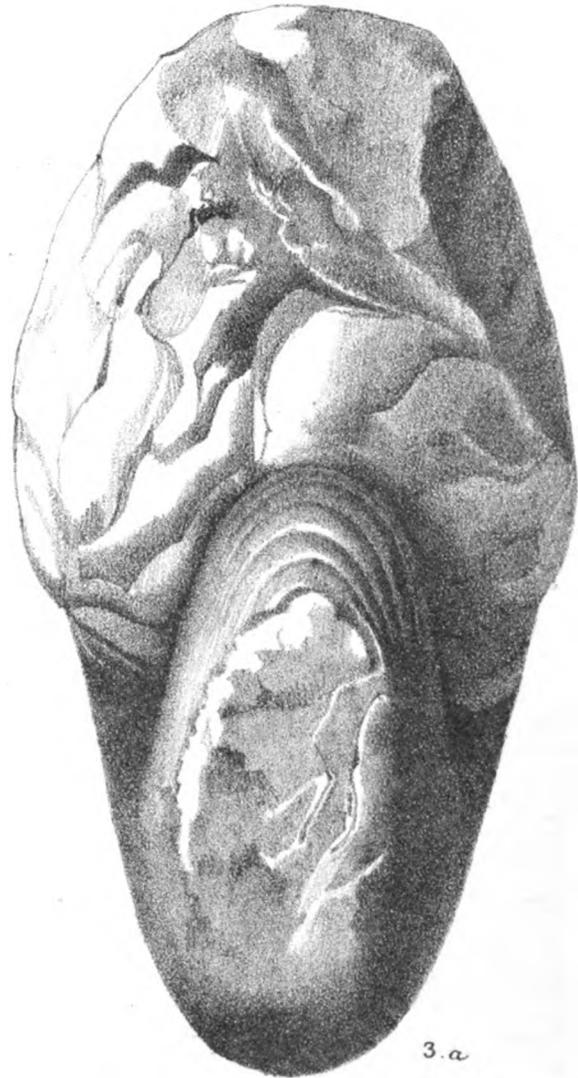
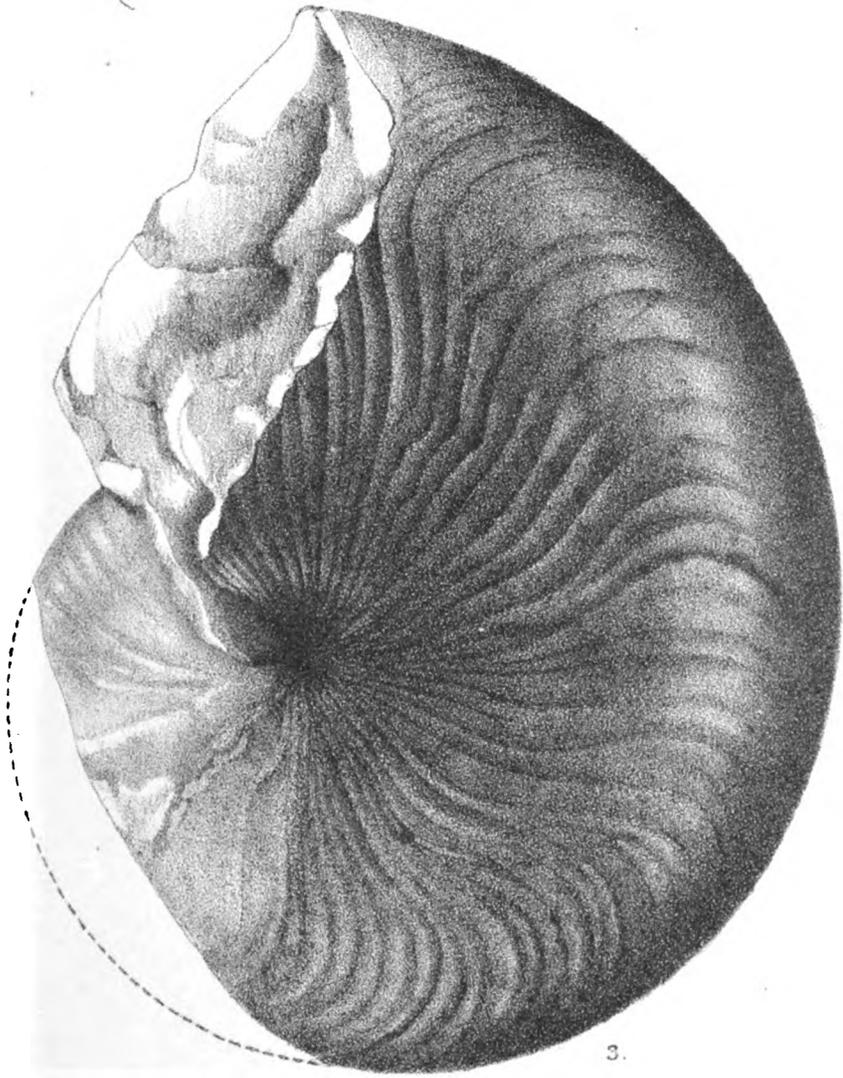
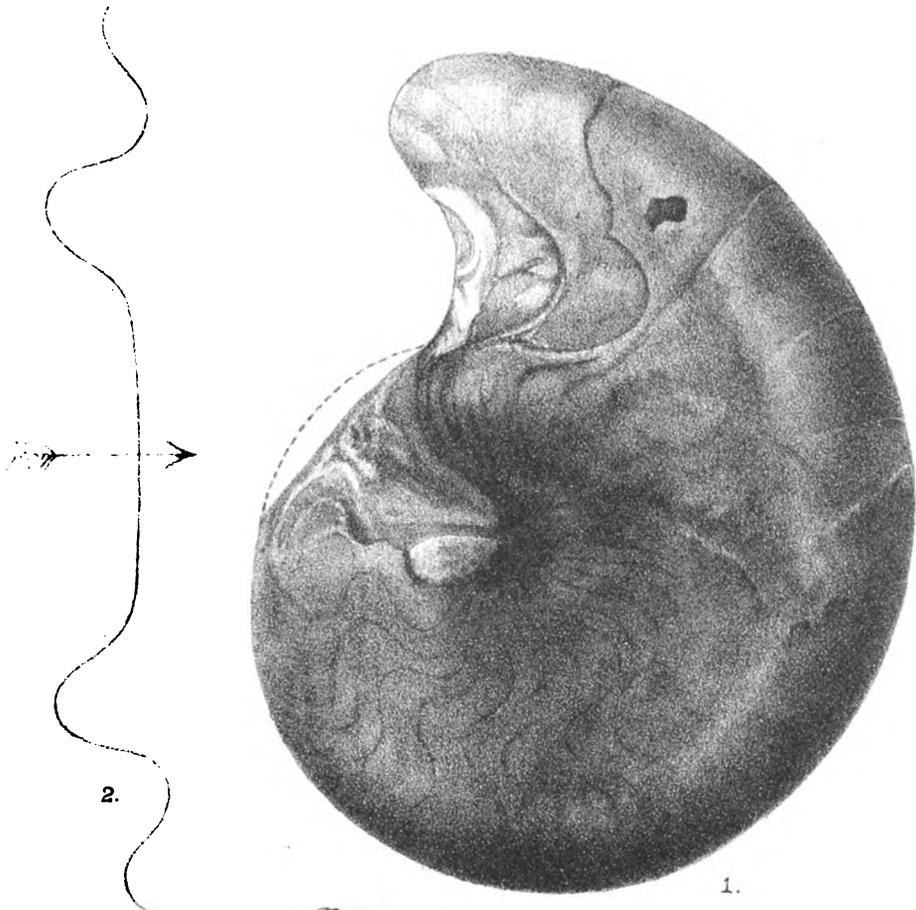




PLATE XXIV.

- Figs. 1, 1a. NAUTILUS TRICHINOPOLITENSIS, *nov. sp.* Cast from Arrialoor, Trichinopoly. Arrialoor group. Side and back views.
- Fig. 2. " " " Outline of septum.
- Figs. 3, 3a. NAUTILUS ROTA, *nov. sp.* Old specimen from Karapady, Trichinopoly. Arrialoor group. Side and front views; *one-half lineal dimensions.*





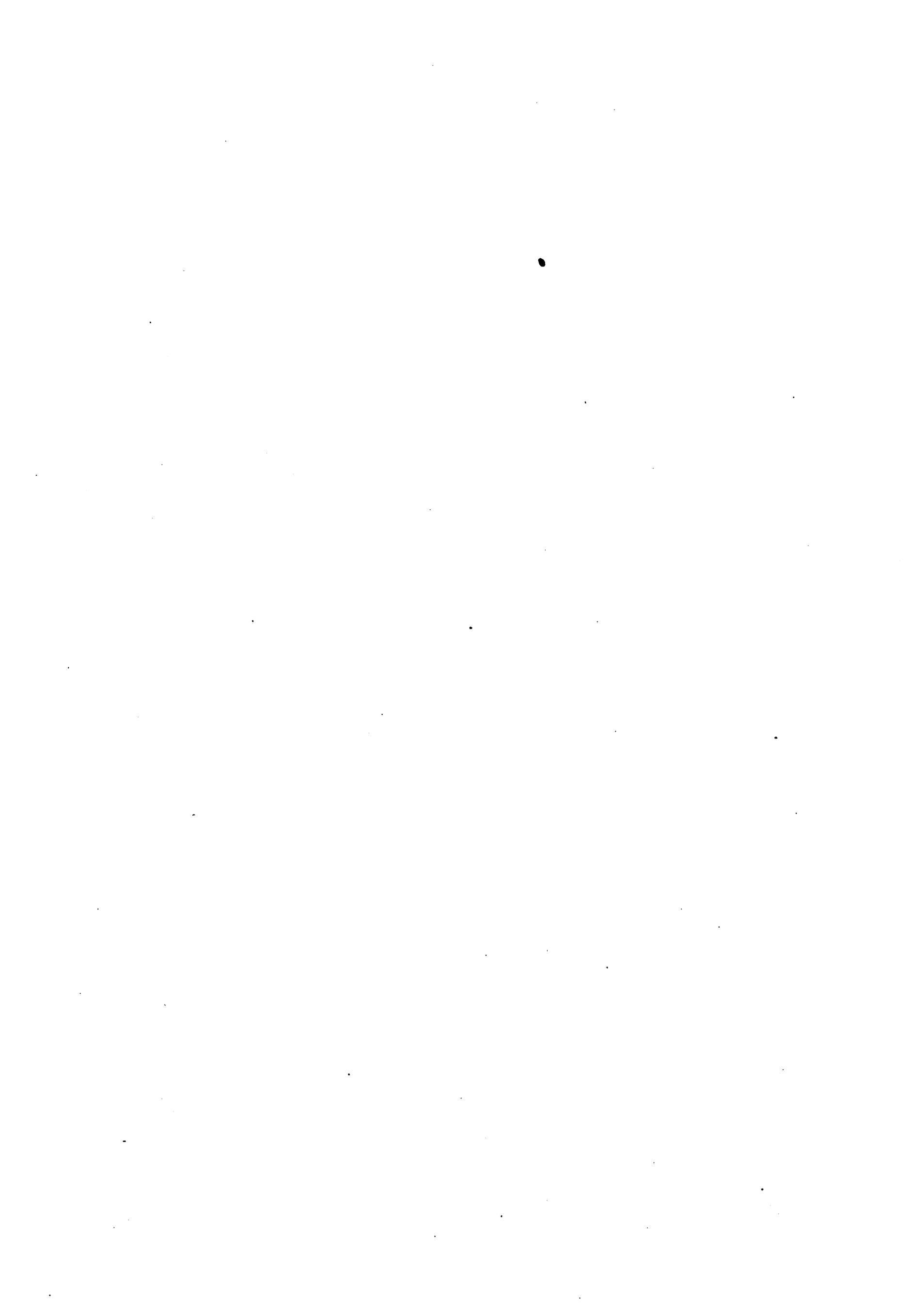


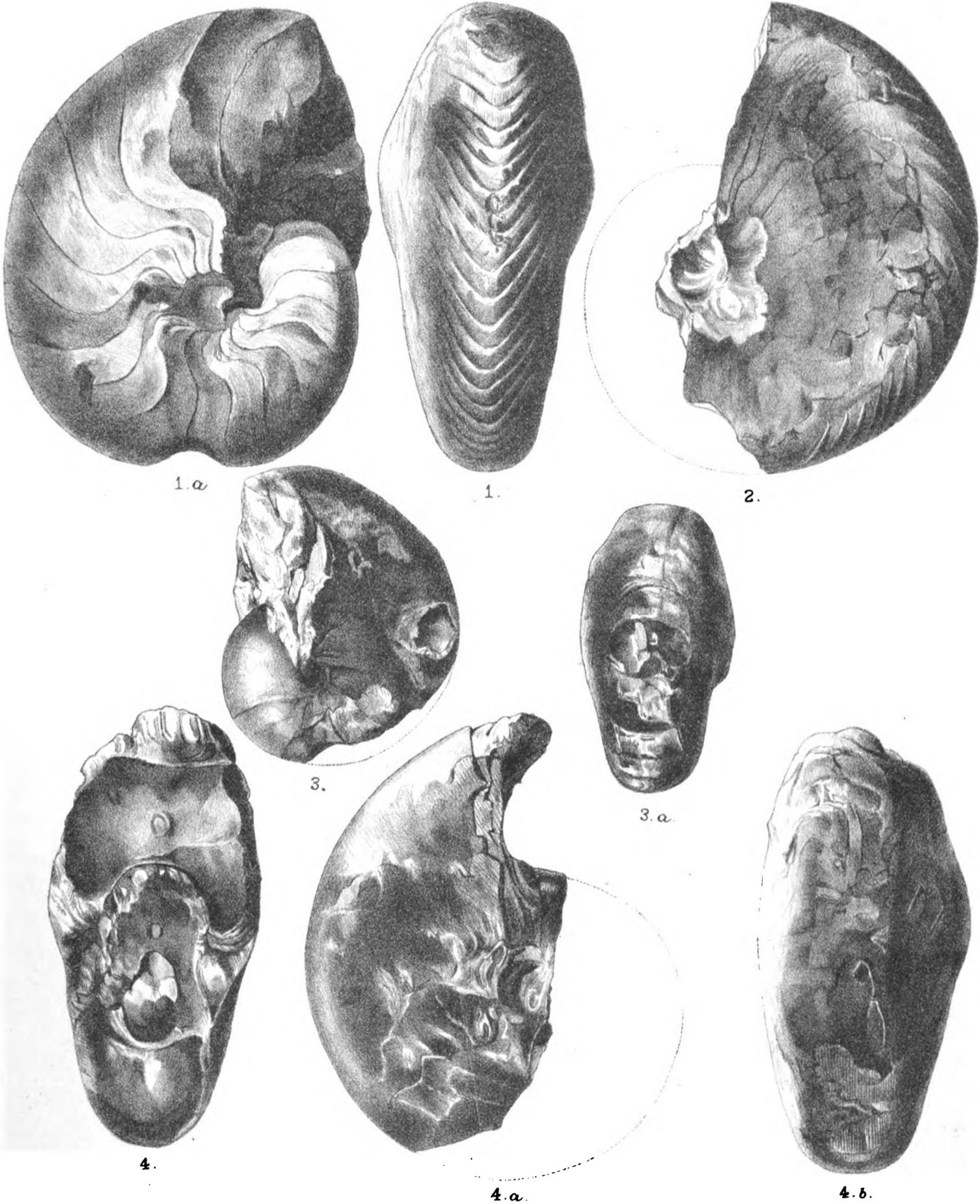
PLATE XXV.

- Figs. 1, 1a. NAUTILUS ROTA, *nov. sp.* Fragment, with shell from Karapaudy, Trichinopoly. Arrialoor group. Back and side views; *one-half lineal dimensions.*
- Fig. 2. " " " Cast from Mulloor, Trichinopoly. Arrialoor group. Side view.
- Figs. 3, 3a. " " " Young and smooth shell from Arrialoor, Trichinopoly. Arrialoor group. Side and back views.
- Figs. 4, 4a, 4b. NAUTILUS PONDICHERRIENSIS, *nov. sp.* Fragment from the Valudayur limestone, near Pondicherry. (Madras Museum.) Front, side, and back views.

CRETACEOUS ROCKS S. INDIA.

Geol. Surv. of India.

Pl. XXV.



R. S. Audhikary, Litho.

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MEMOIRS
OF THE
GEOLOGICAL SURVEY OF INDIA.

Palaontologia Indica.

BEING

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

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL,

UNDER THE DIRECTION OF

THOMAS OLDHAM, LL.D.

*Fellow of the Royal and Geological Societies of London; Member of the Royal Irish Academy;
Hon. Mem. of Leop.-Carolino Academy of Natural Sciences; of the Isis, Dresden, &c. &c.*

SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

The Fossil Cephalopoda of the Cretaceous Rocks of Southern India:
BELEMNITIDÆ—NAUTILIDÆ by Henry F. Blanford,
AMMONITIDÆ, with revision of the **NAUTILIDÆ**, &c. by
Ferd. Stoliczka, Ph. D., Geological Survey of India.

CALCUTTA:

PRINTED FOR THE GOVERNMENT OF INDIA.

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1762

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EXPLANATORY NOTICE.



The present volume contains the completed series of the descriptions and plates of the Fossil Cephalopoda from the Cretaceous rocks of Southern India.

It comprises—

1. The descriptions of the Belemnitidæ and Nautilidæ drawn up by Mr. Henry F. Blanford. These embrace twenty-five plates, and pages 1 to 40 of the letter-press, equivalent to four fasciculi of the *Palæontologia Indica*. These were issued, as the first series, in November, 1861.

2. The descriptions of the Ammonitidæ from the same rocks, drawn up by Dr. Ferdinand Stoliczka. Dr. Stoliczka joined the Geological Survey of India at the commencement of the year 1863, and at once took up the examination of these fossils, which he continued most zealously and ably, without interruption, until completed. Of this portion, (forming Series 3 of the *Palæontologia Indica*) the first fasciculus was issued on the 1st of October, 1863, and the publication of the succeeding parts has been steadily continued since then at regular intervals of three months.

3. A critical review of the Nautilidæ, &c., as given in the first part by Mr. Blanford. This revision was rendered necessary by the discovery of some new species, and of additional evidence as to known species. This revision is also by Dr. Stoliczka.

4. A general summary of the facts as to the distribution, number, and geological position of the Indian species, as compared with those from Europe and other countries; also by Dr. Stoliczka.

The descriptions of the entire series, and the general remarks on these fossils were all completed, and the manuscript in my hands before January, 1865: but, owing to the many difficulties which attend the preparation, in this country, of plates such as are here published, and the necessity for confining the expenditure on such works to the limited means at our command, it has not been possible to complete the series until now. And if the issue had been continued at the regular intervals of three months, the last part of the series would not have appeared until the 1st of January, 1867. The whole is now published in anticipation, the parts now issued (Pts. 10—13 required to complete the volume) representing the publications

of the Palæontologia Indica, from the present date to the close of the first quarter of the year 1867.

It is quite unnecessary here to point out the richness, variety, and beauty of this magnificent series of Cephalopodous fossils, or the great interest which attaches to them, as throwing new and unexpected light on the distribution of organic life during one of the later periods of geologic history. Any general discussion of their true stratigraphical and geological value can also be more effectively entered upon, when the other groups of fossils from the same formations (of which the Gastropoda are now in hand) have been examined and described in similar detail.

THOMAS OLDHAM.

GEOLOGICAL SURVEY OFFICE,

CALCUTTA,

January, 1866.

The several portions of the Palæontologia Indica, contained in this volume, were issued at the dates here given.

Not in this Vol. - out of print.

Series 1, four parts : including	Pages	1-40	Plates	I-XXV.	issued
3, Part 1	"	41-56	"	XXVI-XXXI.	October 1st, 1863.
" " 2	"	57-70	"	XXXII-XXXVII.	January 1st, 1864.
" " 3	"	71-82	"	XXXVIII-XLIII.	April 1st, 1864.
" " 4	"	83-94	"	XLIV-XLIX.	July 1st, 1864.
" " 5	"	95-106	"	L-LIV.	October 1st, 1864.
" " 6	"	107-122	"	LV-LIX.	January 1st, 1865.
" " 7	"	123-130	"	LXI-LXV.	April 1st, 1865.
" " 8	"	131-142	"	LXVI-LXX.	July 1st, 1865.
" " 9	"	143-154	"	LXXI-LXXX.	October 1st, 1865.
" " 10-13	"	155-216	"	LXXXVI-XCIV.	January, 1866.

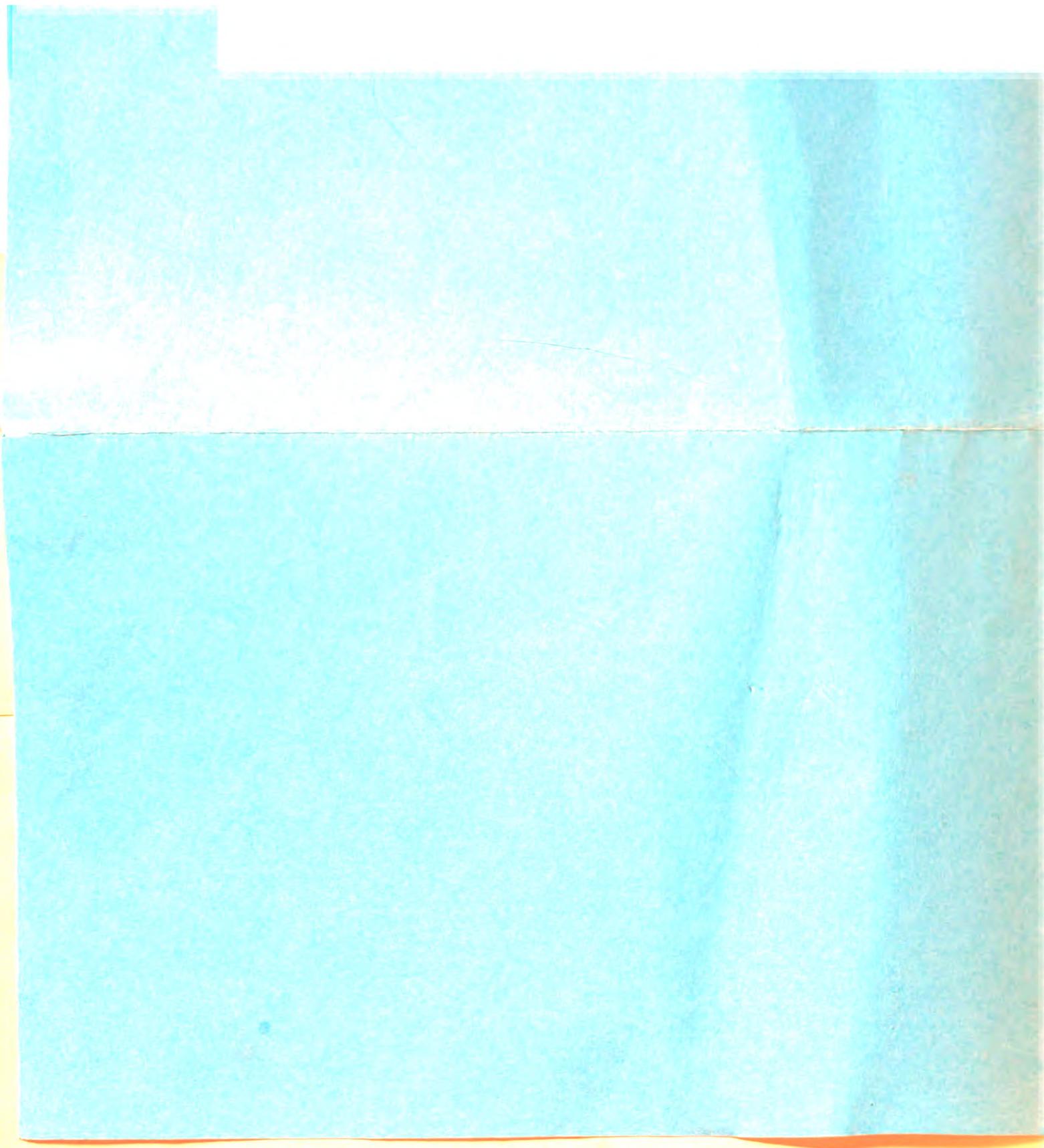
With Appendix, Index, Title, &c. &c.

CRETACEOUS FAUNA OF SOUTHERN INDIA.
 SERIES 1, VOL. I. The Cephalopoda, by H. F. BLANFORD and F. STOLICZKA (186.
 and 3, pp. 216, pls. 94. The Belemnitidae and Nautilidae, by H.
 BLANFORD, pp. 1-40, pls. 25. (*Out of print*). The Ammoniti-
 by F. STOLICZKA, pp. 41-216, pls. 71 (13 parts *complete*).

The following pages form a continuation of the description of the BELEMNITIDÆ AND NAUTILIDÆ of the Cretaceous Rocks of Southern India, already published. The present series, embracing the AMMONITIDÆ, is therefore paged consecutively with the previous portion.

For the convenience of those who may desire to bind them separately, a second paging is added at the lower corner of the page.

The descriptions of the AMMONITES are all by Dr. Ferdinand Stoliczka, of the Geological Survey of India.



Order, TETRA-BRANCHIATA.
 (or, TENTACULIFERA.)
 Family, *AMMONITIDÆ*.

AMMONITES, *Auctorum*.

Animal not known: shell spiral, more or less involute with numerous regularly (?) and gradually increasing whorls in the same plane, many-chambered, the last or body chamber extending generally over about 2-3rds of the last whorl. The margins of the Septa are deeply divided into lobes and saddles, the first having their sub-divisions always pointed, the latter more rounded. The dorsal lobe is divided by a small saddle into two parts, corresponding to the siphuncle: in the regular forms of Ammonites this is always placed in the middle of the back; the Siphuncle is also similarly placed inside the shell.

From the earliest date, at which man first devoted attention to the examination of the earth on which he lives, we find that the study of the Cephalopoda has excited much attention. This was naturally to be expected, seeing the great interest both to the Zoologist and the Geologist, which attaches to a knowledge of their varieties, while the vast extent over which the remains of these Cephalopoda have been discovered adds importance to the study. From the old times in which Herodotus spoke of the horns of Jupiter Ammon down to the recent date of the publication of Pictet's valuable "Materials for a knowledge of the Palæontology of Switzerland," Ammonites have been found throughout almost the whole world. Indeed there is not now a single quarter of the globe in which Ammonites have not been found. In 1861 (Quar. Jour. Geol. Soc. Lond. p. 475) Mr. Gregory announced the occurrence of Ammonites, together with *Trigoniæ* and *Pecten*, in some rocks of the western parts of Australia, which rocks, he believes, to be of Cretaceous age. Some years since others from Africa were described by Baily* and Coquand;† still earlier from America, by Humboldt (Alex.), Leop. von Buch, Roemer, and others—while the labours of Sykes, E. Forbes, D'Orbigny, and others had brought to light many from Asia. The two last mentioned authors described Ammonites and other fossils from the same parts of Southern India, from which the materials for the following descriptions have been obtained.

* Quar. Journ. Geol. Soc. Lond. XI. 1855. p. 454.

† Mem. de la Soc. Geol. de France, II. Ser. V. 1854. pp. 1-155.

It is worthy of notice, that (with some doubt as to Australia) the known or described Ammonites from the other continents belong, to a very great extent, to the Cretaceous formation. This geological formation would therefore seem to be one of the most widely extended over the whole earth. In Europe itself, (the geological structure of which is better known than that of the other continents) it extends from Portugal to Siberia, and from England to the Crimea; and viewed more closely as regards the subdivisions of the Cretaceous series, it may also be stated, that the majority of the species known from Africa, America, and Asia are characteristic of the middle portion of the Cretaceous series as it occurs in well examined parts of Europe; that portion which many Geologists include under the name Gault.

The genus *Ammonites*, (as generally admitted), contains a very large portion of the great group of the chambered Cephalopoda found in the fossil state, and it thus becomes of the very highest importance towards a critical knowledge of the secondary formations, in which it abounds. We do not in the present case think it needful to say anything regarding the Zoological position of the Ammonites in the animal kingdom, not yet to enter upon any detail as to its Geological importance. These subjects will be found treated of in every Manual of Zoology or Palæontology. But it will be of high interest and of great importance to notice in detail the peculiarities of the whole series of these Indian Cretaceous Ammonites, and their relations to European forms. It is obvious, however, that such a summary review of their characters can only be carried out after the whole series has been carefully examined. We shall therefore defer this summary until the whole group of the Cephalopoda has been described, when we shall give a general review of the relations, both Zoological and Geological, which these Indian forms exhibit with those known from other countries.

We have now to say a few words about the materials at our disposal and their treatment. In addition to the splendid collection of the Geological Survey of India we had at our disposal also the valuable series so liberally contributed by Brooke Cunliffe, Esq., and also that of the Madras Museum, an original collection by Mr. Kaye. These have afforded us many illustrations and specimens, which the Survey collection did not contain, and which have been freely used. In many cases these latter collections contain the only specimens which were accessible of some species, and others were duplicates of some of those described by Edw. Forbes.

Looking at the whole fauna of these rocks, I may say, that it is one of the most splendid series I have ever seen from any portion of the Cretaceous formation, not only from its enormous richness in variety, but also from the generally excellent state of preservation of the specimens. Of Ammonites alone there are about one hundred species, of which descriptions will appear in the following pages. Other groups of Mollusca are quite in proportion to the Ammonites: while the Gastropoda are fully as rich, if not richer, in species than in the Alpine Gosau formation, with the fauna of which they offer many very close and positive relations.

I have here to express my deep obligations to Dr. T. Oldham, the Superinten-

dent of the Geological Survey, for the aid he has afforded me. The preliminary examination of the Ammonites which had been made by Mr. H. F. Blanford also proved of considerable assistance. My work was thus made easier and I was enabled to progress more rapidly, than I should have been, if left to myself. The excellently selected and extensive library of the Geological Survey contained all the more valuable works of reference, and only a very few books of no great importance for our present labours were wanting. We look forward also to being able, by means of a large collection of Ammonites, which Dr. Oldham has ordered from Europe, to give hereafter the fullest certainty as to the correct identification of a few species, in which it is important to compare actual specimens.

The plates have been drawn and lithographed at the Survey office with all possible care and with every effort to overcome the almost incredible difficulties of good lithographic printing in this country. The sutures have in all cases been drawn by myself in the first instance, and have been carefully examined on the stone, so that there can be no question as to their accuracy. Some which were not otherwise visible, have been obtained by carefully filing down the specimens, by which operation the smaller lobules are sometimes destroyed. In all cases, when this has been done, the fact is mentioned in the description, although it might readily be noticed from the figure.

It may be thought that there are more figures given than at first seem necessary of the more common and every where known species, such as *A. Rotomagensis*, *A. Mantelli*, *inflatus*, *Velledæ*, *latidorsatus*, &c. But the correct knowledge of these common species with all their varieties, is in reality, the most important and most interesting object of every Palæontological publication, if considered with reference to its Geological value. It is the accuracy and fulness of such identifications which give to the Palæontological studies of later years their great merit, because they fulfil both purposes: they serve not only to elucidate merely Palæontological questions, but are of high value also in the more purely Geological, and especially the stratigraphical, point of view. This latter is of no less importance than the others, as it alone adds so much to our knowledge of the preceding evolutions of life on the earth, from which we may at some future time expect to obtain a natural system of the animal kingdom. We think it is absolutely essential to bring to the careful determination of such species the fullest amount of evidence which can possibly be obtained. The old tendency to draw conclusions from a difference in locality or in strata, as to a necessary difference in the fossils, is still we think too prevalent. We are certain that the recognition of so many old familiar species will be most welcome to all European Palæontologists.

With regard to the Sutures, we are compelled also to express our regret that this all-important point in the shell of Ammonites has very frequently been indifferently attended to in valuable Palæontological works. Besides the general form of the shell the form and distribution of the septa is, we believe, the only character which gives any certain idea of the animal itself; perfectly preserved specimens with the mouth being very rare. And if we desire to arrive at any good natural

systematic arrangement of Ammonites in groups, the form of the septa must be most carefully examined. It is obvious, that a change in the form of the septa must be accompanied by a change in the form of the shell, and that a difference in the form of the base of the animal (the septa) leads us to conclude, that the position of the inner organs of the animal was different; and with this some change in the other organs must have been connected.

In truth, the whole series of Ammonites have not been treated or classified in the same way as other groups, such for instance as the Gasteropoda or the Acephala. I am certain that the animals of *Turritella* and *Cerithium*, for example, were not in any way more different than must have been the animals of *Ammonites discus* and *A. Rotomagensis*. And it is a question of high importance, whether a division of the present genus *Ammonites* into many *genera* would not be much more natural than the existing division into groups. We believe it would. At least the genera could certainly be much better and more precisely determined, and that is all we require—if the development of the animal be connected with the changes of the species. Of course many years may still elapse before any one is able to give such a classification, which would require a very careful knowledge of all described Ammonites and especially of their Sutures.

The present being a continuation of the description of the Cephalopoda from the Cretaceous rocks of S. India, commenced by Mr. H. Blanford's memoir on the Nautilidæ, a few words may be necessary to justify our having adopted a terminology in our descriptions different from that which he used. We agree perfectly in the correctness in principle of the terminology which he has employed, when it can be transferred from the animal to the shell; but such changes must, in our opinion, be made *thoroughly*, regarding not only the general form of the shell, but also as regards the whole ornamentation, otherwise these changes produce more mistakes than they produce advantages. Further our descriptions are of the shell, (*Am. testa*) not of the animal, which was living in it and which we know not. There are indeed great difficulties in the selection of proper and brief terms for a description of the ornamentation of the shell, having regard to the position of the animal in it. And we confess that we are not at present able to make use of such a terminology which shall be consistent throughout; we therefore retain the old and best known terms.

The large lists of references to other writers, which are apparently so much in favour now, have been avoided purposely, and only those writers quoted, who have added anything to the history of the shells under discussion, as *species*. As regards the Geological distribution in India, Mr. Blanford's classification of the Cretaceous beds, (as in the preceding monograph on the Nautili, &c.,) has been retained. (Mem. Geol. Surv. of India, Vol. IV. pt. 1.)

In the following descriptions we shall retain Pictet's classification* of the various groups, with some modifications and some additions. Preceding each group we shall give such few brief remarks as may be necessary; reserving our general observations until the Cephalopoda have been completed.

May, 1863.

F. STOLICZKA.

* *Materiaux. Pal. Suisse. Foss. d. St. Croix, 1860.*

DESCRIPTION OF SPECIES.

Group 1. CRISTATI.

The *Cristati* group is generally spoken of by Palæontologists as one of the most difficult groups to classify; and there is no wonder at this—the continued keel on the back of the shell, coupled with their occurrence in the Cretaceous formation, being the only sufficient character on which to base the connection of Ammonites, which are in reality very different. The organic structure for example which produced the keels on specimens of the *Arietes* and *Falciferi* groups must certainly not have been very different from that producing the keels of many of the *Cristati*. And we are unable to see what argument can be used to distinguish the species of one group from those of another related group, while species themselves which are supposed to belong all to one and the same group, present even greater differences. Pictet has endeavoured to classify the different forms into subdivisions, but as he states himself (p. 300, Palæont. Suisse, 1860), without any other object than to bring together the species, that are more nearly allied one to another, and to show their differences.

Among the Indian collections of Ammonites we have species, which belong to different sub-groups of the Cretaceous *Cristati* as follow :

1. *Am. Blanfordianus*.
2. „ *inflatus*, *Candollianus*, *Ootatoorensis*, and *corruptus*.
3. „ *propinquus*.
4. „ *obesus*.
5. „ *serrato-carinatus*.
6. „ *subtricarinatus*.

Deferring all more detailed discussions to the end of the whole series of Cephalopoda, we shall here only make a few brief remarks referring to *Am. serrato-carinatus* and *Am. Blanfordianus*.

A species similar to the former of these has been described by Prof. Reuss from the Cretaceous rocks of Bohemia as *Am. Germari*, (Verstein. der Böhmischen Kreideformation, Pt. I. 1845, p. 22, Tab. VII. fig. 10). Prof. Reuss and some other authors place this species among the *Flexuosi* and Pictet in his most recent publications has pointed out that *A. Germari* may belong to the *Amalthei* (Pal. Suisse, p. 312). We are compelled, however, to remark that we cannot see why the crenulated or serrate keel should alone produce such a difference in the groups to which the species is to be referred, while the whole character of the shell remains the same as that of other species without any crenulation on the keel. This species is, however, not so exclusively the only one with these denticles on the keel among the *Cristati*. On young but well preserved specimens of *Am. Blanfordianus*, similar denticles or crenulations occur on the keel; and they occur also on young specimens of *Am. inflatus*. Of course the shell must be well preserved to admit of their being seen, as they are very fine and soon become obsolete.

In nearly all species of the *Cristati* the ribs are flexuous and bent strongly forward at the back. The result of this is that the top of the mouth at the keel is prolonged and generally curved upward a little higher than the back, while at the same time the whole aperture is enlarged. It is, however, not impossible, that the animal in the first stage of growth had not the power to absorb all the enlarged parts of the shell, and this is, we think, the reason why all the ornamentation, ribs and striæ, are generally more distinct in the younger growth than when the specimen becomes older. These considerations may justify our placing the two species, mentioned above, among the *Cristati* group.

We must also briefly notice some expressions which we have used in describing the subdivision of the *Cristati*, including *Am. inflatus*, *Candollianus* and all the *Rotomagenses*. By referring to our figure (Pl. XXX. Fig. 2) which represents the sutures of a compressed variety of *Am. inflatus*, it will be observed that only four saddles exist in each half section of the whorls. There is one dorsal saddle on the edge of the back; one smaller lateral in the middle of the flanks or sides of the shell; one broad but short umbilical, beginning on the edge of or even on the wall of the umbilicus; and one very small ventral saddle. The umbilical saddle contains all the subdivisions, which are generally called the auxiliary lobes and saddles. Corresponding to these four saddles there are, besides the dorsal and ventral lobes, only three deeper lobes: two on the sides and one on the inner portion of the shell. This distribution of the sutures appears to be very constant for many species, which are now referred to the *Cristati*, and also for nearly all *Rotomagenses* and some others.

1. AMMONITES BLANFORDIANUS, *Stol.* Pl. XXVI.

Am. testa compressa, discoidea, lateraliter costata: costis numerosis, flexuosis, apud ortum, prope medium dorsumque tuberculatis, in ultimâ parte antice valde curvatis et usque carinam extensis; dorso angustato, acute carinato, non canaliculato; carina juniore crenata; umbilico subangustato, abrupte excavato; apertura compressa, antice mucronata. Septis utrinque 4-lobatis, modice dissectis; lobis ad terminationes unicis, sellis bipartitis; ramis sellarum inequalibus; lobo dorsali brevior quam lobo laterali primo.

Diameter of the largest specimen,	170 mm.
	a b
Proportions, (the diameter of the whole being considered as	mm. mm.
1.00) calculated from specimens with diameters of.....	170 and 75
Diameter of the outer whorl: whole	0.45: 0.49
Width of the umbilicus: whole diameter,	0.25 0.26
Thickness of the section. height.....	0.68: 0.70

a.—Figured specimen, Pl. XXVI.

b.—A small specimen from Karapaudy.

Shell discoidal, much compressed, with slightly convex sides, which are ornamented with numerous flattened and slightly elevated ribs. These ribs are 14 to (6)

18 on each whorl and are marked at their origin or at the edge of the umbilicus with strong tubercles. The ribs then bend forward (either simple or bifurcated) to about the middle of the sides of the whorl, where they form a small tubercle and then bend a little backwards (sometimes again bifurcated) and continue in a line strongly curved to the keel, each being marked with a rounded tubercle on the dorsal margin. In consequence of this extension of the ribs to and partly over the keel, the latter becomes irregularly flexuous in outline and in younger specimens many fine dentels are seen on it. The inner tubercles are the largest and most strongly marked, from these the shell drops perpendicularly to the umbilicus. Both the ribs and the tubercles in the middle row and the back become less marked and obsolete on the body chambers, and gradually die out altogether. Numerous fine striæ or small furrows appear instead, which are curved in the same manner. Back narrow, gradually becoming smaller without any important depression, provided with a sharp keel in the middle and a small row of tubercles on each side. Whorls increase gradually in height and thickness each covering about $\frac{2}{3}$ of the preceding one. The width of the umbilicus amounts (in figured specimen) to nearly 0.25 of the whole diameter of the shell; in younger specimens the umbilicus is still more covered. The section of the inner whorls is more compressed than of the body chambers nearer the mouth. The septa are not very distant and present four lobes and as many equally formed saddles on each side; the former smaller than the latter, both with numerous divisions; the lobes are pointed and trifid at their terminations, the saddles bifid with numerous phylliform subdivisions; the siphonal saddle is rather short, the first lateral lobe deeper than the dorsal. A good distinguishing character is the unequal size of the two principal branches of the saddles, the outer being always shorter than the inner one. Fig. 2, represents filed outlines of a young specimen, which therefore do not appear so numerous divided.

This elegant species belongs to the group of *Am. cultratus*, D'Orb. (Pictet) being slightly related to *Am. Ixion*, D'Orb. (Pal. Franc. Cret. I. p. 186, pl. 56,) from the Lower Neocomien. The difference as compared with both these consists in the absence of the inner and outer row of tubercles, in the larger and more obtuse back, and the smaller increase in height of the whorls of *Am. Ixion*: the sutures of this latter species are unknown. *Am. Tollotianus*, Pictet, (Foss. des Gres Verts, p. 109, pl. 10, f. 5,) differs in having tubercles only near the back and in the ribs not extending to the keel. *Am. dentato-carinatus* Römer (Kreidebildung. v. Texas, 1852, p. 33, pl. 1, f. 2,) differs from the present species by the straightness of the ribs, in which also the middle row of tubercles is wanting. The sutures in both appear to be very similar in form and a comparison of actual specimens would be very desirable.

Range. Arrialoor group.

Localities. Karapaudy and S. W. of Vylapaudy in the Trichinopoly district. Besides the large figured specimen we have only three other smaller ones from the first locality, where they occur in a fine conglomeratic sandstone of dove colour and one specimen from the second locality. (7)

2. AMMONITES INFLATUS, Sow. Pls. XXVII. XXVIII. XXIX. and XXX. Figs. 1—3.

- 1817, *Am. inflatus*, Sowerby, Min. Conch, II. p. 170, pl. 178.
 „ *rostratus*, p. 163, pl. 173.
 1840, „ *inflatus*, D'Orbigny, Pal. Franc. Cret. I. p. 304, pl. 90.
 1847, „ „ Pictet and Roux, Moll. des Gres Verts, p. 103, pls. 9 and 10.
 1849, „ „ Quenstedt, Cephalopoden Deutschlands, p. 211, pl. 17, fig. 2, *partim*.
 1850, „ „ D'Orbigny, Prodrôme II. pp. 124 and 186, (*partim*).
 1852, „ „ Buvignier, Statistique Geologique de la Meuse, Atlas, p. 46, pl. XXXI.
 figs. 8, 9.
 1852, „ „ Giebel, Fauna der Vorwelt, III. p. 715, (*partim*).
 1854, „ *rostratus*, Morris, Catalogue, p. 298.
 1859, „ *inflatus*, Pictet, Palæont. Suisse, Foss. de St. Croix, p. 178, pls. 21 and 22.

Am. testa discoidea, subinflata, transversim costata; costis plerumque bifidis, apud umbilicum et ad peripheriam dorsi tuberculatis, ultimis antice prolongatis, transversim rugosis seu acute elevatis, tuberculis medianis minoribus; dorso truncato, in medio carinato, canaliculato, utrinque tuberculato; umbilico latissimo; sectione anfractuum subquadrata plus minusve rotundata; apertura rostrata; suturis bilobatis, profunde dissectis, lobo laterali primo semper bipartito.

Diameter of the largest specimen about 260 mm.

Proportions (the diameter of the whole being

considered as 1.00) calculated from speci-	a.	b.	c.	d.	e.	f.	g.
mens with diameters of	150	140	125	„	74	188	170
Diameter of the outer whorl : whole,	0.31	0.35	0.39	„	0.39	0.37	0.30
Width of the umbilicus : whole diameter,	0.42	0.32	0.38	„	0.36	0.39	0.41
Thickness of the section : height	1.07	1.15	0.83	0.95	1.07	0.91	0.81

- 1st variety, ... {
 a. Figured specimen on Pl. XXVII.
 b. The most inflated specimen in our collection found at Ootatoor.
 c. Compressed specimen from Ootatoor.
 2nd variety, ... {
 d. Figured section on Pl. XXIX. fig. 3.
 e. „ specimen „ „ fig. 1.
 f. „ „ „ XXVIII.
 3rd variety, ... g. One fragment figured on Pl. XXIX. fig. 4.

Shell discoid, consisting of five or six slightly involute whorls, always leaving a very large umbilicus, the width of which is ordinarily $\frac{4}{10}$ of the whole diameter of the shell. The whorls are either somewhat compressed, or square, or occasionally broader than high, as is seen in the sections, Pl. XXIX. figs. 1—4, taken from several different varieties of this species. With this variation in the section there is also a variation in the general aspect of the shell, the back being sometimes narrower and sometimes broader than the depth of the whorl. The sides of the whorls are flat or very slightly convex dropping suddenly to the deep umbilicus.

The embryonal whorls are generally smooth, the next to these ribbed, the ribs being for the most part bifid, and terminating both on the edge of the umbilicus

and on the back in large tubercles; a row of smaller tubercles is seen between these often distinctly, but occasionally not well, developed. The size of the tubercles and their distinctness varies with the age of the shell and also in the several varieties. In general the outer tubercles are the largest, on the inner whorls prominent, elongated forward, and usually spirally ribbed. Less frequently the inner tubercles are the larger and ribbed in a similar manner. On the body chamber the ribs become single and the outer tubercles very greatly elevated, so that the keel on the back becomes very distinct by deep channeling on each side. Pl. XXVII. fig. 1*b*.

The average number of the ribs on each whorl counted by the inner tubercles is eighteen, varying from fifteen to twenty. The mouth is seen only imperfectly in one fragment from Ootatoor; the rostrum being not so rapidly bent up, but rather smaller and more prolonged than in Sowerby's figure of *Am. rostratus*. The ribs bend forward, corresponding to the outline of the lengthened back. Buvignier gives in his 'Statistique Geologique de la Meuse, Pl. XXXI. figs. 8 and 9,' a figure of a perfectly preserved specimen, on which the rostrum is bent backwards and quite turned over.

The foregoing description is generally correct as regards the more constant characters; but some additional remarks are necessary with regard to the varieties of this species.

Indeed Quenstedt remarks with much reason, that every one will lose courage in making species, when he carefully looks through the very numerous and different forms, which come from the Gault of Perte-du-Rhone. We are quite enabled to confirm the difficulty in fixing certain limits for this species, a difficulty of which so many other authors also complain: although we cannot agree to the extent of uniting so many well characterized species as Quenstedt has done.

In the abundant materials, which we possess from several localities, we find almost all those varieties which are figured by D'Orbigny, Pictet, &c., and we therefore notice here only those which are the most remarkable in the Indian Cretaceous deposits, subordinating all the other forms to these.

Var. I. The first variety is that generally regarded as the typical form of *A. inflatus*. The whorls are only very slightly involute, and the thickness increases very rapidly, so that the back becomes often very large. The width of the umbilicus measures $\frac{4}{10}$ of the whole diameter; the section of the whorls is in the inner whorls greatly rounded, broader than high, in the body-whorl nearer to the mouth somewhat higher than broad. The tubercles at the umbilicus are slight and smooth; the middle ones not very distinct, the outer tubercles at first prolonged and with six short furrowings or ribbings in the direction of the spire. On the last whorl they are very elevated, and without any such spiral ribbing. Not uncommon at Ootatoor and Odium.

Var. II. The 2nd variety is represented by the figures on Pls. XXVIII. XXIX. fig. 1. The section of the whorls is always higher than wide; sometimes rather compressed as seen in fig. 3, Pl. XXIX. which gives the section of a

whorl of a large specimen. The whorls in this variety are but slightly involute, so that the width of the umbilicus generally amounts to $\frac{3}{10}$ of the whole diameter of the shell. The tubercles next to the umbilicus are generally in the last whorl higher than those at the edge of the back, and on the inner whorls sometimes the whole surface of the shell is spirally ribbed; these spiral ribbings being of course better seen on the tubercles. The middle row of rounded tubercles is always quite distinct. This variety is common at Moraviatoor, rather rare at Ootatoor.

Var. III. An important variety of which there are but few specimens from S. E. of Moraviatoor. The whorls are nearly evolute and in section roundish; the width of the umbilicus amounts to $\frac{4}{10}$ of the whole diameter of the shell. The ribs are not very numerous, and in the body-whorl sharp and prominent. The middle tubercles are always perfectly distinct from the outer ones on the edge of the back, but not always from those at the umbilicus; the dorsal tubercles sometimes shew a tendency to a division into two. The sutures are the same as in the other figures. This variety comes nearest to the form described by Pictet from the Gault at Saxonet, (Foss. des Gres Verts. p. 105, Pl. X. fig. 2).

In addition to these three principal varieties, which we have here noticed, there are many intermediate forms, which differ in one or two less important characters. The dimensions of the septa vary in the same marked degree as the ornamentation of the shell; the lobes and saddles are strongly divided. The dorsal and the first lateral saddle are always bipartite, the two portions however never being equally large; the first lateral lobe is also *invariably* bipartite at the end; (D'Orbigny's fig. 3, Pl. 90, in the Pal. Franc. is not correct, as Quenstedt has already stated); the second lateral lobe is in most cases tripartite (fig. 2, Pl. XXX. is the only exception we know) at the end; the auxiliary lobes and saddles form a large umbilical saddle; the ventral saddle, which is seen in fig. 2, Pl. XXX. is very numerous but less regularly divided. The ventral lobe extends lower down than the dorsal. The width and height of the sutures are variable, not only in specimens of the same variety, or in different specimens, but even in the same specimen; an exact and careful comparison of the sutures figured in our plate XXX. will give the best means of obtaining a knowledge of these variations; the figures 1a. and 1b. are taken from the same large specimen, (from Moraviatoor) which belongs to our second variety; fig. a. being taken from the inner whorls, fig. b. from near the body chamber. Fig. 3, on the same plate represents a very narrow form of septa from the figured specimen pl. XXIX. fig. 1, and fig. 2 is from the specimen, the section of which is given in fig. 3, pl. XXIX., it represents very numerous but less regularly divided perfect sutures.

This species was first described by Sowerby in his Mineral Conchology, under the names *Am. rostratus* and *Am. inflatus*—the former of these was published some short time previously to the other, and although in strict priority of time it should therefore be adopted, the other name *Am. inflatus* is so generally and so well known to all Palæontologists, that there seems no advantage to be gained by adopting *Am. rostratus* and we have therefore retained *inflatus* as the specific name.

Am. tetrammatus is by some Palæontologists taken as a synonyme of *Am. inflatus*: this however seems to be not certain. We are rather inclined to think, that *Am. tetrammatus* belongs to *Am. Coupei*, inasmuch as Sowerby (loc. cit. p. 160) expressly notices four rows of tubercles on each side, a fact we have never observed in undoubted specimens of *Am. inflatus*. Quenstedt in his usual manner considers too many varieties as being of the same species; the best descriptions and studies are to be found in Pictet's publications. (Foss. des Gres Verts. and Pal. Suisse, l. c.)

Am. inflatus is a characteristic fossil of the Ootatoor group. It occurs abundantly in the Trichinopoly district, at Ootatoor, Moraviatoor, Odium, &c.; it is also well known as the most characteristic species of the Gault in almost all the European provinces. In *England* it occurs in Gault and upper Greensand (Morris l. c.), in *France* in the Albién and Cenomanien (D'Orb. Prod.); in *Switzerland* in the Gault and Gres Verts. (Pictet, l. c.) In *Germany* in the Flammen-mergel (v. Strombek, Zeitsch. d. Deutsch. Geolog. Gesellschaft, Tom. V. VI. and VIII.); in *Austria* in the Nana-Schichten and at Penzeskut in Hungary (F. v. Hauer, Sitzungsber. d. K. Akad. der Wissenschaften. Wien, 1862. Bd. 44, p. 656.) It has been also found in the Cretaceous formation of *South America*, from whence it was brought by Humboldt and reported on by L. v. Buch.

Range: Ootatoor group.

Localities: Ootatoor, Moraviatoor, Odium, &c., in the Trichinopoly district.

3. AMMONITES CANDOLLIANUS, *Pictet*. Pl. XXX. fig. 4.

1849, *Am. Candollianus*, Pictet, Moll. d. Gres Verts, p. 104, pl. XI.

Am. testa discoidea, compressa, carinata, transversim lateraliter costata; costis simplicibus vel bifidis, apud umbilicum et ad peripheriam tuberculatis; tuberculis ad dorsum antice prolongatis; dorso obtuso, in medio carinato; sectione anfractuum compressa, antice subrotundata; suturis lateraliter bilobatis, modice dissectis: ramis brevibus, lobo laterali primo ad terminationem bipartito.

Diameter of the largest specimen,.....	44 mm.
Proportions (the diameter of the whole being considered as 1.00) calculated from specimen with diameter of,	44 „
Diameter of the outer whorl : whole,	0.40
Width of the umbilicus : whole diameter,	0.34
Thickness of the section : height,.....	0.75

Shell discoidal, compressed, slightly involute, so that the width of the umbilicus amounts to $\frac{3.5}{10}$ of the whole diameter of the shell. The section of the whorl is about one-fourth higher than broad (measured in the middle), and is somewhat narrower on the outer than on the umbilical side. The ribs are about 12 in the whorl and each partly simple or bifurcated; each has one pointed tubercle on the edge of the umbilicus, and another on the edge of the back; the latter being somewhat larger; all extending to the keel with a curve forwards.

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Septa with two lobes on each side, and as many saddles, both with numerous short sub-divisions. The dorsal and first lateral saddle are bifid, as also the first lateral lobe, which is smaller than the dorsal saddle. The umbilical saddle is very large and much divided.

Pictet described this species in his "Mollusques des Gres Verts" (l. c.) separating it from *Am. inflatus*. Subsequently D'Orbigny in his "Prodrome" (II. p. 124) and also Giebel in his Fauna der Vorwelt, (III. p. 715,) reunited the two. Indeed the resemblances between them are considerable. We have from the Indian deposits only one specimen, the figured one, but we are able to distinguish it from all the numerous varieties of *Am. inflatus*, by the following characters: the shell is a little more involute, the section is higher and smaller at the back; the inner tubercles are placed close on the edge of the umbilicus, while the intermediate tubercles on the sides are entirely wanting; the sutures do not shew any great amount of difference from those of *Am. inflatus*, except that the proportions of lobes and saddles are somewhat shorter. These characters may justify the retaining of this species.

Range: Ootatoor group.

Locality: Ootatoor, in a black earthy limestone.

4. *AMMONITES sp. indeter.* Pl. XXX. fig. 5.

We give this fragment as different from all other forms of *Cristati* and belonging to a new species. It comes nearest to *Am. propinquus*, (see below) but is much less involute, and increases much less rapidly in the height of the whorls, only $\frac{1}{4}$ th of the last whorl being concealed by the succeeding one, while in *Am. propinquus* at least $\frac{1}{3}$ th is in like manner embraced. The ribs are numerous, bi- or tri-furcate, slightly marked, rather strong at the back, greatly bent forward and without any well marked tubercles, by which character it is easily distinguished from *Am. inflatus* and *Candollianus*. The sides of the shell fall rather rapidly to the keel, which is strongly elevated; the section of the whorl is compressed and cordate; the septa are three-lobed, formed similarly and divided nearly in the same manner as those of *Am. inflatus*.

We have unfortunately only one poor specimen, which shews the septa imperfectly, and a complete description must be deferred until better specimens are procured; it belongs to the same group of *Cristati* as *Am. cristatus*, *Roissyanus* and *Bouchardianus*, a group already pointed out by Pictet, (Materiaux pour la Pal. Suisse, 1860, p. 308,) all characteristic species of the Gault of Europe.

Range: Ootatoor group.

Locality: Ootatoor, with *Am. propinquus*, *inflatus*, and *Candollianus*.

5. AMMONITES PROPINQUUS, *Stol.* Pl. XXXI. Figs. 1, 2.

Am. testa discoidea, lateraliter compressa, transversim costata; costis numerosis, plerumque bifidis, apud umbilicum et ad peripheriam sub-tuberculatis; anfractibus subinvolutis, lateraliter subconvexis; umbilico mediocri; dorso angustato, carinato, non canaliculato; sectione anfractuum compressa, elongata; suturis utrinque lateraliter 4-lobatis, profunde incisus et ramosis; lobo laterali primo dorsali vix longiore, ad terminationem inequaliter bifido.

Diameter of the largest specimen,	108	mm.
Proportions (the diameter of the whole being considered as 1.00) calculated from specimens with diameter of,	108	70 mm.
Diameter of the outer whorl : whole,.....	0.45	0.49
Width of the umbilicus : whole diameter,.....	0.25	0.26
Thickness of the section : height,	0.68	0.70

Shell discoidal, compressed, flattened on each side, rather involute; the whorls increasing rapidly in height, ornamented with numerous (about 20) generally bifid ribs, which are slightly elevated, both at the edge of the umbilicus and the edge of the back, into small but distinct tuberculations; those at the edge of the back prolonged forward and reaching to the keel. The ribs extend nearly to the back in rather straight lines, bifurcating near to the edge of the umbilicus; the last measures about $\frac{3}{10}$ of the whole diameter, nearly half of each whorl being covered by the succeeding whorl; the involution itself being very nearly $\frac{1}{3}$ th of the height of the last whorl. The sides of the shell slope to the umbilicus more rapidly than to the back. Septa with five saddles on each side; numerous divided and similarly formed to those of *Am. Candollianus*; the lobes however not so broad as the saddles; the dorsal lobe is somewhat shorter than the first lateral; the dorsal and first lateral saddle are bifurcated, and terminate in small phylliform lobules by numerous subdivisions, the strongly marked constriction in their lower portion being characteristic; the first lateral lobe is at its termination bipartite; the succeeding lobes and saddles are not so markedly divided. The septa in fig. 1 b. Pl. XXXI. are taken from the figured specimen, by filing somewhat deeper under the surface of the shell, and appear therefore much more simple.

This species is easily distinguished from *Am. Candollianus*, by the considerable compression of the shell; by its involution, by the numerous ribs, and especially by the more rapid increase in the height of the last whorl. It is more closely related to *Am. Hugardianus* D'Orb. (Pictet, *Gres Verts*, p. 108, pl. X. figs. 3, 4,) but it differs from D'Orbigny's and Pictet's figures in the following characters: it is less involute than any figured specimen of *Am. Hugardianus*, the whorls in which never embrace less than $\frac{1}{4}$ of the preceding one, while in our specimens this proportion is nearly $\frac{1}{3}$; in *Am. Hugardianus* there are no tubercles, and the ribs are flexuous; the sutures in both are similarly divided, but in our species somewhat shorter, and the first lateral lobe smaller.

There is too some relation between our species and *Am. Umbalzi*, from the Cretaceous rocks of the coast of S. Africa, described by *Baily* (Quar. Jour. Geol. Soc. Lon. 1855, Vol. XI. p. 456, pl. XI. fig. 4), but this species also is considerably more involute.

Range : Ootatoor group.

Locality : E. of Ootatoor in the Trichinopoly district, where only three specimens have been found.

6. AMMONITES SUBTRICARINATUS, *D'Orb.* Pl. XXXI. Fig. 3.

1840, *Am. tricarinatus*, D'Orbigny, Pal. Franc. Cret. I. p. 307, pl. 91, figs. 1, 2, (non *A. tricarinatus*, Poitiez, 1838.)

1850, *Am. subtricarinatus*, D'Orbigny, Prodrôme II. p. 212.

1852, *Am. tricarinatus*, Giebel, Fauna der Vorwelt, p. 721.

Am. testa compressa, planulata, lateraliter costata; costis depressis, rotundatis, simplicibus aut bifidis, prope ortum et ad finem tuberculatis; dorso lato, tricarinato; carina mediana altissima; anfractibus numerosis, angustatis; umbilico latissimo; sectione anfractuuum subquadrata; septis bilobatis, suturis septorum inequaliter dissectis, sella dorsali minore quam laterali prima.

Probable diameter of the largest specimen taken from a fragment from Kolakonuttom,.....	320 mm.
Proportions (the diameter of the whole being considered as 1.00) calculated from a specimen with diameter,	128 ,,
Diameter of outer whorl : whole,	0.21
Width of the umbilicus : whole diameter,	0.52
Thickness of the section : height,.....	0.90

Shell compressed, discoidal, only slightly involute; whorls very numerous, ornamented with short ribs on each side, elevated at their ends into smaller or larger tubercles; these being in the inner row extended or elongated in the radial direction, and in the outer row in the spiral; on the body chambers the tubercles are more distinct and sharper. The ribs are partly simple and partly bifid, but not at regular intervals; the number of tubercles is therefore not constant, amounting on the inner row to 18—24, and on the outer row to 32—36. Back broad, rather convex, bordered on each side by a row of tubercles and on the middle portion furnished with three keels, of which the middle one is the most prominent; section of the whorls nearly square, sometimes a little higher than broad. The width of the umbilicus amounts to more than $\frac{1}{2}$ of the whole diameter of the shell. Septa with only two lobes and two saddles on each side, their margins very complex and irregularly divided, the lateral saddle is higher, and smaller than the dorsal one, and is divided into two very unequal portions; the lobes terminate in many unequal dentels and short branches. This form and division of the lobes and saddles is very peculiar, and differs from that in any known Ammonite of the *Cristati* group: and in like manner the whole external appearance of this Ammonite

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is abnormal among fossils of the Cretaceous formation, and has in all respects fully the characters of a species of the Liassic *Arietes*.

Our specimen although not perfect exhibits such slight points of difference from D'Orbigny's description and figure, that there exist no sufficient reasons for making a new species. The only difference is, that the back in our specimen is more convex and the keels a little nearer together. This part of the shell however varies with the age of the specimen, as we see on other specimens in our collection. The Septa, which alone could give sufficient distinction were not known to D'Orbigny.

D'Orbigny changed his first published name of this species "*Am. tricarinatus*" into *Am. subtricarinatus* : this latter we have adopted solely on D'Orbigny's authority, as we have been unable to refer to Poitiez' publication of *Am. tricarinatus*.

Morton in his 'Synopsis of the Organic Remains, &c., of the United States,'* 1834, p. 40, pl. 17, fig. 1, names a fragment of a large specimen *Am. vespertinus*, which fragment by its slight involution and by the visible part of the sutures resembles a similar specimen of *Am. subtricarinatus* in our Indian collection. Also, in the eleventh volume of the "Zeitschrift der deutschen geologischen Gesellschaft," Berlin, 1857, 3 Heft, p. 473, Mr. Karsten offers some additional remarks relative to the Cretaceous fossils of New Granada, and amongst these he details the characteristics of a new species, which he calls "*Am. Willsii*." The absence of tubercles on the edge of the umbilicus, the almost single ribs, and a somewhat higher section of the whorls are, he believes, all the differences which exist between this species and *Am. subtricarinatus*, D'Orb. The sutures of *Am. Willsii* are not known. We are unable to state positively, whether these distinguishing marks are sufficient to establish a new species.

Range : Trichinopoly group.

Locality : Kurribiem, Kolakonuttom, Seeranuttom, East of Poothoor and Karapaudy ; rare in all localities.

7. AMMONITES OBESUS, *Stol.* Pl. XXXII. Fig. 1.

Am. testa discoidea, compressa, carinata, transversim undata, subcostata ; costis depressis, inequalibus, ad peripheriam antice curvatis ; dorso angustato, sublævigato ; anfractibus lateraliter subconvexis ; umbilico parvo, profundo ; sectione anfractuum compressa, elongata, antice obtusa, carinata ; septis numerosis, suturis modice dissectis.

Proportions (the diameter of the whole being considered as 1.00) calculated from a specimen with diameter of.....	130 mm.
Diameter of the outer whorl : whole,	0.54
Width of the umbilicus : whole diameter,	0.08
Thickness of the section : height,	0.50

Shell compressed, discoidal, nearly flat on both sides, slightly ribbed and keeled, with a very small but deep umbilicus. The ribs are very slightly elevated,

* In the Proc. Acad. Nat. Sc. Philadelphia, 1860, p. 202. Mr. Gabb, considers this fragment of *A. vespertinus* as identical with *A. Texanus*. Roem. Morton's name has therefore priority. See also *Am. Texanus* in F. v. Hauer's, Beiträge zur Palæontographie Oesterreichs' Bd. I. Heft. I. 1858.

flexuous and seem to have each a prolonged tubercle near the keel, but they do not reach to it. Back obtuse, with a strong rounded keel, having a depression on each side, which channels or depressions disappear near the mouth of the adult shell, where the ribs also die away. The greater part of the surface of the shell is wanting, but the whole form is very remarkable by its strong involution and compression on both sides; the ribs are therefore scarcely seen on the cast, but they seem to have been stronger on the perfect shell. The septa are numerous, short and not deeply divided; they could be obtained only by filing and therefore it may be, that some of the finer branches have been lost, especially at the dorsal lobe and saddle. Besides the figured specimen only one more has been found.

The general form of this specimen bears some resemblance to *Am. Goupilianus* D'Orb. (Pal. Franc. pl. XCIV. fig. 1—3,) from the gray chalk. Besides the more rapid involution of our specimen, the depression of the shell round the umbilical line, which is so characteristic in D'Orbigny's species, is also wanting in ours.

Range : Ootatoor group.

Locality : N. E. of Odium, a rare shell.

8. AMMONITES OOTATOORENSIS, *Stol.* Pl. XXXII. Fig. 2.

Am. testa compressa, planulata, carinata, lateraliter costata; costis partim simplicibus, partim bifidis; tuberculis ad umbilicum minoribus, ad peripheriam majoribus, antice acute prolongatis; dorso acute carinato, anfractibus tribus, lateraliter planis; umbilico magno; sectione anfractuum elongata, compressa: septis lateraliter bilobatis, modice dissectis, lobo laterali primo dorsali brevior.

Proportions (the diameter of the whole being considered as 1.00) calculated from a specimen with diameter of.....	26 mm.
Diameter of the outer whorl : whole,	0.31
Width of the umbilicus : whole diameter,	0.46
Thickness of the section : height,.....	0.62

Shell discoidal, with few compressed, small whorls, each of them ornamented on the sides with about twenty slightly flexuous, transverse, but not very distinct ribs; each rib rises from a small tubercle at the edge of the umbilicus, and is expanded into another larger tubercle at the edge of the narrow back; on these no other spiral ribbing or striæ are observed; some of the ribs are single, others branching in pairs at the umbilicus; keel distinct, elevated and sharp; umbilicus very large, so that nearly the whole height of the whorls can be seen. The sutures shew two saddles on each side, not deeply divided and bipartite (?); the dorsal lobe is deeper than the others. The figured specimen is the only one which has been seen, it is however a tolerably perfect one; it was found at Odium, in a concretion of the shaly beds associated with the earthy limestone.

The sutures in this specimen exhibit a want of symmetry as is seen in Fig. 2b. namely, the first lateral saddle on one side is bipartite and on the other side

(16)

tripartite. We cannot say if this be of regular occurrence; it is however observed upon all the saddles in this specimen. The last air chambers are much closer than the earlier ones.

At first glance this specimen bears some resemblance to young specimens of *Am. inflatus*, but there is no difficulty in distinguishing it from any others by the absence of the middle row of tubercles, of all spiral furrows on the tubercular ribs, and further in no specimen of *Am. inflatus* is the first lateral lobe shorter than the dorsal lobe.

Range : Ootatoor group.

Locality : Neighborhood of Odium.

9. AMMONITES SERRATO-CARINATUS, *Stol.* Pl. XXXII. Fig. 3.

Am. testa compressa; anfractibus complanatis, numerosis, lateraliter costatis; costis simplicibus, acutis, antice curvatis, ad umbilicum et prope medium subtuberculatis, prope peripheriam bituberculatis; dorso carinato bicanaliculato; carina elevata, acuta, serrata; umbilico lato, non profundo; apertura oblonga.

Proportions (the diameter of the whole being considered as 1.00) taken, from the figured specimen, with diameter of	14 mm.
Diameter of the outer whorl : whole,	0.36
Width of the umbilicus : whole diameter,	0.39
Thickness of the section : height,	0.71

Shell discoidal, consisting of many, nearly flattened whorls, which are ornamented with very numerous sharp, slightly curved and simple ribs; each of them bears four not very widely separated tubercles, which become weaker towards the umbilicus; back narrow, with a sharp, elevated keel, having a channel on each side; a small dentel on the keel corresponds with every rib continuing, as it were, the same line of curvation as the ribs; the channels on each side of the keel are rather more shallow than they are represented in Fig. 3a. Very few Ammonites of the Cristati group, to which I think this specimen properly belongs, are known in which a separate keel has distinct denticles. *Am. Carolinus*, D'Orb. from the Craie Chloritée (Pal. Franc. Terr. Cret. p. 310, pl. 91, figs. 5, 6,) differs from our specimen in the ribs, which do not extend to the edge of the umbilicus; the keel consists of a series of separate tubercles. Another somewhat allied specimen is described by Prof. Reuss in his 'Versteinerungen der Böhmischen Kreide-formation' (I. 1845, p. 22, pl. VII. fig. 10,) as *Am. Germari* from the Plæner-mergel near Postelberg. The dentels on the keel in this species are more numerous than the ribs, which is the main difference. Only one, and that unfortunately not a perfect specimen of this beautiful Ammonite, has been found in a dark earthy limestone in the lowest strata of the Trichinopoly group, near Garudamungulum together with *Am. Gaudama*, Forbes, and others. The figure is enlarged threefold, the specimen measuring only 14 mm. in diameter.

Range : Trichinopoly group.

Locality : Garudamungulum.

10. AMMONITES CORRUPTUS, *Stol.*, Pl. XXXVI. Fig. 2.

Am. testa discoidea, cristata, anfractibus numerosis, lateraliter tuberculato-costatis: costis bifidis, ad umbilicum dorsumque tuberculatis, prope carinam antice extensis; tuberculis ad umbilicum majoribus, acutis; dorso lato, medio carinato; carina continua; umbilico latissimo, profundo; sectione anfractuum subquadrata. Suturis lateraliter bilobatis, sella dorsali latissima, lobo laterali primo angusto, ad terminationem bifido.

Greatest diameter of the figured specimen about.....	32 mm.
Proportions (the whole diameter being considered as 100) calculated from the figured specimen with the diameter of	27
Diameter of the outer whorl : whole,	0.33
Width of the umbilicus : whole diameter,	0.40
Thickness of the section : height,.....	1.30

Shell discoidal, very little involute, consisting of many strongly ribbed and tuberculated whorls, back keeled. The ribs rise from the deep umbilical suture, forming each a high pointed tubercle near to the edge of the umbilicus; from these tubercles they bifurcate and form two other, not very distinct tubercles near to the back, and then curve strongly forward to the keel; on the last whorl *generally* or moreover on the body-chamber (to which the last portion in our figure also belongs) some of the ribs are simple. Back broad with a continued keel in the middle; section of the whorls somewhat broader than high; umbilicus very large, exposing about $\frac{1}{4}$ of the height of the inner whorls; walls of the umbilicus sloping. The sutures are, as generally the case in young specimens, not much subdivided; there are two lateral lobes, of which the first one terminates bifid, being somewhat longer than the very small dorsal lobe; the dorsal saddle is broader than any of the others and also bipartite.

This species is somewhat allied to young specimens of *Am. inflatus*, Sow., from which it is easily to be distinguished by the absence of the middle row of tubercles on the flanks and by the spinose umbilical tubercles being placed rather remote from the umbilical suture. In specimens of *Am. inflatus* of the same size the umbilical tubercles are placed immediately on the edge, from which the shell drops down perpendicularly. Our species is more nearly allied to some varieties of *Am. cristatus*, Deluc, and *Am. Bouchardianus*, D'Orb. (Pictet, Gres verts 1848, p. 90, pl. 8, fig. 2—5 and p. 94, pl. 8, fig. 7—9) and we are indeed in doubt, if we have not given the description of a variety of one of these species.

Range. Ootatoor group.

Locality. S. E. of Cullpaudy in the Trichinopoly district; only *two* specimens have been found in a bluish earthy limestone.

Group 2. CLYPEIFORMES.

The more natural classification of the Indian collections, according to the relations of the species, would have led to commencing the descriptions of these Cretaceous Ammonites with this group *Clypeiformes*. Pictet* also has adopted this classification. Some of the plates, however, of the *Cristati* had been already prepared, and that group was, therefore, taken first in order. We shall refer more in detail to this classification at the end of these descriptions, when treating generally of all the Cephalopoda.

Of this group only one species *Am. Siva*, already described by Ed. Forbes, has as yet been found in the Cretaceous rocks of Southern India.

1. AMMONITES SIVA, Forbes. Pl. XXXIII. Fig. 3.

1846, *Ammonites Siva*. E. Forbes, Geol. Trans. 2nd Ser. Vol. VII. p. 110. Pl. VII. f. 6.

1852, „ „ Giebel, Fauna der Vorwelt. III. p. 503.

Am. testa valde compressa, lævigata, angustissime umbilicata, ad peripheriam acute cultrata; dorso acutissime cultrato, integerrimo; apertura sagittata compressa, antice acute angulata; septorum suturis numerosis, brevibus, foliaceis.

Of this fine species we have seen only one specimen which belongs to the collection of the Madras Museum; it is larger, (about ninety mm. in diameter) but not so well preserved as that figured by Prof. Forbes, from the same beds, near Pondicherry. We have, therefore, little to add to Forbes' description: and our only reason for figuring this specimen was to shew the whole septa or sutures which consist of numerous short lobes and saddles both terminating in short branches and arranged in a slightly curved line. The dorsal lobe is the broadest, and is deeper than any of the others; the saddles decrease gradually in size towards the umbilicus, and terminate in phylliform lobules.

Dr. Dale Owen† figures a species *Am. lenticularis* which, so far as can be seen, belongs to this group of the *Clypeiformes*. It is beyond any doubt, quite different from *Am. placenta*, Morton,‡ but it is much to be regretted that Dr. D. Owen has neither drawn nor described the septa of his species, which judging from the external form of the figure seems to be nearly allied to *Am. Siva*.

Range. Valudayur group.

Locality. Valudayur, near Pondicherry.

Group 3. LÆVIGATI.

This group was proposed by E. Forbes in his description of the Cretaceous fossils of S. India, for 'Ammonites which have smooth ribless compressed sides, with distant flexuous furrows, and the back encircled by a syphoniferous keel.' Under this group we describe three species. *Am. Rembda*, (for the reception of which

* Matér. pour la Pal. Suisse. 1860, p. 300.

† Report of Geol. Surv. of Wisconsin, Iowa and Minnesota. Phil. 1852, p. 579, Pl. VIII. fig. 5.

‡ Synopsis of Org. Rem. of Cretaceous Rocks of U. States, Phil. 1834, p. 36, Pl. XI. figs. 1 and 2.

the group was established), *Am. Gardeni*, and *Am. sugata*. These may be admitted as forming one group, although the last is very different from the others in its involution, and in the division of its sutures, as will be seen by a reference to the following descriptions. *Am. Gardeni* and *Rembda*, are more closely related, the lobes of the sutures in both being very similar to those of the majority of Ammonites of the *Ligati* group.

Am. Rembda, and *sugata*, were both first described by Forbes from the same localities as our specimens: *Am. Gardeni* is a species described by Baily from the Cretaceous rocks of S. Africa, and is probably identical with another species described by Prof. B. Kner, from the chalk near Lemberg, in Galizia, as *Am. sulcatus*.

1. AMMONITES SUGATA, Forbes. Pl. XXXII. Figs. 4—6. Pl. XXXIII. Figs. 1, 2.

1846, *Ammonites sugata*. Forbes, Geol. Trans. VII. p. 113. Pl. X. fig. 2.

1852, „ „ Giebel, Fauna der Vorwelt. Vol. III. p. 498.

Am. testa discoidea subcompressa, lævigata, transversim 6-sulcata, sulcis oblique undulato-flexuosis, antice prolongatis; dorso rotundato, carinato; carina continua elevata; anfractibus lateraliter subplanis, valde involutis; umbilico angustato, profundo; sectione anfractuum compressa; septis numerosis, lateraliter 7-lobatis, ad umbilicum gradatim decrescentibus, profunde dissectis: sellis bipartitis, lobis inaequaliter unicus.

Diameter of largest specimen,.....	95 mm.	
	mm.	mm.
Proportions (the diameter of whole being considered as 1.00)		
taken from specimen figured Pl. ....XXXII. 4	XXXII. 6	
with diameters of.....	49	57
Diameter of outer whorl : whole,	0.50	0.50
Width of umbilicus : whole diameter,	0.12	0.12
Thickness of section : height,	0.72	0.61

Shell discoidal, with few whorls, flattened on both sides, surface smooth; umbilicus small and deep with nearly perpendicular walls, exposing only a very small part of the inner whorls; back roundish, with a sharp elevated keel, expanded at the base, and sometimes margined by a distinct line on each side. Young shells appear generally quite smooth without any ornamentation; adult specimens, as that figured Pl. XXXIII. Fig. 1, on the last whorl shew six oblique flexuous furrows, which are markedly prolonged on the back reaching to the keel, and bounded with slightly elevated swellings. Nearer to the mouth the furrows are more numerous, as is seen on a specimen from Andoor. The section of the shell varies little in thickness: it is generally as broad as high, (excluding the involute portion). Some specimens are somewhat thicker, others more compressed. On well preserved shells, the rostrum on the top of the mouth is drawn out, or prolonged into a point, as occurs in many species of the *Falciferi* group.

Septa with seven saddles on each side, very numerous divided; they gradually diminish in size towards the umbilicus, and in this distribution resemble very much some of the *Heterophylli* group; the lobules being, however, not so phylliform; moreover these have the form of some *Ligati* ammonites. The saddles are all bipartite at their termination, while the lobes have an immense number of little denticles and terminate in one branch, slightly curved towards the keel. The auxiliary lobes become almost regularly bifid.

Am. sugata is a very beautiful and remarkable species, to which nothing similar is known among described Ammonites. The form of the shell and the septa recall much some *Heterophylli*, while the keel characterizes a *Cristate* and the flexuous and prolonged furrows a *Falcifer*. Giebel (*loc-cit*) refers *Am. sugata* to his new group *Multilobati*; and it really appears to be more related to this, than to any other group.

Prof. Forbes established this species for some specimens in Messrs. Kaye and Cunliffe's collection, which seem to have been not well preserved. The Geological Survey of India have since procured a very large number of this species, from a great many localities; some of them in excellent preservation. We have, therefore, been able to give some additional remarks in the description of the species.

Range. Trichinopoly and Arrialoor groups, from both of which the species is already quoted by H. Blanford. Mem. Geol. Surv. Vol. IV. part I. pp. 111 and 127.

Localities; in the Trichinopoly group: N. and E. of Anapaudy (very common); Andoor, (common); Alundanapuram (very rare); E. of Olapaudy (v. r.); W. of Koluture; Vylapaudy (v. r.); Kolakonuttum; Coonum (few but the largest specimens); Kovil; *in the Arrialoor group:* Karapaudy, S. W. of Arrialoor (common); E. of Murvanoor, S. of Arrialoor (r.); Veraghoor (common).

2. AMMONITES GARDENI, *Baily*. Pl. XXXIII. Fig. 4.

1850 ? *Ammonites sulcatus*, Kner. Haidinger, Nat. Abhand. Vol. III. Kreide von Lemberg, p. 8, t. I. Fig. 3. *non, A. sulcatus*, Lamarck, Buckman, &c.

1855. ,, *Gardeni*, Baily. Des. of Cretaceous Fossils from S. Africa, Quar. Jour. Geol. Soc. Lond. 1855, p. 456, pl. XI. fig. 3.

Am. testa discoidea, lateraliter compressa, levigata, carinata; anfractibus numerosis, lateraliter subplanis, transversim 8-9-sulcatis, sulcis oblique flexuosis; lateribus parum elevatis; dorso angustato, carinato; carina continua elevata; umbilico lato abrupte excavato; apertura compressa, ovali, antice acuta; septis utrinque trilobatis, numerosissime dissectis et ramosis, lobis septorum ad terminationes unicis, sellis inæqualiter trilobatis.

Diameter of largest specimen.....	170 mm.
Proportions, (the diameter of whole being considered as 1.00)	
taken with a diameter of	145 mm.
Diameter of outer whorl : whole.....	0.37
Width of umbilicus : whole diameter,	0.36
Thickness of section : height	0.75

Shell discoidal, compressed, smooth, with numerous slightly involute whorls; sides nearly flat, sloping quickly from the sharply margined edge of the umbilicus. The shell slopes gradually to the smaller back, and terminates in a sharp continuous keel, with slight excavations on either side. The surface of the shell is smooth, shewing only on each whorl at moderate distances eight or nine curved, flexuous and slightly depressed, furrows, the margins of which, towards the mouth, or on the forward edge, are marked with small rib-like swellings. Umbilicus large, exposing about $\frac{2}{3}$ of the height of the inner whorls, bordered with a marked elevated line, which is, however, only seen on perfectly preserved shells; the section of the whorls is compressed, elliptical, pointed on the periphery of the shell and lunulate at the involution. The septa consist of only three saddles on each side, they are very numerous and deeply divided and branched, the lobes being at their terminations single, the saddles irregularly tripartite; besides these,—the large dorsal, the first and second lateral saddles,—there is only one, or sometimes two, very small auxiliary saddles, which descend to the umbilicus in the same manner, as is generally the case in Ammonites of the group *Ligati*.

The species here described is identical with that described by Baily under the same name, only the septa in his specimen do not shew as many subdivisions as ours, which are perfectly well preserved. Baily gives the locality thus, "White-men's-houses coast of S. Africa near the Umzanbani river in compact siliceous grit containing numerous fossils, and in greenish sandstone." The rocks, in which our specimens occur have nearly the same character; they are also a siliceous grit, nearly white, at Arrialoor; and a greenish conglomeratic sandstone, at Karapaudy.

Very probably *Am. Gardeni*, Baily, is identical with a species described by Prof. Kner from the Cretaceous rocks near Lemberg (Austrian-Poland) under the name of *Am. sulcatus*. The preservation of the specimen is not sufficient to give any great certainty regarding this; but the fact could have no effect on the name of this species, the name *Am. sulcatus* having been used long before for very different species by Lamarck, Zieten, Buckman and others. The fact of identity would, however, be of great interest in tracing out the geographical distribution of this species, and the relations of the Indian Cretaceous fauna to that of Europe.

In general aspect *Am. Gardeni* bears some resemblance to Pictet's figures of *Am. Gervilianus*. D'Orbigny. (Pal. Suisse. II. Ser. 1859, Pl. XX. from the 'neocomien inferieur,') but differs from it by its keel.

Range. Arrialoor group. (? Trichinopoly group).

Localities. Karapaudy; W. of Arrialoor; and N. W. of Poodoor. The specimens from Karapaudy are generally more compressed, and smaller in size. This species occurs abundantly at Arrialoor, while it is also found N. W. of Poodoor in strata referred to the Trichinopoly group, but near the boundary of the Arrialoor beds.

3. AMMONITES REMBDA, *Forbes*. Pl. XXXIII. Fig. 5.

1846, *Ammonites Rembda*, Forbes, Trans. Geol. Soc. London. Vol. VII. p. 111. Pl. VIII. Fig. 3.

1852, „ „ Giebel, Fauna der Vorwelt. Vol. III. p. 756.

Am. testa compressa lævigata, late umbilicata; anfractibus complanatis transversim sulcatis; sulcis undulate-flexuosis, ad dorsum antice curvatis; dorso angustato, carinato; carina elevata, constricta, integra, solida, punctata, spiraliter 4-lineata, ad peripheriam plane-sulcata; sectione anfractuum ovali-compressa, antice mucronata.

Of this very handsome species we have only one fragment, which belongs to the Madras Museum, and we are therefore unable to add much to Prof. Forbes' description. Our figures are both enlarged to twice the linear dimensions of this fragment. One part of the keel is perfectly preserved and also one transverse flexuous furrow, parts which were not very distinctly seen on Prof. E. Forbes' specimen. The keel is solid, very much elevated, and much constricted below, it has on its upper part four spiral, elevated lines, between which the shell is a little depressed; the surface of the keel is marked with very fine lines of growth and is also finely punctate; similar dimples are also seen on the cast of the shell, in the lateral channels, and on the keel; this latter is very sharp in the cast. The whorls are nearly flat, and shew, besides the small flexuous furrows, only the striæ of growth; they are much compressed, roundish towards the umbilicus, as is seen in the section Fig. 5a. The septa, which are spoken of in Prof. Forbes' description, have not been seen on our specimen.

The character of the keel marks this species so well, that although no perfect specimen is known, it cannot be mistaken for any other species.

Range. Valudayur group.

Locality. The fragment we have before us is from near Pondicherry and belongs to the Valudayur group.

Group 4. PULCHELLI.

This group, established by D'Orbigny, has been partly adopted by other palæontologists, while in part the species belonging to it have been united with the *Rotomagenses*, as Pictet has done in his more recent publications. Many species, however, which are generally put into this latter group, appear to be in reality different from typical *Rotomagenses*.

We shall describe, in this group, two species, which somewhat differ from each other. *A. idoneus* is an abnormal form which gives the impression of belonging to the *Dentati-compressi*. The only important difference from this group is, that the siphon lies below the middle tubercles on the back and is not placed between the two rows of tubercles, as would be required for an Ammonite of the *Dentati* group. *A. rotalinus* bears more the aspect of one of the *Pulchelli*, but is still very distinct from any known form. It would be most desirable to obtain a knowledge of the septa of this Ammonite, which are not visible in our specimen.

1. AMMONITES IDONEUS, *Stoliczka*. Pl. XXXIV. Fig. 1.

Am. testa compressa valde involuta, transversim costata; costis inæqualibus, undulate-flexuosis, in medio dorsi atque prope peripheriam (apud nostrum exemplar in uno latere) sub-tuberculatis; dorso subrotundato; umbilico parvo; apertura oblonga; septis lateraliter quadri-lobatis, modice dissectis, lobo laterali primo bifido, ceteris unicus,

Diameter of figured specimen,.....	18 mm.
Diameter of outer whorl : whole,	0.53
Width of umbilicus : whole diameter,	0.15
Thickness of section : height,.....	0.57

Shell compressed, sides flattened and slightly depressed round the umbilicus; ribs slightly elevated and undulating, flexuous, unequal, and stronger near to the roundish back of the shell; the ribs become much higher, and even tubercular in the middle of the back (in the place of a keel) and—in our specimen only on one side—near the edge of the back: the other side of the back being simply rounded without any such tubercular elevations. The umbilicus is very small and deep, the inner whorl being almost entirely concealed; the aperture is oblong, about $\frac{1}{2}$ higher than broad. The septa are formed similarly to those in Ammonites of the *Rotomagenses* group, and as is generally the case in young specimens, not deeply divided; the dorsal saddle is broadest and is bipartite, as are also the first lateral saddle and the first lateral lobe: the other lobes have single terminations.

Only one specimen has been found of this species which it is, therefore, difficult to determine with full certainty. This specimen, however, is well preserved, and is not crushed, as it might appear to be at the first glance. In some respects it is different from other species of the group *Pulchelli*, and we were at first disposed to place it among the forms of the *Dentati-compressi* group; but inasmuch as the syphon is placed quite symmetrically in the middle of the back, and marked by a row of tubercles, we are more inclined to believe, that one row of tubercles on the edge of the back is accidentally wanting in this specimen, than to consider this an abnormal form of *Compressi*. Such abnormal forms occur but rarely, and must be carefully considered. Sharpe has described a form, *Am. Ramsayanus*, in some respects similar, which he believes to be a malformation.* F. von Hauer also has noticed several abnormal Ammonites.† These were all Liassic forms.‡

The full determination of this species must be deferred until more specimens shall have been found.

Range. Trichinopoly group.

Locality. Andoor in the Trichinopoly district; very rare.

* Foss. Moll. of the Chalk. Palæontog. Soc. 1853, p. 51, Pl. XXIII. Fig. 4.

† Sitzungs. d. Akad. Wissenschaften, Wien. 1854, Vol. XIII. p. 401.

‡ Fr. v. Hauer notices two kinds of asymmetry, 1, the shell is symmetric and the syphuncle eccentric; 2, shell asymmetric and sutures regular. The asymmetry of the present species is of the second kind, while of the first case we have to mention another species of the *Mamillati* group below.

2. AMMONITES ROTALINUS, *Stoliczka*. Pl. XXXIV. Fig. 2.

Am. testa subinflata ; anfractibus numerosis, rotundatis, lateraliter subcostatis ; costis brevibus, claviformibus, ad umbilicum acutis ; dorso rotundato, tuberculato ; tuberculis triserialibus, elevatis, distantibus, antice prolongatis ; umbilico lato ; apertura rotundata ; septis ?

Diameter of figured specimen,	95 mm.
Diameter of outer whorl : whole,.....	0.38
Width of umbilicus : whole diameter,.....	0.36
Thickness of section : height,	1.34

The shell of this very handsome Ammonite consists of about six rounded and slightly involute whorls, which are broader than high. Each whorl bears, on the sides, about twelve oblique ribs, or elongated tubercles, which are sharp and pointed at their origin towards the umbilical edge, and becoming gradually thicker they end with a bluntly rounded termination at about the middle of the side of the whorl. Between these elongated tubercles there are three large and rounded tubercles in the same direction, one row of these tubercles bounding the back on either side, and one row in the middle. The space between the tubercles is transversely grooved, so that they appear connected by shorter ribs which are, however, not distinctly visible. Between the principal ribs and tubercles there are also some intermediate ones : and in front of the principal ribs, there are slightly depressed furrows round each whorl. These will be better understood from a single inspection of the figures than from a lengthened description.

Umbilicus large leaving about two-thirds of the height of the inner whorls visible. Section of the whorls transversely oval, broader than high.

I am not acquainted with any described species of Ammonite from the Cretaceous, or any other formation, which can be compared with this Indian fossil. I greatly regret that only one specimen has been met with ; which is, in some parts only a cast, and on which the septa could not be made visible.

The group *Pulchelli* under which we have placed this form, is certainly the only group known in Europe, to which we suppose it can belong ; the more detailed description must be deferred until better specimens will be found.

Range. Ootatoor group.

Locality. North of Odium ; only one specimen has been hitherto discovered.

Group 5. ROTOMAGENSES.*

This group is well defined by the middle row of tubercles, on the back, and by strongly tuberculated ribs, which mostly form the ornamentation of the shell. The species belonging to this group have many relations with those forming that sub-

* We write this word, without an *h*. The name is from Rotomagus, now called Rouen, where the species so named was first found. This town existed so long since as in Julius Cæsar's time, and in all the old maps is written Rotomagus. The use of the *h* would be more consonant with practice, had the name been first given to the place in mediæval times.

division of the *Cristati*, including *Am. inflatus*, *Candollianus*, *Coupei*, and others, not only in the slight involution of the shells, but also in the ribbings, when the tubercles on them are less distinctly expressed. Some Ammonites, as *Am. Woolgari*, by their continuous and yet tuberculated keel form a passage between the *Cristati* and *Rotomagenses*. The similarity in the sutures has been already mentioned (p. 46); there is generally one dorsal, one lateral, one large and many divided umbilical and one small ventral saddle: these saddles include three lobes (the 1st and 2nd lateral, and the umbilical lobes), besides the dorsal and the ventral lobes.

In the Cretaceous rocks of S. India, eight species of this group have been noticed: two of these *Am. Rotomagensis* and *Am. navicularis* are very common in the middle chalk in Europe, and the first of these known from other continents also; six species are given here, which appear to be new: *Am. Coleroonensis*, *harpax*, *ornatissimus*, *meridionalis*, *Medlicottianus* and *tropicus*; all belong to the Ootatoor group.

1. AMMONITES ROTOMAGENSIS. *Defrance*, Pls. XXXIV. Figs. 3—5. Pls. XXXV, XXXVI. Fig. 1. Pl. XXXVII. Figs. 1—3.

1822. *Am. Rotomagensis*. *Defrance*, apud *Brongniart*, *Env. de Paris*, en *Cuvier*, *Oss. Foss.* Tom. IV. p. 636. Pl. N. Fig. 2.
 1822. *Am. Sussexiensis*. *Mantell*, *Geol. of Sussex*, p. 114. Pl. XXI. Fig. 10.
 1826. *Am. Rotomagensis*. *Sowerby*, *Min. Conchol*, Vol. VI. p. 25, Pl. 515.
 1841. „ „ *D'Orbigny*, *Pal. Franc. Terr. Cret.* p. 345. Pl. 105, 106.
 1847. „ „ *Quenstedt*, *Petref. Deutsch. Cephalop.* p. 213, Pl. 17. Fig. 5 (*part.*)
 1851. „ „ *Bronn*, *Lethæa Geognos.* Bd. 2, p. 319. Pl. 33, Figs. 1 and 3 (*part.*)
 1852. „ „ *Giebel*, *Fauna der Vorwelt*, III. p. 704 (*partim.*)
 1854. „ „ *Sharpe*, *Palæont. Soc. Moll. of Chalk.* I. p. 33. Pl. 16.
 1859. „ „ *Pictet*, *Palæon. Suisse.* II. Ser. 9. Liv. p. 190. Pl. XXV. Figs. 1—3.

Am. testa discoidea, transversim tuberculato-costata; anfractibus quadrato-rotundatis, seu compressis; costis simplicibus, rectis, inæqualibus, junioribus 7-tuberculatis; dorso sub-rotundato vel plano, in medio tuberculato: tuberculis 5-serialibus, in adultis minoribus seu obsoletis; umbilico magno; apertura quadrata, rotundata, seu sub-compressa; septis lateraliter trilobatis, modice dissectis, lobis septorum bifidis; sella dorsali latissima, inæqualiter bipartita, sella laterali prima inæqualiter multifida.

Diameter of the largest specimen. 300 mm.

Proportions, taken from specimens of the different varieties, (the whole diameter being considered as 1.00) with the diameters here given.

	<i>spec. typica.</i>		<i>var. inflata.</i>	<i>var. sub-compressa.</i>			<i>var. compressa.</i>
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Diameter, in millimetres,	48	120	42	28	88	210	65
Diameter of outer whorl : whole,.....	0.39	0.42	0.40	0.42	0.46	0.40	0.46
Width of umbilicus : whole diameter, ...	0.29	0.29	0.30	0.27	0.26	0.31	0.26
Thickness of section : height,	1.50	1.50	1.22	1.33	1.20	1.05	0.90

- (a) Pl. XXXIV. Fig. 4, a small, full grown specimen, from S. E. of Odium.
- (b) Pl. XXXV. Fig. 3, a large specimen, from S. E. of Odium.
- (c) Pl. XXXV. Fig. 2, a young, but well preserved shell, which had been injured on one side, and afterwards restored, from N. W. of Monglepaudy.
- (d) Pl. XXXIV. Fig. 3, a very young but whole specimen, from S. E. of Odium.
- (e) Pl. XXXV. Fig. 1, a specimen of about middle age, common European form, from S. E. of Odium.
- (f) Pl. XXXVI. Fig. 1, a large and nearly full grown specimen, from N. E. of Odium.
- (g) Pl. XXXIV. Fig. 5, a remarkably compressed form, from S. E. of Odium.

Shell discoidal, consisting of four or five rather evolute more or less angular, strongly and numerous ribbed whorls. In all our Indian specimens, (of which the Geological Survey collection has a considerable number) the transverse ribs are more numerous than in the English or French specimens. The latter, from Rouen and elsewhere, have generally only 18—22 transverse ribs in one whorl, the former from 20 to 26. The Indian specimens have 28 to 32 ribs in one whorl, the intermediate ribs being much more numerous. The ribs come up from the deep umbilicus, and rise to distinct tubercles either just on its edge or a little further on, these tubercles never being absent in the main ribs extending all round the shell to the opposite edge of the umbilicus. The ribs bear also two other rows of tubercles bounding the lateral slopes of the back on each side, and another row supplying the place of a keel. All the five rows of tubercles on the back vary extremely in their size, although generally perfectly distinct even on young specimens. The middle, or keel, row which consists of rounded tubercles, disappears regularly on the body chamber of the shell, both in adult, and in young specimens. Of the two other rows on each side of the back, sometimes one, sometimes the other, disappears first. The involution of the shell always extends to the inner row, (that near the edge of the umbilicus), and this row is generally well marked on specimens with a square, or only roundish section of the whorls. The outer row, or that at the periphery of the shell, is well marked on compressed specimens, and is itself also frequently well preserved on the body chamber of adult specimens.

All the five rows of tubercles disappear very soon on specimens with rounded section of whorls, this rounded section being in fact due to the absence of the tubercles.

The ribs themselves are quite straight, or only very slightly bent after they pass the row of the tubercles next to the umbilicus. Frequently another curvature of the ribs is seen on the back of the shell, but they are never so strongly bent as in *Am. harpax* (nov. sp.)

As regards the different sections of the whorls, by which the whole aspect of the specimens is changed, we are able to classify the large collection of Indian specimens under four varieties: and we believe that a similar subdivision can well be made among the European forms. The differences between these varieties can be readily traced by an examination of the various measurements we have given above, and only a few additional remarks will be necessary.

1. *Am. Rotomagensis* (*typicus*, Pl. XXXIV. Fig. 4, and Pl. XXXV. Fig. 1.) We consider this the typical form of the species, because it most closely resembles the first figure given by Brongniart in Cuvier's 'Ossements fossils,' (loc. cit.). Fig. 4, Pl. XXXIV. represents a small specimen of this variety with a part of the body chamber: Fig. 1, Pl. XXXV. is a large specimen shewing, however, only the air chambers. Our specimens, it will be seen, have perfectly the form and angular section of the whorls, common in the European specimens from Rouen, Quedlinburg, Isle of Wight and other places, the only difference being as already noticed, that the European specimens are not so numerously ribbed; the tubercles are all very well marked in the young shells, when older the shell increases more in thickness than in height, the three rows of tubercles on the back disappear; the back becoming nearly flat crossed by slightly elevated ribs.

There are some specimens, from N. of Odium, which have the same large number of transverse ribs, and on which the tubercles of the second row (from the umbilicus) rise to a considerable height, as in *Am. Cenomanensis*, (Sharpe. Moll. of Chalk. Palæont. Soc. 1853, p. 37, Pl. XVII. Fig. 1), non *Am. Woolgari* D'Orb.

If it should prove on further investigation that the only difference between the two species is this, that the transverse ribs are stronger on the adult shell of *Am. Cenomanensis*, than of *Am. Rotomagensis*, there will remain no doubt of the identity of both. Indeed Sharpe himself mentions this as probable. Pictet's figure of *Am. Cenomanensis* D'Arch. (Pal. Suisse, II. Ser. Liv. 9, p. 193, Pl. XXV. Fig. 4,) shews a somewhat different distribution of the keel-tubercles, but he also is not quite certain of its being really distinct from *Am. Rotomagensis* and leaves the question to be decided by the naturalists of Rouen, (loc. cit. p. 195). Our Indian materials do not prove that *Am. Cenomaniensis* and *Am. Rotomagensis* are two distinct species.

2. *Am. Rotomagensis* (*var. inflatus*); Pl. XXXV. Fig. 2, represents a small specimen of this variety; there are, however, much larger specimens. The very young shell does not differ from the regular or typical form, the whorls being angular: but after the shell has grown to a diameter of two inches or more, the five rows of the tubercles on the back disappear altogether, and the back appears to be regularly rounded, crossed by longer and shorter ribs. This roundness of the back is chiefly marked only on the body-chamber. Fig. 2.b. in the same plate represents the opposite side of the same specimen, and is given to shew an early breakage in the shell, and the partial restoration which subsequently took place. It is one of the few cases in which irregularities of this sort in the growth of shells have been noticed.

3. *Am. Rotomagensis* (*var. subcompressus*). This variety is one of the most common among our Indian forms. It is more laterally compressed than the typical form, the back being smaller, and the central portion of it somewhat higher than the sides. The narrowness of the back is caused by the obliteration of the inner row of tubercles, while the outer row is perfectly preserved in young and middle

aged specimens, (see Pl. XXXIV. Fig. 3, and Pl. XXXV. Fig. 3). In the adult shells, all the tubercles on the back become obsolete.

4. *Am. Rotomagensis*, (var. *compressus*). This is a remarkably compressed variety, (Pl. XXXIV. Fig. 5) of which we have some small specimens from S. E. of Odium: all specimens, we have seen, are not fully grown, but the tubercles on them are all well expressed. The specimen figured is also distinguished by the umbilical tubercles, these being placed quite on the edge of the umbilicus, and even projecting into its space.

The four varieties, just noticed, are the principal subdivisions, into which we can group the Indian specimens of this species. It must, however, be understood that there are besides many intermediate forms and among others there are forms, which in different stages of growth belong to different varieties.

There is not much variation in the character of the sutures of this species. We have drawn a good many of them, principally taken from the figured specimens. This, we feel satisfied, will be far from useless, because good figures of them are seldom met with, and they have so many times been confounded with the sutures of *Am. Mantelli* and others. In the distribution and division of its sutures *Am. Rotomagensis* very closely resembles *Am. inflatus*. They are numerous but not deeply divided. In reality, there are not more than two lateral lobes: the dorsal lobe is deepest; the dorsal saddle broadest, and unequally bipartite at the end; the inner lobule, (or that nearer to the umbilicus) being generally smaller and sometimes shorter (see Pl. XXXVII. Fig. 2). The first lateral lobe is invariably bifid, and narrower than the dorsal saddle; the first lateral saddle is much shorter, unequally and irregularly tripartite, but never so deeply cut as the same saddle in *Am. Mantelli*: the second lateral lobe is single at the termination in the younger stage of growth, and bipartite in the adult shell (see Pl. XXXVII. Figs. 2 and 3). The succeeding auxiliary lobes and saddles are on the wall of the umbilicus, and make together a large sutural or umbilical saddle, with many unequal lobules, similar to that of *Am. inflatus* seen in Pl. XXX. Fig. 2. The air-chambers are rather small, as is well seen in several of our figures; on the back the septa are distant from each other by the space of three tubercles of the middle row. This seems to be almost always the case.

In all the European figures of *Am. Rotomagensis* (D'Orbigny, Pictet, Sharpe, &c.), it is remarkable, that the tubercles in the middle of the back, replacing the keel, are represented quite as much elongated as the lateral tubercles. We do not feel certain, whether this is a mistake in the figures, or whether there is in the European forms really no difference in these tubercles. In all our Indian specimens, the keel-tubercles are somewhat roundish, while the others are more elongated. Of course when the shell is not well preserved, little difference is seen between both.

Compared with other similar species, *Am. Rotomagensis* is easily distinguished, by the constant involution, the transverse ribs with seven rows of tubercles, and by the unequal sutures. The close relation and probable identity with *Am. Ceno-*

manensis Sharpe (? D'Arch.) has been already noticed, and its relations to and differences from *Am. harpax*, *Mantelli*, and others will be found in the descriptions of those species. We would here only mention that Sharpe's separation of *Am. hippocastanum*, *navicularis*, and *Sussexiensis*, which are often quoted by other authors as synonyms of *Am. Rotomagensis*, we consider to be quite correct.

Pictet in his later publications (Mat. pour la Pal. Suisse, II. Ser. 9 Liv. p. 190) gives a full list of the literature of this species.

Am. Rotomagensis is one of the most common and widely spread species among Ammonites; it is known from almost every quarter of the globe. In *Europe*, it occurs in the chalk marl, (Morris, Catal.) and lower chalk (Sharpe) of England; in the "etage Cenomanien" (D'Orb. Prod.) of France, Switzerland (Studer. Geol. II. p. 291) and Savoy, (Pictet, Pal. Suisse.); in the Inoceramus chalk-marl of the middle cretaceous group at Briganza, Breno, &c. of Lombardy (Ombroni. Bull. Soc. Geol. France, 1853, Tom. XII. p. 517); in the chalk at Lemberg (Galizia), and in the lower 'Quader' of Bohemia (Reuss. Verst. Bohm.); in the Quadermergel of Saxony (Geinitz. Quader-sandst.); in the lower Plæner of Westphalia (Strombeck, Deuts. Geol. Ges. VI. and VIII.);* and in many other parts of Germany. Abich found this species in a sandstone with green dots of the middle chalk in the valley of Gergebil and Kotschalmaki (country of the Caucasus in Russia), the specimens from which have been determined by Leop. v. Buch (Bull. Soc. Geol. France, VI. pp. 564, 568, 1849.) In *Africa*, from rocks of the "etage cenomanien" in the Province Constantine (Algeria) noticed by M. Coquand (Mem. Soc. Geol. France, II. Ser. V. p. 149). In *America*, the same species occurs in the cretaceous formation of the plateaux of Quito (Santa Fè de Bagota) and was described by L. v. Buch (Petrif. recueil. en Americ. p. 7, fig. 13); it is also mentioned from the same country by E. Forbes, (Quar. Jour. Geol. Soc. London, 1845, p. 175.)

Range. Ootatoor group, (Trichinopoly group?)

Localities: very common in the neighbourhood of *Oodium*, W. of Coonum and E. of Ootatoor; only a few specimens are marked with the locality S. West of Vylapaudy in the Trichinopoly group; the other localities belong all to the Ootatoor group.

* A. v. Strombeck in his most recently published paper "Ueber die Kreide am Zeltberg bei Lüneburg," (Zeitsch. d. Deutsh. Geol. Gesellsch. Berlin Vol. XV. 1863, p. 103) makes *Am. Rotomagensis* peculiar to the uppermost strata of the Cenoman-Plæner in the north-western parts of Germany and proposes for these strata the name *Rotomagensis-Plæner*.

2. AMMONITES COLEROONENSIS, *Stoliczka*, Pl. XXXVII. Figs. 4—6.

Am. testa discoidea, compressa, anfractibus angulatis vel sub-inflatis, transversim tuberculato-costatis; costis junioribus 7-tuberculatis, inaequalibus; adultis, 6-tuberculatis: tuberculis dorsi in medio obsolete; dorso plano, lateraliter angulato vel sub-rotundato, transversim costato et tuberculato; umbilico magno; apertura quadrato-rotundata, sive ovali-elongata: septis lateraliter bilobatis, parum incisiss: lobo dorsali angusto, lobis lateralibus latis, ad terminationes bifidis; sella dorsali angusta.

Diameter of largest specimen from Coonum.....	130	mm.
Proportions, the diameter being considered as 1.00, taken from	<i>a</i>	<i>b</i>
specimens with diameters of	130	100 mm.
Diameter of outer whorl : whole	0.34	0.35
Width of umbilicus : whole diameter	0.38	0.43
Thickness of section : height	1.22	1.33

a. Largest specimen with roundish back, from Coonum.

b. Smaller specimen with more angular whorls, Pl. XXXVII. Fig. 5.

Shell discoidal, flattened on the sides, with few whorls increasing very slowly in size. The whorls are strongly ribbed transversely, the ribs being tuberculated. There are twenty-five to thirty-five ribs, some of them go entirely round the whorl, others are bifid; or they extend only over the back, and disappear at the sides. In the younger stage of growth the tubercles are all very well expressed (see Fig. 4, Pl. XXXVII.); each longer rib has seven tubercles, one at the umbilicus, one (larger) at either edge of the outer slopes to the back, one on the other edge of these slopes, and one in the middle of the back. The full grown shell shews very often some differences. Not only do the tubercles on the middle of the back disappear, but this middle becomes a depression, and some of the ribs are bent over, a little higher on one side, as is seen Fig. 5.*b.* and Fig. 6. Some specimens, from Coonum, have in the later stages of growth somewhat higher whorls with flattened sides and a more rounded back, on which the tubercles are less expressed, but the ribs extending over the whole without interruption. Umbilicus very large, allowing about $\frac{2}{3}$ of the height of the inner whorls to be visible, the involution extends to the peripheral rows of tubercles. Few specimens from Coonum are more involute (as in Fig. 5). The measures and proportions taken from one of these are given above.

The aperture is either roundish, square, or sometimes a little broader or higher. Septa are numerous but not deeply divided, the dorsal lobe is small, not deeper than the large bifid first lateral lobes; the dorsal saddle is unequally bifid, *not larger than the first lateral lobe*; the first lateral saddle is nearly as broad, but shorter; the second lateral saddle is very short and lies on the umbilical wall.

The chief distinctive character of this species lies in the very gradual increase of the whorls in height and in the septa, which although similar in general form to those of *Am. Rotomagensis* are different from those of all nearly allied

species: the dorsal saddle being sometimes smaller, or at least not larger than the first lateral lobe.

Some of our specimens very much resemble Sharpe's figures (specially his Pl. XVII. Fig. 4), of *Am. hippocastanum*, Sowerby: but Sharpe gives just the opposite characters as distinguishing his species; he quotes rapid increase of the shell in height and large dorsal saddle as distinguishing *Am. hippocastanum*; in this respect the species would be much more allied to *Am. navicularis*, Mant.

The name of this species is taken from the main river in the Trichinopoly district, the Coleroon.

Range. Ootatoor group.

Locality. W. of Coonum, not very common.

3. AMMONITES HARPAX, *Stoliczka*, Pl. XXXVIII. Fig. 2, XXXIX. Fig. 1.

Am. testa discoidea, lateraliter compressa, transversim costata; costis inæqualibus, postice curvatis, apud umbilicum et dorsi in medio tuberculatis, prope dorsum lateraliter bituberculatis; dorso convexo, angustato; umbilico moderato; apertura oblonga; septis lateraliter bilobatis, parum incisus, sella dorsali latissima, lobo laterali primo angusto, inæqualiter bipartito.

Diameter of largest specimen	170 mm.	
Proportions taken from specimens (the whole diameter being considered as 1.00) with diameters of	100	92 mm.
Diameter of outer whorl : whole	0.40	0.407
Width of umbilicus : whole diameter	0.32	0.316
Thickness of section : height	0.85	0.90

Shell discoidal, with flattened sides and numerous unequal shorter and longer ribs: the longer ribs reach to the umbilicus, and each begin on its edge with a strong tubercle; the others bear each two separate tubercles on the lateral curvature of the back, and one row of tubercles in the middle in the place of a keel; this last row is generally the most prominent. All the tuberculated ribs are remarkably bent backwards. The tubercles disappear entirely near to the mouth on the body-chamber, while the transverse ribs continue, and are sometimes even stronger than before, having a rounded or angular section. The umbilicus is of moderate size, with perpendicular walls bounded by the row of tubercles already noticed. The involution extends a little over the inner row of tubercles near the back. The mouth is elongated, higher than broad, rounded at the outer edge and slightly excavated on the inner.

Considered with reference to the compression of the shell, two varieties can be distinguished. Pl. XXXIX. Fig. 1. represents a regular or typical, and almost perfectly preserved specimen: there are few specimens larger than this. Pl. XXXVIII. Fig. 2, is a figure of an unusually compressed shell, accidentally (?) of irregular involution, (like a *Scaphites* or *Am. dispar*, Orb.) and also with less

elevated ribs; the rows of tubercles on the slopes of the back being also less marked than in many other specimens.

The septa are very similar in form to those of *Am. Rotomagensis*, having only two lobes on each side, but they appear to be less deeply divided. There is a very deep dorsal lobe, which in the first air chambers extends over three of the keel-tubercles, as in *Am. Rotomagensis*. Nearer to the body chamber, the air-chambers become much smaller, so that the last extends only over two keel-tubercles. The dorsal saddle is broader than any of the others and bipartite; the first lateral lobe is much smaller and also bifid; the first lateral saddle narrow, varies in size and has some irregular short branches on its upper termination. The auxiliary lobes on the wall of the umbilicus become gradually smaller, and form a large umbilical lobe; the inner or ventral lobes and the saddles are very small.

Am. harpax is nearly allied to *Am. Rotomagensis* and especially to that variety which we have described as *Am. Rotomagensis (compressus)*. The different characters, however, are sufficient to justify a new species. The principal differences are, that in *Am. harpax*, the ribs are strongly bent backwards, while those of *Am. Rotomagensis* are straight or a little bent forward; the umbilical tubercles are placed quite on the edge of the walls of the umbilicus, and the involution extends somewhat over the first tubercles on the back, which we have not observed in *Am. Rotomagensis*.

Range. Ootatoor group.

Localities. Neighbourhood of Odium and Coonum; rather a rare shell.

4. AMMONITES NAVICULARIS, Mantell. Pl. XXXIX. Fig. 2—4.

1822. *Am. navicularis*, Mantell, Foss. of South Downs, p. 198, Pl. XXII. Fig. 5.
 1822. „ *Gentoni*, Brongniart, in Cuvier, Oss. Foss. 4. edit. Pl. N. Fig. 6.
 1827. „ *navicularis*, Sowerby, Min. Conch. VI. p. 105, Pl. CCCXLV. Fig. 2.
 1841. „ *Mantelli*, D'Orbigny, (*partim*) Pal. Franc. Terr. Cret. Pl. 103.
 1849. „ *navicularis*, Quenstedt, Petref. Deutschl. I. p. 215.
 1850. „ „ D'Orbigny, Prodrome, II. p. 146.
 1852. „ „ Giebel, Fauna der Vorwelt, III. p. 710, (*partim*).
 1854. „ „ Morris, Catal. Brit. Foss. p. 297, (Lower Chalk).
 1856. „ „ Sharpe, Moll. of Chalk. Palæont. Soc. p. 39. Pl. XVIII., Figs. 1, 3, 5, 8.
 1860. „ „ Pictet, Pal. Suisse. Foss. de St. Croix, p. 339.

Am. testa inflata, transversim costata; costis numerosis inæqualibus vel bifidis, junioribus ad umbilicum bi-, in dorso tri-, tuberculatis, senioribus non-tuberculatis; dorso convexo, transversim costato; umbilico moderato, profundo, margine tuberculato; apertura semilunata, postice excavata; septis lateraliter bilobatis, lobis septorum ad terminationes bifidis, sella dorsali latissima.

Diameter of largest specimen (from Odium).....	160 mm.	
		Pl. XXXIX.
		Fig. 3. Fig. 2.
Proportions (the whole diameter being considered as 1.00)		
taken from specimens with diameters of	100	70 mm.
Diameter of outer whorl : whole	0.41	.43
Width of umbilicus : whole diameter	0.31	0.30
Thickness of section : height	1.52	1.62

The shell consists of few rounded whorls, which are crossed by numerous smooth ribs; these are generally bent a little backwards, but sometimes they are straight or even very slightly bent forward. Some of the ribs are alternately longer and shorter, others are distinctly bifid from their origin. The longer ribs commence from the bottom of the umbilicus, and in the early stages of growth bear two tubercles, one on the edge and the other near to the edge of the umbilicus. There are also, in young specimens, three rows of tubercles on the back, one of these in the middle. All these tubercles, and also the outer row at the umbilicus, disappear in the older shell or on the body chamber of young specimens, and the shell is rounded from the tubercle at the edge of the umbilicus on one side to that at edge of umbilicus at the other side.

There are, however, specimens which have scarcely any trace of either lateral or dorsal tubercles, even in the youngest stages.

The umbilicus is smaller in the earlier stages of growth and increases in the older shells: it is very deep with perpendicular walls. The aperture is transversely oval, broader than high. The septa consist of a strongly branched deep dorsal lobe, a large and also bipartite dorsal and a shorter multifid first lateral saddle; of the two smaller lateral lobes the first one is always bifid, the second generally single at its termination. The branches of the umbilical lobe occupy the whole wall of the umbilicus, (as far as it is seen). The septa of this species are in general form like those of *Am. Rotomagensis*, and in the same degree different from those of *Am. Mantelli*. The more marked constriction of the upper lobules on the dorsal saddle seems to be characteristic of the septa of this species; as it is well seen in Fig. 4, taken from a large specimen from the neighbourhood of Odium.

Many palæontologists have united this species with *Am. Mantelli*, or *Am. Rotomagensis*, from both of which *Am. navicularis* is quite distinct. The merit of placing the present species correctly before the public is, I think, mainly due to Sharpe. From *Am. Mantelli* it is to be distinguished by its inflated shell, by the three rows of tubercles (one in the middle) on the back in the young stage, and by the difference in the first lateral saddle. From *Am. Rotomagensis* it differs by the second lateral row of tubercles, which are strongly marked at the umbilicus in the young shell (Fig. 2,) and disappear perfectly in full grown specimens. The shell slopes down from the umbilical tubercles, and this gives to the shell a rounded form different from the more compressed shape of *Am. Rotomagensis*.

Sharpe (*loc. cit.*) unites *Am. Milletianus*, (Dixon, Geol. of Sussex, Pl. XXIX.

Fig. 15. *non idem* D'Orbigny,) with *Am. navicularis*; but the position of the middle lateral tubercles in Dixon's figure, as well as its compressed form, lead us rather to believe, that Dixon's specimen belonged to *Am. Mantelli*. How far Pictet's speculations (*loc. cit.*) regarding this species may be correct, we cannot say; we are not acquainted with the differences between Sowerby's and Mantell's figures.

Am. navicularis occurs in the Lower Chalk of the South of England (Sharpe and Morris) and in the *étage cénomanien* in France, (D'Orb. Prod.). It is difficult to speak with any certainty regarding the occurrence of this species in other parts of Europe, because it has so seldom been distinguished from other species, and this only within the last few years.

Range. Ootatoor group.

Localities. Neighbourhood of Odium and Coonum, and near Kolakonuttom; not seldom.

5. AMMONITES ORNATISSIMUS, *Stoliczka*, Pl. XL.

Am. testa discoidea, subinflata, transversim tuberculata-costata; costis inæqualibus, longioribus 11-tuberculatis: lateraliter tri-, dorsaliter quinque-tuberculatis; dorso lato, sub-convexo; sectione anfractuum transversim dilatata, rotundate-rectangulari. Septis lateraliter bilobatis, bifidis: sella dorsali lata, profunde bipartita, lobo laterali primo longissimo.

Proportions taken from a fragment of a large specimen; involution of the whorls about 0.16 of the total height.

Thickness of section: height 1.60.

Of this very beautiful species, only the fragment figured on Pl. XL. has been found; this is, however, sufficient to give a good idea of the species. The whorls cannot have been numerous, because they increase rapidly in height, being proportionally narrow, and crossed by numerous unequal ribs. The longer ribs bear eleven tubercles in their entire length, of which three rows belong to each side, and five rows to the back. The umbilical tubercles are not distinct; those on the middle of each side and near the periphery are better marked; to the latter or outer row the involution of the shell extends. Of the five rows of tubercles on the back one is placed in the middle, replacing the keel, and two others on each side of this, the tubercles near the periphery being here also more distinctly marked. In addition to the transverse tuberculated ribs, there are on the back short rib-like elevations, which continue from one tubercle to the next in the direction of the spire (Fig. *b.*) On the outer whorl, that is, nearer to the mouth (Fig. *c.*) the ribs are very strong, but the tubercles not so well expressed.

The umbilicus is deep and very large, only $\frac{1}{3}$ of the height of the whorls being concealed. The section of the whorls is remarkably broad being about one half broader than high. The siphuncle, as seen in Fig. *d.*, is oviform, being narrower in the lower portion, but it cannot be stated with perfect certainty, whether this form be characteristic of the species, or whether it be only accidentally pressed.

The sutures do not differ from those of other *Rotomagenses*. There is a large and very deeply divided bifid dorsal, and a smaller and shorter first lateral, saddle; the first lateral lobe is bifid, and the first and second lateral lobes are both very narrow in proportion to the saddles. Besides these, there are some auxiliary lobules which together form a large but short umbilical saddle.

The sutures as shewn in Fig. *e.*, are taken from the outer whorl, and are figured of the natural size; the shell, however, being very thick (about 3 mm.) on this whorl, it was necessary to file the surface down considerably, and on this account the sutures appear slightly distorted, and without the more minute subdivisions. The width (respectively to the height) was probably greater in the inner whorls than is shewn in Fig. *e.* since the last chambers in all Ammonites are placed more closely together than the earlier ones.

Am. ornatissimus can readily be distinguished from all known species of the group *Rotomagenses*. It is somewhat allied to *Am. Deverianus*, D'Orb. (Pal. Franc. pl. 110) and to *Am. Lyelli*, Michelin, (Leymerie, Mem. de la Soc. Geol. Franc. 1. ser. Tom. V. p. 32, Pl. 17, Fig. 16). The first of these species is more involute; and from the second it differs by the marked thickness of its section, in addition to the greater number of rows of tubercles.

Range. Ootatoor group.

Locality. The specimen occurred in a darkish sandstone E. of Odium.

6. AMMONITES MERIDIONALIS, *Stoliczka*, Pl. XLI.

Am. testa inflato-angulata, transversim tuberculato-costata; costis lateraliter simplicibus, ad umbilicum atque ad peripheriam acute-tuberculatis, costis in dorso bifidis; tuberculis triserialibus, spiraliter costulis conjunctis; umbilico magno, profundo; apertura transversim dilatata, rectangulari; suturis septorum lateraliter bilobatis, multice incisus: lobis ad terminationes bifidis, sella dorsali lata, bipartita.

Diameter of largest specimen	230 mm.
Proportions taken from the figured specimen in the diameter of ...	100
Diameter of outer whorl : whole	0.44
Width of umbilicus : whole diameter	0.27
Thickness of section : height	1.50

Shell with few narrow but thick, angular whorls, of which the last bears about twelve ribs, each of those having a smaller tubercle on the edge of the umbilicus and a larger and pointed one on the periphery. On the wide back each rib is divided into two, and after the shell has become more fully grown, there is also another rib between these bifid ribs, as seen in Fig. 1.*b.* Pl. XLI. Each of these ribs on the back has three tubercles, one of which is in the middle. The tubercles are connected (in the spiral direction) by elevated sharp lines, which cross the grooves between; these lines are only less expressed in the older shells and gradually disappear altogether. Umbilicus very large, as the involution of the last whorl does not extend beyond the slightly convex back; the section of the

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whorl is angular and in breadth one and a half times the height. The septa are numerous and deeply divided, with two saddles on each side; the dorsal lobe is the deepest, the dorsal saddle very large, unequally bipartite; the first lateral lobe smaller and also bifid, it lies in the middle of the side or flank of the shell: the first lateral saddle unequally multifid, the middle incision seems to be the deepest, so that there is at least a tendency to bipartition; it is on the edge of the umbilicus, while the second lateral lobe is already on the sloping wall to the umbilicus.

This species is nearly allied to *Am. Sussexiensis* and *Cuningtoni* of Sharpe's monograph of the Cephalopoda of the Chalk. It differs from the first of these by its whorls being narrower and very broad; from both it differs by the division of the ribs and the distribution of the tubercles on the back, which are united by short ribs among themselves. *Am. Cuningtoni*, Sharpe (*loc. cit.* Pl. XV. Fig. 2) from the grey chalk of Upton Scudamore near Warminster resembles our species much more in its peculiar involution and in the sutures of its septa, but the difference in the section, noted above, and the dorsal ribs with prominent tubercles do not admit of our uniting the two species, although we consider their identity as highly probable. It would be most desirable to procure and examine further specimens of *Am. Cuningtoni*, of which Sharpe had only one specimen at his disposal.

Some of our large specimens give entirely the impression of an Ammonite of the group *Armati*, the lateral ribs being strong and terminating in long and thick spines; the outer tubercles of the last whorl extend beyond the plane and nearly smooth back in an oblique direction, as in Sharpe's *Am. Cuningtoni*.

We would also direct attention to the figures of *Am. armiger*, described by J. C. Sowerby from Cutch (*Trans. Geol. Soc. Lond. II. Ser. Vol. V. Pl. XXIII. Fig. 13*, as representing a form similar to our species.

Range. Ootatoor group.

Locality. Neighbourhood of Odium; a rare shell.

7. AMMONITES MEDLICOTTIANUS, *Stoliczka*, Pl. XLIII. Fig. 1.

Am. testa discoidea, sub-compressa, parum involuta, late umbilicata; anfractibus numerosis, transversim tuberculato-costatis; costis rectis, in ultimo anfractu 20, simplicibus lateraliter 4-tuberculatis; ad umbilicum et prope medium sub-tuberculatis, dorsi ad marginem bituberculatis; dorso lato, sub-plano, in medio tuberculato, tuberculis medianis spiraliter elongatis; apertura rectangulari-elongata; suturis lateraliter bilobatis, lobis angustis, bifidis; sella dorsali latissima.

Diameter of largest specimen	215 mm.
Proportions (the whole diameter being considered as 1.00) taken	a. b.
from specimens in diameters of	215 150
Diameter of outer whorl : whole	0.32 0.36
Width of umbilicus : whole diameter	0.34 0.40
Thickness of section : height	1.17 1.28

a. The figured specimen Pl. XLIII. from North of Odium.

b. A somewhat thicker and less involute specimen from the same locality.

Shell discoidal with a large umbilicus, and compressed flanks; the whorls increase gradually in height and breadth, the last whorl has about twenty strong tuberculated ribs, which are straight on the sides and slightly bent forward near the back. Most of these ribs are of the same length, but a few are shorter. Each of the ribs has nine tubercles on its entire length, of these four are on each side and one in the middle of the back; two rows are placed nearer to the umbilicus and two nearer to the back, the latter being much the larger; the tubercles of the three centre rows (along the back) are prolonged in the direction of the spire. The umbilicus is very large, exposing about three-fourths of the inner whorls; the section of the whorls is nearly square, occasionally somewhat elongated, occasionally somewhat broader. The sutures of the septa are very close together, reaching one into the other. There are two lateral lobes on each side, narrow and bifid; the dorsal saddle is the largest, and is bipartite: the first lateral saddle is smaller, but of the same height; to these follow a short broad umbilical saddle, with many subdivisions.

This species is allied to *Am. Rotomagensis*, Defr., differing from it by the two rows of tubercles being placed nearer to the umbilical edge, and by the tubercles being more widely separated and gradually *increasing* in size at the back, the ribs being depressed on the middle of the sides or flanks of the whorls. There is also a difference in the lobes, of which the first lateral is (proportionally to the others) considerably smaller than is usually the case in specimens of *Am. Rotomagensis*. Judging from the figures only, the present species resembles *Am. vertebralis*, Sow. (Min. Conch. Vol. II. p. 147. Pl. 165), a species which is referred by Morris (Catal. 1854, p. 296), to the Coral Rag. The amount of involution and the compression distinguish the present species from *Am. Lyelli* (Pictet, Pal. Suisse. Foss. d. St. Croix, p. 196, Pl. XXIV.) although the distribution of the ornamentation is very similar. The question of their relations is of some importance, inasmuch as no very large specimens of *Am. Lyelli* have yet been found, and, on the other hand, we are not acquainted with young specimens of the present species.

The species is dedicated to the Messrs. Medicott (brothers), whose labours in Indian Geology are well known.

Range. Ootatoor group.

Locality. North of Odium, in the Trichinopoly district; found in the ruddy calcareous sandstone;—a rare shell.

8. AMMONITES TROPICUS, *Stoliczka*, Pl. XLIII. Fig. 2.

Am. testa discoidea compressa, transversim costata; costis 20-flexuosis, alternatim majoribus, ad umbilicum et ad dorsum tuberculatis; dorso plano, in medio tuberculato, umbilico moderato; septorum suturis lateraliter bilobatis, parum incisiss,
(38)

Proportions (the whole diameter being considered as 1.00) taken from figured specimen in diameter of.....	27 mm.
Diameter of outer whorl : whole	0.44
Width of umbilicus : whole diameter	0.27
Thickness of section : height	0.75

Shell compressed, sides nearly flat, ornamented with about twenty longer and shorter flexuous ribs, of which the former commence on the edge of the umbilicus with a strong tubercle; all terminate with a tubercle on the edge of the back having first been bent strongly forward; there is also a row of tubercles in the middle of the back. Very young shells have also a distinct tubercle at the point near the back, where the ribs bend forward. Umbilicus of moderate size, bounded with only about six tubercles, as there are frequently two shorter ribs between the longer. The aperture is nearly as broad as high, being only slightly narrower on the top. The sutures consist of two lobes on each side, the first lateral is bipartite, the dorsal saddle is the broadest.

The present species is somewhat related to *Am. Bunburianus* Sharpe, (Foss. Moll. of Chalk, p. 25, Pl. IX. Fig. 3,) differing in having more numerous furrows, as Sharpe calls them, similar to those in the *Laticostati* group. (vide Pictet. Pal. Suisse. Foss. d. St. Croix, 1860, p. 224.)

Range. Ootatoor group.

Locality. N. of Odium. Only the figured specimen has been found.

Group 6. **MAMMILLATI.**

In his latest classification of the Cretaceous Ammonites, Pictet has established this group for some species, which had before been placed in different groups, chiefly in *Rotomagenses* and *Dentati*. In this way *Am. Mantelli* has always, until within the last few years, been placed with *Am. Rotomagensis* and others in the same group.

The principal difference between this group and the *Rotomagenses*, is the absence of tubercles, or any separate elevations on the middle of the back in the *Mammillati*, while the tuberculated ribs, and the other ornamentation of the shell are similar to those of the *Rotomagenses*. The *Mammillati* also have, generally, a larger number of lobes and saddles, in connexion with the more compressed form of the shell.

We commence our descriptions of the species in this group, of which *Ammonites Mantelli* may be considered as the type, with one, the position of which is somewhat doubtful, as will be seen more fully stated in the description of *Am. Morpheus*.

Of this group six species are here noticed: of these *Am. Mantelli* is known through all Europe; *Am. dispar*, occurs in the middle cretaceous rocks of France, Switzerland and Austria (Hungary): *Am. vicinalis* is probably (?) identical with *Am. Saxbii*, Sharpe, from the English Chalk; while the other three species are new; *Am. Morpheus*, *argonautiformis*, and *crotaloides*.

1. AMMONITES MORPHEUS, *Stoliczka*, Pl. XXXVIII. Fig. 1.

Am. testa sub-compressa, transversim costata; costis inaequalibus, in dorso postice curvatis, longioribus ad umbilicum tuberculatis, prope peripheriam lateraliter bituberculatis; dorso convexo, quadri-tuberculato, medio plane excavato; umbilico lato, abrupto; apertura ovali-rotundata; septis lateraliter bilobatis, sella siphonali excentrica, (?) sella dorsali latissima, bipartita.

Diameter of largest specimen,	120 mm.
Proportions (the diameter of the whole being considered as 1.00)	a. b.
taken from specimens in diameters of	1.00 92
Diameter of outer whorl : whole	0.42 0.43
Width of umbilicus : whole diameter	0.27 0.26
Thickness of section : height	1.10 1.06

(a.) Figured specimen Pl. XXXVIII. Fig. 1, from S. E. of Odium.

(b.) A smaller specimen from the same locality.

Shell consisting of four or five laterally compressed whorls, which are crossed by numerous unequal tuberculated ribs. These extend to about half the breadth of the whorl, nearly in a straight line, and afterwards bend strongly backwards as in *Am. harpax*. Some of the ribs disappear on the other side of the shell, while others cross only the back without reaching to the umbilicus on either side. They commence from the bottom of the umbilicus and are elevated on its edge into large tubercles, from this they proceed, gradually becoming thicker and have two other sharp tubercles on either side on the slope to the back. The middle of the back is excavate, without any tubercles. All the tubercles disappear on the body chamber of the shell, the ribs, however, continuing to cross over the back as before.

Of this fine species we have only two specimens from the calcareous sandstone S. E. of Odium. The figured one is nearly whole and well preserved. In some respects both differ one from the other. That figured is the larger specimen, but is not symmetrical, one side (the right, in the front view of the shell Fig. 1.a.) being more inflated roundish, and the tubercles on it much larger and also rounded, while those on the other side are smaller and sharply elongated. The other specimen is quite symmetrical, and all the tubercles are equally elongated.

Umbilicus rather large, leaving about two-thirds of the height of the inner whorls visible. The aperture is nearly as high as broad, oviform, rounded at the top, and slightly excavated at the base.

The sutures figured (Fig. 1.b.) are taken from near the last chamber, and therefore shew smaller air-chambers than the preceding ones are; there are only two lobes on each side, numerous divided; the dorsal lobe is not placed in the centre of the back, but corresponds with a lateral row of tubercles. On the second specimen the dorsal lobe also corresponds with a lateral row of the tubercles, but it is on the other or different side of the middle of the back. It is exactly, as if we had two specimens of *Turrilites* before us, one with a sinistral, the other

with a dextral spire. The broad bifid dorsal saddle, two smaller bifid lateral lobes and one short, multifid, first lateral saddle are all formed similarly to those in *Am. Rotomagensis* and *Am. harpax*. There are also two other auxiliary saddles. The ventral lobe could not be traced.

There is still the important question as to the true position of this species. Is it a Turrilite or a true Ammonite? The unsymmetrical form of one specimen, and the excentric position of the dorsal lobe on the back tend to prove the species a Turrilite; while the whole aspect of the shell, its ornamentation, similar to that of most of the *Rotomagenses* and *Mammillati*, (especially to *Am. harpax*), and still more the equal division of the septa agree better with the idea of its being an Ammonite, although not so regular in form as is generally the case.*

The dorsal lobe is in both specimens connected with a row of tubercles although lying on different sides of the middle of the back in the two specimens.

Farther, we describe this species under the group *Mammillati* rather than under the *Rotomagenses*, although it would appear to form exactly an intermediate term between the two. When more specimens of this very remarkable species are found, there are two conclusions which may probably result from their examination. First, it may be proved, that the syphonal saddle properly occupies the middle of the dorsal line, and that the two specimens, we now have, are only extreme varieties of the same Ammonite. In this case the species properly belongs to the *Mammillati*. Or secondly, it may be found that the syphonal saddle is always connected with one of the rows of tubercles; in this case the question will be indeed a puzzling one; and according to the existing classification of the Cephalopoda nothing more could be said than, that it is a species of Turrilites, variable as regarded the spire.

We know of no described species which we could compare with our Indian forms.

Range. Ootatoor group.

Locality. S. E. of Odium, only two specimens.

2. AMMONITES MANTELLI, *Sowerby*. Pl. XLI. Figs. 2, 3, Pl. XLII.

1814. *Ammonites Mantelli*, *Sowerby*. Min. Conch. Vol I. p. 119, Pl. 55.

1862. " " F. von Hauer, Sitz. d. K. K. Acad, Wien. Bd. 44, p. 650.

Full references to the literature of this species, extending from 1814 to 1859, may be seen in Pictet, Mater. p. l. Pal. Suiss, 1859, II. ser. Foss. d. St. Croix, No. 6, p. 200, Pl. XXVI.

Am. testa compressa vel sub-inflata, transversim tuberculato-costata; costis inæqualibus, lateraliter rectis, ad dorsum antice curvatis, ad umbilicum et prope medium tuberculatis, prope dorsum bituberculatis; tuberculis prope aperturam sæpe obsolete; dorso angustato, in medio depresso, transversim costato, lateraliter tuber-

* We refer here again to Fr. v. Hauer's note on "Unsymmetric Ammonites," Sitzungsab. d. K. K. Akademie, Wien, Vol. XIII. 1854, vide above p. 64.

culato; umbilico mediocri, profundo, abrupte excavato; sectione anfractuum subcompressa, ovato-elongata: septis lateraliter trilobatis, lobo laterali primo bifido, sellis inaequaliter bifidis.

Diameter of largest specimen from Garudámungalum	130 mm.					
Proportions (the diameter of the whole being considered as 1.00)						
calculated from different specimens with diameters of ...	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
	23	45	55	64	100	130 mm.
Diameter of outer whorl : whole	0.43	0.44	0.40	0.42	0.43	0.43
Width of umbilicus : whole diam.	0.24	0.24	0.27	0.29	0.27	0.26
Thickness of section : height ...	0.80	1.00	1.32	0.96	1.05	0.76
(<i>a</i>) Specimen figured Pl. XLI. Fig. 2, from Odium.						
(<i>b</i>) " " " Fig. 3, same loc.						
(<i>c</i>) The most inflated specimen in the Survey Collection, same loc.						
(<i>d</i>) The specimen figured on Pl. XLII. Fig. 2, same loc.						
(<i>e</i>) " " " Fig. 1, same loc.						
(<i>f</i>) " " " Fig. 3, same loc.						

Shell discoidal, more or less compressed, with slightly convex sides, which are ornamented with 24—35 strong, nearly straight ribs. Some of these are shorter and do not extend to the umbilicus. Each of the longer ribs bears laterally four tubercles; one at the edge of the umbilicus, one at the edge of the back, and two intermediate. The middle of the back is generally somewhat depressed and crossed by the ribs. The umbilicus is large with perpendicular walls, exposing about three-fifths of the inner whorls, the involution extending over the second row of tubercles, counted from the back. The section of the whorls is often nearly as broad as high, becoming smaller near the top. The sutures consist of three lobes, and three saddles on each side and become gradually smaller towards the umbilicus; the dorsal lobe is unequally bipartite, and also the smaller first lateral lobe and saddle, the succeeding lobes are simple; the second lateral saddle is, in position, connected with the row of the tubercles on the edge of the umbilicus. The umbilical portion of the suture, so far as it is seen, is deeply bipartite by equally bifid subdivisions.

Am. Mantelli is generally separated into two or three varieties, differing one from the other by the thickness of the shell, or by the existence of two or of four rows of tubercles on each side. Looking at the measurements we have given above, the difficulty of distinguishing varieties among our specimens will be noticed, inasmuch as the variation in one character is generally independent of that in another. As regards the proportion of the whorls, Fig. 2, of Plate XLII. represents a specimen, on which the height is very little more than the breadth, and the section is nearly square. This is the most common form in Europe. Fig. 1, shews a specimen which increases gradually in height and thickness while Fig. 3 represents a strongly compressed specimen. The ornamentation is very constant in the first stage of the shell, in young specimens the ribs are alternately longer and shorter, in older specimens there are often two shorter to each longer one;

on these latter there are four tubercles on each side, when the specimen is young; the two middle rows, however, disappear in older shells, and large, full grown specimens, (vide Pl. XLII. Fig. 3), have no tubercles on the body chamber.

The difficulty of distinguishing varieties in this species arises, therefore, from the fact, that one and the same specimen will be found very variable in different stages of its age, although at the same time the change does not proceed equally in the amount of character of the ornamentation of the shell and in the proportions of its several parts.* The ribs crossing the back, on which a middle row of tubercles *never* occurs, are sometimes wanting in young shells (Pl. XLI. Fig. 2). In the strongly ribbed and sharply tuberculated forms these parts of the ribs are also slightly expressed, (Pl. XLII. Fig. 1), while the tubercles themselves terminate in sharp spines.

The history of this species has been very well and fully illustrated in Pictet's Pal. Suisse. (loc. cit.), and it will therefore not be necessary to say anything further about it.

By the four rows of tubercles on the sides and the depression in the middle of the back, by the amount of involution, which still covers the second row of tubercles from the back, (in *Am. Rotomagensis* it only extends up to this row), and by the lobes, especially the smaller, higher and generally bipartite first lateral saddle, this species is easily distinguishable from *Am. Rotomagensis*, *Am. navicularis*, and from other similar forms.

Am. Mantelli is one of the most common fossils in Europe, characterizing the middle ranges of the Cretaceous formation, (*Cenomanien*, *Gault*). It is known from the northern parts of Germany throughout Switzerland to the southern declivities of the Alps, and from the South of England throughout France, Germany, Austria, to the mountains of the Caucasus, from which Abich brought it to the knowledge of Palæontologists (Mem. d. l'Acad. St. Petersburg, VI. Ser. Tom. VII. p. 496). We have not been able to trace any notice of this species as occurring in other parts of the world, but its constant association with *Am. Rotomagensis* in Europe, (and also in India) leads us to anticipate, that this species will be found in other parts also, where *Am. Rotomagensis* is known to occur.

In the Report on the Cretaceous rocks by Mr. H. F. Blanford, (Memoirs of Geol. Survey of India) when the author quotes *Am. Mantelli*, as from all three of the groups, into which he divided the entire series (pages 81, 93, 117 and 127) there has been some error in the determination of the species.

Range. Ootatoor group.

Localities. Neighbourhood of Odium (common), Monglepauddy, Coonum, Moraviatoor, Kullay.

* We refer here to our measures, given above, which are taken from specimens from the same locality, *Odium*.

3. AMMONITES VICINALIS, *Stoliczka*, Pl. XLIV.

Am. testa compressa, discoidea, transversim costata; costis numerosis inaequalibus, parum flexuosis; longioribus ad umbilicum sub-tuberculatis, ad peripheriam bi-tuberculatis: dorso angustato, lateraliter tuberculato, sublaevigato seu transversim costato; umbilico angustato: suturis lateraliter quadrilobatis, inaequaliter bipartitis.

Diameter of largest specimen from W. of Odium,	135 mm.				
Proportions (the whole diameter being considered as 1.00) calculated from the					
figured specimens, with diameters of	11	24	38	85	135 mm.
Diameter of outer whorl : whole	0.45	0.46	0.50	0.49	0.44
Width of umbilicus : diameter	0.23	0.23	0.19	0.19	0.22
Thickness of section : height	0.60	0.63	0.88	0.77	0.64
Fig.	1	4	6	7	8

Shell compressed with flat or slightly convex sides and numerous, alternately shorter and longer, slightly flexuous ribs, terminating in tubercles at the umbilicus, and at the edge of the back. The specimens on Plate XLIV. represent individuals in different stages of growth, and an inspection of these will give the best idea of the variations in the form and ornamentation of the shell. The embryonal shell is quite smooth, with a rounded back: the second whorl shews one row of tubercles at the edge of the umbilicus, and two rows close together at the edge of the back, the umbilical tubercles being only half so numerous as those on the back and the ribs very slightly marked. Growing larger the shell has often in parts two shorter ribs, instead of only one, between the longer ribs (Fig. 3 *a. b.*), this, however, is not constant, or regular, and varies with the specimens; the longer ribs are in some specimens more numerous than in others (Figs. 4, 5,) although no difference can be seen in other characters. The umbilical tubercles are placed precisely on the edge, but they are not always well marked as is seen in Figs. 5, 7 and 8. The same is the fact with the outer tubercles; the second row—counting from the edge—soon become obsolete, and they are only marked by the angle, which the ribs produce by bending slightly forward, and at the same time increasing in thickness. The tubercles on the edge of the back are always sharply elevated; only on some young specimens the ribs are elongated forward, and so join in the middle of the back, (Fig. 2*b.*). In this case the tubercles are nearly obsolete. The middle of the back is in all stages of growth of the shell somewhat convex, and is sometimes well marked by transverse ribs, which connect the tubercles on the edges. The aperture is compressed, in proportion to the compression of the shell; broader at its base than at the top; sometimes with nearly straight and parallel sides. The umbilicus is not large, leaving about two-fifths of the preceding whorls exposed. In some young specimens a deep channel is on its wall (Fig. 4); soon, however, dying away.

The sutures are quadri-lobate on each side; the saddles unequally bifid, and gradually becoming smaller towards the umbilicus; the first lateral saddle is

somewhat higher than the dorsal: the dorsal lobe is shorter than the first lateral, the latter being almost regularly bifid at its termination: the succeeding lobes have only an approach to a bifid division, each of the lobes being smaller than the preceding *saddle*.

Am. vicinalis is nearly related to, (possibly identical with,) *Am. Saxbii*, Sharpe, (Moll. of Chalk of England, p. 45, Pl. XX. Fig. 3,) from the Grey Chalk of Ventnor, Isle of Wight: the description of the latter species being insufficient to enable us to identify both. Sharpe especially mentions the 'straight' ribs (though not shewn so in his figure) as a character distinguishing *Am. Saxbii* from *Am. varians*, while the ribs of our specimens are always flexuous, and sometimes even distinctly double-curved. On full grown specimens, the ribs are nearly straight, shewing only a slight curvature, about the middle of the side. It is to be greatly regretted that the sutures of *Am. Saxbii* are not known. An actual comparison of the Indian Fossil with the English would be most desirable to settle this interesting question.

Range. Ootatoor group.

Localities. North and West of Odium, where they have been found abundantly in a blueish and yellowish calcareous sandstone.

4. AMMONITES DISPAR. D'ORBIGNY, Pl. XLV. Figs. 1—3.

1840. *Ammonites dispar* D'Orb. Pal. Franc. Terr. Cret. Tom. 1, p. 142. pl. 45, Figs. 1, 2.
 1850. „ *catillus*. D'Orb. Prodrome, Tom. II. p. 146, (*non* Sowerby, *idem*).
 1852. „ *dispar*. Giebel, Faun. d. Vorwelt, Bd. III. p. 418.
 1860. „ „ Pictet, Pal. Suisse. Foss. de St. Croix, p. 264, Pl. 38.
 1862. „ „ F. v. Hauer, Sitz. d. k. k. Akad. Wien. Bd. 44, p. 652, Pl. III. Figs. 4—6.

Am. testa compressa, seu sub-inflata, transversim inæqualiter costata; costis nonnullis usque ad umbilicum prolongatis, nonnullis obsolete; dorso rotundato, transversim costato, umbilico gradatim magnitudine crescente, apertura ovato-elongata. Suturis lateraliter trilobatis, lobo dorsali brevioribus quam lobo laterali primo, bifido; sellis latis, brevibus, bipartitis, parum incis.

Diameter of largest specimen from Moraviatoor, Pl. XLV. Fig. 1, 105 mm.

Proportions (the whole diameter being considered as 1.00) calculated from specimens with diameters of	<i>a</i>	<i>b</i>	<i>c</i>
	100	57	83 mm.
Diameter of outer whorl : whole	0.45	0.43	0.43
Width of umbilicus : whole diameter	0.22	0.19	0.23
Thickness of section : height	1.59	1.23	1.06

- a* Specimen figured, Pl. XLV. Fig. 1.
b „ „ „ Fig. 3.
c „ „ „ Fig. 2.

Shell discoidal, more or less compressed, with very few ribbed whorls and a roundish back; some of the ribs extending round the whole periphery of the whorl, but the greater number soon becoming obsolete after they have crossed the back. On the back of the body-chamber, the ribs form strong node-like elevations, so that the outer periphery of the shell appears undulated. These nodes disappear again towards the mouth, where the shell is perfectly smooth. The back is rounded only in the more fully-grown or adult shells, while in the earlier stages each rib forms a small tubercle on the edge of the back, (Fig. 3, Pl. XLV. and Pictet *loc. cit.* Fig. 1). The umbilicus is of moderate size gradually becoming more wide: the body-chamber is (irregularly) less involute than the others as is also the case in the Swiss specimens described by Pictet (*loc. cit.* p. 265). The section of the whorls is elongate-elliptical, more or less broad, according to the thickness of the shell and to the part of the whorl, where it is taken.

The sutures consist of three lobes and four saddles on each side; the dorsal lobe is not so deep as the small and long-pointed first lateral lobe; both are bipartite; the succeeding lobes are unequally tripartite; the saddles diminish in size from the dorsal saddle towards the umbilicus, all are bipartite and shortly branched; the third lateral, or first auxiliary saddle lies on the edge of the umbilicus.

Comparing our specimens and the last figures and descriptions of this species by Pictet, (Palæon. Suisse.) we cannot trace any difference either in the younger shell, or in the more fully grown states. The agreement in all respects is so exact, that no doubt of their identity can exist. The small tubercles on the edge of the back of the young shell, the unequally longer and shorter ribs, the nodular ribs on the back of the body-chamber, the irregular evolution of this last chamber, the division of the septa: all these are characters, which mark this species well and which are specially mentioned by Pictet, (*loc. cit.*). Fr. von Hauer has also noticed the same variation of the shell in the specimens from the Gault of the Bakonyer-Wald in Hungary, (*loc. cit.*), only the sutures, which he figures are much more subdivided, than in our or the Swiss specimens. We have figured two varieties as regards the thickness of the shell, one a more inflated specimen than the other; the measurements of these are given above.

The species can only be properly placed among the *Mammillati*, in consequence of the tubercles on the edge of the back in the young state of the shell. The distribution of the sutures also, which is similar to that in *Am. Mantelli*, brings this species nearer to the *Mammillati* than to the *Augulicostati*,—the species in which latter group ought properly to have sutures divided like those of the *Ligati* group. Pictet has placed the species in the *Ligati*, but for this we can see no plausible reason.

We agree with Pictet in his opinion that *Am. catillus*, Sowerby (Min. Conch. VI. p. 123, Pl. 564, Fig. 2), and *Am. Gestlinianus*, D'Orbigny (Palæon. Franc. Terr. Cret. Pl. 97, Figs. 1, 2,) are both different species from that now described.

Range. Ootatoor group.

Locality. Moraviatoor in Trichinopoly district, a rare shell.

Pictet mentions *Am. dispar* as a characteristic fossil of the 'Gres vert superieur' at St. Croix, and as also occurring at some other localities in Switzerland in Gault (*loc. cit.* p. 267). F. von Hauer (*loc. cit.* p. 654) found this species in a chloritic marl in the valley at Nana and in a greyish marl at Penzeskut in Hungary together with *Am. planulatus*, Sow., *Am. inflatus*, Sow., *Am. latidorsatus*, Michelin, and *Am. Brottianus*, D'Orbigny.

5. AMMONITES ARGONAUTIFORMIS, *Stoliczka*, Pl. XLVI. Figs. 1, 2.

Am. testa compressa, anfractibus duobus, transversim costatis; costis numerosis, alternatim inæqualibus, dorsum versus fortioribus, atque ultimi septi in dorso nodulosis; dorso angustato rotundato; umbilico parvo, celeriter latiore, perforato; suturis septorum lateraliter 4-lobatis, non profunde incisiss, sella dorsali latissima, bipartita, sella secunda brevior et latior quam laterali prima; lobo laterali primo longior quam dorsali.

Diameter of largest specimen figured Pl. XLVI. Fig. 1,	78 mm.	
	<i>a</i>	<i>b</i>
Proportions (the whole diameter being considered as 1.00) calculated from specimens in diameters of	mm.	mm.
	50	70
Diameter of outer whorl : whole	0.57	0.50
Width of umbilicus : whole diameter	0.09	0.12
Thickness of section : height	0.50*	0.55

* This is the greatest thickness taken near the base.

(a) A young specimen from Moraviatoor, Pl. XLVI. Fig. 2.

(b) A nearly full-grown specimen from the same locality, Pl. XLVI. Fig. 1.

Shell discoid, compressed, strongly involute in the younger stages of growth. The whorls are very few, (in our specimen only two) crossed by numerous, slightly flexuous, longer and shorter ribs, which are nearly obsolete towards the umbilicus, and considerably stronger towards the narrow back. On the body-chamber, which has a somewhat irregular evolution, there are at the back node-like tuberculations, which disappear both towards the umbilicus and close to the mouth. The mouth is elongated, at the top not much broader than at the base; but the section of the inner whorls is nearly sagittate as is seen in Fig. 2.a. of a smaller specimen. The umbilicus in the young shell is very narrow, but becomes afterwards considerably larger in consequence of irregular evolution of the body-chamber.

Our figure 1, is a little restored, the specimen having been squeezed or flattened in the body whorl.

The sutures form four lobes on each side, the dorsal being very short; the first lateral is divided at its termination into two points; the dorsal saddle is the largest and bipartite, its first lobule always three-branched; first lateral saddle higher but smaller than the second, both being unequally bipartite.

This species resembles *Am. dispar*, D'Orbigny, having the same involution and similar ornamentation; the ribs, however, being much more numerous. The shell itself is more compressed and more involute than in any specimen of *Am. dispar*; the lobes are proportionally much shorter in *Am. Argonautiformis*.

We have not observed any tubercles on the edge of the back, and can, therefore, only justify placing this species among the *Mammillati* by its close relations with *Am. dispar*, and by the similarity in the distribution of the sutures to those in others of that group. It is not improbable that similar tubercles exist on the edge of the back in the young specimens of *Am. Argonautiformis* to those which occur in *Am. dispar*. After the *Mammillati* the groups, which are most nearly related, would be the '*Angulicostati*' and the '*Flexuosi*.'

Range. Ootatoor group.

Locality. North-east of Moraviatoor in the Trichinopoly district. Only the two figured specimens have been seen in a yellowish earthy limestone.

6. AMMONITES CROTALOIDES, *Stoliczka*, Pl. XLVI. Fig. 3.

Am. testa rotundata, anfractibus subangulatis, transversim costatis; costis inæqualibus, rectis, ad dorsum sub-tuberculatis; dorso sub-convexo; umbilico magno; apertura ovate-elongata, suturis lateraliter trilobatis; lobo dorsali minore quam lobo laterali primo; sellis atque lobis bipartitis.

Proportions (the whole diameter being considered as 1.00) calculated	
from the figured specimen with a diameter of	63 mm.
Diameter of outer whorl : whole,	0.38
Width of umbilicus : whole diameter,	0.28
Thickness of aperture : height,	0.69

Shell round, not much compressed, of few whorls, which are transversely ribbed. The ribs are partially unequal, nearly straight, and form on the edge of the back of the inner whorls strong tubercle-like elevations, being nearly obsolete towards the middle of the back or forming slight nodules. These latter are generally not very distinct, and are therefore difficult to be determined. Towards the mouth, the ribs become gradually weaker. The back is flatter on the inner whorls, and rounded only on the body-chamber; umbilicus large, leaving about three-fourths of the inner whorls visible. The aperture is oval, prolonged forward at the top. The sutures which have been rendered visible by filing a little off the surface are close together, but seem to be not deeply subdivided. There are three bifid narrow lobes on each side, the third lateral—or the first auxiliary—lobe lies on the edge of the umbilicus; the dorsal lobe is shorter than the first lateral; the saddles diminish from the dorsal one gradually in size towards the umbilicus, the dorsal one being the largest and bifid.

Of this species we have only the figured specimen, which is a perfect cast from the neighbourhood of Moraviatoor. The body-chamber, although a little squeezed, occupies only the half of the whorl; it seems also to be, irregularly, somewhat more evolute than the preceding whorls are, as in *Am. dispar*.

There is a great difficulty in deciding as to what group this species should belong. The general character of the shell indicates, that it is most closely related to *Am. Argonautiformis* and *Am. dispar*, as does also the distribution of the sutures. It is probable, therefore, that the group of *Mammillati* is the best place for this species, although some nodules on the middle of the back recall the *Rotomagenses*. To this latter group, however, the other ornamentation of the shell offers very little relation, being in this respect more allied to the *Angulicostati*.

Range. Ootatoor group.

Locality. Near Moraviatoor, in Trichinopoly district, in a yellowish earthy limestone. The specimen is from the collection of Brooke Cunliffe, Esq., and was found together with *Am. Argonautiformis*.

Group 7. DENTATI.

This group is one of the richest in varieties, but contains Ammonites which differ much not only as regards the form of the shell, but also as regards the disposition of the lobes. It is very difficult, therefore, to give any certain characteristic of this group, generally. The species belonging to it have, in many cases, rather an involute shell, with numerous transverse ribs, which terminate on the edge of the back in tubercles, or sometimes cross the back becoming less marked, and forming no tubercles in the middle. The sutures of the Dentati, as generally given are very varied, and can be but little relied on as a ground for classification.

Pictet* has subdivided the group into four sub-groups, which we adopt.

1st. *Dentati-tuberculati*; (*Tuberculati* and *Canaliculati* of other authors,) with a deep channel in the middle of the back. Of this subdivision, there is no species in the present collection.

2nd. *Dentati-interrupti*; characterized by the alternation of the tubercles, which form a row on each side of the back without a separate channel-shaped depression in the middle.

Under this sub-group we describe two species *Am. Guadaloupæ*, and *Orbignyanus*. Both these Ammonites differ considerably from species quoted by Pictet as belonging to this subdivision. They have of course alternate tubercles on the back, but besides these they have tubercles near the middle of the sides or flanks of the whorls, which latter tubercles Pictet excludes from this group. Then comes the consideration of the great difference in the divisions of the sutures. The details will be better seen in the description of each species.

3rd. *Dentati-compressi*, contains Ammonites with strongly compressed and involute shells, these having numerous, though often slightly marked ribs and subordinate tubercles. The lobes of the sutures are much subdivided.

To this sub-group belong three species, *Am. Andoorensis*, n. sp. *Am. Largillierianus*, D'Orbigny, and *Am. subobtectus*, n. sp.

4th. *Dentati-regulares*. The Ammonites of this sub-group are closely allied

* Mat. p. la Pal. Suisse. 1860. Foss. de St. Croix. p. 322.

Shell discoidal, more or less compressed, with numerous rather involute whorls, which are ornamented with seven to ten flexuous slightly elevated ribs, and three rows of tubercles on each side. The ribs each spring from a pointed tubercle on the edge of the umbilicus and continue, for the most part single, to near the middle of the sides, where they form another large but slightly elevated tubercle, and from this proceed, generally bifid, to the sharp edge of the back, where again they form pointed tubercles, which are prolonged in the spiral or peripheral direction. The dorsal tubercles are always alternate but not equally developed. On the perfectly preserved shell, on the surface of which all the fine flexuous striae of growth are well seen, (Pl. XLV. Fig. 1.) they are small and sharply pointed, (Fig. 1.a.) and they become obsolete on the last or body-whorl; on casts of the inner whorls, the same appear still more elongated, and form on the edge of the back an elevated and undulating rise on each side, (Pl. XLV. Fig. 2; Pl. XLVI. Fig. 10). The back is narrow and obtuse, (Pl. XLVI. Fig. 1.a.), or somewhat broader (Pl. XLV. Fig. 2), or roundish (Pl. XLV. Fig. 1), according as the shell is more or less compressed, or as the section is taken from outer or inner whorls. The umbilicus is deep, funnel-shaped, gradually becoming narrower towards the middle, to which the walls slope more or less rapidly. The septa are close to each other, and are divided into many equally formed lobes and saddles, arranged in a double-curved line, and diminishing towards the umbilicus; both lobes and saddles are numerous but not deeply divided: the dorsal lobe is bipartite and considerably broader at its base than in the upper part, the dorsal saddle has just the contrary form, being narrower at its base, and much broader at the top, which is tripartite: the succeeding saddles have more or less an approximation to a bipartite, and the lobes to a tripartite, division: the third lateral lobe is the deepest, from which the others continue in a somewhat convex line to the umbilicus.

The only variation we have noticed in all the numerous and valuable specimens of this Ammonite, which the Geological Survey collection possesses, is in the compression of the shell. Sometimes it is considerably compressed, while other specimens, and especially those from the North of Anapady are more inflate and with convex sides. There is no other difference either in the ornamentation, or in the sutures.

It is now many years since similar forms of Ammonites were described by Morton from the Cretaceous rocks of the United States, and by Dujardin, from the Cretaceous rocks of the Tourain. The identity of these species with that now described is doubtful, and in quoting them above (with a query) we only desired to draw attention to them. *Am. placenta*, Dekay, *apud* Morton, is only a cast, on which all the tubercles had become obsolete, or worn away by exposure; the involution is the same as in our species, and the sutures are very similarly lobed: *Am. syrtalis* has the same ornamentation, the septa are sigmoidal, but they are not drawn with sufficient clearness to give the necessary confidence in identification. *Am. polyopsis* Dujardin, (*loc. cit.* Fig. 12a.) differs not from some of our specimens, excepting that the sutures are not so complete, being evidently not well

preserved on the cast. The figures 12 *b.* and *c.* of the same author (loc. cit.) probably belong to another species, perhaps to *Am. Coupei*, Brongniart, or some allied species.

With greater confidence we have adopted Roemer's name for our Indian fossil. We have above mentioned the variations in the thickness and compression of our specimens, but these characters alone cannot be taken as distinguishing from other species, the sutures being in every respect the same in all. The position of the umbilical tubercles is somewhat nearer to the middle of the sides, but even this is only the case on the outer whorl.

Mr. H. Blanford in his Report on the Cretaceous rocks of Trichinopoly, &c. (Mem. Geol. Surv. of India, Vol. IV. pt. 1.) gave the name of *Am. Tamulicus* to this species without any further description.

Range. Trichinopoly group, a very characteristic fossil of this group; known from the following

Localities. North of Serdamungalum; West of Koloture (very common); North of Anapaudy; and near Alundanapooram.

Roemer described this species from an unique but perfect specimen from the waterfall of the Guadaloup river, below New Braunfels in Texas. He states that traces of the last whorl led him to estimate the size of his specimen as one foot in diameter. Our Indian collection contains specimens larger than this, some being nearly two feet in diameter!

2. AMMONITES ORBIGNYANUS, Geinitz, Pl. XLVIII. Fig. 2.

1843. *Ammonites Vibrayeanus*, Geinitz, Verstein. v. Kieslingswalde, p. 8, Pl. 1, Fig. 8, non *Am. Vibrayeanus*, D'Orbigny.
 1850. „ *Orbignyanus*, Geinitz, Quadersandsteingebirge, Pl. IV. Fig. 1.*
 1851. „ *Geinitzi*, D'Orbigny, Prod. II. p. 213.
 1852. „ *digitatus*, Giebel, Fauna der Vorwelt, III. p. 561.

Am. testa discoidea, compressa et involuta, lateraliter subcostata: costis flexuosis, prope umbilicum et ad dorsum tuberculatis; dorso plano, angustissimo, lateraliter ad margines alternatim tuberculato; umbilico angusto, abrupte excavato; sectione anfractuum sagittata, antice truncata; suturis multilobatis, parum dissectis, lobis atque sellis ad terminationes inæqualiter bipartitis.

Diameter of largest specimen, calculated from a fragment, from	
Moraviatoor,.....	192 mm.
Proportions (the whole diameter being considered as 1.00) calculated from figured specimen in the diameter of	185
Diameter of outer whorl : whole	0.57
Width of umbilicus : whole diameter	0.08
Thickness of section : height	{
on the top.....	0.07
in the middle	0.43

* Giebel, Fauna der Vorwelt, III. p. 494, 1852, adopts the name *Am. Orbignyanus* for the species described by de Verneuil as *Goniatites Orbignyanus*, (Russia and Ural Mountains, II. p. 375, Pl. 26, Fig. 2.) This, however, requires still further proof, as the Russian species appears to be a *Ceratite*.

Shell very much compressed, discoid, gradually becoming thinner from the centre to the periphery, furnished with slight flexuous ribs on each side. These ribs are stronger and broader in about two-thirds of the distance from the umbilicus, becoming nearly obsolete towards the umbilicus, and towards the back and terminating at both ends in small tubercles. The back is very narrow, flat, bounded on each side with elongated tubercles which are placed very close one to the other, and *alternately* (vide Fig. 2*b*). The edge of the small umbilicus is rounded, and the shell slopes rapidly down from it to the centre. The sutures are numerous divided into lobes and saddles, both with many but short subdivisions. They extend in a double-curved concave line, being somewhat contracted at their bases, or nearly equally broad: both are bipartite at their terminations, excepting the *third lateral lobe* which is the deepest of all, (as if it were the equivalent of the first lateral lobe) and is tripartite; the next succeeding saddle is less bipartite than the others.

The greater compression and involution, and the more distinctly bipartite lobes and saddles distinguish the present species easily from *Am. Guadaloupæ*.

Our specimens do not in any way contradict the descriptions and figures of Geinitz (loc. cit.), but before admitting the perfect identity of the species it was necessary to ascertain whether in *Am. Orbignyanus* the tubercles on the edge of the back were alternate, and whether the lobes, as figured by Geinitz, were complete or not. We applied to Prof. Geinitz himself for information on these two points and he in a letter (dated 8th August, 1863, Dresden,) affirms the first, while regarding the second he is not able to give full evidence of the form of the first saddle. Geinitz's specimens are in this part not well preserved; but he says it is probable that the dorsal lobe is formed as seen in our figure.*

Range. Ootatoor group.

Locality. Moraviatoor; two but imperfect specimens have as yet been found.

* While these pages were passing through the press, (December 1863) I received a second letter from Professor Geinitz in which he gives a fuller description of the form of the lobes, as they have been very lately noted by Mr. Drescher. He also kindly enclosed a copy of the drawing, with the reference to the XV. Vol. of the Zeitsch. d. deutsch. Geol. Gesellschaft, Pl. VIII. Fig. 1, which part we have not yet received in Calcutta. From this drawing the lobes appear to be identical with those in our specimens. The only difference is in the first saddle (which in Mr. Drescher's figure is given as the dorsal saddle) being tripartite, in our figure the second division from the dorsal lobe is so distinctly separated, that we are led to view the dorsal saddle as bipartite, and the one next after the division as the first lateral saddle. Our dorsal and first lateral saddles together are, therefore, to be taken as equivalent to Mr. Drescher's dorsal saddle. The sutures in our specimen (which is a cast) are only very slightly eroded, although not quite perfect, as may be easily recognized from the obliteration of the smaller subdivisions, but M. Drescher's figure is also evidently taken from a specimen not in the best state of preservation, so that the slight difference we have noticed between our figures and his, may very probably have arisen from the want of clearness, with which the lobes are seen in one or other of the specimens.

3. AMMONITES ANDOORENSIS, *Stoliczka*, Pl. XLVII. Fig. 3.

Am. testa discoidea, compressa, anfractibus lateraliter subplanis, transversim costatis: costis flexuosis, alternatim inaequalibus seu in medio bifidis; ad umbilicum et ad dorsum subtuberculatis; dorso lato, transversim costato; umbilico parvo; apertura elongata et angulata, antice truncata, lateraliter cornuta. Suturis lateraliter trilobatis, sella dorsali latissima, lobo laterali primo bifido, ceteris ad terminationes unicus.

Proportions (the whole diameter being considered as 1.00) calculated from the figured specimen in the diameter of	23 mm.
Diameter of outer whorl : whole.....	0.50
Width of umbilicus : whole diameter.....	0.19
Thickness of section : height	0.72

Shell discoidal, compressed, flattened on both sides and transversely ribbed: ribs flexuous, strongly curved forward in the middle of the sides, and afterwards bi- seldom tri-fid; towards the umbilicus the ribs become smaller and terminate at the edge of the umbilicus, and of the back, in slight elevations, scarcely forming solid tubercles; these are strongest near the mouth, although the ribs themselves become nearly obsolete. Back broad, crossed by numerous ribs, with tubercles on each of the margins. Umbilicus narrow, leaving only a very small part of the inner whorls visible: aperture oblong, angulate, having two short horn-shaped elevations on its top, one on each corner.

The sutures consists of three lobes and as many saddles, on each side, gradually becoming smaller towards the umbilicus; the dorsal lobe is the deepest, the first lateral is bifid, the succeeding lobes single: the saddles are all bipartite and the dorsal is the largest.

This species has no resemblance to any described forms excepting *Am. Salteri*, Sharpe, (Moll. of Chalk, p. 80, Pl. XXIII. Fig. 3). In that, however, the ribs are bifid or trifid from their very origin, and they do not cross the back. The tubercles on the sides of the back are also alternate not opposite.

Range. Trichinopoly group.

Locality. Andoor in Trichinopoly district. The specimen figured is the only one procured; this however is well preserved.

4. AMMONITES LARGILLIERTIANUS, *D'Orbigny*, Pl. XLIX. Fig. 1.

1822.	<i>Ammonites complanatus</i> ,	Mantell, Geol. of Sussex, p. 118, non <i>Am. complanatus</i> , Bruguiere (1789) and others.
1829.	„	„ Sowerby, Min. Conch. Pl. 569, Fig. 1.
1840.	„	<i>Largilliertianus</i> , D'Orbigny, Pal. Franc. Terr. Cret. Tom. I. p. 320, Pl. 95.
1850.	„	<i>sub-complanatus</i> , D'Orbigny, Prod. Pal. Tom. II. p. 146.
1852.	„	<i>Largilliertianus</i> , Giebel, Faun. der Vorw. Tom. III. p. 563.
1852.	„	<i>complanatus</i> , Sharpe, Moll. of Chalk. p. 19, Pl. VII. Figs. 1—3.
1854.	„	„ Morris, Catal. Brit. Foss. p. 296.
1860.	„	<i>Largilliertianus</i> , Pictet, Pal. Suisse. Foss. de St. Croix, p. 257.

Am. testa valde compressa, involuta, transversim striato-costata, striis numerosissimis, flexuosis, ad umbilicum majoribus, ceteris minoribus, ad marginem dorsi sub-tuberculatis; dorso angustato, truncato, lateraliter sub-tuberculato, in medio subconvexo; umbilico clauso; sectione anfractuum sagittata, in medio latissima, antice truncata. Septis lateraliter 6-lobatis, numerosissime dissectis et foliaceis; sellis bipartitis, lobo dorsali latissimo, lobo laterali primo bifido, ceteris ad terminationes unicus.

Diameter of the largest specimen only including the air-chambers, (Fig. 1),	102 mm.
Proportions (the whole diameter being considered as 1.00) calculated from	
figured specimen in diameter of	100
Diameter of outer whorl : whole	0.63
Width of umbilicus : whole diameter	0.08*
Thickness of section in middle : height	0.41

Shell discoidal, greatly compressed and perfectly involute. The whorls increase rapidly in height, and are covered with flexuous unequal striæ, or lines of growth, which are nearly obsolete near the umbilicus, but become stronger as they proceed, and form sharp tubercular elevations on the margins of the back. Of these five, in the circuit of the whorl and at equal distances one from the other, are considerably stronger and more marked near the umbilicus, but do not extend further than the middle of the side, where they divide and branch. Back narrow with ribs crossing, somewhat elevated in the middle of the section, and with rows of elevated tubercles on each side. Section of the whorls is sagittate, thickest towards the middle, and truncate at top. The sutures consist of numerous and deeply divided lobes and saddles; the saddles are bipartite, with long phylliform branches: the dorsal and the first lateral lobes are also bifid; the succeeding lobes are simple. The dorsal lobe is the broadest of all, with short secondary saddles, one on each side, which are formed similarly to the others and can be considered also as short dorsal saddles: the dorsal saddle proper consists of three branches on each side, these being here, as in all other saddles, placed alternately; the lowest branch on the outer periphery is in the dorsal saddle somewhat longer than the others. The succeeding lobes and saddles diminish gradually in size towards the umbilicus.

The form of our specimens does not in any way differ from D'Orbigny's and Sharpe's figures, the short thicker ribs being also marked in Sharpe's Fig. 2. A little difference may be noticed in the lobes, and to this we would direct the attention of those naturalists, who may have an opportunity of observing these on European specimens; the differences appearing rather to be due to the state of preservation than to any real distinction. The sutures of *Am. Largilliertianus* have been only once given from the actual specimens, namely, by D'Orbigny; of these, Sharpe's figure was only a copy. We here refer, therefore, only to the original figure of D'Orbigny. In this figure, the diametrical dimension of the sutures is somewhat longer, when compared with the diameter of the shell: the height from

* This measure is taken on the cast, while on the preserved shell it is only 0.02, which gives the thickness of the columella or solid spire.

the top of the dorsal saddle to the lowest termination of the dorsal lobe or to the whole diameter of the septum (= the height, or radius of the whorl), being as 46 : 100. In our specimens this proportion is 49 : 100. The lowest divisions of the dorsal lobe are distinctly bifid; the next lowest branch of the dorsal saddle is a little shorter, and not so deeply separated; the first lateral saddle is not so broad, as is seen in D'Orbigny's figure. All the other distinguishing characters leave scarcely a doubt as to the identity of the species.

Range. Ootatoor group.

Localities. North and West of Odium.

Only a few specimens have hitherto been met with in a yellowish earthy limestone and it is quite as rare a shell in India as in Europe, where it was first noticed from the lower chalk, at Hamsey, in England, (Mantell, Sharpe), subsequently at Rouen and Cassis in France, in the *etagé Cenomanien* by D'Orbigny, and lately at St. Croix, by Pictet, also in the *etagé Cenomanien*.

5. AMMONITES SUBOBTECTUS, *Stoliczka*, Pl. XLIX. Fig. 2.

Am. testa discoidea, compressa, involuta; anfractibus lateraliter subconvexis, tuberculato-costatis; costis in medio tuberculatis, antice curvatis et prope obsolete, deinde ad dorsi marginem prolongatis, atque in tuberculos extensis; costis prope dorsum inæqualibus, longioribus et brevioribus alternantibus; dorso truncato, in medio convexo, numerosissime costulato, lateraliter tuberculato: tuberculis oppositis; sectione anfractuuum elongato-elliptica; suturis multilobatis, lobis et sellis numerosissime et profunde dissectis, umbilicum versus decrescentibus, inæqualiter bipartitis, loborum ramulis angustatis, acutis; sellarum ramulis latis, foliaceis.

Proportions (the whole diameter being considered as 1.00) calculated from the figured specimen with a diameter of	163 mm.
Diameter of outer whorl : whole	0.63
Width of umbilicus : whole diameter	0.02 (a)
Thickness of section : height	{ on the outer whorl 0.54 (b)
	{ on the inner whorls..... 0.45

(a). This measurement taken on the cast gives the thickness of the columella or solid spire on a perfectly preserved shell.

(b). By the difference between these two measurements taken about the middle, it is seen, that the shell increases more rapidly in the height when it grows larger; the increase of the thickness in one half whorl amounts in our specimen to 0.09 of its height, or in actual measurements the increase of the thickness in one half of an entire circuit is 26 mm. in the outer whorls, and 11 mm. in the inner whorls: the increase of the height in the same distance is 72 mm. on the outer; and 44 mm. on the inner whorls.

Shell discoid, compressed, perfectly involute, and truncated at the back; whorls rapidly increasing in height, with slightly convex sides, which are ornamented with flat tuberculate ribs. These commence inside of the umbilical depression, and proceed (about 24 in number) in nearly straight lines to the middle of the sides, where they form a rounded tubercle each, and become nearly obsolete; they continue, however, gradually increasing again in strength in a more or less curved

(56)

line to the edge of the back, where they terminate in sharp tubercles. The dorsal tubercles are, in consequence of the bipartition of the ribs, double in number, as compared with those of the flanks. The back is narrow, bounded on each side with a row of elongated tubercles, and numerous ribs on the convex part between; the section of the whorls is elongated-elliptical, broadest towards the middle. The septa are very close together, one reaching into the divisions of the other; they consist of many lobes and saddles, which are arranged, so as to form a convex outline; they gradually diminish in size towards the umbilicus and are much subdivided; both lobes and saddles are unequally bipartite; the subdivisions of the lobes are small and pointed, those of the saddles broader and phylliform; dorsal lobe longer than the first lateral, and nearly four times as broad; it has on each side a short bipartite secondary saddle, the divisions of which coincide with the edge of the back. All the divisions of the sutures are similar to those in *Am. Largilliertianus*.

Our specimen, although an imperfect one, is sufficient to shew all those characters which distinguish this species from others. The peculiar ornamentation of this shell is somewhat extraordinary among Ammonites, and there is only one other species known, nearly allied to ours. This was described by Sharpe as *Am. obtectus* (Moll. of the Chalk, p. 20, Pl. VII. Fig. 4), from a unique specimen; it differs from our Indian fossil by the less numerous ribs and by the tuberculated keel on the middle of the back: the Indian shell is also considerably thicker. It is, however, possible, that the two may be identical; we have not been able to obtain the inner whorls of our specimen, which may in the younger stages of growth have possessed a tuberculated keel as is sometimes the case in other young Ammonites.

This and the preceding species give additional proof of how very nearly allied the fauna of the Cretaceous rocks of India is to that of the same formation in Europe, and it may most fully be anticipated, that some species which in the present state of our knowledge we are compelled to regard as distinct, although allied, species, will, after a time, be recognized as identical, when specimens have been obtained in a better state of preservation and in different stages of growth.

Range. Ootatoor group.

Locality. West of Odium: only the figured specimen has been found.

6. AMMONITES CUNLIFFEI, *Forbes*, Pl. L. Fig. 3.

1846. *Ammonites Cunliffei*, Forbes, Trans. Geol. Soc. Lond. Vol. VII. p. 109, Pl. VIII. Fig. 2.

1850. " " D'Orbigny, Prodr. II. p. 213.

1852. " " Giebel, Fauna der Vorwelt. III. p. 605.

Of this species, we have seen only one specimen which belongs to the collection of the Madras Museum and, inasmuch as this is not better preserved, than the specimen represented in Prof. Forbes' figure, we have little to add to his description of the species.

The specimen is a cast, and is figured of the natural size, (Fig. 3). It consists only of the air-chambers, and is evidently of a young shell, which, however, considering the great number of whorls may probably not grow much larger. The inner whorls are perfectly smooth, and on the last, the tubercles of the umbilical margin are scarcely marked. On either side of the last ribs, there is a slight furrow seen, which also crosses the back, which is slightly convex. E. Forbes' figure 2.*b*. shews on the top of the aperture an elevation which looks like a keel, this is probably the result of an oblique break of the shell, for nothing like this is really seen in *Am. Cunliffei*. With reference to the sutures we can state, that the second lateral saddle is not higher than the preceding ones.

Prof. Forbes (loc. cit. p. 110, Pl. VII. Fig. 5) describes another species of the group *Dentati* as *Am. pavana*. Of this we have not been successful in procuring a single specimen, and we therefore only notice the differences given by Forbes: stronger compression, more rapid involution and want of tubercles at the umbilical edge distinguish this species from *Am. Cunliffei*. It offers some resemblance to young specimens of *Am. vicinalis*, described above, p. 84. D'Orbigny considers *Am. pavana* as a young shell of *Am. Cunliffei*, probably forgetting at the moment to refer to Forbes' figures, which are given of the natural size. The diameter of *Am. pavana* is 12 mm., and that of *Am. Cunliffei* only 11 mm.: the larger can scarcely be considered as a young specimen of a smaller shell!

Range. Valudayur group.

Locality. Pondicherry. The only specimen we have seen belongs to the Madras Museum.

7. AMMONITES CRASSITESTA, *Stoliczka*, Pl. L. Figs. 1—2.

Am. testa discoidea, compressa, lateraliter tuberculato-costata; costis (15—25) numerosis, prope dorsum antice curvatis, ad umbilicum et dorsi ad marginem tuberculatis; dorso angustiore, truncato, lævi, bituberculato; umbilico lato; sectione anfractuum elongata antice truncata, postice cordata. Suturis lateraliter bilobatis, modice dissectis; lobo dorsali angusto, lobo laterali primo lato, ad terminationem bipartito; sellis inæqualiter divisiss, sellæ dorsalis ramulis lobum lateralem versus decrescentibus.

Diameter of largest specimen.....	150 mm.
Proportions (the whole diameter being considered as 1.00) calculated from the figured specimen with diameter of	132 mm.
Diameter of outer whorl : whole	0.37
Width of umbilicus : whole diameter	0.35
Thickness of section : height	{
on body-chamber	0.84
on air-chambers.....	0.73

The discoid shell consists of but few not much involute whorls, ornamented with numerous slightly elevated ribs. These ribs are nearly straight, rising from a tubercle at the edge of the umbilicus, and afterwards bend somewhat forward near

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the edge of the back, where they terminate in more or less distinct tubercles. Of the longer ribs there are about 15 in a whorl, with intermediate shorter ones. Back is obtuse, margined by a row of tubercles on each side, the flat part being either smooth or crossed by very slightly marked or elevated ribs. Umbilicus very large about three-fifths of the inner whorls being exposed; the walls are nearly straight. The section of the whorls is ovato-elongate, truncate at the top, somewhat broader in the body-chamber, and narrower in the air-chambers. The septa are not deeply divided, they have two lateral lobes on each side, both bipartite, the first broader and not reaching deeper than the small dorsal lobe: the dorsal saddle is largest, its branches diminishing gradually in size towards the next lobe, the first lateral saddle is without any deeper subdivisions; the second lateral saddle is very short, distinctly bipartite, and considerably narrowed at its base.

The degree of involution of this species recalls some others of the *Dentati* group, such as *Am. Michellianus*, D'Orb., *Am. regularis*, Bruguiere, and others, but the peculiarity of the lobes and the ribs, which extend to the edge of the umbilicus, distinguish it easily from all hitherto described forms.

Range. Ootatoor group.

Localities. W. of Coonum; and Monglepaudy. The species seems to be rather rare, as only five specimens from the first, and one from the second, locality have been seen.

8. AMMONITES CONCILIATUS, *Stoliczka*, Pl. L. Fig. 4, Pl. LI. Fig. 1.

Am. testa inflata, angulata; anfractibus subrotundatis sive prope quadratis; transversim tuberculato-costatis; costis parum elevatis, apud ortum seu prope dorsum bifidis, tuberculis dorsalibus lateraliter biserialibus, ad umbilicum majoribus, ad dorsum numerosis, acutis; dorso medio excavato, lateraliter bituberculato; sectione anfractuum sub-quadrata; suturis lateraliter bilobatis, modice dissectis; sella dorsali latissima, lobo laterali primo bifido.

Diameter of the largest specimen about	230	mm.
Proportions (the whole diameter being considered as 1.00)	<i>a</i>	<i>b</i>
calculated from specimens with the diameters of.....	100	155
Diameter of outer whorl : whole	0.42	0.40
Width of umbilicus : whole diameter	0.30	0.33
Thickness of section : height	1.36	1.29

(a) Pl. LI. Fig. 1. A large specimen from Monglepaudy.

(b) Pl. L. Fig. 4. Inner whorl of a very large specimen from same locality.

Shell with few, strong, more or less square whorls, which are ornamented with transverse ribs and three rows of tubercles on each side.

The ribs have their origin in very strong tubercles at the edge of the umbilicus, they extend partly simple (Fig. 4) and partly bipartite (Pl. LI. Fig. 1) in nearly straight lines to the edge of the back, where they form another tubercle from which they continue mostly bipartite to near the middle of the back, terminating here in

small pointed tubercles. The middle of the back itself being smooth and channel-shaped. The umbilical tubercles are fewer in number, but (on the inner whorls) stronger than those on the edge of the back: the latter are more numerous owing to the bifurcation of the ribs and also to the formation of intermediate tubercles; they are, on the last whorl, sometimes stronger than the umbilical tubercles. Those bounding the channel on the back are the least marked, but most numerous; these are sometimes alternately placed, (Fig. 4.b.). The involution covers the dorsal tubercles and extends up to the tubercles on the edge of the back leaving about two-thirds of each of the inner whorls visible. The section of the whorls is broader than high, squarish, occasionally considerably smaller at the top, (Fig. 4.b.) The sutures have two lobes on each side; the saddles are unequally bifid (the branches nearest to the umbilicus being the shorter) and larger than the preceding lobes, which are also unequally bipartite: the dorsal lobe is the deepest, the dorsal saddle the largest of all; the first lateral saddle not much shorter.

The only species to which our Indian fossils bear any resemblance is *Am. radiatus*, Brug., often known as *Am. asper*, Merian. Inflated specimens of the Indian shell remind us of similar fossils in Europe. One is figured by Quenstedt, (Cephalop. Deutschl. 1849, Pl. X. Fig. 16.). The back of *Am. radiatus* is, however, not excavate, but generally somewhat convex. By this channel-shaped depression of the back this species forms a good transition from the *Dentati* to the *Nodoso-costati*.

Range. Ootatoor group.

Locality. Monglepaudy: a very rare shell.

9. AMMONITES USHAS,* *Stoliczka*, Pl. LI. Fig. 2.

Am. testa compressa; anfractibus transversim costatis: costis bipartitis seu simplicibus: alternatim longioribus brevioribusque, primis ad umbilicum tuberculatis; dorso juniore plano, lateraliter bituberculato; in aetate proveciore dorso rotundato: tuberculis evanescentibus atque costis dorsum transeuntibus; umbilico magno, abrupto; apertura subquadrangulari; septis — ?

Proportions (whole diameter being considered as 1.00) calculated	
with a diameter of	28 mm.
Outer whorl : whole diameter	0.39
Width of umbilicus : whole diameter	0.36
Thickness of section : height.....	0.95

Shell discoidal, with flattened sides, transversely ribbed, the ribs being either single and alternately longer and shorter, or more frequently bipartite; tuberculated at the edge of the umbilicus. In the earlier stages of growth, each of the ribs has two tubercles at the edge of the back, between which the ribs disappear. Quickly, however, as the shell grows larger, these tubercles gradually become

* Ushas is the Aurora of Vedaic mythology.

obsolete, and the ribs cross the rounded back with the same strength as on the sides of the shell. This causes considerable variation in the species at different stages of growth, both in regard to the ornamentation of the shell and the shape of the section: this latter being at first nearly square, and afterwards becoming a little higher than broad with a rounded top. The umbilicus is very large with nearly perpendicular walls, and a row of tubercles on the edge; the involution extends merely to the second row of tubercles from the middle of the back. The sutures could not be seen.

We have placed this species under the group *Dentati* in consequence of its shape and form in the earlier stages of growth, having opposite tubercles on the edges of the back, similarly to other species of the sub-group *Dentati-regulares*. In the older state, in consequence of the change in the ornamentation, the species could be placed, with equal justice, among the *Mammillati* of Pictet.

Range. Ootatoor group.

Locality. Odium; only the figured specimen has been met with in the yellowish calcareous shales. The specimen was somewhat larger as a portion of the outer whorl was broken away, in rendering the inner whorls visible.

Group 8. NODOSOCOSTATI.

This group, formed by Pictet,* is distinguished by the predominance of the tubercles over the ribs; there are no tubercles on the middle of the back, which is depressed, channel-shaped and bordered closely on either side by a row of separate tubercles; between each two longer ribs there is generally one, often two or three, shorter ribs, on which smaller ribs the tubercles also are correspondingly smaller. The existence of the ribs distinguishes this group from the *Pretiosi* of Pictet.

This is a group of small extent; indeed such small groups, and in considerable number, become necessary, if the Ammonites are to be properly classified. Pictet refers only a few species to this, and we have found only one, *Am. Footeanus*, which we believe to belong to this group; at least in the younger whorls of the shell there is no genuine difference between our fossils and those referred to the *Nodosocostati*.

1. AMMONITES FOOTEANUS, *Stoliczka*, Pl. LII. Figs. 1, 2.

Am. testa discoidea, parum involuta; anfractibus quadrato-angulatis, lateraliter subcostatis; costis ad umbilicum dorsumque tuberculatis, ultimis majoribus: dorso lato, subconvexo, lateraliter bituberculato; tuberculis prope medium minoribus, saepe obsoletis; dorso mediano parum excavato: umbilico magno profundo; sectione anfractuum subquadrata. Suturis septorum lateraliter bilobatis, parum incis; lobo dorsali angustissimo, lobo laterali primo latissimo, ad terminationem bipartito; sella dorsali angusta, bifida, laterali prima lata, irregulariter tripartita.

* *Mater. p. l. Pal. Suisse. Foss. d. St. Croix, 1860, p. 335.*

Diameter of largest specimen.....	260 mm.
Proportions (the whole diameter being considered as 1.00) calculated from the figured specimen in diameter of.....	245
Diameter of outer whorl : whole diameter	0.39
Width of umbilicus : whole diameter	0.05
Thickness of section : height.....	1.05

Shell discoidal with small amount of involution ; whorls numerous, increasing gradually in height and breadth, ornamented on the flat sides with many slightly elevated, nearly straight, ribs, which have a tubercle both at the umbilicus and at the edge of the periphery, the latter being much the larger ; back very broad generally not much curved (Fig. 1.a.) bounded close to the channel-shaped depression in the middle by one row of small rounded tubercles on each side, and by large tubercles on the edge. In the young shells, there are longer and shorter ribs placed between the tubercles, these ribs, however, generally become obsolete on the larger shell. Umbilicus large and deep, the outer whorls only covering the convex back of the inner. The section is roundish-square, somewhat broader than high. The sutures have short, rounded and not deep subdivisions, and consist of two lobes on each side ; there is a very small and short dorsal lobe, and also a narrow bipartite dorsal saddle, the latter not reaching over the plain of the back, (and being, therefore, truly dorsal) : the first lateral lobe is also bipartite and the broadest of all ; the first lateral saddle is unequally tripartite, and broader but shorter than the dorsal one ; the second lateral lobe is very small and short, and placed just on the edge of the umbilicus.

This species is principally characterized by the gradual and very regular increase of the whorls in height and breadth, and by the divisions of the sutures, which in some respects only resemble those of *Am. conciliatus*, *n. sp.*, described above. We have examined several specimens of this species, with special care as to the inner whorls, but we have not seen any tubercles on the middle of the back, a fact which might refer this species back to the group of the *Rotomagenses*.

Among European fossils we know only the small species *Am. euomphalus*, Sharpe. (Cephal. of Chalk, Pl. XIII. Fig. 4.) which reminds us of this species, or at least, of the small specimens of it.

The species is named after R. Bruce Foote, Esq., Geological Survey of India, who was engaged with Mr. Blanford in the examination of the Cretaceous rocks of Southern India.

Range. Ootatoor group.

Locality. North of Odium, in a sandstone of dark yellowish colour. Rare, only seven specimens, mostly large sized, were found.

Group 9. **ARMATI.**

The Ammonites of this group are generally less involute, with angular whorls, and a row of tubercles on both peripheries of the shell, the inner and outer one; the tubercles are connected by ribs. The sutures are not very deeply divided and have a very broad dorsal saddle.

The only species, we have to notice as belonging to this group, is *Am. Menu*; in this the sutures are rather different from those of the Jurassic Ammonites of the *Armati* group, but at certain stages of growth it agrees with that group as regards the ornamentation of the shell.

1. **AMMONITES MENU**, *Forbes*, Pl. LII. Figs. 3, 4.

- 1846. *Ammonites Menu*, Forbes, Trans. Geol. Soc. Lond. VII. p. 111, Pl. X. Fig. 1.
- 1850. „ „ D'Orbigny, Prodrôme II. p. 213, (*sénonien*).
- 1852. „ „ Giebel, Fauna der Vorwelt. III. p. 676.

Am. testa discoidea, inflata; anfractibus rotundatis, prope umbilicum et partim prope dorsum tuberculatis, transversim striate costatis, ultimo anfractu ad aperturam sulcato; dorso lato, convexo, lateraliter partim tuberculato, medio sublævi; umbilico profundo, moderato; apertura lunulata; suturis septorum lateraliter trilobatis, profunde et multice dissectis; sellis umbilicum versus magnitudine decrescentibus, bipartitis, lobis ad terminationes unicus, angustioribus quam sellis precedentibus.

Diameter of largest specimen from Arrialoor.....	76 mm.
Proportions (the whole diameter being considered as 1.00) taken	a b
from specimens with diameter of	56 45
Diameter of outer whorl : whole.....	0.46 0.40
Width of umbilicus : whole diameter.....	0.33 0.31
Thickness of aperture : height	0.76 0.75
(a) Figured specimen from Pondicherry (Valudayur group).	
(b) „ „ from Anapady (Trichinopoly group).	

The shell consists of numerous round whorls, which are ornamented with a row of tubercles near the umbilicus, and partially with another row near the back; these latter rounded tubercles do not exist in the young shell and they die out again near to the mouth. In our complete specimen (Fig. 4.) they begin at the base of the body-chamber and continue for about one half its extent. The surface of the shell is covered with transverse striæ of growth, which are a little stronger in the intertubercular space on the flanks of the shell, separated by numerous slight furrows. One or two deep furrows, which pass round the whole whorl are distinctly marked only near the mouth.

Back convex, smooth, bordered on a part of the body-whorl with a few tubercles on each side; umbilicus of moderate size, measuring a little more than one-third of the whole diameter, and leaving about two-fifths of the inner whorls exposed; aperture lunulate, semi-circular, broader than high.

The sutures form four saddles, and as many lobes on each side, all are much subdivided, equally formed, and gradually diminishing in size towards the umbili-

cus; the dorsal lobe does not reach deeper than the first lateral and is four-branched on each side of the siphuncle, all other lobes are trifold, saddles bifid.

The nearest allies of this species, as Prof. Forbes has already remarked, are Oolitic. Excepting the somewhat doubtful species *Am. curvinodus*, Phillips, (Geol. Yorkshire 1829, Pl. II. Fig. 50,) there is no other Cretaceous Ammonite known, which belongs to the group, *Armati*.

Range. Valudayur group (?) in the Pondicherry area: Trichinopoly and Arrialoor groups, in the Trichinopoly district.

Localities. Near Pondicherry, specimen from the Madras collection: Anapady in the Trichinopoly group; Arrialoor and Comarapolliam in the Arrialoor group; a rare shell in all the localities.

Group 10. FLEXUOSI.

Since the first establishment of the *Flexuosi* group by Leop. von Buch, a large number of Ammonites have been referred to this division and again withdrawn. More recently Pictet* limited this number, and, as we think, with full reason. To define the group, however, by a single good character is not so easy as it might seem to be: the distinctions consisting of a combination of many variable marks, which it is sometimes not possible to fix. The flexuous lateral ribs of Ammonites in this group ought to be in some degree altered as they cross the back, thus, the ribs crossing the back, having formed slight tubercles on the edges become at the same time less marked, remaining as numerous as, or more numerous than, the lateral ribs; or, they form indistinct tubercles on the middle as in the *Rotomagenses*; or, the ribs die out altogether: the back itself is either flat or somewhat convex. The amount of compression and of involution, (generally not considerable) also varies in a similar manner. The sutures in some of the species resemble those of the *Mammillati*, in others, those of the *Ligati*.

In all these respects, the "*Flexuosi*" form a good transition from those Ammonites with more or less flat, excavate, or tuberculated backs, to those with a regularly rounded back.

In the Indian collection we have two species only, already described by Prof. Forbes from the Pondicherry rocks. *Am. Egertoni* (identical with *Am. Chrishna*, Forbes) and *Am. Ganesa*.

1. AMMONITES EGERTONIANUS, Forbes, Pl. LIII. Figs. 1—4.

1846. *Ammonites Egertoni*, Forbes, Trans. Geol. Soc. Lond. Vol. VII. p. 108, Pl. IX. Fig. 1.
 „ „ *Chrishna*, Forbes, „ „ p. 108, Pl. IX. Fig. 2.
 1850. „ „ D'Orbigny, Prodr. II. p. 213, (including *Am. Yama*, *Soma*, *Garuda*, *Ganesa*, probablement! *A. Gaudama*, Forbes.)
 1850. „ *Egertoni*, D'Orbigny, Prodrome, II. p. 213.
 1852. „ „ Giebel, Fauna der Vorwelt. III. p. 572.
 1852. „ *Chrishna*, Giebel, „ „ „ p. 415, (including *A. Ganesa* of Forbes.)

* Mater. p. l. Paleont. Suisse. Foss. d. St. Croix. 1860, p. 331.

Am. testa discoidea subcompressa, anfractibus numerosis, transversim costatis; costis longioribus quatuordecem, parum flexuosis, dorsum versus prope obsoletis, atque cum pluribus minoribus alternantibus; costis omnibus in dorso juniorum speciminum continuis, costis in adultis obsoletis, seu ad marginem dorsi in tuberculis terminantibus; dorso angustato; umbilico moderato; sectione anfractuum ovate-elliptica; suturis septorum lateraliter 4-lobatis, numerosissime et profunde incisis, umbilicum versus gradatim minoribus: sellis bipartitis, lobis trifidis, lobo laterali primo longiore quam lobo dorsali.

Diameter of largest specimen from Arrialoor.....	140 mm.
Proportions (the diameter being considered as 1.00) calculated	a b
with diameter of	125 140 mm.
Diameter of outer whorl : whole	0.44 0.43
Width of umbilicus : whole diameter	0.26 0.27
Thickness of section : height.....	0.64 0.81

(a) Large specimen, being a compressed variety; *Am. Chrishna*. Forb.

(b) Pl. LIII. Fig. 1, „ thicker, „ „ *Egertoni*. Forb.

Shell compressed, with nearly flat or slightly convex sides and about fourteen longer, slightly flexuous ribs, which are most strongly marked round the umbilicus, and become less developed or nearly obsolete towards the back; in the first case there are generally two shorter ribs between each of the longer. In young specimens the ribs are distinct and cross the back. When the shell becomes older, the ribs on the back disappear nearly altogether or they terminate on both margins in tubercles. Indeed this would seem to be the ordinary case, and the smoothness of the back, which is to be seen in some specimens, appears due to the shell not being well preserved.

The back is always more compressed than the sides, ribbed in the young shell and tuberculated on the margins in the older stages of growth; umbilicus moderate, exposing about two-fifths of the inner whorls, with sloping walls. Section of the whorls elliptical, cordate below. The sutures are much and deeply divided: there are four lobes and as many saddles on each side, the lobes are trifid, long and sharply branched, gradually diminishing towards the umbilicus; the first lateral lobe is the largest and exceeds the dorsal one in length; the saddles are bipartite, each termination having again bifid subdivisions, the first lateral saddle is very slightly higher than the dorsal one, which is much larger. The last auxiliary saddles descend obliquely to the umbilical suture. Edward Forbes has described this species under two names *Am. Egertoni* and *Am. Chrishna*. We have specimens of both forms, and after careful comparison we are unable to see any marked difference; the sutures in both being also the same. Forbes' figure (1, Pl. VII.) of *Am. Egertoni* shews a specimen similar to that represented in our Fig. 1, Pl. LIII.; while our Fig. 4, Pl. LIII. represents another specimen with more flattened sides like *Am. Chrishna*. In Fig. 2, Pl. LIII. which is taken from a large specimen, the tubercles on the margins of the back are well developed.

The species is characterized by its involution, by the slightly flexuous longer ribs and the intermediate shorter ones on the back, and by the distribution of the sutures, of which the saddles are bipartite, the lobes tripartite.

D'Orbigny (loc. cit.) supposed the two species of Forbes to be identical but he also united with *Am. Chrishna* many well marked and distinct species. In a similar way, Giebel, (loc. cit.) treated several of Forbes' species, neither having seen even a single specimen of these fossils. Such a proceeding assigns but little value to the admirable labours of one of the best of English Palæontologists, while neither of the authors, I have mentioned, had the slightest ground for their presuming to correct the characteristics given by Forbes. Such a proceeding, also, only introduces confusion into the literature of Palæontology, by uniting species, which may possibly (?) appear to be the same, but which in reality are far from being identical.

Range. Arialoor and Valudayur group.

Locality. Arialoor in Trichinopoly, a single specimen; from near Pondicherry, a few specimens in the collection of the Madras Museum.

2. AMMONITES GANESA, Forbes, Pl. LIV. Fig. 2.

1846. *Ammonites Ganesa*, Forbes, Trans. Geol. Soc. London, Vol. VII. p. 103, Pl. IX. Fig. 8.

1850. „ „ D'Orbigny, Prodrôme, p. 213, and 1852 Giebel, Fauna der Vorwelt. III. p. 415, as a synonym of *Am. Chrishna*, Forbes.

Am. testa subcompressa, lævigata, anfractibus numerosis, convexis, ad umbilicum 10-tuberculato-costatis; dorso rotundato; umbilico moderato, abrupte excavato; apertura ovato-elongata; Septis lateraliter 3-lobatis, multice dissectis, sellis bipartitis, lobis inæqualiter trifidis; lobo dorsali non longiore quam lobo laterali primo.

Proportions (the whole diameter being considered as 1.00) calculated	
from the figured specimen in diameter of	49 mm.
Diameter of outer whorl : whole diameter,	0.43
Width of umbilicus : whole diameter,	0.30
Thickness of section : height,	0.76

Shell discoidal, with slightly convex sides, which are ornamented at the rounded edge of the umbilicus with about ten distant short ribs, which are like strongly compressed elongated tubercles; the remainder of the surface being smooth: back rounded; umbilicus of moderate size, leaving about one-third of the inner whorls exposed; its walls are nearly perpendicular and deep; aperture ovate, lunulate at the base. The sutures of the septa are strongly divided into three lobes and four saddles on each side, both becoming smaller towards the umbilicus; the lobes forming a curved ascending line, while the saddles are nearly of the same height, and nearly in a right-line; they are bipartite and considerably contracted below; the lobes are tripartite, the dorsal lobe being very nearly as deep as the first lateral.

These characteristics of the sutures are very well shewn in Forbes' figures, and distinguish this species, at the first glance, from *Am. Egertoni*; from which it also differs by the smooth and rounded back. In form it is very like *Am. Soma*, Forbes, (loc. cit. Pl. VII. Fig. 7) of which we have not seen any specimen.

Range. Valudayur group.

Locality. Near Pondichery. We have had only the figured specimen of this species before us; it belongs to the Madras Museum.

Group 11. ANGULICOSTATI.

The Ammonites of this group are chiefly characterized by the distribution of the ribs, which should, alternately, extend from the edge of the umbilicus on one side to about the middle of the flank of the whorl on the other side, without forming any tubercles, or being interrupted on the back. This is, however, comparatively rare, and occurs only in a few Ammonites. Generally, those species in which the ribs are alternately longer and shorter (the first reaching from the edge of the umbilicus on one side to the edge on the other side, and the shorter—one or two between each of the longer—from the middle of one flank of the whorl to the middle of the other) are also referred to the *Angulicostati*. This latter form is by much the more common. In some species there is regularly, or only at certain stages of growth, an interruption or sometimes only a remarkable depression of the ribs in the middle of the back, but no distinct tubercles. To remove such forms from this group would necessitate a new group for every few species. Such facts only give another proof that it would, in all such cases, be preferable to separate the present genus, Ammonites, into many genera, than into uncertain groups. We cannot as yet pretend to be able to fix these genera, as including invariable forms, but if the groups, in the classification of the Mollusca, are to be in any way of equal value, such a system of separation is desirable.

The sutures of the *Angulicostati* are strongly divided, similarly to those of the *Ligati*. Belonging to this group we have two rather variable species, both of which have hitherto been known from the upper strata of the Cretaceous rocks of Southern India; *Am. Tweenianus* and *Am. Ootacodensis*, n. spp.

1. AMMONITES TWEENIANUS, *Stoliczka*, Pl. LIV. Fig. 3, and Pl. LV.

Am. testa discoidea; anfractibus subcompressis, seu subinflatis, transversim costatis; costis alternatim inæqualibus, parum flexuosis; dorso rotundato, transversim costato; umbilico magno, sectione anfractuum elliptica vel rotundata; suturis septorum lateraliter tri-lobatis, numerosissime dissectis et profunde incisis, umbilicum versus gradatim minoribus; sellis bipartitis, lobis tri-partitis; lobis auxiliaribus tribus, obliquiter umbilicum versus descendentibus.

Diameter of largest specimen, Pl. LV.	180 mm.
Proportions (the whole diameter being considered as 1·00) calculated from specimens with diameters of	<i>a</i> <i>b</i>
	174 120 mm.
Diameter of outer whorl : whole	0·33 0·38
Width of umbilicus : whole diameter	0·30 0·35
Thickness of section : height	0·89 1·04

(*a*) figured specimen from Arrialoor, Pl. LV.; typical species.

(*b*) " " from Anapady, Pl. LIV. Fig. 1, variety with round whorls.

F F

(67)

Shell discoidal, and consisting of many more or less inflated whorls, which are covered with numerous transverse ribs; these are somewhat flexuous and unequal in size: there being always from one to three shorter ones between each pair of longer ribs, which reach from the umbilical line on one side to the same on the other; some of these longer ribs at the edge of the outer periphery of the shell form tubercular-like elevations. The ribs extend across the rounded back with equal strength: on the cast there is sometimes an interruption of these by the furrow which marks the siphuncle inside. Umbilicus large, about one-half of the inner whorls being concealed; section of the whorls rounded or elliptical. A reference to our figures will shew the variation in the inflation of the shell, and consequently in the more or less rounded section of the whorls. Fig. 1, Pl. LV. represents the typical compressed specimen from the Arrialoer beds (N. W. of Arrialoer). Fig. 1, Pl. LIV. a variety with round whorls from the north of Anapady in the Trichinopoly group. The difference between these two is only the greater compression of the shell and the less numerous transverse ribs of the first. The general character of the ornamentation in both is perfectly the same, as are also the sutures of the septa. These consist of three lateral lobes* on each side much and deeply divided, and gradually diminishing in size towards the umbilicus: the saddles are nearly as broad as the lobes, and are bipartite; the lobes are tripartite, the dorsal lobe being only very little shorter than the first lateral: three auxiliary lobes descend in an oblique line towards the umbilical suture.

On comparing the sutures and the ornamentation of the two figured specimens, it will be seen that they are much more nearly related than they would, at the first glance, appear to be; the only difference being in fact the amount of compression of the shell. We have as yet seen only these two specimens, and we consider it therefore much better not to separate them. The only allied species we know is *Am. Oldhami*, Sharpe (Moll. of the Chalk, p. 32, Pl. XIV. Fig. 2), which differs only by its still greater compression and its more numerous longer ribs.

The species is dedicated to A. Tween, Esq., A. R. S. M., Curator of the Geological Museum, Calcutta.

Range. Arrialoer and Trichinopoly groups.

Localities. N. W. of Arrialoer, in light siliceous grit, with *Am. Gardeni*: and N. of Anapady (?) in a brownish sandstone of the Trichinopoly group; both localities in the Trichinopoly district: a rare shell.

* The distribution of the lobes, especially in this species, affords a good opportunity for a remark, which might probably have been necessary some pages earlier. In naming the sutures, we have throughout used the older terms, 'first and second' lateral instead of 'upper and lower.' If we look at the sutures of the species now spoken of, we see that there are in fact *three* lateral lobes, equally formed; and, therefore, there is no reason to call the two first lobes upper and lower (as they are not upper and lower), and to call the third lateral first lateral or first auxiliary lobe. They are all of equal value, and equally formed even in the youngest shells we have observed. It seems, therefore, much more simple to call the first three lobes, the first, second, and third (&c.) lateral, and the succeeding lobes, which descend obliquely to the umbilical suture, auxiliary lobes. From other considerations also we prefer the terms first and second lateral, because in other groups of Ammonites such as the *heterophylli*, some *dentati*, &c., the terms upper and lower have no real signification.

2. AMMONITES OOTACODENSIS, *Stoliczka*, Pl. LIV. Figs. 3—4, Pls. LVI. and LVII.

1862. *Ammonites colligatus*, Binkhorst. Mon. d. Gaster. et Cephal. du Limbourg. Pars II., p. 25: non *idem*, Hoeninghaus.

Am. testa subcompressa; anfractibus, subinvolutis, transversim inæqualiter costatis; costis flexuosis, nonnullis umbilicum versus prope obsolete; dorso rotundato; umbilico moderato, apertura ovali seu subrotundata. Septorum suturis lateraliter trilobatis, numerosissime et profunde dissectis, lobo dorsali non brevioribus quam lobo laterali primo, lobis tripartitis, sellis bifidis, lobis auxiliaribus oblique umbilicum versus sensim gradatimque magnitudine decrescentibus.

Diameter of largest specimen from N. of Ootacod	480 mm.
Proportions (the whole diameter being considered as 1·00)	<i>a</i> <i>b</i>
taken from specimens with diameters of	75 164
Diameter of outer whorl: whole	0·49 0·47
Width of umbilicus: whole diameter	0·19 0·24
Thickness of section: height	1·00 0·84

(a) Small, inflatè variety figured, Pl. LIV. Fig. 4.

(b) Larger, regular form figured, Pl. LVI.; the greater width of the umbilicus is owing to the specimen being partly a cast.

Shell discoidal, whorls numerous, transversely ribbed, the ribs varying considerably both in size and strength. The young shell is sometimes nearly smooth, as seen in Fig. 4, Pl. LIV. Sometimes there are some distant ribs on the back. (Fig. 3, Pl. LIV.) When the shell grows larger the flexuous ribs become more numerous, and are very well developed at the back, while towards the umbilicus they are entirely or with few exceptions obsolete. (Pl. LVI.) In the case of these exceptions, the longer ribs extend from one side of the umbilicus to the other with equal strength. In some specimens the ribs become gradually slighter towards the mouth, so that with a diameter of 160 mm. they die out altogether; in other specimens they continue with the same strength as before. In very large specimens (300 to 400 mm. in diameter) the ribs all become obsolete.

There are two varieties, as regards the thickness of the shell: one more compressed, represented in Pl. LVI.; and another more inflated, of which a specimen is given, Pl. LVII., two-thirds of the natural size. This inflated variety is common in the young states of the shell. (Fig. 4, Pl. LIV.) The back is rounded, and, according to the degree of compression of the shell, is more or less narrow than the middle of the whorls, the casts shew a furrow in the middle, as is also the case in other known species, such as *Am. leptophyllus*, *Gollewillensis*, Sharpe (loc. cit., Pl. XXII.), *Am. Neubergicus*, Hauer (Pal. Oesterr.), and others. The presence of this furrow cannot be admitted as any differential character between species, as it undoubtedly depends merely on the state of preservation of the shell, and has, therefore, nothing to do with the specific character of an Ammonite.

The umbilicus is of moderate size, there being one-third of the inner whorls exposed; the section of the whorls is elliptical or semicircular according to the amount of compression of the shell. The sutures form on each side three lobes and three saddles, both numerous and deeply divided, and gradually diminishing in size towards the umbilicus; the saddles are bipartite with bifid sub-divisions; the lobes are tripartite; the first lateral scarcely longer than the dorsal; besides the three lateral lobes, there are some auxiliary lobes, three or four in number, which descend obliquely towards the umbilical suture. In this species the auxiliary saddles are easily recognized, their inner lobules being considerably larger than the outer, these diminishing in size in the same proportion: the consequence being that the saddles gradually lose the bipartite character and become simple.

We have no doubt that our fossil is identical with Binkhorst's recently published species *Am. colligatus* (loc. cit.) from the upper Cretaceous formation near Limbourg. But, as this name *Am. colligatus* had been applied long since by Hoeninghaus to a different species (Bronn's Jahrbuch, 1830, p. 447), we retain our name given from the Indian locality of the specimens, which name we had selected some time before Binkhorst's monograph had reached Calcutta. There are also two other known Ammonites (also mentioned by Binkhorst) which are nearly allied to this species, *Am. Neubergicus** and *Am. Gollevillensis*.† It is indeed very difficult to give any certain differences between our fossils and *Am. Neubergicus*. The tubercle-like ribs round the umbilicus, which Fr. v. Hauer especially mentions, are also seen in some of our specimens (Pl. LVII.), but generally the ribs are in our fossils nearly obsolete: in *Am. Neubergicus* also the saddles are of about the same height, while they diminish considerably in our species. But these differences seem to be of subordinate value, the points of relation of the two being much more numerous. This fact renders the identity of both probable. *Am. Gollevillensis* is another nearly allied species: this, according to Sharpe's figure, may be distinguished by a somewhat larger umbilicus, and by the dorsal lobe being considerably shorter than the first lateral.

Range. Arrialoor group.

Localities. About one mile to the north of Ootacod, seven miles N. E. of Arrialoor, the largest and most numerous specimens were found; some of these are nearly two feet in diameter: south of Cumalypooram (about six miles S. S. W. of Arrialoor) a few were met with. It seems, therefore, to be a truly characteristic shell of the Arrialoor group.

Binkhorst describes his species from the upper Cretaceous rocks of Limbourg: and the other allied forms belong also to the upper Cretaceous series.

* Fr. v. Hauer, Beit. Z. Pal. Oesterreichs. 1858. Bd. 1, Heft 1, p. 12, Taf. II. 1-3, Taf. III.

† Sharpe, Cephal. of Chalk, Palæont. Soc., p. 48, Pl. XXII. Fig. 2.

Group 12. HETEROPHYLLI.

The Ammonites of this group are generally strongly involute shells, with rounded back and only slight ornamentation, the lateral ribs and furrows, which are often present, being only the indications of the former positions of the mouth. The best characters are the great complication of the sutures and the phylliform terminations of the saddles.

Under this group, from our Indian collection, we describe ten species, of which three are common European Cretaceous fossils, namely, *Am. Royleanus* D'Orb., *Am. Velledæ* Mich., and *Am. sub-alpinus* D'Orb.; while the remaining seven are only known from Southern India, viz., *Am. Varuna*; *Indra*; *improvisus*; *Surya*; *diphylloides*; *Yama* and *inanis*.

Some of these Ammonites, as *Am. Varuna*, *diphylloides*, *inanis*, do not exactly agree with the Ammonites of the *Heterophylli* group as regards the undeveloped *phylliform* terminations of the saddles. But it is well known that the partition of the sutures is always more simple and less developed in young than in full-grown specimens. Inasmuch, therefore, as the species just quoted are only known from specimens of small size, and as the lobes and saddles gradually diminish in size towards the umbilicus without any marked descent of the last lobes, we have considered it more correct to place these Ammonites in the present group than among the *Ligati*. The rather constant and characteristic shape of the sutures of this latter group will be found more fully detailed in the introductory remarks to that group.

1. AMMONITES VARUNA, Forbes, Pl. LVIII. Fig. 1.

1846. *Ammonites Varuna*, Forbes, Trans. Geol. Soc. Lond. VII. p. 107, Pl. VIII. Fig. 5.

Am. testa discoidea, sub-compressa, lævigata; umbilico angusto; apertura sub-dilatata, elongata, sub-trigona; septis lateraliter multi-lobatis, lobis sellisque inæqualiter bipartitis, vix foliaceis, lobo dorsali multum minore quam laterali primo bifido.

Diameter of the figured specimen	19 mm.
Outer whorl : (whole diameter considered as 1·00)	0·45
Width of umbilicus : diameter	0·24
Thickness of section : height.....	0·75

Shell consists of numerous smooth whorls, which are laterally compressed and towards the mouth somewhat enlarged: the greatest thickness of the shell is at a short distance from the umbilicus, from which point the shell slopes gradually down to the umbilical suture; back roundish; umbilicus not deep, narrow, only a very small portion of the numerous inner whorls being exposed; aperture higher than broad, elongated sub-triangular. The septa shew numerous lobes on each side: these are very deeply incised, descending in an oblique line and diminishing

in size towards the umbilicus; the saddles are bipartite, and their branches little rounded, not truly phylliform: the lobes are unequally bifid, the first lateral is almost regularly bipartite, and is much longer than the very narrow dorsal lobe.

As Prof. E. Forbes has already mentioned (loc. cit., p. 108), this species forms a transition between the *Heterophylli* and the *Ligati*. From the Trichinopoly districts we have in the Geol. Survey collection only the figured specimen; there are besides two others, much smaller specimens, from Pondicherry belonging to the Madras Museum. Of these latter the whorls are less compressed and not so high as in Forbes' original figures of a larger specimen: the inner whorls are also somewhat [more visible, so that we have some doubt whether these two specimens in reality belong to the same species.

In some respects this species much resembles *Am. Indra*, Forbes; it differs by the greater compression of the shell. Giebel (Fauna der Vorwelt, III. p. 441) has united this species with *Am. Yama*, Forbes.

Range. Ootatoor group: Valudayur group (?).

Localities. A single specimen from west of Odium between that and Moravitoor, Pondicherry, two specimens (probably of this species) from the Madras Museum.

In his report on the Cretaceous rocks of these districts (Mem. Geol. Surv. of India, Vol. IV. pt. 1) Mr. H. F. Blanford has noticed the occurrence of *Am. Varuna* twice: but as (page 99) he quotes *Am. Varuna* from the Ootatoor beds between Assoor and Puravoy, and at the same time alludes to page 86, where he states that *Am. Varuna*, Forbes, attains a large size, I believe that there was some mistake in the determination of the species, which was confounded with *Am. Beudanti*, Brongt.

2. AMMONITES INDRA, Forbes, Pl. LVIII. Fig 2.

1846. *Ammonites Indra*, Forbes, Trans. Geol. Soc. Lond., VII. p. 105, Pl. XI. Fig. 7.

1852. „ „ Giebel, Fauna der Vorwelt, III. p. 437.

Am. testa inflata; anfractibus amplexantibus, sub-compressis, in altitudine celeriter crescentibus, transversim oblique striatis atque in brevibus intervallis delicatissime sulcosis; dorso rotundato; umbilico angusto et profundo; apertura ovato-dilatata. Suturis septorum numerosissime dissectis, umbilicum versus sensim magnitudine decrescentibus, lateraliter tri-lobatis; sellarum lobulis, parum foliaceis, sellis bipartitis, sella dorsali latissima; lobo laterali primo bifido, vix longiore quam lobo dorsali; lobis ceteris irregulariter bifidis.

Diameter of largest specimen from Verdoor.....	125 mm.
Proportions (whole diameter being considered as 1·00) calculated from figured specimen in diameter of	125 mm.
Diameter of outer whorl : whole.....	0·56
Width of umbilicus : whole diameter	0·15
Thickness of section : height	1·91

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Shell consisting of few rounded whorls, which grow very rapidly in height and breadth, the greatest thickness being round the umbilicus. The surface is covered all over with fine striæ, and at short distances with slight furrows; both spring from the umbilicus with a delicate curve forwards (being on the wall of the umbilicus nearly straight), and again recurve backward over the roundish back of the shell; the furrows increase in number on approaching the mouth and at it a ribbing, very similar to that which occurs in *Nautilus elegans*, is formed. Umbilicus very deep and narrow, leaving only about one-third of the inner whorls exposed; aperture elliptical, broadest below and becoming gradually narrower towards the top. The septa form three lobes on each side, much and deeply divided and diminishing in size towards the umbilicus; saddles bipartite with short phylliform lobules: of the lobes, the dorsal is the largest with four branches on either side of the siphuncle; the first lateral lobe is not much longer and is bipartite, the succeeding lobes irregularly tripartite.

Am. Indra, already described by Prof. E. Forbes from Pondicherry, is one of the finest species of Ammonites from these districts, both as regards the peculiar nautiloid form of the shell and the delicate ornamentation. The specimen we have figured contains only the air-chambers, and the species may, therefore, attain a considerable size.

Range. Valudayur group.

Locality. Verdoor or Valudayur, near Pondicherry: only three specimens were obtained.*

3. AMMONITES IMPROVISUS, *Stoliczka*, Pl. LVIII. Fig. 4.

Am. testa inflata, rotundata; anfractibus celeriter altitudine crescentibus, lævigatis; dorso convexo, umbilico angusto, profundo; suturis lateraliter 6-lobatis; sellis foliaceis, bi-lobis tri-partitis; lobo dorsali multo brevior quam laterali primo; sella dorsali minore quam laterali prima.

Diameter of figured specimen	46 mm.
Outer whorl: (whole diameter considered as 1·00)	0·52
Width of umbilicus: whole diameter	0·13
Thickness of section: height	0·88

The inflate shell is formed of a few round whorls, only slightly compressed at the sides, smooth and very regularly and rapidly increasing in height and thickness; a few small transverse furrows are to be observed on the young shell; they are straight. The shell slopes gradually to the umbilicus, which is small, exposing nearly one-fifth of the inner whorls; the section is ovate, rounded at the top, and lunulate at the base. The sutures are six-lobed on each side, diminishing in size towards

* In the geological report on these Cretaceous rocks (Mem. Geol. Surv. of India, IV. Pt. I. p. 159) Mr. H. F. Blanford quotes *Am. Indra* from the limestone of the Arrialoor beds at Royapoothoopakkam. As I have not been able to discover any other specimens of this species in the Survey collections, I have retained only the locality attached to the specimens, which had been labelled by Mr. Blanford himself.

the umbilicus; saddles with phylliform lobules, bipartite; lobes tripartite; the dorsal lobe is the shortest, and the first lateral the largest and deepest; the dorsal saddle is also much smaller than the first lateral, but is equally high.

This species is well characterized by the regular increase of the roundish whorls, both in height and thickness, and by its phylliform sutures, which easily distinguish it from other similar forms. In Europe such forms are more frequent in the Jurassic than in the Cretaceous strata.

Range. Ootatoor group.

Locality. Neighbourhood of Odium; only the figured specimen, which is a cast, has been examined.

4. AMMONITES SUB-ALPINUS, *D'Orbigny*, Pl. LVIII. Fig. 3.

1840. *Ammonites alpinus*, *D'Orbigny*, Pal. Franc. Terr. Cret. I. p. 283, Pl. 83, Figs. 1—3.
non *idem* *Risso*.

1850. „ „ *sub-alpinus*, *D'Orbigny*, Prodr. II. p. 124.

1860. „ „ „ *Pictet*. Pal. Suisse. Foss. d. St. Croix, p. 271.

Am. testa inflata, lateraliter sub-compressa; anfractibus amplexantibus, transversim minutissime striatis atque intervallim sulcatis; dorso convexo; umbilico angustissimo; apertura ovate-elongata; suturis septorum lateraliter 5-lobatis; lobo dorsali brevissimo, sella dorsali minore quam laterali prima, lobis trifidis cum terminationibus acutissimis, sellis bipartitis, foliaceis.

Diameter of the figured specimen from Penangoor.....	75 mm.
Outer whorl : (whole diameter considered as 1·00).....	0·57
Width of umbilicus : whole diameter	0·08
Thickness of aperture : height.....	0·65

Shell inflate, somewhat compressed from both sides, strongly involute and rapidly increasing in height. The surface of the shell, which is partly seen on our cast, shews very numerous fine striæ in a transverse direction, while on the cast itself, and especially at the mouth, there are some transverse furrows. Back round; umbilicus very narrow, exposing only a very small portion of the inner whorls, with a slightly rounded edge: aperture elliptical, elongated. The sutures form 5–6 lobes on each side, all equally formed, and becoming smaller towards the centre; the saddles are provided with phylliform lobules and are unequally bipartite; the dorsal lobe is very small; lobes are trifid, acutely pointed, the dorsal lobe is scarcely half as large as the first lateral lobe.

This species is easily distinguished from *Am. improvisus*, n. sp., by the greater compression of the shell and by the proportionally smaller sutures. Of allied European *Heterophylli*, we would quote *Am. Guettardi*, *Rasp.* (*D'Orbigny*, Pal. Franc. I. p. 169, Pl. 53, figs. 1–3); from this our species differs only in the considerable height of the whorls, the other characters and the septa being very similar. From *Am. Velledæ*, *Mich.*, it is distinguished by the greater thickness of the

shell, and by the less numerously divided sutures, the dorsal saddle especially being very simple, consisting merely of three lobules (*vide* p. 116).

It is very remarkable with what regularity these two species occur together both in India and in Europe; we noticed also a similar occurrence of *Am. Rotomagensis* with *Am. Mantelli*, and of *Am. inflatus* with *Am. Candollianus*. As the differences are very constant, we cannot but retain such forms as species; but, on the other hand, the idea that these are sexual differences only, readily presents itself.

Range. Ootatoor group.

Locality. Penangoor, about two miles west of the village; the single figured specimen was found in a yellowish earthy limestone. *Am. Sub-Alpinus* is a very characteristic fossil of the Gault (middle and lower) in France (Perte du Rhone), Savoy, and Switzerland.

5. AMMONITES SURYA, Forbes, Pl. LVIII. Fig. 5.

1846. *Ammonites Surya*, E. Forbes, Trans. Geol. Soc. Lond., VII. p. 106, Pl. VII. Fig. 10.

1852. „ „ Giebel, Fauna der Vorwelt. III. p. 503.

Am. testa discoidea, compressa, transversim striato-sulcata, s'riis nonnullis longioribus, ad umbilicum extensis, ceteris umbilicum versus sensim obsolete; dorso subrotundato; umbilico angustissimo; sectione anfractuum elongata, compressa, antice angustata; suturis-septorum lateraliter 7-lobatis, numerosissime divisis, sellis bipartitis, foliaceis, lobis ad terminationes unicus; lobo dorsali brevissimo, lobo laterali primo maximo; sella dorsali minima, brevior quam laterali prima.

Diameter of largest (fragmentary) specimen from Pondicherry about	80 mm.
Proportions (whole diameter being considered as 1.00) from the figured specimen in the diameter of.....	32 „
Diameter of outer whorl : whole.....	0.56 „
Width of umbilicus : whole diameter.....	0.09 „
Thickness of section : height	0.50 „

Shell discoid, much compressed and strongly involute, whorls rapidly increasing in height, and covered with numerous transverse striæ, of which the greatest number become obsolete towards the umbilicus, only a few, at moderate distances from each other, reaching to the umbilicus, somewhat stronger in the middle of the flanks of the shell and a little curved. Back rounded, somewhat more compressed than the middle of the flanks; umbilicus very narrow; section of the whorls much compressed, elongated. The sutures form seven lobes on each side, numerously divided and long-branched; the saddles are bipartite, with small phylliform lobules; lobes tripartite, acutely pinnate; the dorsal lobe is the shortest, the first lateral the largest and deepest, from which the succeeding ones diminish gradually in size towards the umbilicus; the dorsal saddle is also very small and shorter than the first lateral saddle, which exceeds the others in size.

Am. Surya is an elegant species of the *Heterophylli* group, nothing similar to which is known among the Cretaceous Ammonites of Europe. *Am. Bogotensis*, from the Cretaceous rocks of Santa Fé de Bogota (Forbes, Quar. Jour. Geol. Soc. Lond., 1, p. 178), has a similar ornamentation; but in that species the back is excavated as in Ammonites of the group *Dentati*.

Giebel, without considering the lobes in the present species, which were described but not figured by Prof. E. Forbes, has placed this Ammonite among the *Clypeiformes*. He may have been led to this by Forbes' figure (Pl. VII. Fig. 106, loc. cit.), which by an error in the shading gives the idea of a sharp keel on the back.

Range. Valudayur group.

Locality. Pondicherry; only three, partly broken, specimens have been seen; they belong to the Madras Museum.

6. AMMONITES VELLEDEÆ, *Michelin*, Pl. LIX. Figs. 1-4.

1834. *Ammonites Velledæ*, Michelin, Mag. de Zoologie de Guérin, 1833, Pl. 35.

1840. " " D'Orbigny, Pal. Franc. Terr. Cret. I, p. 280, Pl. 82.

1860. " " Pictet, Pal. Suisse. Foss. de St. Croix, p. 268, Pl. XXXVI.

Fig. 8 (with other references).

Am. testa discoidea, subcompressa, involuta, transversim numerosissime striata; striis umbilicum versus subobsolete; dorso rotundato; umbilico angustissimo, profundo; apertura elongate-ovata. Septorum suturis lateraliter 6-lobatis; sellis bipartitis, foliaceis, lobis trifidis; sella dorsali multum brevior quam laterali prima, lobo dorsali minimo, sella siphonali ad terminationem 3-dentata.

Diameter of largest specimen from Ootatorr	150	mm.
Proportions (whole diameter being considered as 1.00) calculated	<i>a</i>	<i>b</i>
from diameter of	35	68
Outer whorl : whole diameter	0.57	0.57
Width of umbilicus : whole diameter	0.08	0.06
Thickness of section : height	0.87	0.59

a. Inflate variety figured, Pl. LIX. Fig. 4.

b. Compressed ditto, ditto, Fig. 1.

Shell discoid, compressed from the sides, very involute, transversely striated; the striæ are stronger at the back and become nearly obsolete towards the umbilicus, which is very narrow and deep, leaving a minute portion of the inner whorls visible; back roundish, aperture elongate-elliptical. The sutures present a large number of saddles and lobes on each side, generally ten, both diminish in size towards the centre of the shell; saddles are bipartite, phylliform, lobes trifid with long pointed branches; the dorsal lobe is the shortest, and with the first lateral the deepest; the siphonal saddle has three denticles at its termination, the dorsal saddle is much smaller than the first lateral.

The Geological Survey collection contains some very large and well-preserved specimens of this species, which, in form, differ only as regards the degree of compression: to shew which we have figured three specimens in different stages of growth, which also shew the varieties. In all, the lobes are equally formed and

strongly divided. The species is well separated from all other Ammonites of the *Heterophylli* group by this character of the lobes, and by the entire absence of all transverse furrows. The nearest ally known is *Am. Sub-Alpinus*, D'Orb., from which it differs chiefly by the two characters just mentioned, and usually also by the compression and the proportions of the shell. There is also a difference between them in the form of the umbilicus, which in *Am. Velledæ* is funnel-shaped, having (where the shell is well preserved) rather a marked rim or edge all round, while in *Am. Sub-Alpinus* (in the last whorl) the edge of the umbilicus is slightly rounded. D'Orbigny (loc. cit.), Ewald (*Zeit. d. Deutsch. Geol. Gesell.* 1850, II. p. 450) and most recently Pictet (loc. cit.) have carefully noticed the differences and relationships of these two species, and it is therefore unnecessary to go further into this question here. Forbes has also described a species very nearly allied to *Am. Velledæ* as *Am. Buchiana*, from the Cretaceous rocks of Santa Fé de Bogota. (*Quar. Jour. Geol. Soc. Lond.*, I. p. 177.)

Range. Ootatoor and Arrialoor groups.

Localities. Neighbourhood of Odium, in yellowish earthy sandstone, and east of Ootatoor in dark earthy limestone; common in Ootatoor group. South-west of Arrialoor in the Trichinopoly district, two specimens in siliceous grit; this latter locality is in the Arrialoor group.

In Europe *Am. Velledæ* has a wide spread in the middle strata of the Cretaceous series; it occurs in many localities in the Gault of France and Savoy (Pictet). It is also quoted by D'Orbigny from his *Etage Albien*; from the *Etage Cenomanien* by Gras, and from the *Neocomien* of Switzerland by Brunner. Sharpe (*Ceph. of the Chalk*, p. 39) quotes it from the Upper Chalk near Norwich and from the grey chalk of the Isle of Wight. Abich (*Vergleich. Geol. Grund. d. Kaukasischen Lænder*, 1828, p. 136) found the species in the Cretaceous rocks (middle strata) of the southern declivities of the Caucasus.

7. AMMONITES ROUYANUS, D'Orbigny, Pl. LIX. Figs. 5-7.

- 1841. *Ammonites Rouyanus*, D'Orbigny, Pal. Franc. Terr. Cret. I. p. 362, Pl. 110, Figs. 3-5.
- 1846. " " Sowerby, Trans. Geol. Soc. Lond., VII. p. 108, Pl. 8, Fig. 6.
- 1850. " *Forbesianus*, D'Orbigny, Prodrôme, II. p. 213

Am. testa inflata, lævigata seu transversim striata; umbilico impresso, clauso; anfractibus amplexantibus, convexis, ultimo $\frac{6}{10}$ dorso rotundato; apertura dilatata, antice rotundata; suturis septorum numerosissime dissectis, lobis lateraliter 10-lobatis, sellis bipartitis, lobulis foliaceis.

Diameter of largest specimen, from Odium	40 mm.
Proportions (whole diameter being considered as 1.00) calculated	a b
from specimen with diameters of	40 38
Diameter of outer whorl : whole	0.60 0.62
Width of umbilicus : whole diameter	0.02 0.03
Thickness of section : height	0.62 0.58

a. Largest and most inflate specimen in the collection from Odium.

b. Figured specimen, from same locality.

Shell inflate consisting of a few entirely embracing rounded whorls, which are on the whole surface covered with fine transverse striæ; these are only seen on the perfect shell, not on the cast, which appears smooth. On the body chamber the striæ become a little stronger than on the air-chambers. The sutures are divided on each side into about ten lobes, and about as many saddles, both diminishing in size towards the umbilicus; the first lateral lobe and saddle are both nearly as deep as the dorsal lobe and saddle; lobes tripartite with sharp pointed terminations; saddles bipartite, with bifid phylliform lobules.

Am. Rouyanus, with the characters just quoted, was first described by D'Orbigny in the *Paléontologie Française* (loc. cit.), and with this species Forbes identified the Indian fossils in question. Subsequently, in 1850, D'Orbigny thought that his *Am. Rouyanus* might be merely a young specimen of *Am. infundibulum* (Prodr. II. p. 98), and he, therefore, considered the Indian Ammonite different, and named it *Am. Forbesianus*. D'Orbigny having done so, other Palæontologists, (Pictet, Ewald, Giebel, &c.) also quoted *Am. Rouyanus* as a young specimen of, and identical with, *Am. infundibulum*. About this point of identification we are unable to decide, as we have no such form as *Am. infundibulum* in our collections from S. India. Pictet states very distinctly (*Mater. p. l. Paléont. Suisse Foss. d. Voirons. 1858. Part II. No. 1, p. 19*) the identity of *Am. Rouyanus* and *infundibulum*, D'Orb., and we must, therefore, give our reasons for not having quoted *Am. infundibulum* above.

Our specimens, fourteen in number, are in all respects identical with the first published descriptions of *Am. Rouyanus*. Parts of the shell, where preserved on some of these specimens, shew only fine transverse striæ, but in none are the ribs so distinctly shewn as in D'Orbigny's and Pictet's figures of *Am. infundibulum*. Further, the whorls of *Am. Rouyanus* are much broader on the back and continue to increase in this dimension. It is, therefore, difficult to see from the existing figures how the more compressed form with a narrow back could grow, in a regular way, from inflated forms with a broad back. We compared our specimens with one from the Neocomian of Escragnolles,* a true *Am. infundibulum*, which shews the same distinctive characters as do the figures. The lobes in both are nearly identical, but seem to be less numerous in *Am. infundibulum*. We do not wish to convey anything by this remark further than to attain correctness in our determinations; and we would leave the final decision of the question to European palæontologists, who have better opportunities of comparing actual and well-preserved specimens of the two forms.

There can, however, be no doubt as to the correctness of Prof. E. Forbes' statement (loc. cit., p. 108), "I cannot distinguish between them (*Am. Rouyanus*, D'Orbigny, and the Indian fossil), so prefer identifying the Indian with the French species."

* We have had the opportunity of comparing undoubted specimens from European localities with our Indian fossils, since we referred to the matter (p. 43), and have in all cases found our conclusions quite confirmed as to the identity of species.

Range. Ootatoor group, Trichinopoly district; Valudayur group, near Pondicherry. In Europe known from the Neocomien. Ewald (Über die Grenze zwischen Neocomien und Gault. Zeitschrift der deutsch. Geol. Gesellsch. 1850, II. p. 452), considering *Am. Rouyanus* as identical with *Am. infundibulum*, D'Orb., states that the species occurs not only in the Neocomien but also in the 'Apt-mergel' near Apt and Méonville, which marl he believes to be of middle Cretaceous, or Gault, age.

Localities. Neighbourhood of Odium, and Pondicherry.

D'Orbigny at first gave the Neocomien locality, 'environs de Castellane' (Sisteron?) 'Basses Alpes' (Pal. Franc. II. p. 363). In the Prodrôme (II. p. 98) he omits this locality, and quotes only those of *Am. infundibulum*, D'Orb. Of other European localities for *Am. Rouyanus*, as restricted, we know scarcely anything; although there can be little doubt of its occurrence in the Swiss and Savoy Alps. Abich, in his list of fossils from Daghestan (Zeits. d. deutsch. Geol. Gesellsch. 1851, III. p. 25), among other Cretaceous fossils quotes also *Am. infundibulum*, D'Orb.: remarking that the shell is very thin, without any nodes or plicæ, only covered with fine striæ. Dyon. Stur also quotes *Am. Rouyanus*, D'Orb., from the Neocomien of the Habrove valley, south of Habrove, and near Hlubina, both localities in the north-western provinces of Hungary (Jahrb. K. K. Geol. Reichsanstalt. 1860, XI. p. 44).

8. AMMONITES DIPHYLLOIDES, Forbes, Pl. LIX. Figs. 8-11.

1846. *Ammonites diphyloides*, Forbes, Trans. Geol. Soc. Lond., VII. p. 105, Pl. VIII.

Fig. 8.

1852. „ „ Giebel, Fauna der Vorwelt, III. p. 436.

Am. testa discoidea, lateraliter compressa, transversim minutissime striata atque distanter 7-sulcata; sulcis flexuosis, ad dorsum antice curvatis et continuis; dorso rotundato; umbilico angustissimo profundoque; apertura ovato-elongata, lunulata; suturis septorum lateraliter 7-lobatis, multice incisiss, sensim umbilicum versus magnitudine decrescentibus; lobis tri-partitis, sellis bi-partitis, infra valde constrictis earumque lobulis parum foliaceis; lobo laterali primo non longiore quam dorsali.

Diameter of largest specimen from Pondicherry.....	56 mm.	
Proportions (whole diameter considered as 1·00) calculated from specimens with diameter of	<i>a</i>	<i>b</i>
.....	15	45 mm.
Diameter of outer whorl: whole	0·50	0·48 „
Width of umbilicus: whole diameter	0·10	0·13 „
Thickness of section: height	0·94	0·90 „
<i>a.</i> Small figured specimen from Pondicherry.		
<i>b.</i> Larger specimen from the neighbourhood of Odium.		

The shell consists of few compressed whorls, which are very involute and roundish at the back. The surface of the shell, when well preserved, shews numerous fine striæ of growth, and, on the cast, there are on the last whorl seven or eight transverse furrows, which are doubly curved in the middle of the flanks of

the shell, and over the back forward. Young specimens, with the shell preserved (Figs. 8 and 8a), do not shew any furrows, but on more fully grown specimens they are marked by slightly elevated ribs. Back round and smooth, umbilicus very small, the inner whorls being scarcely exposed at all; aperture ovate, compressed, rounded at the top and lunulate at the base. The sutures form generally seven lobes on either side; they are not deeply but very numerous divided, gradually diminishing in size towards the umbilicus; saddles all equally formed, bipartite with small and slightly phylliform lobules, and in the lower parts strongly contracted; lobes tripartite terminating in very numerous denticles, dorsal lobe about as long as the first lateral. In young specimens the lobes and saddles are comparatively less incised, and therefore appear to be broader.

Am. diphyloides is readily distinguished by the compression and smoothness of the shell, by the transverse furrows and the numerous lobes and saddles. In fact it is more nearly allied to *Am. inornatus*, D'Orb. (Pal. Franc. I. p. 183, Pl. 55, figs. 4-6) both in the compression of the shell and in the form (not the number) of the saddles, than to *Am. diphyllus*, D'Orb., which is laterally convex.

Range. Ootatoor group, in the Trichinopoly district; Valudayur group, near Pondicherry.

Localities. Neighbourhood of Odium, not unfrequent. Pondicherry; three small specimens from the Madras Museum.

9. AMMONITES YAMA, *Forbes*, Pl. LIX. Fig. 12.

1846. *Ammonites Yama*, Forbes, Trans. Geol. Soc. Lond., VII. p. 107, Pl. VII. Fig. 4.

1852. „ „ Giebel, Fauna der Vorwelt, III. p. 441.

Am. testa discoidea, sub-compressa, lævigata; dorso rotundato; umbilico angusto, abrupte excavato atque profundo; sectione anfractuum elongate-compressa; suturis lateraliter quinque lobatis, sensim umbilicum versus magnitudine decrescentibus, sellis bipartitis, vix foliaceis, lobis, trifidis, lobo dorsali parum brevioribus quam laterali primo.

Diameter of figured specimen from N. E. of Odium	30 mm.
Outer whorl: (whole diameter considered as 1·00).....	0·48 „
Width of umbilicus: whole diameter.....	0·18 „
Thickness of section: height	0·89 „

Shell discoid with flat sides and convex back, the whorls embrace much and, so far as is seen in our specimen (in part only a cast), are smooth; umbilicus narrow with perpendicular walls, exposing only a very small portion of the inner whorls; aperture somewhat elongated, not much higher than broad, rounded at top. The sutures of the septa are laterally five-lobed, there being besides these two or three very small lobes on the straight walls of the umbilicus; the saddles are bipartite, all equally formed, but their terminations are not truly phylliform,

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but merely rounded as in Ammonites of the *Ligati* group; lobes are tripartite, the dorsal one a little shorter than the first lateral.

This species in form resembles *Am. diphyloides*, but differs from it by the smaller number of lobes in the sutures, and by the straight walls round the umbilicus. It is more closely related to *Am. inanis*, n. sp., differing from this by the lateral compression of the shell (which in *Am. Yama* is compressed more round the umbilicus than near the back), by the absence of any transverse furrows, and by a narrower umbilicus.

'The whorls,' Prof. E. Forbes says (loc. cit.), "are very gently increasing towards the mouth, which consequently has an oblong compressed form, distinguishing it from all the species in the collection." Notwithstanding this, European palæontologists, without having seen or known anything about this Indian species, have not dealt fairly with it. D'Orbigny (Prodr. II. p. 213) considers *Am. Yama* as identical with *Am. Chrishna*, Forbes, to which it has nearly as close a resemblance as any other Ammonite, and Giebel (loc. cit.) believes it to be the same as *Am. Varuna*, Forbes, evidently taking Forbes' notice of the relations of these two species as implying identity.

Range. Ootatoor group; Valudayur group.

Locality. North-east of Odium, in a gritty whitish limestone, a single specimen was found. Professor Forbes described one from Pondicherry.

10. AMMONITES INANIS, *Stoliczka*, Pl. LIX. Figs. 13-14.

Am. testa sub-inflata, lateraliter compressa, lævigata, transversim 7-sulcata; sulcis ad dorsum parum flexuosis; dorso rotundato; umbilico moderato, abrupte excavato; sectione anfractuum lunulata, sub-compressa; suturis septorum lateraliter quadrilobatis, sellis vix foliaceis, bi-, lobis tri-, partitis; lobo dorsali non longiore quam lobo laterali primo.

Diameter of largest specimen from Odium	36 mm.
Proportions (whole diameter being considered as 1·00) calculated	<i>a</i> <i>b</i>
from specimen with diameter of	23 36 mm.
Outer whorl: whole diameter	0·45 0·14
Width of umbilicus: whole diameter	0·23 0·22
Thickness of section: height.....	1·00 1·06

a. Young specimen with a portion of the body-whorl, Pl. 59, Fig. 13.

b. Further grown specimen, containing only the air-chambers, Pl. 59, Fig. 14.

Shell inflate, smooth, with somewhat compressed sides; the whorls increase very regularly in height and thickness, sloping gradually towards the outer periphery and very rapidly towards the umbilicus, which is of moderate size, exposing about one-fifth of the inner whorls. The last whorl, on the cast, presents seven transverse furrows, which are nearly straight on the flanks and bend forward on the roundish back: the section of the whorls is lunulate, nearly as broad as high. The sutures form four lobes and four saddles on each side, and two or three still

smaller ones on the wall of the umbilicus; saddles are scarcely phylliform, saddles bi-, lobes tri-, partite; dorsal lobe not deeper than the first lateral, the dorsal saddle is the largest, and the fourth lateral saddle is placed on the edge of the umbilicus.

This species is allied to *Am. diphyloides* and *Yama*; from the first it differs by the number of lobes on each side of the shell, and from the second by the more inflated shell, the larger umbilicus and the transverse furrows.

Range. Ootatoor group.

Locality. About one mile north of Odium; only the two figured specimens have as yet been found.

Group 13. GLOBOSI.

Inflated, strongly involute shells with roundish back, very deep umbilicus, smooth or slightly ribbed surface, and multilobed and deeply divided sutures, which are often like those of the *Heterophylli*, are the characters of this group. Excepting the small specimen of *Am. simplex*, D'Orbigny, there has not yet been found in the Cretaceous rocks any Ammonite which could have been, with sufficient certainty, referred to this group, the representatives of which are as yet only known from the Triassic formation and almost exclusively from the Alpine Trias.*

In this group from the Cretaceous rocks of Southern India, we have to notice three species,—*Am. Rudra*, *Am. Xetra*, and *Am. Telinga*,—of which detailed descriptions, as regards the distinctions in the lobes, will be found fully given under each species. All three Indian species belong to the lowest group of the Cretaceous series in the Trichinopoly district.

1. AMMONITES RUDRA, *Stoliczka*, Pl. LX.

Am. testa globosa, sublævigata, anfractibus numerosis, sub-amplexantibus, junioribus transversim costatis; umbilico aperto; profundissimo; sectione anfractuum semilunulata; suturis septorum lateraliter quadri-lobatis, umbilicum versus magnitudine sensim decrescentibus, multice et profunde incisis; sellis inæqualiter tripartitis, ramulis phylliformibus; lobis ad terminationes bifidis; lobo dorsali non longiore quam laterali primo.

Diameter of figured specimen	170 mm.
Outer whorl: (whole diameter considered as 1·00).....	0·39 „
Width of umbilicus: whole diameter	0·23 „
Thickness of section: height	2·12 „

* Mr. Drescher (Zeitsch. d. deutsch. geolog. Gesellsch. 1863, Vol. XV. p. 330) states that the lateral compression in *Am. Orbignyanus*, Gein., disappears nearer to the mouth, and the section becomes in consequence oval. I am much inclined to believe that this species should be transferred to the group of 'Globosi.' Perfect specimens, when found, will, of course, decide the matter.

The globose shell consists of numerous whorls, which are uniformly rounded from the one edge of the umbilicus to the other, with perpendicular walls to the very deep umbilicus, in which only a small portion of the inner whorls remains visible. The surface of the shell on the inner whorls shews transverse ribs, being otherwise smooth. The aperture is semi-lunulate measuring in breadth more than twice the height. The sutures present on each side of the roundish part of the shell four lobes and as many saddles, very deeply and numerously divided; both are high and proportionally small; the saddles are unequally tripartite with phylliform lobules becoming shorter towards the umbilicus; the lobes are bifid, the first lateral not longer than the dorsal: in addition to these there are some short lobules on the straight umbilical wall.

The figured specimen, from the yellowish sandstones of the Ootatoor group near Odium, consists only of the air-chambers: two other specimens have been found, somewhat more ribbed. Among known Ammonites, there is only one Cretaceous species, *Am. simplus*, D'Orb. (Pal. Franç. Terr. Cret. I. p. 208, Pl. 60, Figs. 7—9), which we can compare with our fossil. D'Orbigny's figure represents a very small specimen, which in its shape does not differ from ours and he also mentions that M. Duval, who found the specimen in the *Neocomien* of Lieous near Senez (Basses-Alpes) possessed another specimen of twice the size, that is, about 42 mm. in diameter. It would be of the highest importance in the study of the Cretaceous forms of Ammonites, that further and more accurate enquiry should be made regarding this species described by D'Orbigny, which is so closely related to our Indian fossil.

D'Orbigny was the first (Prodr. II. p. 64) to unite *Am. simplus*, with *Am. verrucosus*. His figure of *Am. simplus* is, however, very different from that of *Am. verrucosus* (Pal. Franç. Terr. Cret. I. Pl. 58, Figs. 1—3) and I can scarcely think, that D'Orbigny could have been so much mistaken in the first examination of *Am. simplus*, even of a young shell, as to describe a smooth specimen of *Am. verrucosus* for a young shell of this characteristic species. Following D'Orbigny's example, Giebel, Pictet and other Palæontologists have quoted *Am. simplus* as a synonym of *Am. verrucosus*. And we may remark that no less confusion exists as to the proper designation of *Am. verrucosus* itself, (*vide* Giebel's *Fauna der Vorwelt*, 1852, III. p. 602.)

Of other similar forms of Ammonites, which occur in the Cretaceous rocks, we may mention *Am. Jaubertianus*, D'Orb. (Journal de Conchyliol. par Pitet, I. p. 200, Pl. VIII. Figs. 9—10) from the *etagé Aptien* of Middle France (Barème, etc.); and also *Am. Jugurtha*, Coquand, (Mem. Soc. Geol. France, 1854, II. Ser. V. p. 142, Pl. 3, Figs. 12—13,) from the *Neocomien* of Algeria. The first species has laterally sharp angular, and the second rounded, whorls.

Range. Ootatoor group.

Locality. Neighbourhood of Odium, Trichinopoly district, in a brownish calcareous sandstone; very rare.

2. AMMONITES XETRA, *Stoliczka*, Pl. LXI.

Am. testa orbiculari, lentiforme; anfractibus amplexantibus junioribus transversim subcostatis, adultis lævigatis, ultimo anfractu prope aperturam dilatato, deinde rursus depresso; umbilico clauso; apertura elongate-compressa, lateraliter sinuosa; columella callosa: suturis septorum lateraliter trilobatis; sellis inæqualiter bipartitis, umbilicum versus magnitudine crescentibus; lobis angustis, bifidis; lobo dorsali multum brevioris quam laterali primo, lobis auxiliaribus tribus, minimis.

Proportions (the diameter being considered as 1.00) calculated from	
the figured specimen in the diam. of	135 mm.
Outer whorl : whole diameter	0.55
Width of umbilicus : whole diameter	0.02
Thickness of section : height {	
at the involution	0.64
at the umbilicus.....	0.88

Shell orbicular and lentiform, consisting of laterally compressed whorls, which are quite involute, having their greatest thickness in the centre, and becoming narrower towards the periphery. Young specimens (of which one is figured Pl. LXI. Fig. 2,) present numerous transverse ribs, which are distinct at the back, and become ill-defined towards the umbilicus; on adult shells the surface is nearly smooth. The umbilicus, on the perfect shell, is entirely covered with a callous mass of the inner lip and a small funnel-shaped umbilicus can be seen, only when this is broken away. Fig. 1, represents a large well-grown specimen, on which a part of the mouth is preserved, while the other part has been restored in outline. Near to the mouth, the body chamber is enlarged, and at the margin itself is again depressed, and prolonged forward at the sides, by which the sinuous margins are caused. The horny-like callous mass of the inner lip, which Quenstedt (*Cephalopoden Deutschlands*, 1849, p. 244), notices as peculiarly characteristic of the *Globosi* group of Ammonites, is distinctly seen in this specimen, and its thickness marked by the line adjacent to the inner whorl, in the front view (Fig. 1a) Traces of the surface, so far as they are visible, enable us to recognize the nacreous structure of the shell.

The sutures of the septa are very peculiar; the dorsal lobe is bifid, with three branches on either side of the siphuncle, and is much shorter than the first lateral; this latter is very deep, gradually smaller towards the end, and with a bifid termination, as has also the short second lateral lobe: the saddles, three in number, are bifid, have short rounded branches, and are each broader, towards the umbilicus, than the preceding one, the dorsal saddle being the narrowest. To these succeed, up to the edge of the umbilicus, three very short saddles and lobes, which look like the terminations of a broad third lateral lobe.

Nothing similar to this species is known among the fossils of the Cretaceous or other secondary deposits in Europe.

Range. Ootatoor group.

Group 14. **MACROCEPHALI.**

Of Ammonites from the Cretaceous formation belonging to this group only a few are known. And these few generally shew remarkable differences from the Jurassic *Macrocephali*, in which the lateral ribs form a tubercle about the middle of the sides, and then divide into two or more ribs. The shell of Ammonites in this group is inflata, and the whorls rounded, the divisions of the sutures narrow.

In this group we notice four species all peculiar to the South Indian deposits; *Am. Deccanensis*, *Arrialoorensis*, *Koluturensis* and *Brahminicus*. Species similar to the two first have been described in Europe, while *Am. Koluturensis* is most nearly related to characteristic Jurassic species (as *Am. Herveyi* and others). *Am. Brahminicus* differs much from all the others, by its compression, although it cannot be easily united to any other group.

1. **AMMONITES DECCANENSIS**, *Stoliczka*, Pl. LXIII. Fig. 1.

Am. testa inflata; anfractibus rotundatis, prope umbilicum tuberculatis, transversim subcostatis; costis ad umbilicum tuberculatis, fascicularibus, tripartitis; nonnullis simplicibus; dorso rotundato; umbilico angusto; apertura semilunata dilatata; septis — ?

Proportions calculated from the figured specimen in the diameter of	100 mm.
Outer whorl : whole diameter	0.51
Width of umbilicus : whole diameter	0.21
Thickness of section : height.....	1.33

Shell inflata, with numerous round whorls, with large tubercles at the umbilicus : numerous but slight transverse ribs cross the shell, either single or bipartite from the tubercles. Back round; umbilicus narrow, only a small portion of the inner whorls being exposed; aperture semilunate, broader than high. The figured specimen has been a little injured by lateral pressure, the dotted lines in our figures representing the probable true shape. The septa could not be seen.

We are not acquainted with any species among the European Cretaceous or Jurassic Ammonites similar to this remarkable form.

Range. Arrialoor group.

Locality. Karapaudy, S-west of Arrialoor; only a single specimen has been hitherto met with in the conglomeratic and siliceous sandstone of this locality.

2. **AMMONITES ARRIALOORENSIS**, *Stoliczka*, Pl. LXIII. Figs. 2—4; Pl. LXIV. Fig. 1.

Am. testa discoidea, inflata, transversim costata; costis nonnullis bifidis, ad umbilicum tuberculatis, ceteris simplicibus; dorso rotundato; umbilico angusto; apertura semilunulata. Suturis numerosissime et profunde incisiss; sellis inaequaliter bi-, lobis tri-, partitis.

Diameter of largest specimen from Arrialoor about	100 mm.
Proportions (whole diameter being considered as 1.00) calculated from the specimens figured with the diameter of.....	LXII, 3. LXIII, 1. 74 125 mm.
Outer whorl : whole diameter	0.54 0.42
Width of umbilicus : whole diameter.....	0.17 0.24
Thickness of section : height	1.29 1.32

Shell discoid, inflate with rounded whorls, which are crossed by numerous sharp ribs ; some of these being bifid and terminating on either side at the edge of the umbilicus in tubercles, others single, without any such tuberculations. On large specimens, and especially on their body whorls, all the ribs often become single and the tubercles scarcely marked. The thickness of the ribs varies on the casts, on which they appear often more slightly marked and more rounded. Back roundish with the ribs bent somewhat forward ; on some of the ribs there is a kind of bending or, at least, a depression on one or other side of the middle of the back, as represented Fig. 3a. Pl. LXIII. This anomaly only occurs on the body whorl, but is not by any means regular. Umbilicus narrow, allowing scarcely one third of the inner whorls to be seen ; aperture semi-lunulate, broader than high. The sutures exhibit only two lobes on each side of the whorl, much and deeply divided ; the saddles bipartite, with long phylliform lobules ; the lobes tripartite with very long pointed divisions ; the dorsal lobe extends somewhat deeper than the first lateral ; the second lateral saddle is placed on the edge of the umbilicus.

There are two varieties in form, one, of which a small specimen is represented in Fig. 3, Pl. LXIII, is more inflate, having at the same time a narrower umbilicus : the other, figured Pl. LXIV. Fig. 1, in which the whorls are more rounded, and the umbilicus larger.

The only European ally of this species is *Am. bidichotomus*, Leymerie, (Pictet, Palæont. Suisse. Foss. St. Croix, 1860, p. 291, Pl. XLI.) but in our Indian specimens we have never observed so repeated a bi-division of the ribs, or any such compressed forms, as *Am. bidichotomus* regularly shews. Our specimens also differ by the more rapid increase of the whorls in height and thickness.

The Indian shells grew to a diameter of 400 mm. and they appear to be very characteristic of the uppermost group of Mr. Blanford's subdivision of the Cretaceous rocks.

Range. Arrialoor group.

Localities. Karapaudy, South of Arrialoor ; and West of Arrialoor in white siliceous sandstones, numerous specimens have been found.

3. AMMONITES KOLUTURENSIS, *Stoliczka*, Pl. LXIV. Fig. 3.

Am. testa inflata ; anfractibus prope dimidium involutis, depressis, lateraliter ad umbilicum tuberculatis, transversim numerosissime striate-costatis ; costis partim fasciculatis, tripartitis, partim unicus ; dorso lato, subconvexo, transversim continu-

iter costato ; umbilico moderato ; apertura semilunata, dilatata. Suturis septorum lateraliter trilobatis, numerosissime dissectis ; lobis tri-, sellis bi-, partitis, lobo dorsali vix longiore quam laterali primo.

Proportions (whole diameter being considered as 1.00) calculated from the figured specimen with diameter of	74 mm.
Outer whorl : whole diameter	0.44
Width of umbilicus : whole diameter	0.27
Thickness of section : height.....	1.42

Shell inflate, whorls numerous, depressed and widely expanded, transversely ribbed with a row of tubercles on either side placed somewhat nearer to the umbilicus, than to the outer periphery. Some of the ribs, at the lateral tubercles, unite in threes, others are single, or bifid without forming any tubercles on either side. The back is roundish, very broad and with the ribs somewhat bent forward. Umbilicus of moderate size leaving nearly two fifths of the inner whorls visible; the aperture is semilunate, strongly depressed, much broader than high. The septa exhibit three lobes on each side; the saddles are bipartite, the lobes are trifid, both are narrow with numerous subdivisions, the dorsal lobe is nearly as long as the first lateral; the third lateral lobe is placed on the edge of the umbilicus.

The species allied to this are truly Oolitic Ammonites such as *Am. macrocephalus*, *Am. Herveyi*, and others: they differ, however, by their whorls being still more dilated and by their ribbings. The only known Cretaceous form, approaching our species is *Am. Astierianus*, D'Orb., in which the tubercles are placed much closer to the umbilicus.

Range. Trichinopoly group.

Locality. Koluture; a short distance to the north of this place, two specimens were found on the right bank of the river, and one specimen in similar gritty sandstone on the left bank of the same river.

4. AMMONITES BRAHMINICUS, *Stoliczka*, Pl. LXIV. Fig. 2.

Am. testa compressa ; anfractibus in juventute lævigatis, in ætate proevectiore transversim costatis ; costis lateraliter simplicibus, subrectis, prope dorsum tuberculatis atque deinde bipartitis, ceteris brevioribus interpositis, alternantibus ; umbilico angusto, abrupte excavato ; apertura elongata, lateraliter compressa. Septis lateraliter bilobatis, sella dorsali latissima, bipartita, lobis inæqualiter bifidis angustis.

Proportions (the diameter being considered as 1.00) calculated from the figured specimen in the diameter of.....	23 mm.
Outer whorl : whole diameter	0.43
Width of umbilicus : whole diameter	0.26
Thickness of section : height	0.70

Shell discoidal, compressed, whorls in the young state nearly smooth, afterwards transversely ribbed; the ribs being nearly straight on the sides, and forming

a tubercle near the back, they become for the most part bipartite and cross the back, alternating at the same time with other short ribs. Back roundish : umbilicus small, only one fifth of the inner whorls being exposed ; aperture prolonged, compressed. The sutures of the septa are not very distinctly visible on our specimens ; the lobes and saddles are bipartite, the dorsal saddle is large, but short, and the first lateral lobe is about half the width ; the second lateral saddle is placed on the edge of the umbilicus.

This very remarkable little species differs from all known Ammonites, that we are acquainted with. It is even difficult to fix the position of the species in any known group of Ammonites. We have preferred placing it among the *Macrocephali* to ranging it with the *Coronari*, although the peculiar ornamentation, namely the bipartition of the ribs after having formed a tubercle near the back is characteristic of this latter group. The question can only be satisfactorily settled, when better specimens have been found. Again, as the tubercles are not present in the early stage of growth of the shell and as the shell is compressed, it might, with nearly as much justice, be placed among the *Planulati*.

Range and Locality. The number referring to the locality where, the two specimens as yet known were procured, has unfortunately been lost in this case ; but from the similarity of the matrix, which is a light siliceous grit, it is very probable, that it was from near Veraghoor, in the Arrialoor group.

Group 14. **LIGATI.**

The Ligati form one of the most extensive groups of Ammonites, not only with reference to the number of species, but also as containing Ammonites, which it is impossible to arrange under any general characters. The characters are in fact mostly of a negative kind, and so the group contains Ammonites, which in form agree with others belonging to the *Heterophylli*, *Planulati*, *Macrocephali*, *Fimbriati*, and others, differing either by the lobes of the sutures or by the ribs. For these reasons, Pictet endeavoured to form subdivisions, of which he enumerates ten, excluding those species which do not occur in Europe.

Of those foreign Ammonites we have to notice here (27) twenty-seven species, and if we had to give general characteristics for these we could only mention the existence of certain transverse furrows bounded by swelling rims and marking the previous positions of the mouth, and, secondly, the invariable and marked descent of the last lobes to the umbilical suture.

We do not think that much success would follow an attempt to mark out various sub-groups. They would, probably, be scarcely less numerous, than the species themselves. We shall therefore simply describe the species in the order of their relative position between the *Macrocephali* and the *Planulati* and *Fimbriati*.

Of the twenty-seven species noticed, only five are identical with fossils common to the middle portion of the Cretaceous series in Europe, namely, *Am. peramplus*, *planulatus*, *Beudanti*, *Timotheanus* and *latidorsatus*. The remaining twenty-

two are hitherto only known from Southern India, although some of these also bear very strong resemblance to other European species, as will be found stated in the more detailed descriptions of each species. The new species are thus named: *Am. Vaju*, *Denisonianus*, *Bhima*, *Bhavani*, *Madrasinus*, *Kandi*, *Kalika*, *Æmilianus*, *Durga*, *alienus*, *Garuda*, *involutus*, *Madraspatanus*, *revelatus*, *Cala*, *Sacya*, *Kayei*, *Cliveanus*, *Moraviatoorensis*, *Paravati*, *papillatus* and *pacificus*. Many of these species have been already noticed by Prof. E. Forbes in his memoir in the Geological Transactions.

1. AMMONITES PERAMPLUS, *Mantell*, Pl. LXV. Figs. 1—2.

1822. *Ammonites peramplus*, Mantell, Foss. of South Downs, p. 200.
 1823. " " Sowerby, Min. Conch. Vol. IV. p. 79, Pl. 357.
 1840 (?) " " D'Orbigny, Pal. Franc. Terr. Cret. I. p. 333, Pl. 100, Figs. 1—2 (?)
 1840. " *prosperianus*, " " " " p. 335, Pl. 100, Figs. 3—4.
 1849. " *peramplus*, Quenstedt. Cephal. Deutschl. p. 216.
 1850. " " Geinitz. Quadersandsteingeb. in Deutschland, p. 116, (*partim*,) Pl. V. Figs. 1—2, (3 ?)
 1850. " " Rømer. Bronn's Jahrbuch f. Mineral. p. 386.
 1852. " " and *prosperanus*, Giebel. Faun. der Vorwelt, III. p. 423—4, (*partim*).
 1856. " " Sharpe. Cephal. of Chalk, p. 26, Pl. X.
 1860. " " Pictet, Mater. Palæont. Suisse. Foss. d. St. Croix, p. 354.

Am. testa discoidea, subinflata, anfractibus rotundatis, transversim costatis; costis flexuosis, inæqualibus, ad dorsum antice multum curvatis; longioribus in ultimo anfractu 6—8, ad umbilicum tuberculatis, antice sulcatis atque costis brevioribus interpositis 3—6, haud tuberculatis: testis senioribus sublævigatis, distanter (6—8.) transversim sulcatis; dorso rotundato; umbilico moderato; apertura semicirculari, postice cordata. Septis lateraliter bilobatis, lobis auxiliaribus quinque; sellis bipartitis, multice dissectis, lobis inæqualiter trifidis, lobo dorsali brevioribus quam laterali primo.

Diameter of largest specimen from Anapady.....	110 mm.
Proportions (whole diameter considered as 1.00) calculated from	<i>a</i> <i>b</i>
figured specimens, with diameter of.....	45 90 mm.
Outer whorl : whole diameter.....	0.35 0.37
Width of umbilicus : whole diameter.....	0.35 0.35
Thickness of section : height.....	1.43 1.33

(a) Young specimen figured, Pl. LXIV. Fig. 2.

(b) An older and more grown specimen, Pl. LXIV. Fig. 1.

The shell consists of numerous rounded whorls, which are crossed by longer and shorter flexuous ribs, all strongly bent forward on the back. The longer ribs, 6—8 on the whorl, commence from a sharp, elongated tubercle on the edge of the umbilicus, and have in front a deep furrow, which is more distinctly seen on the cast. The shorter ribs, between, are also of different length, in larger grown (90)

specimens three of them are generally longer, and three alternately shorter, while in young shells there are only three, or sometimes only two ribs of nearly the same length. These secondary ribs very rarely commence from a tubercle, but they form one at the point where they are curved forward.

In all the Indian specimens, the ornamentation is well marked, even on the casts; but none of them attain the size of the English specimens from the Chalk, or of the German specimens from the Pläner, where they often measure one foot and even more in diameter. The back is always roundish, the umbilicus of moderate size exposing about two-fifths of the inner whorls, on which the terminating tubercles of the longer ribs are all well seen. The aperture is semicircular, and in all our specimens broader than high.

The septa are numerous and deeply divided into lobes and saddles, which gradually diminish in size towards the umbilicus: the saddles are all bipartite, with similar subdivisions, the lobes unequally trifid; the dorsal lobe is shorter, than the first lateral; the second lateral saddle lies on the edge of the umbilicus, to which succeed five auxiliary lobes, obliquely descending to the umbilical suture.

The Indian specimens, of which the Geological Survey collection possesses fourteen, do not exhibit any great variation in the form and ornamentation.

D'Orbigny's *Am. peramplus* seems to differ very considerably from the original English figures, while his *Am. Prosperianus* is identical with them. The septa of the species have been only twice noticed. Geinitz, figure (loc. cit. Fig. 3) gives a very small dorsal saddle, of which size we have not observed it in any of our specimens. This has not been noticed either by Sharpe, whose figure agrees much more with ours.

Am. peramplus is characteristic of the middle portion of the Cretaceous rocks. In England it is quoted by Sharpe as occurring throughout the middle chalk of the counties of Kent, Sussex, Surrey, Hertfordshire, Wiltshire, the Isle of Wight, and the South downs. It extends from the white chalk without flints into the chalk with flints. Morris (Catal. p. 298) mentions it only from the lower chalk. In France, it maintains the same Geological horizon (Turonien, D'Orb.: Angoumien, Coquand, Bull. Soc. Geol. Franc. XVI. p. 968). In Switzerland it has been noticed by Stüder in the Severkalk (du Sentis); in Germany by Geinitz in the Pläner-Kalk near Dresden in Saxony; by Von Dechen in the same strata in the Duchy of Brunswick, (Neues Jahrb. 1856, p. 817); by Roemer in the Flammenmergel of many localities in the North-Western parts of Germany; and also by others (Neues Jahrb. 1850, p. 386 and 1851, p. 311.) In India the species has also been found in the middle portion of the cretaceous series, in the Trichinopoly district.

Range. Trichinopoly group.

Locality. North-West of Anapady, whence all the specimens were obtained.

2. AMMONITES VAJU, *Stoliczka*, Pl. LXV. Fig. 3.

1840 ? *Ammonites peramplus*, D'Orbigny, Pal. Franc. Terr. Cret. p. 333, Pl. 100, Figs. 1—2.

Am. testa discoidea, subcompressa, transversim costata; costis inæqualibus, subrectis; longioribus octo intus subtuberculatis; brevioribus alternantibus imprimis duobus; umbilico angusto, abrupto; apertura ovata; septis utrinque trilobatis, sellis bi-, lobis inæqualiter tri-, partitis; lobis auxiliaribus tribus, oblique descendentibus atque magnitudine decrescentibus.

Diameter of largest specimen from North-West of Anapady.....	80 mm.
Proportions (whole diameter being considered as 1.00) calculated from figured specimen, in diameter of	60 mm.
Outer whorl : whole diameter.....	0.40
Width of umbilicus : whole diameter	0.30
Thickness of section : height.....	0.97

Shell discoid, compressed, ornamented with numerous transverse ribs, of which generally eight are longer and originate at the edge of the umbilicus in a small tubercle; the other ribs are considerably shorter and are placed two or three between each pair of the longer ribs, and without any tubercles. Many of the ribs are regularly straight, none have more than a very slight bending forward. The back is roundish, crossed by the ribs; the umbilicus of moderate size with perpendicular walls and leaving one third of the inner whorls visible; the aperture is ovate, cordate at the base. The septa exhibit three lobes on each side and three obliquely descending auxiliary lobes: the third lateral lobe lies on the edge of the umbilicus; the saddles are bipartite, the lobes unequally trifid; the dorsal lobe is somewhat shorter than the first lateral.

This species is somewhat related to *Am. peramplus*, and has probably been mistaken by D'Orbigny for the true English form. This point we cannot decide, but, so far as D'Orbigny's figure is correct, it agrees much more with the species in question, than with *Am. peramplus*, from which our fossil can be distinguished by the following characters; a greater compression of the shell, the strength and straightness of the lateral ribs, which are only very slightly bent forward across the narrow back, want of deep furrows, perpendicular walls of the umbilicus and the lateral lobes; while the shell of *Am. peramplus* is always rounded, the ribs strongly bent forward, flexuous and proportionally thinner, with distinct furrows in front of each of the longer ribs, the umbilical walls gradually sloping and the second lateral saddle placed on the edge of the umbilicus, whereas in *Am. Vaju* the third lateral lobe is placed there. Further the second lateral saddle is proportionally much larger than in similar specimens of *Am. peramplus*.

Range. Trichinopoly group.

Localities. North-West of Anapady, with *Am. peramplus*, Mantell; Garudamungalum and West of Serdamungalum; the species must be rare, as only a single specimen has been met with in each of these localities.

3. AMMONITES DENISONIANUS, *Stoliczka*, Pl. LXV. Fig. 4, Pl. LXVI. and Pl. LXVI.a.*

Am. testa discoidea; anfractibus compressis, in juventute prope lævigatis, ætate proveciore transversim costatis: costis crassis, inæqualibus, plerumque simplicibus atque ad dorsum antice valde prolongatis: 8—10 costis fortioribus, longioribus atque antice sulcis profundis marginatis; ceteris interpositis tenuioribus, nonnullis usque ad umbilicum extensis, alteris obsoletis. Umbilico moderato; apertura compressa; dorso rotundato, subangulato; septorum suturis lateraliter trilobatis, lobo dorsali multum brevioris quam laterali primo, lobis tri-, sellis bi-, partitis; lobis auxiliaribus quatuor, minimis.

Diameter of largest specimen from N. East of Odium,..... 945 mm.

(See frontispiece.)

Proportions (whole diameter being considered as 1.00) calculated from specimens with diameter of	a	b	c
Outer whorl : whole diameter	70	85	130
Width of umbilicus : whole diameter	0.35	0.37	0.38
Thickness of section : height	0.38	0.33	0.29
.....	0.92	0.93	0.96

(a) Variety with large umbilicus and strong ribs, Pl. LXV. Fig. 4.

(b) Variety with strongly bent ribs, Pl. LXVI. Fig. 1.

(c) Dittò, with less bent ribs, Pl. LXVI. Fig. 2.

Shell discoidal, with compressed whorls, which in the young state of age are nearly smooth, and afterwards become ornamented with numerous unequal ribs and furrows. Eight to ten of the ribs are generally stronger and longer than the others, each bounded in front with a furrow which, generally speaking, appears more distinctly marked on the cast. The other intermediate ribs are shorter, but are unequal among themselves, both in length and in number; they are for the most part simple, seldom bipartite. All the ribs are bent forward on the back, and do not shew any tubercles near the umbilicus. It can be generally observed, that the bending or curving of the ribs has some relation to the compression of the shell. Strongly compressed shells have the ribs very much bent across the back, (Pl. LXVI. Fig. 1,) while in thicker specimens they are less bent. (Pl. LXVI. Fig. 2, and Pl. LXV. Fig. 4).

The three specimens figured on Plates LXV and LXVI may be considered as the varieties of this species differing each from the other either by the compression of the shell or by the curvature of the ribs. The variation is similar to that noticed in *Am. planulatus*, Sow. and in other species. The difference in the thickness of the ribs depends much on the preservation of the shell itself; when this is preserved, the ribs are very sharp, while on the cast, as is seen in all our figures, they appear thicker and more rounded.

The umbilicus is large, (about three fifths of the preceding whorls being covered by the involution), with sloping walls, on which the longer ribs only project

* Frontispiece.

into the space of the umbilicus; the section of the whorls is ovate, more or less elongated according to their compression. The sutures of the septa are much subdivided, the lateral lobes are three, all somewhat unequally tripartite, the first lateral is the longest, the dorsal lobe being much shorter; the saddles are bipartite, the dorsal being largest, and the third lateral being placed on the edge of the umbilicus; to this succeed four very small auxiliary lobes and saddles, descending in an oblique line.

To this species belongs the largest Ammonite yet found in Southern India, the diameter being more than three feet; of this a representation is given in plate LXVI.a.

Am. Denisonianus differs from *Am. planulatus* chiefly in the larger number of longer ribs, which in the present species are generally eight, but in the other seldom exceed six; the ribs are also all proportionally stronger in this species. As regards the sutures it is to be noticed, that in the present species, the third lateral saddle lies on the edge of the umbilicus, while in *Am. planulatus* the second lateral saddle extends to the edge of the umbilicus, and the succeeding lobe has a direction quite oblique to the preceding lateral lobes. This difference is truly characteristic, as the height of the whorl is not greater than in *Am. planulatus*.

Of allied European forms we have only to notice *Am. versicostatus*, Michelin, which D'Orbigny (Pal. Franc. Terr. Cret. p. 273, Pl. LXXXI. Figs. 1—3), has described from the Gault of France. The increase in thickness of the ribs towards the periphery, the smaller umbilicus, the large first lateral lobe, and some differences in the auxiliary lobes may be noticed as distinguishing this from our Indian species.

The species is dedicated to His Excellency Sir Wm. Denison, the Governor of Madras, whose zealous cultivation of science and more especially of Conchology has been long known.

Range. Ootatoor and Trichinopoly groups.

Localities. *Ootatoor-group*: North-East of Odium, where the largest specimens have been procured. *Trichinopoly-group*: West of Illpagoody and North of Anapady. In all these localities, it seems to be a rare shell.

4. AMMONITES PLANULATUS, Sowerby, Pl. LXVII. Pl. LXVIII.

1827. *Ammonites planulatus*, Sowerby, Min. Conch. Vol. VI. p. 136, Pl. 570, Fig. 5, (non *planulatus*, Schlotheim.)
1840. *Ammonites Mayorianus*, D'Orbigny, Pal. Franc. Terr. Cret. I. p. 267, Pl. 79.
1846. „ *Gaudama*, Forbes, Trans. Geol. Soc. Lond. VII. p. 113, Pl. X. Fig. 3.
1848. „ *Mayorianus*, Pictet et Roux, Foss. d. Gres Verts. p. 37, Pl. II. Fig. 5.
1849. „ *planulatus*, Quenstedt, Cephal. Deutschl. p. 221, Pl. 17, Fig. 13.
1850. „ *Mayorianus*, Geinitz, Quadersandstein, p. 116.
1854. „ *Griffithii*, Sharpe, Foss. Cephal. of Chalk, p. 28, Pl. XI. Fig. 3.
1854. „ *planulatus*, „ „ „ p. 29, Pl. XII. Figs. 3—4.
1860. „ *Mayorianus*, Pictet, Pal. Suisse, Foss. d. St. Croix, p. 283.
1862. „ *planulatus*, F. v. Hauer, Sitz. d. K. K. Akad. Wien. Bd. 44, p. 654.

Am. testa discoidea; anfractibus numerosis, complanatis, transversim costatis; costis inæqualibus, ad dorsum linguiforme prolongatis: longioribus in ultimo anfractu imprimis 5—6, continuis, antice cum profundis sulcis marginatis, brevioribus intersectis plus minusve numerosis, umbilicum versus evanescentibus; dorso rotundato, subcompresso; umbilico lato; apertura ovate-compressa. Suturis septorum multice atque profunde incisiss, lateraliter bilobatis, sellis bipartitis, lobis inæqualiter trifidis, acute terminantibus; lobo dorsali brevissimo, laterali primo maximo, lobis auxiliaribus quatuor, oblique umbilicum versus descendentibus atque magnitudine decrescentibus.

Diameter of largest specimen from Anapady about	800	mm.	
Proportions (whole diameter being considered as 1.00) calculated from diameters of.....	a	b	c
Outer whorl : whole diameter	76	75	130 mm.
Width of umbilicus : whole diameter	0.39	0.38	0.42
Thickness of section : height	0.34	0.34	0.30
(a) Compressed young specimen, very similar to English specimens, Pl. LXVII. Fig. 1.			
(b) A cast with somewhat thicker whorls, as in <i>Am. Griffithii</i> , Sharpe, Pl. LXVII			
(c) An inflate variety, with thicker ribs, Pl. LXVII. Fig. 3.			[Fig. 2.]

Shell discoid, whorls compressed, flattened on the sides and ornamented with numerous unequal ribs, which are all bent forward and prolonged tongue-like on the back: of these ribs generally five or six in each whorl are longer, extending from the edge of the umbilicus on one side to that on the other, and bounded on either side by a furrow, that in front of the ribs being stronger, and appearing also strongly marked on the casts of the shells: the other ribs, between the longer ones, vary only slightly in length, and all become obsolete towards the umbilicus, the edge of which is slightly rounded and slopes down to the suture. The umbilicus itself is large, exposing generally three-sevenths of the inner whorls; the aperture compressed elongated, always higher than broad, on large full-grown shells, if well preserved, strongly constricted by a deep furrow, as is seen in the reduced figure of the large specimen, represented in Plate LXVIII.

This species is very common in the Cretaceous rocks of Southern India, and grows to a considerable size. It varies but little in its ornamentation, and a comparison of our Figure 1, Pl. LXVII. with the drawing of Sowerby's original specimen (Sharpe. loc. cit. Fig. 3) will remove any doubt, which might exist, as to their identification. Two varieties can generally be separated, 1st, strongly compressed specimens with a large number of fine intermediate ribs (Fig. 1, Pl. LXVII) and 2nd, somewhat thicker specimens with a smaller number of intermediate and stronger ribs (Fig. 3, Pl. LXVII). The compression of the shell, however, does not always occur in connection with the variation of the ribs, so that this character cannot be taken as always correct without exception. The size of the umbilicus and the obsolescence of the ribs towards the umbilicus are generally very constant.

We agree with F. von Hauer in not considering *Am. Griffithii*, Sharpe, different from the present species, and we give a figure of a cast on Plate LXVII. Fig. 2, similar to Sharpe's. Our two figures of the sutures of the septa, Pl. LXVII. Figs. 1 and 3, are taken, the first from a young, the second from a larger and more grown specimen: the sutures are always much subdivided; the dorsal lobe is the shortest, with a long siphonal saddle with short branches. There are, strictly speaking, only two lateral lobes and four auxiliary lobes which descend to the umbilicus in an oblique direction. The first lateral is the largest, and both are unequally bipartite, one part of the inner branches of the lobes extending beyond any part of the other branch. Sharpe considers the lobes bipartite and views this as a difference between this species and *Am. Mayorianus*, D'Orbigny. They might in fact be said to be unequally bi or tri-partite; but they appear more disposed to be tripartite. We have never seen them, in any of our numerous specimens so regularly tripartite as they are represented by D'Orbigny and it remains to be proved, whether in this respect D'Orbigny's figure is exactly correct; we think not. The saddles of *Am. planulatus* are always bipartite, with similar subdivisions.

Am. Emerici, D'Orb. (Pal. Franc. Terr. Cret. I. p. 160, Pl. 51, figs. 1—3) is by many Palæontologists considered identical with *Am. planulatus* on account of M. Ewald's examination (Zeitsch. d. Deutsch. Geol. Gesellschaft, 1850, II. p. 445),* but we think it different. *Am. Emerici* is in fact a ribless species, allied to *Am. latidorsatus*, Mich. Well preserved casts of *Am. Emerici* are ribless, while casts of *Am. planulatus* become ribless, only when they have been exposed to weathering, or have been incrustated from mineral solutions.

Range. Ootatoor, Trichinopoly, and Arrialoor groups.

Localities. *Ootatoor group*; neighbourhood of Odium; Ootatoor; Shutanure; Seeragunoor; South-East of Ootatoor. *Trichinopoly group*; neighbourhood of Anapaudy; Garudamungalum; Koloture; Alundanapooram; North of Andoor; East of Poothoor; Kolokanuttom. *Arrialoor group*; Karapaudy; S. West of Arrialoor; South of Arrialoor; South-West of Mulloor and East of Veraghoor.

All the localities here given are in the Trichinopoly district. Professor Forbes described his species, as *Am. Gaudama*, from Verdachellum, whence we did not obtain any specimen. *Am. planulatus* is one of the very few species, which have been found in all the three groups of the Cretaceous series of S. India. In Europe it is widely distributed: in England it occurs in the Chalk-Marl and upper Greensand (Morris, Catal. p. 298): in France, Savoy, and Switzerland in the Gault and 'gres verts,' and it maintains the same geological horizon of the middle cretaceous strata in Germany (Flammenmergel and Pläner) and in the Eastern parts of Austria (Hungary, F. von Hauer, loc. cit.; and the Carpathians, Hohenegger, Haidinger's Abhandl. VI. p. 106). Leop. von Buch notices the species, as undoubtedly identical with D'Orbigny's *Am. Mayorianus*, from the cretaceous rocks of the Andes of

* See also, Ooster, Catal. Ceph. Foss. des Alpes. 1, 1861, p. 126.

Venezuela and in the collection made by Mr. Abich from Daghestan (Zeitsch. d. deutsch. Geol. Ges. 1850, p. 342 and 1851, p. 16).

5. AMMONITES BHIMA, *Stoliczka*, Pl. XLIX. Figs. 1—3.

Am. testa compressa, sublævigata ; anfractibus transversim 7—8 sulcatis atque minutissime striatis, sulcis obliquis, antice versus prolongatis ; dorso subangustato, rotundato, transversim costulato ; costulis in lateribus obsoletis ; umbilico angusto, abrupto ; apertura ovali-elongata : suturis septorum lateraliter trilobatis, sellis bi-, lobis inæqualiter tri-, partitis, lobis auxiliaribus quatuor ; lobo dorsali brevissimo, laterali primo maximo.

Diameter of largest specimen from Moraviatoor ..	135 mm.
Proportions (whole diameter being considered as 1.00) calcu- lated from specimen figured in diameter of ..	a b 48 130 mm.
Diameter of outer whorl : whole diameter ..	0.41 0.46
Width of umbilicus : whole diameter ..	0.30 0.23
Thickness of section : height ..	0.82 0.75

(a) Small specimen, only a cast, Pl. LXIX. Fig. 1.

(b) Largest specimen, partly with the shell preserved, Pl. LXIX. Fig. 2.

Shell discoidal, with flattened sides, and 7-8 transverse furrows on each whorl. These furrows are obliquely bent forward and are bounded with a slight swelling ; they are less distinctly marked on the shell, when well preserved, than on the cast. In addition to these furrows the whole surface of the shell is ornamented with very fine striæ, and on the back with slight ribs, which disappear at the sides. Umbilicus narrow, exposing about one third of the inner whorls with nearly perpendicular walls ; aperture ovate elongated.

The sutures of the septa are very similar to those of *Am. Denisonianus* ; there is a short dorsal, three lateral and four very small auxiliary lobes, all unequally tripartite with similar subdivisions ; the first lateral lobe is the largest of all.

This species, by the slight ribbings only on the back and the fine striæ, forms an intermediate link between the smooth shell of *Am. latidorsatus*, Michelin, and *Am. Timotheanus*, Major, and the ribbed shells of *Am. planulatus*. It is easily to be distinguished from the latter species by its smooth flanks, the smaller umbilicus and the larger number of furrows and of lateral lobes. From *Am. Denisonianus* it differs principally by the want of any stronger ornamentation and by a narrower umbilicus.

Range. Ootatoor group.

Localities. Neighbourhood of Moraviatoor and Odium : not very common.

6. AMMONITES BHAVANI, *Stoliczka*, Pl. LXIX. Figs. 4—7.

Am. testa discoidea ; anfractibus compressis, transversim costatis atque (5—6.) • sulcatis ; costis nonnullis fortioribus, utrinque sulcosis, ceteris tenuioribus, partim simplicibus, partim bipartitis ; omninis antice curvatis interdumque flexuosis ; umbilico moderato abrupto ; apertura elongata, compressa. Suturis lateraliter trilobatis, lobis auxiliaribus tribus ; lobo dorsali brevior quam laterali primo, longissimo ; sellis bi-, lobis tri-, partitis, sella laterali umbilici ad marginem posita.

Diameter of largest specimen estimated from a fragment from Kolakonuttom about.....	100	mm.
Proportions (whole diameter being considered as 1.00) calcu- lated from the figured specimens, in diameter of.....	<i>a</i>	<i>b</i>
Outer whorl : whole diameter	0.37	0.41
Width of umbilicus : whole diameter.....	0.34	0.26
Thickness of section : height	0.86	0.77

(a.) Pl. LXIX. Fig. 5.

(b.) Pl. LXIX. Fig. 6.

Shell compressed, whorls transversely ribbed and with five or six sulcations at some distance, the sulci being bounded by stronger ribs, of which that in front is the less strongly marked. The other ribs vary in size and number, they are either alternately longer and shorter or they become bipartite near the middle, or, only in a few cases and only those next to the furrows are bipartite from the edge of the umbilicus. All the ribs have a tendency to be flexuous and bent forward on the back ; the umbilicus is large, only half of the inner whorls being concealed by the involution ; the aperture is ovate-elongated, more or less compressed.

In this species there is little variation in the shells. Young specimens (Figs. 4—5) have often somewhat convex sides, while, when more grown, they retain the same form, or more frequently become somewhat more strongly compressed. We have, on this account, given figures of young specimens from two localities and of a larger, which is the most compressed specimen in the collection, from Ootacod.

The sutures consist of three lateral and three auxiliary lobes ; the lobes are tri-partite, the saddles bipartite, the dorsal lobe is shorter than the first lateral, and the third lateral saddle lies on the edge of the umbilicus.

The present species is readily distinguishable from some varieties of *Am. Theobaldianus*, n. sp. by the compression of the shell, the smaller umbilicus and the flexuous ribbings ; also by its three lateral lobes.

Range. Trichinopoly and Arrialoor groups (? Ootacod group).

Localities. *Trichinopoly group* : South of Serdamungalum, very near the boundary of the Arrialoor group, from which several specimens have been obtained ; and also from Ootacod in the *Arrialoor group*.

8. AMMONITES KANDI, *Stoliczka*, Pl. LXX. Fig. 4.

Am. testa compressa, transversim costata; costis flexuosis, antice curvatis, ad umbilicum sub-tuberculatis, nonnullis tripartitis atque sæpe rursus bipartitis; in ultimo anfractu quinque simplicibus, fortioribus atque utrinque sulcosis; dorso rotundato, angustiore; umbilico magno, abrupte excavato; apertura ovali-compressa: septis? — ?

Proportions (whole diameter being considered as 1.00) calculated from figured specimen in a diameter of	55 mm.
Outer whorl : whole diameter	0.40
Width of umbilicus : whole diameter	0.33
Thickness of section : height	0.86

The shell of this species consist of few compressed and transversely ribbed whorls; the ribs commence at the edge of the umbilicus with sharp tubercles, and proceed for the most part tripartite and somewhat flexuous to the back, curving forward at the same time; near the back some of them frequently become again bifurcated. On the last whorl five of the ribs are stronger than the others, bounded on either side with a deep furrow, and without any tubercle at the edge of the umbilicus. The back is roundish and narrow, crossed by all the lateral ribs and furrows: umbilicus large, somewhat more than two thirds of the inner whorls being exposed; aperture ovate-compressed. The sutures of the septa could not be distinctly made out.

Am. Kandi differs from *Am. Bhavani*, chiefly by the tripartition of the ribs at their commencement from a small tubercle at the edge of the umbilicus. From *Am. Kalika* it is distinguished by this tripartition and by the stronger curvature or bending of the ribs, and by the larger umbilicus.

Range. Arrialore group, (Trichinopoly group?)

Locality. N. East of Koluture; the locality is at the boundary of the Trichinopoly and Arrialore groups, as laid down in Mr. H. F. Blanford's map.

9. AMMONITES KALIKA, *Stoliczka*, Pl. LXX. Fig. 5.

Am. testa discoidea; anfractibus compressis, transversim costatis; costis sub-rectis, tenuibus, ad umbilicum tuberculatis plerumque quadri-partitis, granulosis; quinque in ultimo anfractu fortioribus, binis, sulcis profundis separatis; umbilico angusto, abrupto, marginibus spinulose-tuberculatis; apertura elongata, compressa; septis — ?

Proportions (the diameter being considered as 1.00) calculated from figured specimen in diameter of.....	50 mm.
Outer whorl : whole diameter	0.42
Width of umbilicus : whole diameter	0.28
Thickness of section : height	0.76

The shell of this pretty species exhibits numerous thin ribs, which have their origin in sharp tubercles at the edge of the umbilicus, and become after that mostly quadri-partite, and towards the back finely granulated. On the last whorl there are in short distances five furrows somewhat stronger marked, having on either side a thicker, non-tuberculated rib, and appearing markedly only on the cast of the shell. All the ribs are only slightly bent on the sides and across the back, nearly in straight lines. The sides of the whorl are nearly flat, and they become somewhat more compressed towards the rounded back. Umbilicus of moderate size, with perpendicular walls, of which the edge is tuberculated; the aperture is prolonged elliptical. The septa have not been seen.

The species differs from *Am. Kandi* by the partition of the ribs into four, by their granulation and comparative straightness, and by the smaller umbilicus. The character of the ornamentation is, however, very similar in both, although we cannot identify them. A further examination and description must be deferred, until more specimens of this interesting species have been obtained.

Of European species the only allied Cretaceous Ammonite is *Am. Jeannoti*, D'Orb. (Pal. Franc. Terr. Cret. 1, p. 188, Pl. LVI. Figs. 3—5,) from the neocomien (?) of the Hautes-Alpes. If D'Orbigny's figure be correct, it differs by the equal convexity of the whorls at the sides and by the want of any sulci.

Range. Arrialoor group.

Locality. The only specimen was met with at Ootacod, North of Arrialoor.

10. AMMONITES ÆMILIANUS, *Stoliczka*, Pl. LXX. Figs. 6—8.

Am. testa discoidea; anfractibus subcomplanatis, transversim multice striatis atque distanter 4—5 sulcatis, striis prope sulcos multum fortioribus, ad umbilicum acute subtuberculatis deindeque bi-, vel tri-, partitis; umbilico angustato, apertura ovali-elongata; suturis septorum lateraliter tri-lobatis, lobis inæqualiter tri-, sellis bi-, partitis, lobo dorsali lato, brevissimo.

Diameter of largest specimen from Arrialoor.

Proportions (whole diameter being considered as 1.00) calculated from

figured specimen in diameter of	60 mm.
Outer whorl : whole diameter	0.50
Width of umbilicus : whole diameter	0.16
Thickness of section : height	0.73

Shell discoid, flattened at the sides, somewhat convex, becoming more compressed towards the back. All the surface is ornamented with fine striæ, only slightly bent, flexuous and mostly bi-, or tri-, partite from the very edge of the umbilicus, where they form sharp compressed tubercles. Four or five deep sulci, bounded on either side with stronger elevated ribs, mark on the last whorl the previous positions of the mouth. Umbilicus small, generally not more than one fourth of the inner volutions being exposed; aperture compressed, elliptical, abrupted with umbilical walls.

The sutures of the septa have three lateral lobes, the first of which is the largest and the dorsal the shortest. All the lateral lobes are unequally tripartite, while the saddles are bipartite, the third lateral saddle being placed on the edge of the umbilicus.

This species is readily distinguished from *Am. Kalika*, which it resembles in ornamentation and in the nearly straight ribs, by its convex sides, which gradually slope towards the back.

I feel much pleasure in naming this species after C. Æmilius Oldham, Esq., who has been for several years engaged in the Geological Survey of the South Indian Peninsula and who collected the greater number of the specimens described in this volume.

Range. Arrialoor group, (Trichinopoly group ?)

Localities. Near Karapady, and South-West of Mulloor, South of Arrialoor. Nine specimens have been examined. A single specimen is marked as from Shutanure in the Trichinopoly group; the ribs in it are somewhat stronger, but the whole shell is not so well preserved as to admit of a perfectly certain determination of the species.

11. AMMONITES BEUDANTI, *Brongniart*, Pl. LXXI. Figs. 1—4, Pl. LXXII.

1822. *Ammonites Beudanti*, Alex. Brongniart in Cuvier's envir. de Paris, pp. 95 and 99, Pl. VII. Fig. 2.

1860. „ „ Pictet, Pal. Suisse. Foss. d. St. Croix. p. 277, Pl. XL., with references of other authors.

1861. „ „ Ooster, Catal. d. Ceph. Foss. Suiss. p. 135.

Am. testa discoidea; anfractibus compressis, sublævigatis, ad intervalla transversim costatis; costis flexuosis, aperturam versus cum sulcis marginatis; umbilico angusto; dorso rotundato; apertura ovate-elongata. Suturis septorum multice atque profunde incisiss, lobis lateralibus duobus, inæqualiter tripartitis, lobis auxiliaribus oblique umbilicum versus descendentibus atque magnitudine decrescentibus, lobo dorsali multum brevioribus quam laterali primo; sellis bipartitis, ramis sub-foliaceis.

Diameter of largest specimen from Moraviatoor.....	515 mm.
Proportions (whole diameter being considered as 1.00) calculated from specimens with diameters of	a b
Outer whorl : whole diameter	80 515
Width of umbilicus : whole diameter	0.45 0.42
Thickness of section : height.....	0.22 0.21
(a) Small specimen from the Madras Museum collection, Pl. LXXI. Fig. 1.	0.64 0.61
(b) Largest specimen, figured, Pl. LXXII. Fig. 1.	

Shell discoid, with flattened sides and numerous flexuous ribs at short distances from each other. Young specimens are quite smooth, in older specimens the ribs are accompanied in front with furrows, which only shew well marked on casts.

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Back narrow, rounded ; umbilicus with steep walls, exposing scarcely one third of the inner whorls ; aperture prolonged, elliptical. Septa very numerous and deeply divided ; lateral lobes only two, unequally tripartite, with very long points, while there are five auxiliary lobes, gradually diminishing and descending obliquely towards the umbilical suture ; saddles bipartite with many divided branches, which have a tendency to become phylliform ; the dorsal lobe is shorter than the first lateral.

This species grows to a very large size, but I have not been able to identify it with any of Professor E. Forbes' Ammonites, although it occurs at Pondicherry also ; one small specimen having been labelled with others as *Am. Durga*. The only species to which it bears any relations is *Am. Yama*, which will be found fully described above.

Pictet (loc. cit.) gives a full account of this species and of its differences from *Am. Parandieri*, and *Am. Cleon*, D'Orbigny : we need only refer to this detail. The similarity of our specimens to those from France is so exact, that there can be scarcely a doubt as to their identity in species.

Pictet does not mention any lateral ribs, but notices the furrows as they appear on the casts. When the shell is well preserved, (which we have only seen on a few of our fragments) the ribs are well marked, and sometimes quite as numerous as they have been shewn in D'Orbigny's figure (Pal. Franc. Pl. 34). In many cases, however, there is scarcely any trace of these ribs or swellings along the sides of the furrows, and even these latter are not seen on some specimens, which are casts. *Am. Beudanti* is, in Europe, characteristic of the Gault, especially of its middle strata ; it is known from many localities in France, Switzerland, Germany, England, Italy and Russia ; and also from the province of Constantine in Algeria. The Geological Survey collection contains specimens, which greatly exceed in size the common European forms. We give a figure of the largest specimen, lithographed from a reduced drawing, and the sutures of the septa from another large specimen, to shew their foliation.

Range. Ootatoor group.

Localities. Odium and Moraviatoor, in the earthy limestone, which occurs between and in the neighbourhood of these two places.

12. AMMONITES DURGA, Forbes, Pl. LXXI. Figs. 5—7.

1846. *Ammonites Durga*, Forbes, Trans. Geol. Soc. Lond. VII. p. 104, Pl. VII. Fig. 11.

1852. „ *Soma*, (Forbes), Giebel. Fauna der Vorwelt, III. p. 421.

Am. testa discoidea ; anfractibus percompressis, junioribus transversim 5-, in ætate proveciore 3-4.-sulcatis atque ad dorsum obsolete-costatis ; costis atque sulcis obliquis, antice curvatis ; umbilico magno, ad margines abrupto : dorso junioribus subcarinato, adultis rotundato ; apertura lanceolate-ovata. Sutura septorum latera-

lites bilobatis, lobis auxiliaribus tribus, oblique descendentes; lobis inaequaliter tri-, sellis bi-, partitis, lobo dorsali brevissimo, sella siphonali lata, denticulata.

Diameter of the largest specimen calculated from a fragment from	
Moraviatoor	160 mm.
Proportions (whole diameter being considered as 1.00) calculated	
from figured specimen in diameter of	120 mm.
Outer whorl : whole diameter	0.32
Width of umbilicus : whole diameter.....	0.42
Thickness of section : height	0.61

Shell discoidal, much compressed; whorls of young specimens smooth, 5—6 transversely sulcated; in older shells the sulci become less in number; in large specimens there are often only three on the last whorl, and there appear along the outer periphery short oblique ribs, which cross the back, becoming obsolete on the flanks. On the casts the ribs are generally scarcely visible, in young specimens with preserved shell (Fig. 5) even the furrows are sometimes not seen. The back is rounded and in the early stages of growth slightly carinated, something similar to *Am. Gardeni*, to which this species has some resemblance as regards its form also. Umbilicus large with steep walls, exposing two thirds of the inner whorls; aperture elongated. The chambers exhibit two lateral and three, obliquely descending, auxiliary lobes, being all irregularly tri-, while the saddles are bi-, partite: the dorsal lobe is much shorter than the first lateral, with a broad denticulated siphonal saddle.

We have figured two young specimens of this species. Fig. 5, represents a specimen similar to Professor E. Forbes' figure of this species, from the same locality: the transverse furrows are only slightly marked, even on the other side of the specimen, where the shell has been removed; the lobes are quite the same, so that no doubt can exist as to its identification with Forbes' species, although he describes the divisions of the sutures somewhat differently. Fig. 6 is a small specimen from Odium; it is a cast and shews distinctly the transverse sulci. On both these specimens, a slight keel-like elevation can be observed in the middle of the back, while in the adult specimens this is rounded, or even somewhat flattened (Fig. 7a.).

Range. Ootatoor and Valudayur groups.

Localities. Ootatoor group: Odium and Moraviatoor, not very rare; Verdoor or Valudayur near Pondicherry, only known from a small specimen in Messrs. Kaye and Cunliffe's collection.

13. AMMONITES ALIENUS, *Stoliczka*, Pl. LXXIII. Figs. 1—2.

Am. testa orbiculari; anfractibus rotundatis, laevigatis, transversim 7-9.-sulcatis, sulcis parum flexuosis, ad dorsum antice prolongatis, umbilico moderato ejusque marginibus rotundatis; apertura juniore transversim circulari, postice lunulata, adulta elliptica. Suturis septorum lateraliter trilobatis, lobis auxiliaribus
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quinque, obliquis, sellis bi-, lobis tri-, partitis, omninis magnitudine umbilicum versus minoribus, lobo dorsali vix longiore quam laterali primo.

Diameter of the largest specimen from Odium,.....	60 mm.
Proportions (whole diameter being considered as 1.00) calculated	<i>a</i> <i>b</i>
from figured specimens, with diameter of	34 60 mm.
Outer whorl : whole diameter	0.41 0.43
Width of umbilicus : whole diameter	0.26 0.28
Greatest thickness of section : height.....	1.21 0.84
(a) Figured specimen containing only the air-chambers, Pl. LXXIII. Fig. 1.	
(b) " " with part of the body whorl and, therefore, shewing a different proportion of the thickness of the section of the whorls, Pl. LXXIII. Fig. 2.	

The shell consists of few rounded whorls, which are but slightly compressed in the young shell, while the body-chamber of larger grown specimens is somewhat higher than broad. The surface of the shell is smooth, showing only seven to nine transverse furrows on each whorl at short distances. These furrows are but little flexuous on the flanks, more prolonged forward on the convex back. The umbilicus is of moderate size, exposing about two-fifths of the height of the inner whorls, its margins are rounded, not perpendicular as in *Am. latidorsatus*, Mich. The section of the whorls, in young shells, or on the air-chambers, is nearly circular, lunate at the base, sometimes a little broader than high; on the body-whorl the section becomes elliptical-cordate, higher than broad. The sutures shew three lateral and five auxiliary lobes, all becoming smaller in size towards the umbilicus; the auxiliary sutures descend obliquely to the umbilical suture; the saddles are bipartite with branching subdivisions: the lobes are trifid, the first lateral is scarcely longer than the dorsal one.

We hesitated long, whether we should unite our Indian fossil with D'Orbigny's *Neocomien* species *Am. Emerici*, or not. However, as the literature of this latter species is very confused, and as the species has been identified with other Ammonites, which are unquestionably different from the Indian fossils, we have finally determined to retain a new name for these. It is beyond a doubt, that the species is very closely related to D'Orbigny's *Am. Emerici*, as first published, the differences being only, the greater compression of the latter species and the umbilicus being very little larger. In 1850, Ewald (*Zeitsch. d. Deutsch. Geol. Gesellsch.* II. p. 445,) stated, that *Am. Emerici* is identical with *Am. Mayorianus* D'Orbigny, and after him several Palæontologists as Giebel (*Faun. d. Vorwelt*, 1852, III. p. 419,) F. v. Hauer, (*Sitzungsb. Akad. Wien.* XLIV. p. 654,) Ooster, (*Catal. Ceph. Suisses*, 1861, p. 126,) and others have adopted this view. Pictet, (*Pal. Suisse; Foss. d. St. Croix*, p. 285,) says, that he is not able to solve the question. We think much stronger proof, than has yet been given, is required, before the identity of these two species can be admitted. A smooth shell carries with it as a consequence a smooth cast, while in cases of a ribbed shell the cast may be either also ribbed or smooth, so that there can be no conclusion drawn from a ribless cast, as to the existence or

Shell discoid, thick; whorls numerous, squarish, crossed by six or seven furrows, which are strongly bent forward on the flattened sides, and somewhat flexuous on the broad back; at the umbilicus the whorls are suddenly bent inwards, forming straight walls; the surface of the shell when well preserved exhibits distinct striæ of growth, the furrows themselves being less expressed. Umbilicus of moderate size, allowing nearly one fourth of each of the inner whorls to be visible; aperture squarish, somewhat narrower at its top than at the lunulate base; in larger and older specimens, in which the back of the last whorl is more rounded, the aperture becomes also more semilunate. The sutures of the septa are very numerous and deeply divided; there are three lateral lobes, five much smaller auxiliary lobes on the walls of the umbilicus, and three on the inner or ventral side; the saddles on the outer side of the shell are unequally trifid, fan-like and very much constricted in their lower portions, those on the ventral region are smaller and bifid. Of the lobes the dorsal and the ventral are each longer than the lateral lobes next to them; the first dorsal lobe is nearly equally bifid, the succeeding lobes are unequally tripartite.

This species is very well marked by its laterally compressed whorls, the oblique transverse furrows, and the bipartite lobes and tripartite saddles, so that there is little chance of mistaking it for *Am. latidorsatus*, Mich., with which, however, Giebel has united it. We cannot decide, whether D'Orbigny is correct in considering *Am. Bourritianus*, Pictet, as identical with *Am. Timotheanus*. Our Indian specimens agree in all respects, both as to the form of the shell and of the lobes, with the Swiss specimens of *Am. Timotheanus*. And so far as the figure of *Am. Bourritianus* enables us to judge (Pictet, *Gres Verts*. p. 42, pl. IV. fig. 1,) it would seem to be retained as an independent species on good grounds. (*Vide* Pictet, *Pal. Suisse*; *Foss. de St. Croix*, 1860, p. 290).

Am. Timotheanus was first described by Pictet (loc. cit.) from the *Gres Verts* at Saxonet, in Savoy, and afterwards noticed by D'Orbigny (*Prodrome*, II. p. 124), by Gras (1852, *Foss. de l'Isere*. p. 38), by Renevier (1854, *Foss. d. Perte-du-Rhone*, p. 37), and by others from the Gault and étage Albien of South France. The species has not been hitherto noticed either in Germany or England. Fran. v. Hauer in examining the fossils from the Gault of the Bakonyer-wald, in South-Western Hungary, merely remarks, (*Sitzung. der k. Akademie, Wien*. 1862, XLIV. p. 657), that among the specimens of *Am. latidorsatus* from the Nana valley, there are some fragments with squarish section, which may belong to *Am. Timotheanus*.

Range. Ootatoor and Trichinopoly groups.

Localities. *Ootatoor series*: neighbourhood of Odium; Moraviatoor; Penangoor; *Trichinopoly series*: Serdamungalum, North of Anapaudy and near Andoor. The specimens from both groups are undoubtedly identical in species, they are not unfrequent, although not so numerous as *Am. latidorsatus*.

15. AMMONITES LATIDORSATUS, Michelin, Pl. LXXIV. Figs. 1—4.

1838.	<i>Ammonites latidorsatus</i> ,	Michelin, Mem. Soc. Geol. Franc. III. p. 101, Pl. XII. Fig. 9.
1840.	„ „	D'Orbigny, Pal. Franc. I. p. 270, Pl. LXXX.
1847.	„ „	Pictet et Roux, Foss. d. Gres Verts. p. 44, Pl. III. Figs. 4—5.
1849.	„ „	Quenstedt. Cephalopoden Deutschland's, p. 222.
1850.	„ „	Ewald, Zeitsch. d. Deutsch. Geol. Gesellseh, II. p. 445.
1852.	„ „	Giebel, Faun. d. Vorwelt, p. 420, <i>partim</i> .
1860.	„ „	Pictet, Palæont. Suisse, II. Ser. Foss. d. St. Croix, p. 287.
1862.	„ „	F. v. Hauer. Sitz. d. k. Akademie Wien, XLIV. p. 657.

Am. testa discoidea, inflata, lævigata; anfractibus transversim 6—10.-sulcatis; sulcis flexuosis eorumque marginibus inflatis, ad dorsum rotundum valde antice curvatis; umbilico angusto, abrupte excavato et profundo; sectione anfractuum junioribus semilunata, adultis subcompressa, cordata. Septis lateraliter trilobatis; lobis auxiliaribus in umbilici latere positis, lobis internis (ventralibus) quinque; omninis magnitudine umbilicum versus decrescentibus; sellis bipartitis, lobis trifidis.

Diameter of largest specimen from Moravia	180 mm.
Proportions (the whole diameter considered as 1.00) calculated	<i>a</i> <i>b</i>
from the figured specimens with diameter of	38 150
Outer whorl : whole diameter	0.45 0.48
Width of umbilicus : whole diameter	0.24 0.23
Thickness of section : height	1.28 1.05

(a) Specimen figured, Pl. LXXIV. Fig. 2, having only the air-chambers.

(b) „ „ „ Fig. 3, with the greater part of the body whorl.

Shell discoid, inflata, smooth, with only fine striæ of growth on the well preserved shell, and with six to ten transverse furrows at short distances. Very seldom there is a kind of ribbing to be seen, as represented in Fig. 2. The furrows are bounded on either side with more or less strongly marked swellings, which on the rounded back are strongly curved forward. In young specimens these furrows as also the rib like swellings are much less distinctly marked, or are scarcely visible. The umbilicus is small, but deep, leaving nearly one-fourth of the inner whorls exposed, the walls are perpendicular. The aperture is in young specimens semilunate, and in older shells somewhat more compressed. The species varies but slightly in form : when young it is sometimes quite globular, with a sharp edged umbilicus, when more fully grown the specimens become generally a little compressed on the sides, without however, losing their inflated form. Our figures represent the species in different stages of growth.

The sutures of the septa are numerous and deeply divided into lobes and saddles, the former being trifid, the latter bifid at their terminations, the branches of the saddles from their rounded terminations being like those of some *Heterophylli*. The dorsal lobe is very little shorter than the first lateral ; of the others, there are three lateral lobes, extending to the edge of the umbilicus, to which

succeed four auxiliary lobes on the straight umbilical wall, rapidly becoming smaller in size : on the inner or ventral side of the shell, in addition to the median ventral lobe, there are five lateral lobes, also diminishing towards the umbilical suture, and considerably smaller than the outer lobes.

Am. latidorsatus is a very characteristic species and is readily distinguished by the roundness of the whorls and the tripartite lobes from *Am. Timotheanus*. The differences between it and *Am. Inca*, Forbes, have been noticed previously.

The species was first described by Michelin, and afterwards well determined by the more careful and exact studies of D'Orbigny and Pictet. Until the last few years, it was only known from the middle Cretaceous groups of France, Savoy and Switzerland, (Gault and Gres Verts). Ewald (loc. cit.) states that the species occurs also in the étage Aptien (D'Orbigny) at Hiéges. In India we find it occurring with forms of the lower as well as of the upper Cretaceous series. In Germany, we are not aware of any notice of its occurrence ; the species was badly recognized. Quenstedt (1849 p. 222 in his *Cephal. Deutschl.*) considers it only apparently (!) a new species and thinks it a more grown variety of *Am. planulatus* Sow. ! Giebel also (loc. cit.) unites it with other well marked forms. The only authentic notice of it we find in F. v. Hauer's remarks on the Cretaceous fossils of the Bakonyer-wald in South-West Hungary, where it was found in the valley near Nana, associated, as in India, with *Am. inflatus*, Sow. *Am. dispar*, D'Orb. and others. The species has not been noticed in England.

Range. Ootatoor group ; upper beds.

Localities. North and West of Odium, and South of Moraviatoor : it occurs most numerously, and of the largest size in the yellowish and brownish sandstones near Moraviatoor ; the specimens from the calcareous shales near Odium are generally of smaller size.

16. AMMONITES GARUDA, Forbes, Pl. LXXIV. Fig. 5.

1846. *Ammonites Garuda*, Forbes, Trans. Geol. Soc. Lond. Vol. VII. p. 102, Pl. VII. Fig. 1.

1852. " " Giebel, Fauna der Vorwelt, III. p. 416.

Am. testa discoidea, anfractibus paucis, subrotundatis, transversim minutissime striatis atque spiraliter sulcatis : sulcis lateraliter duobus ; dorso rotundato, ad lineam medianam elevato : umbilico moderato, profundo ; apertura subrotundata, postice sinuosa ; suturis septorum lateraliter septem-lobatis, magnitudine umbilicum versus decrescentibus, lobis atque sellis brevibus, inæqualiter bipartitis, lobo dorsali longiore quam laterali primo.

Proportions (whole diameter being considered as 1.00) calculated	
from the figured specimen with diameter of	39 mm.
Outer whorl : whole diameter	0.38
Width of umbilicus : whole diameter.....	0.30
Thickness of section : height	1.06

Shell discoid, with few rounded whorls, which are covered with very numerous fine striæ of growth, these being more distinctly marked on the umbilical walls and strongly bent forward on the back. The edges of both the umbilicus and the back are roundish, and on the latter there are on each side two furrows, placed close to each other in spiral direction. The median line, at the place of the siphuncle is also somewhat elevated, causing a small depression on either side. All the furrows are very shallow and only slightly marked, but are visible both on the well preserved shells and on the casts: they are, therefore, very characteristic for this species. The umbilicus is of moderate size, deep, bounded with sloping walls, and exposing nearly three-fifths of the inner whorls: aperture roundish, somewhat broader than high. The sutures exhibit seven lobes on each side, much subdivided and unequally bipartite; the dorsal lobe is the broadest and is longer than any of the succeeding lobes; the dorsal saddle is also the largest, the saddles have small round terminations, recalling the form in the group Heterophylli. These phylliform terminations of the branches, although a little better expressed in the very young shells, are seldom so well developed as they are represented in Forbes' figure of the lobes of this Ammonite (loc. cit).

The remarkable involution, the form of the septa, and more especially the peculiar spiral furrows distinguish this species readily from all known allies. D'Orbigny in his Prodrôme (Vol. II. p. 213) has very erroneously united this and many other well characterized species with *Am. Krishna*, Forbes.

Range. Valudayur group.

Locality. Near Pondicherry. The Madras Museum collection contains several specimens of this species.

17. AMMONITES INVOLVULUS, *Stoliczka*, Pl. LXXV. Fig. 1.

Am. testa discoidea, compressa; anfractibus numerosis, dimidium involutis, celeriter in altitudine crescentibus, transversim minutissime striatis; dorso rotundato; umbilico moderato, abrupto; sectione anfractuum ovate-elongata. Suturis lateraliter trilobatis, lobo dorsali brevioribus quam laterali primo; lobis atque sellis bipartitis, ultimis ad partes inferiores valde angustatis, sellis auxiliaribus tribus, obliquis.

Proportions (the whole diameter being considered as 1.00) calculated	
from the figured specimen	44 mm.
Outer whorl : whole diameter	0.43
Width of umbilicus : whole diameter	0.30
Thickness of section : height	0.84

Shell discoid, flattened on both sides, the whorls sloping rapidly to the umbilicus and gradually to the outer periphery, quickly increasing in height, on the well preserved surface covered with numerous transverse flexuous striæ; where these are not preserved, the shell appears smooth, without any sulci or furrows.

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The umbilicus is of moderate size, exposing half of the numerous inner whorls, its walls are perpendicular; the back is roundish, the sections of the whorls prolonged-ovate, a little narrower at the top than in the middle. The sutures consist of three lateral, and three much smaller obliquely placed auxiliary, lobes; both lobes and saddles are deeply bipartite, their branches being again bifid: the saddles in their lower, and the lobes in their upper, portions are considerably narrower; the dorsal lobe is shorter than the first lateral. This peculiar shape of the lobes seems to be very characteristic of this species, and distinguishes it readily from the ribless and compressed varieties of *Am. Timotheanus*, Pictet. From *Am. Kayei*, it differs by its compression and by its much smaller umbilicus.

Among English species there is one described by Sharpe (Cephal. of Chalk, 1853, p. 32, Pl. XIV. fig. 3), very similar to this in form and involution, namely, *Am. leptonema*. As, however, the lobes of that species are unknown, the marked roundness of its whorls must be considered as distinguishing it from our Indian species.

Range. Ootatoor group.

Locality. North of Odium: only the single specimen now figured has as yet been met with.

18. AMMONITES MADRASPATANUS, *Blanford*, Pl. LXXV. Fig. 2.

1846. *Ammonites Juilleti* (?), Forbes, Trans. Geol. Soc. Lond. Vol. VII. p. 101, Pl. VII. Fig. 2, non D'Orbigny, Pal. Franç.
 1850. „ *Durga*, D'Orbigny, Prod. II. p. 213, non *idem*, Forbes, (loc. cit.)
 1862. „ *Madruspatanus*, Blanford, Mem. Geol. Surv. India, IV. Pt. I. p. 92.

Am. testa discoidea, circulari, anfractibus numerosis, rotundatis, parum involutis, transversim minutissime striatis, striis flexuosis, amplexantibus; umbilico lato; dorso rotundato; apertura circulari, postice sinuata. Suturis lateraliter quadri-lobatis, sellis atque lobis bipartitis, sellarum ramulis trifidis, lobo dorsali non longiore quam laterali primo.

Diameter of largest specimen from Odium.....	35 mm.
Proportions (the whole diameter being considered as 1.00) calculated from figured specimen with diameter of.....	30 „
Outer whorl : whole diameter.....	0.40
Width of umbilicus : whole diameter	0.36
Thickness of section : height.....	1.08

Shell consisting of numerous round whorls, which are only slightly involute, increasing regularly in height and thickness, and crossed by dense fine flexuose striæ. On the casts of some of our specimens, slight transverse furrows are seen which correspond with the sutures of two air-chambers. Umbilicus large and deep, three-fifths of the inner whorls being exposed; aperture circular, excavate at the base. Sutures with three lateral lobes and as many saddles, both much subdivided;

both are bipartite, with narrow three-branched fan-like subdivisions; the dorsal lobe is the broadest, but not longer than the first lateral.

This species was first described by Prof. E. Forbes (loc. cit.) as *probably* identical with *Am. Juilleti*, D'Orbigny. In his Prodrôme II. p. 213, M. D'Orbigny gave it as synonymous with *Am. Durga*, Forbes; while Giebel (Faun. d. Vorwelt, III. p. 400), quotes both these species as synonymous with *Am. quadrisulcatus* D'Orb. (Pal. Franc. Pl. XLIX. Fig. 13). We cannot decide whether the *Am. Juilleti* and *Am. quadrisulcatus* of D'Orbigny are the same, but our Indian fossil is certainly different from both, and is easily distinguished by the slight involution and by its having three lateral lobes, as in the group *Ligati*, instead of two which is the common number in the *Fimbriati*. Besides those already mentioned, there are three other Ammonites to which *Am. Madraspatanus* has a resemblance, *Am. Hamilcar*, Coquand, (Mem. Soc. Geol. Franc. 2. Ser. V. p. 142, Pl. III. Figs. 16-17), from the Neocomien strata of Algeria; *Am. leptonema*, Sharpe, (Cephal. of Chalk, p. 32, Pl. XIV. Fig. 3), from the grey chalk of Ventnor, Isle of Wight; and *Am. circularis*, Sowerby, (Geol. Trans. Lond. IV. Pl. XI. Fig. 20), from the Gault of Barham. Each of these, however, differs either in the roundness of the whorls, or in the amount of involution.

The name *Madraspatanus* was applied to this species by Mr. H. F. Blanford in his report on the Trichinopoly district (loc. cit.) but no description was given.

Range. Valudayur, and Ootatoor groups.

Localities. Near Pondicherry: described by Prof. E. Forbes from that locality. West and North of Odium in yellow earthy limestone; a few specimens only have been met with.

19. AMMONITES REVELATUS, *Stoliczka*, Pl. LXXV. Fig. 3.

Am. testa discoidea, planulata, lateraliter compressa; transversim subtilissime costulata, atque 6-sulcata; sulcis atque costulis flexuosis; dorso subrotundato, umbilico latissimo, haud profundo; apertura elliptice-elongata, postice cordata. Suturis septorum lateraliter trilobatis; lobis et sellis angustis, in terminationibus bifidis; lobo dorsali vix brevior quam laterali primo.

Proportions (whole diameter being considered as 1.00) calculated from	
the figured specimen with diameter of	38 mm.
Outer whorl : whole diameter	0.34
Width of umbilicus : whole diameter	0.42
Thickness of section : height	0.92

Shell discoid, with numerous slightly involute whorls, compressed sides, and a narrow roundish back. The surface is covered with very numerous transverse striæ, and on the last whorl has six distant furrows, marked on either side by slight swellings. Both striæ, and furrows are flexuous, the latter alone being visible on the cast. The umbilicus is very large, with sloping walls, two thirds of the inner

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whorls being exposed ; the section of the whorls is elliptical, elongated, compressed, somewhat narrower at the top, than at its cordate base. The sutures have three lateral lobes on either side, they are moderately divided, into narrow lobes and saddles, both with bifid terminations ; the dorsal lobe seems to be very little shorter than the first lateral : three or four short auxiliary and simple saddles follow these descending obliquely to the umbilical suture.

This species has a planulate form, in consequence of the slight increase of the whorls in height and thickness. It differs from *Am. planulatus*, Sowerby, by the numerous fine striæ, and the bifid lobes.

Range. Ootatoor group ?

Locality. Shutanure to the south-east, where two specimens were met with ; one figured and the other not larger. The locality is at the boundary between the Ootatoor and Trichinopoly groups as laid down by Mr. H. F. Blanford.

20. AMMONITES CALA, *Forbes*, Pl. LXXV. Fig. 4.

1846. *Ammonites Cala*, Forbes, Trans. Geol. Soc. Lond. VII. p. 204, Pl. VIII. Fig. 4.

1852. „ „ Giebel. Faun. d. Vorwelt, III. p. 421.

Am. testa discoidea, anfractibus numerosis, parum involutis, lævigatis, subrotundatis ; dorso rotundato ; umbilico latissimo ; apertura transversim dilatata ; suturis septorum lateraliter bilobatis ; lobo dorsali lato, lateraliter bipartito ; sella siphonali linguiforme, denticulata ; sellis ceteris inæqualiter tri-, lobis bi-, partitis ; lobis auxiliaribus tribus, oblique umbilicum versus magnitudine sensim decrescentibus.

Diameter of largest specimen from Shutanure	70 mm.
Proportions (whole diameter being considered as 1.00) calculated	
from the figured specimen in diameter of.....	69 mm.
Outer whorl : whole diameter.....	0.35
Width of umbilicus : whole diameter	0.45
Thickness of section : height	1.12

The shell consists of numerous rounded whorls, which are only slightly involute, and smooth. On well preserved surfaces there are merely fine flexuous striæ of growth visible, and on the last whorl near to the mouth a few slight distant transverse furrows, which in connection with slight swellings of the shell, mark the former positions of the mouth. The umbilicus is very large, about two thirds of the inner whorls being seen ; the walls are nearly perpendicular ; the back is roundish and broad ; the section of the whorls, broader than high, transversely ovate. The sutures of the septa shew three lobes on each side ; they are much, though not deeply, divided ; the dorsal lobe is broad, with two branches on either side, separated by the tongue-shaped syphonal saddle, which has numerous fine denticles ; the saddles are unequally tri-partite, and considerably constricted in their lower portions, the lobes unequally bi-partite ; the second lateral lobe having a great tendency to tri-partition : the auxiliary lobes are three, rapidly diminishing in size, and in an oblique line, towards the umbilicus.

The present species differs by its smooth surface and its tripartite saddles from *Am. Sacya*, Forbes, to which young specimens bear much resemblance. D'Orbigny (Prod. II. p. 213), has united *Am. Cala*, Forbes, with *Am. Juilleti?* Forbes (*non* D'Orb.) under the head of *Am. Durga*, Forbes; the three are, however, so markedly different that there cannot be the slightest doubt of their being distinct species.

From European cretaceous rocks, we only know of any similar species, by M. D'Archiac's notice, (Mem. Soc. Geol. Franc. 2. Ser. VI. p. 348, 1859), who states that he has found in the southern parts of the departments "de l'Aude et des Pyrenées Orientales," in the 'marnes bleues' of the upper cretaceous formation, species allied to *Am. Durga*, and *Am. Cala*, Forbes.

Range. Ootatoor and Valudayur groups.

Localities. South of Shutanure in the Trichinopoly district, in yellowish gritty sandstone, and near to Pondicherry, in bluish limestone, full of fragments of shells : rare.

21. AMMONITES SACYA, Forbes, Pl. LXXV. Figs. 5—7 and Pl. LXXVI.

1846. *Ammonites Sacya*, Forbes, Trans. Geol. Soc. Lond. VII. p. 113, Pl. XIV. Fig. 10.
 " " *Buddha*, Forbes, " " " " p. 112, Pl. XIV. Fig. 9.
 1850. " *Sacya*, D'Orbigny, Prodrome, II. p. 213.
 1852. " " Giebel. Fauna der Vorwelt, III. p. 757 and 559.

Am. testa discoidea, circulari; anfractibus numerosis, subcompressis, ad umbilicum abruptis vel subconvexis, transversim striatis atque sulcatis, striis minutis, flexuosis; sulcis 6-8, distantibus, ad marginem posteriorem costulatis, prope aperturam ultimi anfractus late-costatis; dorso rotundato; umbilico lato; apertura juniore transversim circulari, adulta elliptica, postice cordata. Suturis septorum bilobatis, magnitudine umbilicum versus decrescentibus, lobis auxiliaribus quatuor, oblique positis; lobo dorsali vix longiore quam laterali primo; lobis atque sellis bipartitis, ultimis in portionibus inferioribus valde constrictis; sella siphonali denticulata, linguiforme.

Diameter of largest specimen from Moraviatoor ...	140 mm.				
Proportions (the whole diameter being considered as 1.00) calculated from specimens with diameters of.....	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
Outer whorl : whole diameter	45	95	40	50	120
Width of umbilicus : whole diameter	0.33	0.43	0.30	0.34	0.40
Thickness of section : height	0.44	0.32	0.50	0.46	0.33
	1.06	0.83	1.16	0.88	0.91

(a) Figured specimen, Pl. LXXV. Fig. 6, regular form containing only the air-chambers.

(b) Figured specimen, Pl. LXXV. Fig. 7, regular form complete with the body whorl.

(c) Figured specimen, Pl. LXXVI. Fig. 1, Var. *multiplexa*, calculated from the air-chambers.

- (d) Figured specimen, Pl. LXXVI. Fig. 1, Var. *multiplerus*, calculated from the whole diameter, of same specimen, with a portion of the body-whorl, shewing the differences, in one and the same specimen.
- (e) „ „ Pl. LXXVI. Fig. 3, containing only the air-chambers.

The discoid shell consists of numerous whorls, which are somewhat compressed on the sides, and which gradually increase in height. The surface, when well preserved, is covered with very numerous fine thread-like striæ, which are somewhat flexuous near the umbilicus, and with six or eight stronger ribs. A furrow on the cast in front of these, corresponds to their direction. On the body-whorl of more adult specimens, there appear numerous broad ribs, which are especially well marked near to the mouth. A portion of such a body-whorl was described by Prof. E. Forbes as *Am. Buddha* (loc. cit.) as will be better seen by comparing our Fig. 7, Pl. LXXV. with Forbes' original figure. Where the shell is well preserved striæ are also seen on these broad ribs.

In the form and number of the whorls in several stages of growth, this Ammonite exhibits a good many variations, of which we mention especially two,

1st, *Am. Sacya* as described by Forbes, is represented in our Fig. 6, Pl. LXXV. The whorls of this are rounded in the young stages of growth and become more compressed and higher when more fully grown as will be seen in Fig. 2, Pl. LXXVI. given expressly for that purpose; the variations in the measurements given above may also be compared.

2nd. *Am. Sacya*, var. *multiplerus* is a variety, which we have represented in the figures 2 and 3, Pl. LXXVI. The specimens agree in their ornamentation and the form of the sutures exactly with the regular form of *Am Sacya*, but the whorls are somewhat more numerous, and are abrupt at the edge of the umbilicus, which is also a little larger. Although we have a sufficient number of specimens of this variety, we cannot consider the differences sufficient for specific distinction.

The sutures of the septa have laterally two lobes, and become gradually smaller in size towards the umbilicus; they are very much and deeply subdivided. Both saddles and lobes are bipartite, with bifid subdivisions; the dorsal lobe is about as long as the first lateral which is the largest; the saddles are fan-like, much constricted in their lower proportions, with alternate branchings. Of auxiliary lobes there are four (the first of which is placed on the edge of the umbilicus) smaller sized, and descending obliquely to the umbilical suture. A comparison of the several figures of the septa, which we have given will shew the minute alterations in form combined with the general similarity, as they are taken from the two varieties in different stages of growth.

We are not acquainted with any European Ammonites similar to this.

Range. Ootatoor group.

Localities. Neighbourhood of Odium, and Moraviatoor; common in the nodular earthy limestone of the latter locality; specimens chiefly small.

22. AMMONITES KAYEI, Forbes, Pl. LXXVII. Figs. 1—2.

1846. *Ammonites Kayei*, Forbes, Trans. Geol. Soc. Lond. VII. p. 101, Pl. VIII. Fig. 3.

1850. „ „ D'Orbigny, Prod. II. p. 213.

1852. „ „ Giebel. Faun der Vorwelt, III. p. 422.

Am. testa discoidea ; anfractibus numerosis, angustis, dilatatis, lateraliter angulatis seu subrotundatis, transversim minutissime striatis ; striis flexuosis bi-, vel tripartitis ; ultimo anfractu transversim quadri-sulcato ; umbilico latissimo ; dorso subconvexo, lato ; apertura reniformi. Sutura septorum lateraliter bi-lobatis, multice et profunde incisus ; sellis bipartitis in ultima parte valde angustatis, sellis auxiliaribus multo minoribus, oblique ad umbilicum descendentibus, lobis inæqualiter bipartitis, lobo dorsali longiore quam laterali primo.

Diameter of largest specimen from Pondicherry.....	46 mm.	
Proportions (the whole diameter being considered as 1.00) calculated from the figured specimens in diameter of.....		Fig. 1. Fig. 2.
Outer whorl : whole diameter.....	0.22	0.28
Width of umbilicus : whole diameter	0.58	0.52
Thickness of section : height.....	1.54	1.38

Shell discoidal, with many narrow whorls, which are covered on their surface with very numerous fine transverse striæ, and on the last whorl with four equally distant furrows. All the striæ are bi-, or tri-furcate at the edge of the umbilicus, from which they proceed strongly bent forward. The back is roundish, and the umbilicus very large, exceeding one half of the whole diameter, so that the shell has very much the look of a vertebra of a fish. All the lateral portion of the whorls is exposed in the umbilicus, and only the convex peripheral part is covered by the involution. In section the whorls are nearly one half broader than high. Our two figures shew the difference in the number of the whorls ; the one from Pondicherry, Fig. 1, has more numerous whorls than the other from Penangoor, in Trichinopoly ; but as there is no other difference in the form of the whorls, or of the septa, both forms must be viewed only as varieties. The septa shew very small and much subdivided sutures, both lobes and saddles unequally bipartite ; the saddles very narrow in their lower portions, and with long branches in the upper ; the dorsal lobe is a little longer than the first lateral : besides the two lateral lobes and saddles, there are also three auxiliary lobes and saddles, which descend obliquely to the umbilicus.

I am not acquainted with any similar Ammonite either from European or other Cretaceous deposits. It is, indeed, one of the most interesting Ammonites in the collection. It is distinguished from *Am. Cala*, Forbes, by its laterally angular whorls.

Range. Valudayur and Ootatoor groups.

Localities. Pondicherry, West of Penangoor, and North of Odium in the Trichinopoly district, seems to be rather a rare fossil.

23. AMMONITES CLIVEANUS, *Stoliczka*, Pl. LXXVII. Fig. 3.

Am. testa orbiculari; anfractibus rotundatis, transversim costatis atque sulcosis; sulcis in ultimo anfractu 4—5, antice curvatis; costis ad umbilicum subtuberculatis, bipartitis plerumque prope dorsum rursus bifidis; in ætate proveciore costis crassioribus, plerumque simplicibus, nonnullisque prope dorsum tuberculatis; umbilico magno atque profundo; dorso in junioribus rotundato, in adultis subconvexo lato; apertura ovate-subangulata.

Diameter of largest specimen from Moraviatoor	56 mm.
Proportions (whole diameter being considered as 1.00) calculated	
from the figured specimen, with diameter of	55 mm.
Outer whorl : whole diameter	0.36
Width of umbilicus : whole diameter	0.40
Thickness of section : height.....	0.95

The whorls of this species are rounded and crossed by numerous sharp ribs, the last whorl with four or five transverse furrows at some distance one from the other. All the ribs begin with a small tubercle at the edge of the umbilicus, and there become bipartite, some being again bipartite towards the back. In an older stage of growth, the ribs become thicker, less in number, and unite in pairs at the edge of the back in tubercles, again separating. The back in the young shell is rounded, and in older specimens is broader, when the lateral ribs appear on its edge; umbilicus large, scarcely half of the inner whorls being covered by the involution of the shell, the walls are sloping, and tuberculated at the edge. The section of the whorls in young shells is ovate, in older shells more angular, and broad at the top. The sutures of the septa exhibit two lateral lobes, which are tripartite, the dorsal lobe is nearly as long as the first lateral; the saddles are bipartite, the second lateral being broad, and occupying the edge of the umbilicus, to that succeed about three small auxiliary lobes, descending in an oblique line.

The rounded whorls in the young state, and the tubercles near the back in older shells; the bipartition of the ribs, the numerous small tubercles on the edge of the umbilicus, and the few transverse furrows, characterize this species, and distinguish it at first sight either from *Am. Paravati*, (n. sp.) or *Am. Moraviatoorensis*, (n. sp.). As a peculiarity in this species we may notice, that in all the specimens which have been examined, five in number, the siphuncle is excentric on one or the other side. The figured specimen is a cast, on which, therefore, the ribs are less distinct.

Range. Ootatoor group.

Localities. Moraviatoor and North of Odium, in yellowish earthy limestone, a rare shell.

24. AMMONITES MORAVIATOORENSIS, *Stoliczka*, Pl. LXXVII. Fig. 4.

Am. testa discoidea, complanata; anfractibus subangulatis; compressis, transversim costatis atque 6—7-sulcatis, costis tripartitis, junioribus ad umbilicum tuberculatis, ad dorsum plerumque rursus bipartitis; adultis ad umbilicum non-tuberculatis simplicibus; dorso rotundato, umbilico magno, apertura ovate-cordata. Suturis septorum lateraliter bilobatis, lobis tri-, sellis bi-, partitis, angustis.

Proportions (whole diameter being considered as 1.00) calculated from the largest specimen (figured) in diameter of.....	53 mm.
Outer whorl : whole diameter	0.32
Width of umbilicus : whole diameter.....	0.43
Thickness of section : height	0.88

Shell consisting of numerous rounded whorls, transversely ribbed and on the last whorl with 6 or 7 sulcations. The ribs in young specimens, are tripartite from their origin at the edge of the umbilicus, having formed three small tubercles, and most of them become again bipartite at the rounding off of the back. As the shells grow older, the ribs become merely bipartite on the back, being, from their origin, mostly single, and without any tubercles. Back equally rounded in all stages of growth; umbilicus large with steep walls; aperture ovate. The sutures form two lateral lobes on each side which are tripartite, while the saddles are bi-partite, the second lateral being on the edge of the umbilical wall and not so obliquely placed as in *Am. Cliveanus*, from which the species differs also by having stronger tubercles on the edge of the umbilicus, tripartite ribs, a greater number of transverse furrows, and no tubercles at the edge of the back.

Range. Ootatoor and Trichinopoly groups.

Localities. Moraviatoor, 2 specimens; North of Anapady; 1 specimen.

25. AMMONITES PARAVATI, *Stoliczka*, Pl. LXXVII. Figs. 5—6.

Am. testa discoidea, complanata; anfractibus subangulatis, compressis, transversim costatis atque sulcatis; costis plerumque simplicibus, obliquis, antice curvatis, ad dorsum subobsoletis; sulcis in ultimo anfractu decem—duodecem; dorso lato, subplano, in adultis speciminibus apud margines tuberculato; umbilico magno plano; apertura subquadrata, angulata; suturis lateraliter bilobatis, sellis bi-, lobis tri-, partitis.

Diameter of largest specimen from near Garudamungalum	96 mm.
Proportions (whole diameter being considered as 1.00) calculated from the figured specimen (Pl. LXXVII. Fig. 6), with diameter of	42 mm.
Outer whorl : whole diameter	0.38
Width of umbilicus : whole diameter	0.42
Thickness of section : height	0.94

Shell compressed, transversely ribbed and sulcated; ribs numerous, oblique, bent forward, and becoming nearly obsolete on the back; there are for the most part one or two single ribs between two furrows, which are bounded on either side with bi-, or sometimes tri-, partite ribs: sulci 10 to 12 on one whorl and therefore at short distances from each other, having the same direction as the ribs. There are no tubercles seen at the umbilicus in any of our specimens, which are, however, merely casts. The back is broad, nearly flat in the older stages of growth, having on its edge some few tubercles at either side; each of these tubercles being generally the termination of the single rib, between two furrows: umbilicus large and plane, about one-fifth of the inner whorls being covered by the involution; aperture mostly a little higher than broad, subangular. The sutures exhibit two lateral lobes, being tripartite; saddles bipartite, the second lateral being on the edge of the umbilicus; besides these there are two or three very small auxiliary lobes; the dorsal lobe seems to be somewhat shorter than the first lateral, but this is not very plainly seen.

This species differs from *Am. papillatus*, n. sp. chiefly by its compression, its being much less involute, the stronger curvature forwards of the ribs, and the marginal tubercles on the back.

Range. Trichinopoly group.

Locality. Garudamungalum, in a darkish calcareous sandstone; only seven specimens have yet been obtained.

26. AMMONITES PAPILLATUS, *Stoliczka*, Pl. LXXVII. Figs. 7—8.

Am. testa complanata, transversim costata, atque sulcosa; costis ad umbilicum tuberculatis, bi-, vel tri-, partitis, in junioribus ad dorsum sub-obsolete, in adultis transeuntibus; sulcis decem, obliquis; dorso lato, umbilico moderato, abrupto; apertura elliptica, subangulata; septorum suturis lateraliter bilobatis, lobis tri-, sellis bi-, partitis.

Diameter of largest specimen from Moraviatoor.....	60 mm.
Proportions (whole diameter being considered as 1.00) calculated from specimens with diameter of.....	a b 45 35 mm.
Outer whorl : whole diameter.....	0.40 0.34
Width of umbilicus : whole diameter	0.33 0.40
Thickness of section : height.....	0.83 1.00
(a) Figured specimen, measurement taken on specimen with shell preserved.	
(b) " " " " cast.	

Shell discoid, compressed, transversely ribbed; ribs on the well preserved surface sharp, mostly bipartite, originating in a small tubercle at the edge of the umbilicus and becoming considerably less marked on the flat of the back in the young state, while in older shells they cross the back with the same strength. At short distances the ribs are interrupted by ten furrows (on the last whorl), these

being the marks of the previous positions of the mouth. The umbilicus is of moderate size, about one-half of the inner whorls being concealed; back is broad, somewhat convex; aperture sub-angulate, generally higher than broad. The septa present two lateral tripartite lobes and about three auxiliary lobes descending obliquely, the dorsal lobe is nearly as long as the first lateral; saddles bipartite with numerous short branches.

Am. papillatus is most nearly related to *Am. Paravati* especially in the general aspect of casts; as may be well seen in the lateral views of one and the same specimen, which we give. It is distinguished by the existence of tubercles at the umbilicus (these being absent in all stages of growth in *Am. Paravati*) by the greater involution, and consequently narrower umbilicus, and finally by the slighter compression of the shell. The relations of the two species are about the same as those between *Am. Moraviatoorensis* and *Am. Cliveanus*,

Range. Ootatoor group.

Locality. Moraviatoor; not very rare.

27. AMMONITES PACIFICUS. *Stoliczka*, Pl. LXXVII. Fig. 9.

Am. testa discoidea, complanata, anfractibus transversim costatis atque distanter sulcatis; costis antice obliquis plerumque simplicibus, ad umbilicum subtuberculatis; dorso angustato rotundato; umbilico magno et plano; apertura ovali-cordata. uturis septorum lateraliter bilobatis, lobis tri-, sellis bi-, partitis, lobis auxiliaribus quatuor.

Diameter of largest specimen from Vencataramapooram,	100 mm.
Proportion (whole diameter being considered as 1.00) calculated from the figured specimen in diameter of.....	58 mm.
Outer whorl : whole diameter	0.28
Width of umbilicus : whole diameter	0.55
Thickness of section : height.....	0.94

Shell consisting of numerous laterally compressed whorls, of which the sides slope towards the back, transversely ribbed, the last whorl with five sulcations at some distance from each other. The ribs are oblique in the direction forwards, subtuberculated at the edge of the umbilicus, and cross the back either of the same strength as on the side, or, as in larger specimens, somewhat less marked; they are for the most part single, only those next to the sulci being bi-, or tri-, partite. Back roundish, crossed by the ribs, and in large specimens, when the ribs become partly obsolete, there remains in the middle of the back, generally a tubercle-like elevation from those ribs which bound the sulci below them; umbilicus large, leaving about two-thirds of the inner whorls exposed: aperture ovate, cordate.

The septa exhibit two tripartite lobes on either side, and four auxiliary lobes; the dorsal lobe about as long as the first lateral; saddles bipartite and narrow, the second lateral is on the edge of the umbilicus.

(120)

This species is easily distinguished by the involution, and compression of the whorls and by the ribs being chiefly single. From the European Cretaceous rocks we do not know any allied form. It is from the uppermost group of the Trichinopoly series.

Range. Arrialore group.

Locality. Vencataramapooram, and North of Camarapolliam. Only three specimens have been found, two from the former, and one from the latter locality. It must be a rare shell.

Group 16. PLANULATI.

The *planulati* Ammonites are slightly involute, compressed, shells, on which the lateral ribs become bipartite towards the middle of the sides, without forming any tuberculations. Pictet, (Pal. Suisse. Foss. de St. Croix, 1860, p. 365,) quotes only two species of this group, namely *Am. Ambrosianus*, Catullo* from the 'Biancone' of the Venetian Alps, and *Am. Tucuyensis*, von Buch,† from the Andes of Venezuela. We regret much that we have not as yet been able to procure the Bologna Annals of Nat. Science, and are therefore compelled to leave the decision of the question of the relations of the single Indian Planulate *Am. Theobaldianus* to the Palæontologists of that country.

1. AMMONITES THEOBALDIANUS, *Stoliczka*, Pl. LXXVIII. Figs. 1—3.

Am. testa compressa, complanata, anfractibus transversim costatis atque distanter sulcatis; costis lateraliter prope in medio bipartitis; umbilico magno, non profundo; apertura ovali; suturis septorum lateraliter bilobatis; lobis tri-, sellis bi-, partitis, lobis auxiliaribus quatuor.

Diameter of largest specimen from Koloture	135 mm.	
Proportions (whole diameter being considered as 1.00) calculated	<i>a</i>	<i>b</i>
from figured specimen in diameter of	50	135 mm.
Outer whorl : whole diameter	0.38	0.32
Width of umbilicus : whole diameter	0.33	0.40
Thickness of section : height.....	0.99	0.81

(a) Fig. 1, small specimen with preserved shell.

(b) Fig. 2, large ditto cast.

Shell discoid, whorls compressed with nearly flat, or slightly convex sides, ornamented with numerous transverse ribs, slightly bent forward, and with five to seven furrows, at some distance from each other, and marking the previous positions of the mouth. The ribs alongside the furrows are stronger, terminating at the

* 1846, Rem. Geog. palæoz. des Alpes Venet. Nuov. Annal. Sc. Nat. Bologna, 2nd Ser. V. p. 81-107,

† 1850, Zeits. d. Deutsch. Geol. Gesells. II. p. 342, Pl. X.

umbilicus with sharp tubercle-like elevations; the other ribs are for the most part bifurcated near the middle of the sides of the whorls. This bifurcation, however, is sometimes not quite evident, and the shorter ribs then appear to alternate with the longer. On casts, in which state the majority of specimens are found, the ribs appear stronger and rounded, while on well preserved shells they are thinner and sharp, as shewn in our Fig. 1. The umbilicus is large and plane, about one-half of the inner whorls being exposed, the involution extending sometimes to the bifurcation, or often leaving the commencement of this visible within the umbilicus. Aperture ovate, somewhat compressed.

The sutures of the septa present two lateral, and four smaller and obliquely descending auxiliary lobes; they are all tripartite and long-pointed; the first lateral is longer than the many-divided dorsal lobe; all the saddles are bipartite, and the second lateral extends to the edge of the umbilicus.

This is one of the most interesting species in our collection of Indian fossils. It is very similar to the upper jurassic *Am. bplex*, or *Am. Achilles*, D'Orb.

The species is named after Wm. Theobald, Junior, Esq., of the Geological Survey of India, long connected with Indian Geological researches.

Range. Trichinopoly and Arrialoor groups.

Localities. The greater number of the specimens are from the Trichinopoly group, as from the North and West of Serdamungalum; West of Koloture; North of Andoor; Coonum; Kolakonuttum; East of Shutanure; West of Olapaudy; North of Anapaudy. From the Arrialoor group, there are only a few specimens from the North east of Serdamungalum, and from Ootacod, North east of Arrialoor.

Group 17. FIMBRIATI.

This group established by D'Orbigny is characterized by very slight, or scarcely any involution, in connection with the roundness of the whorls and generally only two bipartite lateral lobes. The ornamentation of the shells consists of continuous, often undulating, fine striæ or ribs, without any conspicuous tuberculations.

We have to describe four species in this group. *Am. Vishnu*, and *Am. Brahma*, already noticed by E. Forbes; *Am. Mahadeva*, a species similar to *Am. Fimbriatus*, of the lias, and *Am. Marut*. All belong to the lower group of the Cretaceous series of South India.

1. AMMONITES MARUT, *Stoliczka*, Pl. LXXIX. Fig. 1.

Am. testa discoidea, anfractibus numerosis, parum involutis, lateraliter subcompressis, transversim costatis; costis obliquis, antice curvatis, in dorsum subobsoletis; dorso subrotundato; umbilico lato; apertura rectangulari, compressa; suturis septorum lateraliter bilobatis; lobis atque sellis bipartitis, lobo dorsali longiore quam laterali primo.

(122)

Proportions (the whole diameter being considered as (1.00) calculated from figured specimen, with diameter of.....	14 mm.
Outer whorl : whole diameter	0.39
Width of umbilicus : whole diameter	0.45
Thickness of section : height.....	0.88

Shell discoid, small, somewhat compressed, with many whorls which are ornamented with numerous oblique ribs, becoming nearly obsolete on the roundish back; the ribs are strongly bent forwards without any tubercles. Umbilicus large and shallow, exposing three-fourths of the inner whorls; the shell slopes very gradually to the umbilicus, so that no walls are formed; section of the whorls roundish triangular, a little higher than broad. The sutures form two lateral lobes, and four much smaller auxiliary lobes, which latter are placed obliquely: both are bipartite, each division again bifid: the dorsal lobe is very small, but somewhat longer than the first lateral.

This species is easily separated from *Am. Honnoratianus*, D'Orb., Pal. Franç. Terr. Crét. p. 124, Pl. XXXVII.) from the French and Swiss Neocomien, by its numerous ribs, and by the broader dorsal saddle.

Range. Ootatoor group.

Locality. West of Odium; only the figured specimen has as yet been found.

2. AMMONITES BRAHMA, Forbes, Pl. LXXIX. Figs. 2—4.

1846. *Ammonites Brahma*, Forbes, Trans Geol. Soc. Lond. VII. p. 100, Pl. VIII. Fig. 1.
 1852. „ „ Giebel. Fauna der Vorwelt. III. p. 408.

Am. testa discoidea, planulata, anfractibus quinque, junioribus lævigatis, ad umbilicum acute tuberculatis, adultis transversim costatis; costis dorsi in medio subobsoletis; umbilico latissimo; apertura semicirculari, postice cordata: suturis septorum lateraliter bilobatis; sellis bipartitis, lobis trifidis; lobis auxiliaribus tribus, obliquis.

Diameter of largest specimen from Pondicherry	105 mm.
Proportions (whole diameter being considered as 1.00) calculated from the figured specimen with diameter of.....	a b
Outer whorl : whole diameter	50 103 mm.
Width of umbilicus : whole diameter	0.32 0.31
Thickness of section : height.....	0.44 0.48
	1.25 1.03

(a) Young specimen, Fig. 2.

(b) Larger grown specimen, Fig. 3, both from Pondicherry.

Shell discoid, whorls roundish, having their greatest thickness nearly at the inner or umbilical margin and sloping gradually to the outer periphery. The edge of the umbilicus is marked by a row of sharply pointed tubercles, which become less distinct on the outer whorl. The outer whorls are crossed by numerous transverse ribs while the young shell is smooth, shewing only three oblique furrows on

each whorl at some distance from each other. The ribs of the last whorl are all bent forward, nearly of equal strength at length, but on the middle of the back a little slighter. Umbilicus large, allowing two-thirds of the inner whorls to be seen; aperture semi-circular, cordate at the base, broader than high. The sutures of the septa consist of two lateral lobes and saddles; the saddles are bipartite with short branches; the lobes trifid; the dorsal saddle is the largest, the dorsal lobe equally deep as the first lateral; the auxiliary lobes, and saddles which succeed the second lateral saddle descend in an oblique line to the umbilicus, becoming at the same time gradually smaller.

This species differs from *Am. Vishnu*, Forbes, chiefly by the roundness of the whorls, and the existence of sharp umbilical tubercles, even at the earliest stages of growth. The sutures have in both very similar divisions.

Range. Valudayur group, in the South Arcot district; and Arrialoor group, in the Trichinopoly district.

Localities. Pondicherry, from which several specimens have been examined, all belonging to the Madras Museum collection. In the Trichinopoly district, a single specimen has been met with, about two miles north of Ootacod, North-East of Arrialoor, in the uppermost group of Mr. Blanford's tri-division of the Cretaceous strata in that district.

3. AMMONITES VISHNU, Forbes, Pl. LXXIX. Fig. 5.

1846. *Ammonites Vishnu*, Forbes, Trans. Geol. Soc. Lond. VII. p. 100. Pl. VII. Fig. 9.

1852. „ „ Giebel. Fauna der Vorwelt, III. p. 408.

Am. testa orbiculari; anfractibus 5—6, subrotundatis transversim costatis atque intervallim sulcatis; costis junioribus numerosis, atque prope umbilicum obsoletis, adultis distantibus, inaequalibus; costis fortioribus umbilici ad marginem, et dorsi in medio tuberculatis, costis brevioribus ad dorsum plerumque interruptis; umbilico latissimo, apertura ovate-rotundata. Suturis septorum lateraliter bilobatis, sellis bipartitis, sella dorsali maxima; lobis trifidis, lobo laterali primo vix longiore quam dorsali.

Proportions (whole diameter being considered as 1.00) calculated from the largest known specimen figured, from Pondicherry, in diameter of	124 mm.
Outer whorl : whole diameter	0.31
Width of umbilicus : whole diameter.....	0.47
Thickness of section : height	0.92

Shell orbicular, very little compressed, discoid with five to six rounded whorls, which are ornamented with numerous transverse slightly curved ribs, and furrows. The young shell is nearly smooth, shewing merely three to four transverse furrows on each whorl, marking the previous positions of the mouth. Specimens of medium size, of diameter between one and a half and three inches, exhibit a great number (124)

of slight ribs, which become obsolete towards the umbilicus. On still larger shells, the ribs become less numerous unequal and distant each from the other. The stronger ribs extend from the edge of the umbilicus on one side to that on the other, beginning on either side with a sharp tubercle, and uniting in the middle of the back in a large rounded tubercle: the shorter ribs do not reach to the umbilicus, and are on the back considerably slighter, or even interrupted. The furrows are seen on the last whorl only in front of the stronger ribs, eight in number. Umbilicus very large, exposing about three-fourths of the inner whorls; aperture higher than broad, ovate, cordate at the base. The septa, which are plainly seen in our specimens, exhibit two lateral lobes on each side, which are trifid, with pinnate divisions, the dorsal lobe is a little shorter than the first lateral; the saddles are bipartite with short rounded branches, the dorsal one is the largest.

This species is readily distinguished from *Am. Brahma*, Forbes, by the want of umbilical tubercles, and the somewhat compressed shell.

Range. Valudayur group.

Localities. Pondicherry: from the Madras Museum collection.

4. AMMONITES MAHADEVA, *Stoliczka*, Pl. LXXX.

Am. testa planulata prope evoluta; anfractibus 5—6, cylindricis, transversim numerosissime striatis, striis undulatis, parum antice extensis; umbilico latissimo; apertura circulari integra; suturis septorum trilobatis profunde et numerosissime incisis, sellis atque lobis inæqualiter bipartitis; lobo dorsali multum minore quam laterali primo, sellarum ramis externis longioribus quam internis.

Proportions (whole diameter being considered as 1.00) calculated	
from figured specimen, with diameter of	218 mm.
Outer whorl : whole diameter.....	0.34
Width of umbilicus : whole diameter	0.41
Thickness of section : height.....	1.02

Shell orbicular, consisting of five or six perfectly rounded whorls, which very regularly increase in height and thickness, and are merely touching one the other, so that the umbilical suture is very deep. The surface shews very numerous transverse undulating striæ, some of them are a little stronger, but there are no such distant strong ribs seen, as in *Am. subfimbriatus*. All the ribs are bent a little forward. The umbilicus is very wide, or only a very small part of the inner whorls is concealed: aperture circular, slightly broader than high. The septa form three lobes on each side, they are very numerous and deeply divided and long-branched: the lobes and saddles are bipartite, the divisions being again bifid; the dorsal lobe is very short, and the first lateral the broadest; the syphonal saddle is prolonged and linguiform; the dorsal saddle is also smaller than the first lateral, and the outer branches are, in all the saddles, higher than the inner ones; the ventral or inner lobe seems to be very much divided, and deeper than any of the others.

(125)

This species much resembles some European Neocomian Ammonites of the *Fimbriati* group; from which, however, it is readily distinguished by its regular round whorls, and by the want of any strong ribs on the last whorl. This latter character in connexion with the undulate striæ, is the only character, by which it differs from *Am. lepidus* D'Orb., (Pol. Franç. Ter. Crét. Pl. 48), while *Am. subfimbriatus*, D'Orb., (Pal. Franç. Pl. 35), is also laterally compressed. Both the distinguishing marks, we have mentioned, separate the present species from *Am. recticostatus*, D'Orb., (Pal. Franç. Pl. 40.)

Range. Ootatoor goup.

Locality. Moraviator; in the neighbourhood of which a single but well preserved specimen has been found in the yellowish earthy limestone.

SCAPHITES, *Parkinson*, 1811.

Shells in the first stages of growth consisting of whorls in a regular spiral, the last being prolonged for a greater or less distance, and afterwards reflected towards the inner volutions. The sutures of the septa are generally trilobate, the lobes being much narrower than the preceding saddles.

The inner whorls of a Scaphite cannot be distinguished from a shell of a young Ammonite, with which it agrees in every respect; some of the forms have the characters of Ammonites of the Fimbriate group, others of those of the Macrocephali; the horizontal extension and reflexion of the last whorl consist merely of the body-chamber, which is often more inflate, and more strongly ornamented than the inner whorls.

The genus, *Scaphites*, is as yet only known from the Cretaceous rocks of Europe and America. Pictet in describing the species which occur at St. Croix, (Mater. p. 1. Pal. Suisse. p. 18), gave a general review of all known Scaphites, the number of which amounted to twenty-four well characterized species, to which he adds about ten others, which are somewhat doubtful. Mr. Gabb, in his Synopsis of Cretaceous fossils (Proceedings of the Acad. Nat. Science, Philadelphia, 1861. Vol. VIII. p. 88), quotes many more, but there is a doubt about some of the American species.

Pictet divides the European *Scaphites* into four groups, of the third of which only have we any representatives in the Indian Cretaceous rocks namely *Scaphites* of *small or medium length, with branching ribs or striæ on their sides, not forming tubercles at the point of partition.* Of this group we have three species, two of which *Sc. æqualis* and *Sc. obliquus* are common European fossils, while the third *Sc. Kingianus* is new.

As regards the measurements we have given, we intend to express by the total length or diameter the longer diameter of the ellipse formed by the whole shell, and by the transverse diameter, the diameter of the regularly involute and spiral portion of the shell taken at right angles to the former: and then we give the

proportion which the width of the umbilicus has to this transverse diameter of the spiral. By these three measurements, any one is enabled to draw the outline of the Scaphite and can complete the ornamentation from the description. It is evident, that these measurements can only be taken as accurate, in a *general* way. None of the Mollusca invariably assume such regular proportions of growth, as some Palæontologists would appear desirous of fixing. The ever-varying changes in Nature do not correspond with such mathematical calculations. We have not given the actual measurements as they can be better seen in the figures, than in any series of tabulated numbers.

1. SCAPHITES ÆQUALIS, Sowerby, Pl. LXXXI. Figs. 4—6.

1813. *Scaphites æqualis*. Sowerby, Min. Conchol. I, p. 53, Pl. 18, Figs. 1—3.
 1861. „ „ Pictet, Mat. p. l. Pal. Suisse. Foss. d. St. Croix, p. 11,
 (Pictet gives full references to other authors.)

Sc. testa elliptica, lateraliter compressa et transversim striate-costata; spira testæ junioris regulari, late umbilicata, anfractibus numerosis, sublævigatis; testa in adultis lateraliter costata, dorsaliter transversim multice striata; ultimo anfractu reflexo, sub-inflato; suturis lateraliter trilobatis, partitionibus umbilicum versus magnitudine decrescentibus, lobis atque sellis bipartitis, lobis multum angustioribus; lobo dorsali longissimo, sella dorsali latissima.

Total length of largest specimen from North of Odium	26 mm.
	Fig. 2. Fig. 3.
Diameter of spiral : total length	0.56 0.61
Width of umbilicus : diameter of spiral .. .	0.25 0.20

Shell with elliptical outline, laterally compressed, and ribbed. The young shell consists of numerous slightly embracing whorls in a regular spiral with a large umbilicus, and very fine transverse striæ. In this stage of growth it much resembles an Ammonite of the *Fimbriate* group, as seen in our Figure 4, Pl. LXXXI.* Growing larger the last whorl extends in a nearly straight direction, becoming at the same time thicker, and then recurves again towards the spiral portion. The ornamentation consists of straight or only slightly bent ribs on the sides, which at the reflexion of the shell are generally reduced to small tubercles on the margin of the periphery. The whorl terminates with an elliptical aperture, somewhat enlarged after being constricted by a deep furrow. The back is roundish with numerous transverse striæ: the umbilicus always open, shewing the inner volutions of the spiral portion.

* D'Orbigny's figure (Pal. Franç. Pl. 129, Figs. 5—6) of the whorls is much like those of *Scaphites obliquus*, of which also we give a figure. If true, this would be a most remarkable difference in the inner whorls of a Scaphite in one and the same species. In other respects D'Orbigny's figure correctly represents *Sc. æqualis*.

The sutures (as figured by D'Orbigny) consist of three lateral lobes, of which the dorsal is the deepest; the lobes and saddles are bipartite, the former being considerably narrower than the latter; the dorsal saddle is the broadest of all and is unequally bipartite.

The species varies but little, retaining always its elliptical form, and the enlarged last whorl with its peculiar ornamentation; the straight portion of the last whorl is in some specimens longer than in others, and the compression also varies, as will be seen on comparing our figures 2, and 3. A comparison of our specimens with one from the lower chalk with green grains, (Dela Beche) of Chardstock, Devonshire, proved the entire identity of the two.

Range. Ootator group.

Locality. The species is not uncommon in the shaly limestone, North of Odium. In Europe it is characteristic of the upper and middle cretaceous groups: In England from the lower chalk (Morris); in France the 'craies chloritées inférieures' (D'Orbigny); Gault, (Hebert. Bull. Soc. Geol. Franc. XIV. p. 732): Rotomagien, (Coquand. *ibid.* pp. 57 and 747); in Switzerland and Savoy, the étage cénonanien (Studer and Pictet); in Germany, particularly the strata of the Pläner (Geinitz. Reuss, Ewald and others).

2. SCAPHITES OBLIQUUS, Sowerby, Pl. LXXXI. Figs. 1—3.

1813. *Scaphites obliquus*. Sowerby, Min. Conchol. I, p. 54, Pl XVIII. Figs. 4—7.

1861. „ „ Pictet, Pal. Suisse. Foss. de. St. Croix, p. 14, (full references to other authors are given by Pictet).

Sc. testa ovali-elliptica, subinflata, anguste umbilicata; in juventute testa late-umbilicata, anfractibus in latitudine celeriter crescentibus, transversim striatis; in adultis transversim costulata, costulis ad dorsum bi-, vel tri-,partitis; apertura rotundata ad marginem constricta. Suturis septorum lateraliter trilobatis, sella dorsali inaequaliter bipartita, latissima; ceteris sellis atque lobis bifidis.

Total length of largest specimen from Odium	35 mm.
Transverse diameter on spiral : total length	0.63
Width of umbilicus : transverse diameter on spiral	0.07
Calculated from the specimen shewn, Fig. 3.	

The shell is inflated with elliptical form, and transversely ribbed. The inner whorls are numerous, in the early stage of growth smooth, afterwards covered densely with transverse striae. In this stage the young Scaphite resembles much an Ammonite of the group *Macrocephali*, and possesses a large and deep umbilicus, as the whorls increase rapidly in thickness. The last or body-chamber is altogether more inflated, and is on its basis somewhat projecting in the space of the umbilicus, which becomes nearly thoroughly covered by this overlap, as is seen in our Figs. 2-3, of a fragmentary specimen, the inner volutions of which are figured separately.

(128)

The shell varies in length, as seen in Figs. 2 and 3, depending on the horizontal extension of the body-chamber. The ribs on the surface are slightly bent forward, and are simple on the sides, and bi-, or tri-,partite on the broad back. Aperture roundish, constricted at the margin, and afterwards somewhat enlarged. The sutures exhibit three lateral lobes, all proportionally much narrower than the saddles, of which the dorsal is largest, and is unequally bipartite, they are altogether very similar to those of *Scaphites æqualis*. The two species have been, indeed, considered identical by many French and German Palæontologists (D'Orbigny, Giebel, Geinitz. and others) although the distinguishing characters of both have been clearly given by Sowerby and shewn in his figures. *Sc. obliquus* is always proportionally thicker, and the ribs are bi-, or tri-,furcate on the back, while in *Scap. æqualis* the lateral costæ are generally perpendicular to the length of the shell, much stronger, and scarcely connected with the dorsal striæ. The umbilicus of *Scap. obliquus* is nearly overlapped by the bottom of the body-chamber; that of *Scap. æqualis* is always open. The inner whorls also exhibit great differences.

Range. Ootatoor group, (Valudayur ?)

Localities. Neighbourhood of Odium; chiefly in the yellowish sandstone: common. A single, not very distinct, fragment from Pondicherry seems to belong to this species.

In Europe *Scap. obliquus* is known from many localities of the lower chalk in England (Morris); in France, from the craie inférieure of Rouen and Havre (Passy) Cénomaniens (D'Orbigny) and others: in Savoy and Switzerland, from the Cénomaniens (Pictet); and from the Pläner sandstone and limestone of Germany and the chalk of Rugen (Geinitz: Hagenow; Bronn's Jahrbuch, 1842, &c.)

3. SCAPHITES KINGIANUS, *Stoliczka*, Pl. LXXXI. Fig. 7.

Sc. testa ovate-rotundata, compressa, umbilicata, transversim striate-costulata: costulis antice versus obliquis, lateraliter multice divisis atque dorsum transcendentibus, in ultimo anfractu aperturam versus evanescentibus; apertura ovali-elongata; dorso rotundato, compresso. Septorum suturis—?

Total length	23 mm.
Transverse diameter on the spiral : total length.....	0.79
Width of umbilicus : transverse diameter on spiral	0.18

Shell elliptically roundish, much compressed with a large round umbilicus, and numerous transverse ribs. These latter are broad, but not very prominent, and are separated by shallow furrows. On the last whorl they become more numerous, branching toward the back into a great number of very fine striæ, and they die out altogether nearer to the aperture. The aperture is prolonged, elliptical, and constricted close to the end. The horizontal part of the body-chamber forms a nearly regular and continuous curve on the outer margin, and is nearly straight

on the inner margin, becoming soon recurved, so as to reach the inner whorls. The sutures could not be made out.

This remarkable species (dedicated to Wm. King, Junior, Esq. who has for several years been engaged in connection with the Geological Survey of India, in the examination of Southern India), can very readily be distinguished from other allied forms (as *Scap. æqualis*, *Sc. constrictus*, and others,) by its peculiar ornamentation as regards the ribbing, and by its roundish form, being at the same time strongly compressed laterally.

Range. Otatoor group.

Locality. A single, but rather complete, specimen was found about a mile north of the village of Odium, in a yellowish calcareous sandstone.

ANISOCERAS, *Pictet*, 1854.

Shell at first growing in an open helicoid spire, afterwards more or less prolonged and reflected. Ornamentation consisting mostly of transverse ribs, with or without tubercles: sutures of the septa divided into five lobes and five saddles both bipartite, the lateral saddles are generally the largest; the ventral saddle more or less deeply divided by a trifid incision, but, as compared with the other lobes, always so as to approach more the character of a lobule than of a separate ventral lobe.

There is no more difficult point in the literature of the Cephalopoda than to fix properly the limits of the numerous genera of the Ammonitidæ. Not a single publication on this point appears which does not notice these difficulties; and yet no one can, at the present, foresee, how long we may have to wait, before all these questions are settled. It was generally believed, that all the different forms of the Ammonitidæ could be best explained by a consideration of their Geological ages, and that all the different excentric evolute curved and straight shells were the steps by which the rich Jurassic fauna of the genus Ammonites passed to extinction with the Cretaceous period. Indeed this idea seemed more probable than any other. But the careful studies of the Alpine fossil faunæ, in Europe, have, within the last few years, brought forward genera which seem to be the early representatives of the several Cretaceous genera; we mean the *Auloceras*,* *Cochloceras*, *Rhabdoceras*, and others of the upper Triassic strata of Hallstadt in the Austrian Alps. In these we have forms resembling Baculites with the sutures of a Goniatite described as *Rhabdoceras*, and similarly those of Turrilites, as *Cochloceras*. Further research will doubtless teach us more of these forms, which are of high interest in the classification and development of the whole group of the Cephalopoda.

These Triassic genera then seem to indicate that the different Cretaceous forms of the Ammonitidæ have existed long before the Cretaceous epoch, and that their classification possesses a firmer basis of stability than appeared at first.

* F. von Hauer. Sitzungb. der K. Akad. Wien. 1860, XLI. p. 113, &c.

Under the genus *Anisoceras*, we describe several forms of the Ammonitidæ. This genus was first proposed by Pictet in his *Traité de Paléontologie II.*, p. 705, and afterwards much better determined and illustrated by several new forms in his *Paléontologie Suisse*.* The principal difference from the genus *Ancyloceras*, consists in the coiled portion of the shell, which is helicoid in *Anisoceras*; and in one plane in *Ancyloceras*. Among other characters which Pictet gives as distinguishing *Anisoceras* from *Ancyloceras*, he notices the constant obliquity of the transverse ribs in consequence of the spiral turning. This is, of course, always the case on the coiled portion but not always on the prolonged and straight portion, as may be seen here in the species *A. rugatum* which obviously belongs to the genus *Anisoceras*. Pictet also considers the form of the sutures to be very characteristic, and, we think, with good reason. A difference will be noted between the number of lobes given by him and by us. He says (*loc cit.* p. 59,) there are always *six* lobes. Indeed the difference is merely a subjective one. But looking to all the sutures in the genus, which we have here figured, and also to those given by Pictet, it will be seen that this lobe which he quotes as the sixth, the ventral lobe, may much more correctly, as compared with the others, be considered as only a division of the ventral saddle. In fact, it is very often scarcely longer than any of the other divisions of the saddles, and, as well as the ventral saddle, corresponds perfectly in form to the others. In another way also, we think our view has an advantage,—we have then not to think of any irregularity in the sutures; there are five lobes, and five saddles, all bipartite. Of the saddles, the lateral are the largest, and the lobes, as well as the incisions of the saddles, increase in length from the dorsal to the ventral region. This fact is observed in all our species, but we will not say that it is a constant rule in all species of *Anisoceras*. Many apparent regularities of a similar kind have been noticed, which further discoveries proved to be exceptions; and this may be the case here also. Indeed we do not desire to make rules for Nature, but rather to seek out and find those which exist.

D'Orbigny gave as an invariable character of his genus *Ancyloceras*, the tripartition of the superior lateral lobe, and this was the chief reason why Professor E. Forbes referred all the S. Indian species to *Hamites*, considering *Ancyloceras*, "as only a section, and scarcely even that, of *Hamites*, to which *Crioceras*, or at least a part of that genus, belongs." Much has been done in these investigations since Professor E. Forbes wrote this, and yet we may confess that we know very little more about the true nature of these fossils. So far as our present knowledge goes, *Hamites* differs from *Ancyloceras*, by the absence of any coiled portion of the shell, the posterior part being only reflected. I confess I have never had an opportunity of seeing any perfect specimens either of *Hamites* or of *Ancyloceras*; I mean an *Ancyloceras* in the strict sense as the genus is taken now, as being rolled up in one plane. I have no doubt, they exist, and in this case the genus *Anisoceras* may be well retained. I would suggest a further examination of the one section of *Ancyloceras* with bipartite lobes, (which section Pictet, *loc cit.* p. 40, finds a

* Fossiles de Ste. Croix, 1861, p. 57, &c.

natural one) to determine whether these forms have in reality the spiral portion of the shell coiled up in one plane, or in a helicoid spire. Should the latter prove to be the fact, the bipartition of the lateral lobes would form a good character for the genus *Anisoceras*. And the geological question also would be to some extent satisfied, for Pictet says that these forms all belong to the upper Cretaceous series.

We cannot conclude without noticing M. Ooster's recently published speculations on the genus *Ancyloceras*.* He enlarges the characters of D'Orbigny's *Ancyloceras*, inasmuch as he says that the nucleus is not always to be found in the centre of the spire, as it is in *Crioceras*. We do not view this as very important; the excentricity is very natural, as every *Ancyloceras* ought to have one end of the shell prolonged and reflected, so that we cannot expect a symmetrical spire. But I am surprised to find Mr. Ooster so much astonished at Quenstedt's *Hamites bifurcati* possessing a helicoid spire! I should otherwise have been strongly disposed to believe that at least a few of his numerous *Ancyloceras*, which are like some of the Indian species, belonged to *Anisoceras*. It would be difficult to shew, why these Indian fossils should prove such an entire exception.

Under the genus *Anisoceras*, we describe eleven species, one of which remains undetermined. These are *Anis. armatum*, Sow. *Oldhamianum* and *angulatum*, nov. sp. *undulatum*, Forb. *tenuisulcatum*, Forb. *rugatum*, Forb. sp. *sub-compressum*, Forb. *large-sulcatum*, Forb. *indicum*, Forb. *Nerei*, Forb. Only the first of these species could be determined to be identical with any known European species.

1. *ANISOCERAS ARMATUM*, Sow. sp. Pl. LXXXI. Figs. 8—10, Pl. LXXXII.

1818. *Hamites armatus*, Sowerby, Min. Conch. II. p. 153, Pl. CLXVIII.

1861. *Anisoceras armatus*, Pictet, Mat. p. 1. Pal. Suisse. Foss. de Ste. Croix, p. 62, Pl. XLVIII. Figs. 1—6.

1861 (?) „ *perarmatus*, Pictet et Campiche, ibid, p. 65, Pl. XLVIII. Figs. 7—8, Pl. XLIX.

1862 (?) *Hamites armatus*, Sowerby, *H. Saussureanus*, Pictet, *H. perarmatus*, Pictet et Campiche, F. v. Hauer. Sitzungsab. K. Akad. Wien. Vol. XLIV. p. 644—649, Pl. I. Figs. 9—10, Pl. II. Figs. 1—4.

Anis. testæ fragmenta elongata subcylindrica, (reflexa) transversim costata; costis externe fortioribus, bifidis vel simplicibus, pluribus ad medium lateraliter, atque ad dorsum, tuberculatis, costis interne numerosis, multo tenuioribus; sectione ovata, plus minusve rotundata. Suturis septorum quinque-lobatis, lobis atque sellis bipartitis; sellis lateralibus majoribus quam dorsalibus; sella ventrali in medio profunde incisa.

Several fragments of this species have been obtained from the Cretaceous rocks of South India, but all belong to the straighter parts of the shell, no portion evidently belonging to the spiral part having yet been seen. In describing the species we

* Cat. Céphal. des Alpes Suisses. 1860, part V. p. 5.

shall use the term *prolonged portion* proper to mean the direct prolongation of the spiral part, and *reflected portion*, meaning the reflected part of the prolonged portion.

The prolonged portion of the shell is more or less cylindrical, transversely ribbed, and ornamented on each side with two rows of tubercles, of which one is placed nearly in the middle of the side, or nearer to the interior region, while the other is situated at the dorsal region. The former are either rounded or spinose; the latter are extended in the direction of the longitudinal axis. As regards the ribbing, the ornamentation differs greatly on different portions of the shell of the *Anisoceras*. On the sides and back the ribs are much stronger than on the ventral region. On the sides of the prolonged portion, they are generally bipartite, or in many instances there is one thinner rib above and a stronger below, so that they appear to be bipartite (Fig. 8, Pl. 81). More rarely specimens are met, on which only the stronger middle rib is well preserved (Fig. 10, Pl. 81). On the back of the prolonged portion the ribs are very often not so well marked as on the sides. As soon as the shell becomes reflected intermediate ribs appear, which are not connected with the tubercles, and when the reflected portion grows longer, two or even three of these ribs appear between each two lateral tubercles, the bipartition of the former still existing. The ribs on this portion of the shell are generally more oblique than on the former. The dorsal tubercles gradually disappear altogether, (Fig. 9, Pl. 81,) and the ribs cross the back equally strong as on the sides. The ventral or internal region of the shell is numerously ribbed, as each outer rib here divides into three (Fig. 1*b*. Pl. 82).

It must be remarked that all our specimens though numerous, are merely casts, and these all of older shells. Young specimens, and even older when the shell was preserved, had certainly more of the secondary ribbings, as may be traced on a few of our specimens.

The section of the shell (it must always be taken on uncompressed specimens) is either oval, laterally somewhat compressed (Fig. 9*a*. Pl. 81), or very nearly circular (Fig. 8*a*. Pl. 81), or dilatate broader than high (Fig. 9*b*. Pl. 81). It is in fact impossible to fix definite limits, the section of the prolonged portion being (even in one and the same specimen) generally more rounded than of the reflected portion. The sutures exhibit five lobes, and five saddles much subdivided, and bipartite; the lateral saddles are larger and higher than the dorsal ones, and the lobes are much narrower than the saddles; the ventral saddle is deeply bipartite by a trifid incision; the second or lower lateral lobe is unequally bipartite.

Sowerby first described this species as *Hamites armatus*, (loc. cit.) and although his specimen seems to have been a good deal pressed, a similar distribution of the ornamentation on the two portions of the shell will be remarked. He distinctly says, "besides the two spines upon every *third* undulation," with which remarks our Fig. 2, Pl. 82, may be compared. Mantell's specimens were very poorly preserved. Dixon gives (Geol. of Sussex, Pl. XXIX. Fig. 13,) a very characteristic figure. D'Orbigny's figure of *H. armatus* is evidently compiled from several frag-

ments, on which the ornamentation differs. Several other authors have treated of the species, each according to his own view, partly identifying with it, and partly separating from it, other forms which they described as distinct species. I fully agree with Prof. Pictet in his criticism on the literature of this species, only that I am more inclined to think that Sowerby's *Ham. plicatilis* (Min. Conch. III. p. 59, Pl. CCXXXIV. fig. 1) is rather a portion of the spiral part of the shell of *Anis. armatus*, than a distinct species. Pictet devoted great attention to a full consideration of the species, and at the same time separated from it under the name of *perarmatus* a form which in some respects differs, but which we cannot think is specifically distinct from the typical *Anis. armatus*. He gives the following characters as separating the latter from the former; 1. stronger lateral compression of the shell; 2. distinct lateral tubercles placed in the middle of the flanks of the shell; 3. greater* number of intermediate ribs and, 4. their oblique direction. Prof. Pictet further remarks (p. 66) that he has not, as some English authors did, admitted the identity in species of some different types, but that he still believes the point deserving of a careful discussion. We confine our remarks to the two forms we consider identical. *Anis. armatus* and *per-armatus*, without entering on the questions regarding the other allied species, *Saussureanus*, *pseudo-elegans*, *alternatus*, and others, which we rather think are different.

As regards then the first point, namely, the greater compression, we can only compare our own materials, and refer to our own figures of sections. On one and the same specimen different fragments exhibit sometimes different sections, so that we cannot admit this character as in any way distinctive. The lateral tubercles are quite as distinct in *Anis. armatus*, as in *per-armatus*, and in both are placed about the middle of the sides, as may be seen on comparing Prof. Pictet's figures, and the variations shewn in our figures. As regards the greater number of intermediate ribs, we would specially refer to our figures and remarks above, noticing the changes in the ornamentation on the prolonged and reflected portions of the shell. In fact, a glance at Pictet's own figures would shew that the distinction is not so strict, and that intermediate ribs appear in one variety as well as in the other. We believe we shall not be far wrong if we consider Pictet's figures of *Anis. armatus*, as representing fragments belonging chiefly to the spiral portion, and those of *Anis. per-armatus* as being of the prolonged and reflected portions. Any one comparing our Fig. 9, Pl. 82, would refer one half of this specimen to *Anis. per-armatus*, (Pictet, *loc. cit.* Pl. XLIX. Fig. 2), and the other half to *Anis. armatus*, (*ibid.* Pl. XLVIII. Fig. 7). We think our specimens and figures are thus much more instructive in shewing the identity of the two forms, and we therefore refer again as regards the fourth point of distinction, to our Figs. 9—10, Pl. 81, on which the straightness of the ribs on one half, and the obliquity on the other half, of the two figures respectively will be observed.

More recently F. von Hauer, in describing the Cretaceous fossils from the 'Bakonyer wald' in Hungary (*loc. cit.*) has offered some additions to our knowledge

* ? 'peu nombreuses,' see page 66, *loc. cit.* and the figure of *A. armatus*.

of these forms of *Anisoceras* (*Hamites*), but that he did not recognize accurately all the distinctive characters, is clearly shewn by his remark (p. 645) "in case the separation from *H. armatus* can be retained."* F. von Hauer's specimens undoubtedly belonged to *Anis. armatus* of Sowerby. We have further given his *Anis. Saussureanus* as identical, inasmuch as the specimen figured by him, (Pl. 11, Fig. 1, *loc. cit.*) does not at all agree with *Anis. Saussureanus* of Pictet, but with *Anis. per-armatus*.†

We hope these remarks will justify our having reunited under the older specific name the two forms.

Range. Ootatoor group.

Localities. Neighbourhood of Odium, and Moraviatoor in the calcareous yellowish sandstones as well as in the shaly limestone; not uncommon.

In Europe, the species has been met with in several countries; Morris (Catal. p. 305) quotes it from the lower chalk and Gault of England: D'Orbigny (Prodr. II. 147) refers it to the étage Cénomanién, but it is known from several localities of the Gault and Craie chloritéé, as well in France as in Savoy, and Switzerland. In Germany, it has been quoted by several authors from the Flammenmergel, and Quadermergel, and in Austria (from Hungary) by F. von Hauer from strata which correspond to the Gault of other parts of Europe.

2. ANISOCERAS OLDHAMIANUM, *Stoliczka*, Pl. LXXXIII. Figs. 1—4, Pl. XCII.
Fig. 1.

Anis. testa ab initio spiralis postea prolongata, subrotundata, transversim annulate-costata atque tuberculata; costis fortioribus et tenuioribus alternantibus, apud ventralem regionem subobsoletis, vel in costulas numerosas divisiss; tuberculis lateraliter biserialibus spinosis: suturis septorum quinque lobatis, lobis atque sellis bipartitis numerosissime atque profunde incisiss, lobo dorsali multum minore quam laterali primo; sella laterali prima latissima.

The shell begins to grow with a spire, which does not remain in the same plane, and therefore is properly a member of this genus. It is ornamented with transverse ribs, and with two rows of tubercles on each side. The ribs are placed close together, and alternate with much thinner intermediate ones, which latter have no tubercles. The tubercles on the former in the very young stage are somewhat elevated on the casts, while on the prolonged portions they are merely flat nodes; the spinose portion being composed only of the shell. The casts of this species are well marked by these flat nodes which are close together. When the shell is

* "falls die Trennung von *H. armatus* aufrecht erhalten werden kann."—&c.

† Pictet's figures of *Anis. Saussureanus* in the 'Gres Verts,' and in the *Paléontologie Suisse*, exhibit rather noteworthy differences, and we are disposed to think that some of the fragments figured on Plate XIII. in the 'Gres Verts' belong in reality to *Anis. armatus*, Sow.

preserved more secondary ribbings appear. The ventral region of the shell is provided with numerous transverse but much weaker ribs, derived chiefly from the subdivision of the outer ribs. The section is in the young shell more angular, on the back is nearly flat, but it afterwards becomes nearly quite circular.

The prolonged part of the shell exhibits a kind of bending, as if intending to reflect itself in the opposite direction to the spire. The sutures of the septa consist of five lobes and five saddles, both very numerous divided and bipartite. The dorsal lobe is rather small and shorter than the first lateral. The dorsal saddles are also small, and the first lateral is the largest.

The species is well distinguished from any yet known by its closely set, annular ribbings, and its peculiar ornamentation. The fragment of the spire which we have figured is the most perfect as yet known of an *Anisoceras*. Broken portions have some resemblance to those figured by Pictet, (Pal. Suisse. Fossiles de Ste. Croix, Pl. L.) under the name of *Anis. Saussureanus*.

Range. Ootatoor group.

Locality. Penangur, S. W. of Odium, where, in addition to the figured specimens, another coiled and not less imperfect fragment (Pl. XCII. Fig. 1) has been found in the shaly limestone with *Ammonites inflatus*, *Rotomagensis*, and others.

3. ANISOCERAS ANGULATUM, *Stoliczka*, Pl. LXXXIV.

Anis. testæ fragmenta elongata, curvata, lateraliter compressa atque transversim costata; costis præcipue obliquis, uno vel duobus tenuioribus cum fortioribus alternantibus, ultimis dorsi ad marginem tuberculatis, atque nonnullis prope ventrem subtuberculatis; dorso plano; suturis septorum quinque-lobatis, sellis atque lobis bipartitis, multice incisis, sella laterali prima majore quam dorsali.

Several large fragments have been found which sufficiently mark this as a yet undescribed species, although no part of the spiral portion has yet been seen. We consider ourselves justified in placing these under the genus *Anisoceras* from the similarity with allied species.

The fragments are all of large size, that figured is the most perfect. The shell of this consists merely of the body-chamber, the sutures of the last chamber being marked on the shorter or the prolonged part of the shell. This is strongly compressed laterally, so that the outer or dorsal region is quite flat on well preserved specimens, being bounded on either side by sharp edges. Numerous transverse ribs cross the shell alternating with one or generally with two much thinner ribs. The former have a strong tubercle on the edge of the back and often a smaller one towards the ventral region, not in the middle of the sides. All the ribs become nearly obsolete towards the ventral region, and more equal in strength towards the mouth. It will be seen that in this species, as already noticed also in *Anis. armatus*, the transverse ribs are more oblique on the reflected than on the prolonged portion of the shell.

The sutures as in other *Anisoceras* have five lobes and saddles, both bipartite, and the lateral saddle the largest. In our figure the sutures can only be taken as correct in general outline, as they have been copied from a rather badly preserved specimen, with water-worn surface.

The lateral compression, the more angular section in consequence, and the peculiar kind of ribbings, which remind us partly of those in *Anis. alternatum*, Mantell, distinguish this species at a glance from any others.

Range. Ootatoor group.

Locality. Odium : several large fragments were obtained from the yellowish calcareous sandstones.

4. *ANISOCERAS UNDULATUM*, Forbes, sp. Pl. LXXXV. Fig. 6.

1846. *Hamites undulatus*, Forbes, Trans. Geol. Soc. Lond. VII. p. 118, Pl. X. Fig. 6.
 1850. „ „ D'Orbigny, Prodr. II. p. 216.
 1852. „ „ Giebel, Fauna der Vorwelt, III. p. 312.

A very slender slightly curved fragmentary specimen from Pondicherry, belonging to the Madras Museum, is the only one we have seen. This differs from all the other species by the thick transverse ribs, which give to the shell an undulating surface. The section is oval, the species being slightly compressed laterally. We could not trace the sutures : but we have been induced to place the species under the genus *Anisoceras* from the curvature of the shell. It is not an *Hamites*, but it may be an *Ancyloceras*.

Range. Valudayur group.

Locality. Near Pondicherry ; apparently very rare.

5. *ANISOCERAS TENUISULCATUM*, Forbes, sp. Pl. LXXXV. Figs. 14—16.

1846. *Hamites tenuisulcatus*, Forbes, Trans. Geol. Soc. Lond. VII. p. 116, Pl. X. Fig. 8,
 and Pl. XI. Fig. 3.
 1847. *Hamites Indicus*, D'Orbigny, Voy. de l'Astrolabe et Zélee ; Paléon. Atlas. Pl. III.
 Figs. 13—14—*non Hamites Indicus, Forbes.*
 1850. *Ancyloceras tenuisulcatus*, D'Orb. Prod. II. p. 214.
 1852. „ „ Giebel, Faun. der Vorwelt, III. p. 319.

Anis. testa ab initio spiralis, postea prolongata, transversim numerosissime striata, atque distanter profunde sulcata ; striis atque sulcis obliquis, ad dorsum ascendentibus ; sectione subrotundata ; septis—?

The shell of this pretty *Anisoceras* seems to have had only few volutions in the coiled portion, and proportionally rather a long prolonged part. The whole surface is covered with fine striæ, which are separated each from the other by

somewhat broader shallow furrows; at some intervals these are interrupted by deep sulcations, which are bounded by stronger ribbings. Both the striæ and the sulci maintain a rather oblique direction descending considerably towards the ventral region. The section is either oval or nearly circular, according to the fragments. Among our specimens, we have only one (Fig. 16,) which may belong to the reflected part of the shell, as it is rather sharply curved to belong to the spiral portion.

In our specimens we could not trace the sutures. Prof. Forbes describes the chambers as being distant, and the partitions divided into evenly furcated lobes and saddles; the largest saddle being the superior lateral, which also corresponds well with the relative size of the saddles in other species of *Anisoceras*.

The specimen figured by Professor Forbes, (Pl. X. Fig. 8), is the most perfect yet known, and the figure gives a very good idea of the species. D'Orbigny figured as *Hamites Indicus*, only a poor fragment, and according to his note in the Prodrôme (II. p. 219,) where he mentions only one locality, there is little doubt that all the other specimens of *Hamites* figured on the same plate, (probably all the fossils on Plates III—V.) were derived from near Pondicherry, and from the same strata as those described by Professor Forbes.

Several species, very similar to this, have been described from the Cretaceous rocks of Europe and other countries (*Ancyl. pulcherrimum*, D'Orb.; *Moussoni* Ooster; and others; see Ooster, Cat. der Céphal. Suis.); but so long as no perfect specimens have been found in either country, it is certainly preferable not to enter on such questions of uncertain identification.

Range. Valudayur group in the Pondicherry district, and Arrialoor group in Trichinopoly district.

Locality. Near Pondicherry: all the specimens from this locality we have had the opportunity of examining belonged to the Madras Museum: the species appears comparatively rare. Two specimens from Olapaudy attain a thickness nearly equal to that in Forbes' figures: these belong to the Survey collection.

6. ANISOCERAS RUGATUM, Forbes, Pl. LXXXV. Figs. 10—13.

1846. *Hamites rugatus*, Forbes, Trans. Geol. Soc. Lond. VII. p. 117, Pl. XI. Fig. 2.

1847. „ *simplex*, D'Orbigny, Voy. de l' Astrolabe et Zélee; Paléon. Atlas. Pl. III. Figs. 15—17.

1850. „ *rugatus*, D'Orbigny, Prod. II. p. 216.

1852. „ „ Giebel, Fauna der Vorwelt, III. p. 310.

Anis. testa transversim costata; costis acutis angustioribus quam sulcis, æqualibus; sectione rotundata; suturis septorum 5-lobatis, lobis atque sellis bipartitis, sella dorsali paulum minore quam laterali prima; sella ventrali minore.

The shell grows from a helicoid spire into a straighter prolonged and nearly cylindrical portion. Excepting small and somewhat doubtful fragments, none

have been obtained definitely belonging to the reflected portion. The section is generally round, rarely somewhat oval. Numerous transverse ribs form the ornamentation of the shell, and are sharp and separated by furrows which are more than twice as large. On the straight part of the shell the ribs are with slight exception perpendicular to the axis, and of the same thickness all round. The sutures are, as in other *Anisoceras*, divided into five lobes and five saddles; they are all bipartite, and the lateral saddles do not much exceed in size the dorsal.

Professor Forbes figured a rather thick fragment, and I have no doubt he meant this species as we have shewn it, for he also notices in his description (*loc. cit.* p. 117), the helicoid spire, resembling a *Helicoceras* of D'Orbigny. These helicoid fragments are not at all rare near Pondicherry, and Forbes could not refer them to any other of his figures, as the ribs in all the other three similar fragments which he describes are more distant from each other. D'Orbigny in the *Voyage of the Astrolabe*, figured a fragment of the coiled portion as *Hamites simplex*, and united this in his *Prodrome* with *H. subcompressus*, Forbes, not with good reason, as Forbes' figure seems to represent quite a different shell, as will be found more fully stated under the description of the latter species further on.

Range. Valudayur group.

Locality. Near Pondicherry; seems to be rather common in the blueish calcareous sandstones at Valudayur, near Pondicherry. The specimens examined by us belonged to the Madras Museum.

7. *ANISOCERAS* ——— ? sp. Pl. LXXXV. Fig. 19.

The only fragment known is figured. It is from a blueish clay or decomposed earthy limestone, near Pondicherry. It is preserved with its shell, and differs from all the other species known from South India by its thick ribs, which are of equal dimension all round the periphery, are annular, and separated by deep furrows about as broad as the ribs.

Range. Valudayur group ?

Locality. Pondicherry, presented to the Geol. Survey of India by Brooke Cunliffe, Esq.

8. *ANISOCERAS SUBCOMPRESSUM*, Forbes, sp. Pl. LXXXV. Fig. 7.

1846. *Hamites subcompressus*, Forbes, Trans. Geol. Soc. Lond. VII. p. 116, Pl. XI. Fig. 6.

1847. „ *acuticostatus*, D'Orbigny, Voy. de l' Astrolabe, Atlas Pal. III. Figs. 11, 12,
(non idem Figs. 9—10.)

Anis. testæ fragmenta transversim costata; costis acutis, continuis, sub-distantibus, simplicibus, uno in latere subundulatis; sectione subrotundata vel elliptica.

The few straight fragments which we possess of this species, exhibit rather distant transverse ribs, which on the well preserved shell are sharp, and, on the

cast roundish. On one side they are a little bent, similar to those in *Ancylloceras Brunneri*, Ooster (Cat. Céph. Suiss. 1861, Pl. XXXVII. Figs. 10—13) from the Swiss Alps, to which fossil the Indian species bears much resemblance in the kind of ribbing also. The distance of the ribs from each other is about three times their thickness. Prof. Forbes mentions some stronger sulcations at intervals, of which no trace is seen on our specimens. The section is either roundish or oval, as seen in our figures. Prof. Forbes describes the sutures as consisting of bifurcated lobes and saddles and even Forbes' figure of the species represents a much thicker fragment; we also think that D'Orbigny's figure of his *Hamites acutisulcatus* ought to be referred to this species. There is in fact a marked difference easily noticed, even in small fragments, as compared with those, of equal thickness, belonging to *Ancyl. rugatum* or *large-sulcatum*. The ribs in the former are closer together, in the latter more distant. D'Orbigny, in his *Prodrome* (II. pp. 215, 216, Nos. 83 and 88,) has admitted more confusion about these forms than could have been expected, seeing that he had examined specimens from the same locality. And later, Prof. Giebel (Faun. der Vorwelt, III. p. 309, 1852) strangely united these very distinct fossils, viz. *Ham. subcompressus* and *Indicus* of Forbes, and *Ham. simplex* of D'Orbigny. Forbes' figures are far from being well executed, but I cannot think Prof. Giebel would have identified these species, if he had looked at the descriptions, as well as the plates. And of what use is it to *assert* the identity of fossils, which only more numerous and better preserved specimens can establish?

Of the spiral portion of this species, nothing has yet been seen, and it is therefore placed in this genus, from its similarity to others which are known to belong to it.

Range. Valudayur and Ootatoor groups.

Localities. Near Pondicherry, from the Madras Museum collections; and from the calcareous sandstone near Odium in the Trichinopoly district, Geol. Survey collections: apparently rare.

9. ANISOCERAS LARGE-SULCATUM, Forbes, sp. Pl. LXXXV. Figs. 8, 9.

1846. *Hamites large-sulcatus*, Forbes, Trans. Geol. Soc. Lond. VII. p. 117, Pl. XI. Fig. 1.
 1847. „ *acuticostatus*, D'Orbigny, Voy. de l' Astrolabe, Atlas Pal. Pl. III. Figs. 9, 10.
 1832. • „ *large-sulcatus*, Giebel, Fauna der Vorwelt, III. p. 310.

Anis. testa transversim costata; costis distantibus continuis, acutis, atque simplicibus; sectione subcompressa, vel rotundata; suturis quinque-lobatis, lobis atque sellis bipartitis, sellis lateralibus maximis, lobo dorsali brevioris quam laterali superiore.

The distinctive character of this species consists especially in the distance of the sharp transverse ribs from each other. On the coiled portion they are a little nearer and oblique, but on the straight fragments they have a distance of about four times the thickness of the ribs, are perpendicular to the axis, and have

(140)

scarcely any noticeable bending. The section generally is somewhat oval, the specimen being laterally somewhat compressed. The sutures form five lobes, and as many saddles (not six) and all bipartite. The dorsal lobe is shorter than the lateral, the lateral saddles are the largest, the ventral saddle broad and deeply bipartite.

The species is easily distinguished from any other occurring near Pondicherry, by its more distant ribs. Our figured fragment (Pl. LXXXV. Fig. 8,) belongs probably to the coiled portion of the shell, and seems to indicate a very open spire.

We have examined only a few fragments from the Madras Museum collection, but have no doubt that D'Orbigny's figure, quoted above, belongs to this species, and not to *Anis. Indicum*, to which he refers it (*Prodrome* II. p. 215). He also thinks Forbes, *Anis. large-sulcatum* is probably identical with Morton's *Ham. (Baculites) columna*, (Synopsis, p. 44, Pl. XIX. Fig. 8.) This appears to us very improbable if we suppose even the outline of Morton's species to be correct. It indicates a conical shell, while our much longer straight fragments are nearly cylindrical.

Range. Valudayur group.

Locality. Near Pondicherry, rather rare.

10. ANISOCERAS INDICUM, Forbes, sp. Pl. LXXXV. Figs. 1—5.

1846. *Hamites indicus*, Forbes, Trans. Geol. Soc. Lond. VII. p. 116, Pl. XI. Fig. 4.

non *Hamites Indicus D'Orbigny*.

1850. „ „ D'Orbigny, Prodr. II. p. 215.

Anis. testa lateraliter compressa, transversim costulata, costulis numerosis rotundatis, ad ventrem sub-obsoletis; sectione ovali-compressa; suturis septorum quinque-lobatis, lobis atque sellis bipartitis, sellis lateralibus maximis.

Shell growing from an open spire, and afterwards prolonged into a long shaft. Neither the inner volutions of the spiral portion, nor the reflected portion has been seen.

The shell is laterally compressed and closely ribbed transversely, the ribs being oblique on the coiled, and perpendicular to the axis on the straight parts. At first they are distant from each other, only about their own thickness, but afterwards this distance increases to nearly double their thickness. On the ventral region also they become generally somewhat slighter. The section is regularly oval, and in the first stage of growth, rather compressed. The sutures form five lobes and five saddles, both bipartite, the lateral saddles being the highest and the ventral the broadest. This species differs from *Anis. subcompressum* by the great lateral compression, and the rather close ribbings, and also by the more slightly marked ribs on the ventral region, characters which easily distinguish the two.

It may be questioned, why the species has been put under the genus *Anisoceras* and not *Ancyloceras*. It is indeed a doubtful point. But there seems to be in the

fragment of the coiled portion (Pl. LXXXV. Fig. 2) a tendency to a helicoid spire: and, further, the distribution of the sutures into five bipartite lobes, induced us to place the species, as we have done under the genus *Anisoceras*.

Range. Valudayur and Ootatoor groups.

Localities. The species is not uncommon, both near Pondicherry, and in the yellowish calcareous sandstone of Odium.

11. ANISOCERAS NEREIS, *Forbes*, sp. Pl. LXXXV. Figs. 17—18.

1846. *Hamites Nereis*, Forbes, Trans. Geol. Soc. Lond. VII. p. 117, Pl. X. Fig. 7.

1850. " " D'Orbigny, Prodrôme, II. p. 216.

1852. " " Giebel, Fauna der Vorwelt, III. p. 314.

We have seen only three slightly curved fragments which we can refer to this species. They are very like those of *Anis. subcompressum*, and are from the same locality, near Odium. The ribs are close set, and are partially interrupted on the back, but on the further prolonged portion become continuous, as seen Fig. 18. This makes the species rather a doubtful one. Still, inasmuch as our three fragments, as well as Prof. Forbes' figures, indicate specimens which are not so broad, and not so much compressed as similar fragments of *Anis. subcompressum*, we prefer retaining for these forms the published name, until further discoveries shall establish the point with some certainty. The sutures exhibit, as in all other *Anisoceras* we have examined, five bipartite lobes and saddles, of which the lateral saddles are the largest. The subdivisions are not well preserved in our specimens, but they do not differ much from those of *Anis. subcompressum*.

Range. Valudayur and Ootatoor groups.

Localities. Near Pondicherry and Odium: apparently rare.

HELICOCERAS, *D'Orbigny*, 1840.

Shell turritid, chambered; whorls either contiguous or separated, mostly rounded and transversely ribbed; the siphuncle placed in, or very near to, the middle of the outer region of the whorls; the sutures of the septa divided into symmetrical lobes and saddles; lobes pointed, mostly bipartite, saddles rounded, as in Ammonites.

When D'Orbigny first established the genus *Helicoceras* (Paléont. Franç. Vol. I. p. 611,) he described under it two species, which very probably do not belong to this genus, and which may prove to be coiled fragments of *Anisoceras*. The genus, however, was proposed and was afterwards retained by other authors, for helicoid chambered shells, which differed from *Turrilites* in having their whorls separate, and not contiguous. In this latter genus (*Turrilites*) itself, D'Orbigny distinguished two groups, *Turr. rotundati*, and *Turr. angulati*.

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Turr. rotundati differed from *Helicoceras* only by the contiguity of their whorls : and *Turr. angulati* by the sutural position of the siphuncle, from *Helicoceras*, as well as from the *Turr. rotundati*. Further the *angulati* had the whorls ornamented with tubercles, while the *rotundati* had generally only transverse ribs ; this latter character must, however, be abandoned as it has been proved not to be a general one. The *Turr. rotundati* agree with the genus *Helicoceras*, in the position of the siphuncle, in or near the middle of the outer region of the whorls, and in the regular and symmetrical distribution of the sutures, while the *Turr. angulati* have the siphuncle placed at or near to the (lower) suture of the contiguous whorls, and the divisions of their septa are consequently irregular and unsymmetrical. This difference in the shells unquestionably points to a difference in the organization of the animals forming them, or at least, to a different position of the equivalent organs in the animals of the two sub-groups *Turr. rotundati*, and *angulati*. The *rotundati* differ also from *Helicoceras* in the separation of the whorls.

If we take a perfect shell of any of the species of *Anisoceras* (*Ancyloceras*) which agree in the transverse ribbings, and in the distribution of the sutures, we see on the same specimen, a helicoid, a prolonged, and a reflected portion, of one and the same shell. This clearly shews that one and the same animal did not always strictly retain the same form. And that, therefore, the variations in the character of the volutions of the shell cannot be admitted as characters of any high importance as distinguishing genera ; and that, even in species, the value of this character is very limited. In this point of view, we think that the position of the siphuncle and the symmetrical or unsymmetrical division of the sutures ought to be regarded as a much better distinguishing character than the kind of volutions. And we, therefore, adhere to Mr. Sharpe's proposition (*Palæont. Soc. Moll. of Chalk*, p. 59,) to transfer the *Turr. rotundati* to the genus *Helicoceras*.

Taking the genus in this sense, we have only a single species from the South Indian rocks *Helic. Indicum*.

Pictet divided* the genus *Helicoceras* into two sections ; 1°. Those with a short spire and widely separated whorls, and 2°. Those with a long or high spire and less distant volutions. He retained as well (*ibid*, p. 149), D'Orbigny's two sections of the *Turrilites*. He further proposes (*ibid*, p. 123) to retain the sub-group *Turr. angulati* as constituting the proper genus *Turrilites* (as we have done) ; to form a new genus for *Turr. rotundati* and the second section of *Helicoceras* ; and to retain the first section of *Helicoceras* as forming the genus *Helicoceras* proper. We do not think there will be any necessity to form a new genus in this sense, as the distinction would consist merely in the greater separation of the whorls, which we have shewn to be of little value. And after all, the fact is that we do not know anything positively of the first section of *Helicoceras*, for the two species given by D'Orbigny, *Helic. annulatus* and *gracilis*, may just as well be helicoid portions of shells belonging to the genus *Anisoceras* : as may also be the fragmentary portion of *Ham. rotundatus*, of Sowerby (*Min. Conch. LXI. 2, 3*).

* *Paléont. Suiss. Foss. de Ste. Croix. 1861, p. 120.*

All other species in this section are known only from brief notes in D'Orbigny's *Prodrome*.

1. *HELICOCERAS INDICUM*, *Stoliczka*, Pl. LXXXVI. Figs. 1—2.

Helic. testa turrata sinis-, vel dex-, trorsa; anfractibus rotundatis, contiguis, transversim costatis, costis exterioribus partim bipartitis, obliquis, interioribus multum minoribus; suturis multice atque profunde divisis, sella dorsali parva, inæqualiter bipartita, lobo laterali primo maximo, late bipartito.

Angle of the spire about 30°

Shell turrated, turned either to the right or left. The rounded and contiguous whorls are ornamented with numerous (about 50 in one circuit) oblique transverse ribs which are partly bipartite near the suture; and nearer to the aperture are interrupted by somewhat deeper furrows in connexion with stronger ribs, indicating the previous positions of the mouth. On the inner or umbilical side of the whorls the ribs are much thinner and some of the outer ones disappear here. The section of the whorls is more or less rounded, but generally elliptical somewhat higher than broad. The umbilicus is large.

The sutures, so far as they are seen in one of our specimens are much and deeply divided: the siphuncle lies in the middle of the whorls, the dorsal saddles are small, and irregularly bipartite; the first lateral lobe is the largest and is widely bipartite.

We have examined only the three figured specimens, of which two are turned to the right, and one to the left, being in every other respect evidently identical.

The nearest ally of the Indian fossil, as regards ornamentation and the form of the spire, is *Helicoceras* (*Turrilites*) *Emericianum*, D'Orbigny (*Pal. Franç. Terr. Crét.* p. 580, pl. 141, figs. 3—6,) differing by its narrow umbilicus, and by the form of the septal sutures, the saddles of which (in the French species) are equally bipartite, and the lobes tripartite.

Range. Arrialoor group.

Locality. East of Veraghoor, in a fine oolitic calcareous sandstone of a brownish colour.

TURRILITES, *Lamarck*, 1801.

Shell turrated, sinistral or dextral; whorls contiguous, generally ornamented with ribs and tubercles; siphuncle placed at or near the lower suture between two whorls; the sutures of the septa divided into six lobes, and six saddles, generally both bipartite, unequal and unsymmetrical; the upper dorsal lobe and the succeeding first lateral lobe being generally the largest.

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We have retained, in this genus, for reasons which will be found more fully explained under *Helicoceras*, only D'Orbigny's second section of *Turrilites*, the *Turr. angulati*, characterized by the above generic description. The other section, *Turr. rotundati*, we would transfer to *Helicoceras*.

Adopting these limits for the genus, the number of the *Turrilites* will be somewhat reduced. Pictet quotes (Pal. Suiss. Foss. de Ste. Croix. p. 132) twenty-four species and some doubtful ones. We have to describe from the Indian rocks, six species, of which one only, *Turr. Cunliffeanus*, is new. Among the others are some of the most characteristic species of the Gault in Europe, as *Turr. costatus*; *Bergeri*; *Gresslyi*; *tuberculatus*; and *Brazoensis*, the last being a North American form.

Prof. Forbes (Trans. Geol. Soc. Lond. VII. p. 115, pl. IX. fig. 5,) mentioned and figured merely in outline, a planorbis-like fossil as a doubtful *Turrilites planorbis*. It was from near Pondicherry. As we have not been fortunate enough to procure any specimen of this kind, we are not in a position to state whether it is really a *Turrilite* or not. We have not seen any traces of a *Turrilite* from the rocks near Pondicherry; although we see no reason why they should not be found there.

The terminology adopted in the following descriptions is that generally accepted, the reversed cone being taken as the position of the shell, and accordingly the terms upper and lower suture, &c. are used.

1. TURRILITES BERGERI, *Brongniart*, Pl. LXXXVI. Figs. 3—6.

1822. *Turrilites Bergeri*, *Brongniart*. Env. de Paris. Cuvier Oss. Foss. 4. Ed. 1834. Vol. IV. pp. 178, 641, Pl. O. Fig. 3a.
1861. " " *Pictet*, Pal. Suiss. Foss. de Ste. Croix. p. 134, Pl. LVIII. Figs. 1—5. with full references to previous authors.
1861. " " *Ooster*. Cat. Ceph. Foss. des Alpes Suisses, p. 94. Pl. V.
1862. " " *F. von Hauer*. Sitzungsb. d. K. Akad. Wien, XLIV. p. 640.
1862. " " *Coquand*. Geol. et Paléon. de la Prov. Constantin, p. 288. (*Etage Rotomagien*.)

Turr. testa turrita, sinistrorsa, anfractibus sub-convexis tuberculatis; tuberculis quadri-serialibus prope æquidistantibus, spinosis vel rotundatis; sectione anfractuum subrotundata; umbilico angusto; suturis septorum 6-lobatis, numerosissime atque profunde incisiss; lobis inæqualibus bipartitis; sella dorsali externa latissima.

Angle of the spire 30° to 40°

Shell turrited, sinistral; whorls roundish and ornamented with four rows of tubercles, which are often spinose and sharp, or larger and node-like. The uppermost row of the tubercles generally lies immediately on the suture, and the lowest is at about a distance from the lower suture equal to one-third the height

of the whorl: the others being nearly at equal distances. The specimens often differ in their coiling (as Pictet has already stated, *loc. cit.* p. 186,) some of them having their whorls quite contiguous (Fig. 6), the consequence of which is, that the uppermost series of tubercles is covered by the succeeding whorl and then only three rows of tubercles are seen on the outer part. Others have their whorls more separated, in which case all the four rows of tubercles become visible (Fig. 5.); the tubercles are generally connected, in the transverse direction, by indistinct ribs, which near the mouth are better developed; they form also at the uppermost corner a thickened part (Fig. 6a. 6b.), after which the shell becomes considerably constricted as seen in Fig. 6a. Pl. LXXXVI.

In the young shell of which we have figured several specimens, the two uppermost rows of tubercles are close to each other, and the lowest is more distant from the preceding, the tubercles on this row being also occasionally somewhat larger than those of the others, but the number in both is always equal. The top part of the whorls is a little convex, either smooth or with oblique ribs, which spring from the uppermost row of the tubercles, and disappear in the region of the umbilicus without forming any tubercles on its margin.

The septa are divided into six unequal bipartite lobes and saddles; the outer dorsal saddle is the largest, as is also the outer first lateral lobe; the inner (or lower) dorsal lobe is much smaller, and is only about the size of the upper first lateral. Our figured complete outline of a suture corresponds exactly with that given by Pictet, as does also the form of the shell (*loc. cit.* Pl. LVIII.). Pictet also gave a full notice of the variations, which we need not repeat here, and therefore only refer to his paper.

Range. Ootatoor group.

Locality. Common in the yellowish calcareous sandstone, between Odium and Moraviatoor.

Turrilites Bergeri is one of the most characteristic fossils of the middle cretaceous series—the Gault—and is known from these deposits throughout Switzerland, Savoy, Italy, France, &c. In England it occurs in the lower chalk: and in Hungary it has been noticed by F. von Hauer in the deposits, corresponding to the Gault, of the Bakonyer Wald.

2. TURRILITES GRESSLYI, *Pictet et Campiche*, Pl. LXXXVII. Figs. 1—5.

1861. *Turrilites Gresslyi*, *Pictet et Campiche*, *Pal. Suiss. Foss. de Ste. Croix.* p. 132, Pl. LVII. Figs. 11—13.

Turr. testa turrita sinis-, vel dex-, trorsa; anfractibus convexis vel subangulatis, transversim subcostatis, atque tuberculatis; tuberculis tri-serialibus; sectione anfractuum subangulata; umbilico lato, ad marginem subtuberculato; suturis septorum sex-lobatis, lobis atque sellis bipartitis, inæqualibus; lobo dorsali exteriori latissimo, altero dorsali multum minore.

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Angle of the spire from 25° to 40°
 Length of axis of largest complete specimen from Moraviatoor..... 210 mm.

Shell turreted, either sinistral or dextral, with slight transverse ribs, and three rows of tubercles on each whorl. The two upper rows are more closely set than the third. All the tubercles are connected by ribs, which are more or less distinct, sometimes nearly entirely wanting; on other specimens they often become bipartite from the lowest row of tubercles to the suture. The whorls are either more or less angulate or rounded: this depending much on the development of the tubercles. When young, there are often only two rows of tubercles on each whorl; while in more fully-grown specimens the uppermost row appears on the suture and gives to it an undulating outline. The upper portion of the whorls is covered with transverse oblique ribs, which form small tubercles on the edge of the umbilicus, and continue into the lumen.

The sutures are divided into six lobes and six saddles, unequal among themselves, and bipartite: the outer or upper dorsal saddle is the largest, and the first lateral lobe is also much deeper than the dorsal. The sutures altogether are very like those in *Turr. Bergeri*, but are not so much subdivided. From this species *Turr. Gresslyi* differs chiefly in having only three rows of tubercles on the whorls, and the fourth on the edge of the umbilicus, and in having strong ribs on the upper part of the whorls.

In every respect, the turning of the spire either to left or right, the disposition and number of the tubercles (18—20,) and their position with reference to the sutures, as well as the sutures themselves, the Indian agree entirely with the Swiss specimens, so that no doubt appears to remain of the identity of the two.

Range. Ootatoor group.

Localities. Odium and Moraviatoor, not uncommon both in the calcareous sandstone, and in the compact earthy limestone.

Pictet described the species from the upper strata of the *Gres Verts* of Ste. Croix, and quotes it, from the *Gault* of two other localities in Savoy.

3. TURRILITES TUBERCULATUS, *Bosc*, Pl. LXXXVII. Figs. 6—8.

1801. *Turrilites tuberculatus*, *Bosc*, Buffon de Déterville, 2nd Edit. 1824, Coquilles, Tom. V. p. 183, Pl. XLII. Fig. 8.

1861. „ „ *Pictet*, Paléon. Suiss. Foss. de Ste. Croix, 3 Ser. p. 146, (*with references to previous notices.*)

Turr. testa turrata, conica, sinistrorsa; anfractibus subangulatis tuberculatis; tuberculis quadiserialibus; seriebus superioribus tribus cum tuberculis minoribus, serie inferiori cum tuberculis majoribus, sed minus numerosis: sectione anfractuum angulata. Suturis septorum sex-lobatis, lobis atque sellis bipartitis et inæqualibus, sella dorsali superiore, vel externa, latissima.

Angle of the spire, from 18 to 24°.

Shell turreted, sinistral; whorls angulate, with four rows of tubercles, of which the lowest placed near the middle or at one-third distance from the lower suture) consists of large tubercles, the number of which is always less than those in the three upper rows. The tubercles of the latter are much smaller and those of the two uppermost rows are often so closely set, that they appear to form only one thickened row. The middle of these latter three rows occupies the suture. Short ribs are sometimes visible below the lowest row of tubercles, which continue to the lower suture. The top-portion of the whorls is ornamented with radiating oblique ribs, which disappear towards the centre, without forming any tubercles on the edge of the small umbilicus. The section of the whorls is angulate and squarish.

The sutures do not differ from those of similar *Turrilites*: the superior dorsal saddle is unequally bipartite and remarkably large, as is also marked by Sharpe in some of his figures.

Our specimens, none of which are of large size, agree in all respects with the well known European forms, so that we would only repeat here the subordinate variations in the form or number of the tubercles. Some, with reference to the arrangement of the upper rows of tubercles, are perfectly like *Turr. Morrisii*, Sharpe, (Ceph. of Chalk. p. 65, Pl. XXVI. Figs. 4—8.) Others, by the somewhat larger angle of the spire agree with *Turr. Gravesianus*, D'Orbigny (Pal. Franç. Pl. CXLIV. Figs. 3—5, so that we have some doubt as to the specific distinction of this last, from the typical *Turr. tuberculatus*. There is a difficulty in distinguishing young specimens of this species from those of *Turr. Bergeri*, as these latter always have the same number of tubercles in each of the four rows, even when the size of those in the lowest row is a little greater.

Range. Ootator group.

Locality. Odium; some specimens have been found north of the village, in blueish, and others to the south-west, in yellowish, calcareous sandstone.

In Europe the species is met with in the *Gault*, and *Gres-Verts*, deposits of France, Savoy, Italy, Germany (*Flamenmergel and Plüner*); in England (*Lower Chalk*); &c.

4. *TURRILITES COSTATUS*, *Lamarck*, Pl. LXXXVII. Figs. 9—10, Pl. LXXXVIII. Figs. 1—2.

1801. *Turrilites costata*, Lamarck, Sys. des Animaux sans vertebres, 1801, p. 102.
 1861. „ *costatus*, Pictet. Pal. Suisse. Foss. de Ste. Croix. p. 142, (with full references to previous authors.)
 1861. „ „ Ooster. Cat. Céph. Foss. des Alpes Suisses, pt. V. p. 96.
 1862. „ „ Coquand, Geol. et Paléon. de la Prov. Constantin. p. 288, (*étage Rotomagien.*)

Turr. testa turrita, sinistrorsa; anfractibus subplanis, transversim tuberculato-costatis; serie superiori tantum continua; sectione anfractuum subquadrata; aper-
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tura elongata, elliptica. Suturis septorum sex-lobatis, lobis atque sellis bipartitis inæqualibus, lobo laterali primo superiore maximo.

Angle of the spire,..... from 20° to 25°.

Shell turreted, sinistral, consisting of numerous slightly convex whorls which are ornamented on the lower-half portion with close oblique costæ, and above with two rows of tubercles. Between the ribs and the tubercles there is rather a strong constriction, which encircles all the whorls like a furrow. The upper series of tubercles is much the smaller of the two, and the tubercles are either partly concealed by the succeeding whorl, or they form together an undulated carina.

The lower contiguous portion of each whorl is slightly excavated, and the upper rounded, which produces a subangular section; both are generally smooth. The umbilicus is very narrow. The mouth is elongate, oval, higher than broad: the last whorl forming near to it, on the uppermost part, a kind of node-like expansion after which the aperture becomes somewhat constricted.

The sutures of the septa are divided into six lobes, which, as well as the saddles are unequal among themselves and bipartite; the saddles also are unequally subdivided, the upper dorsal saddle, and the next first lateral lobe are the largest; the former is rather short, but large. The other lobes and saddles do not differ much from the general form of sutures in *Turrilites*.

The Indian specimens agree so well in every respect with the European, in the ornamentation, in the form of the mouth, and the divisions of the septa, that there is no doubt of their identity in species. Our specimens are all casts, and do not therefore generally shew the upper terminations of the ribs so much thickened as when the shell is preserved. For the same reason, the tubercles in the upper row do not appear so distinct. Among our specimens some varieties can be traced similar to those which Sharpe (*Ceph. of Chalk. Pl. XXVII.*) has figured; but in all, the characters of the shell are constantly retained.

Range. Ootatoor group.

Locality. Odium: common in the brownish sandstone, north of the village.

Turrilites costatus is one of the most characteristic fossils of the middle portion of the Cretaceous deposits of Europe. It is known throughout France; (*Cénomaniens,—Gres verts,—Gault*) Savoy; Italy; Germany (*Pläner and Flamenmergel*); England (*Lower chalk*); M. H. Coquand also noticed the species in the south of Algeria (*étage Rotomagien.*)

5. *TURRILITES BRAZOENSIS*, Römer, Pl. LXXXVIII. Fig. 3.

1849. *Turrilites Brazoensis*, F. Römer, Texas, p. 415.

1852. „ „ „ Kreidebild. von Texas, p. 37, Pl. III. Fig. 2.

We cannot distinguish the only known fragment here figured from the similar form described by F. Römer, from the Cretaceous rocks of Texas. Prof. Römer

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mentions the shell as sinistral, while our fragment appears to belong to a dextral shell. The four rows of tubercles, of which the uppermost is partly covered by the preceding whorl (marked on our specimen by a line); the partial connexion of these rows by rib-like elevations; the continuation of the latter on the inner parts of the shell; and its prolonged elliptical section, agree perfectly with the American form, which is also known only from three fragments.

Range. Ootatoor group.

Locality. Moraviatoor in earthy limestone.

6. *TURRILITES CUNLIFFEANUS*, *Stoliczka*, Pl. LXXXIX.

Turr. testa turrita, sinistrorsa; anfractibus convexis supra tri-tuberculatis, infra oblique-costatis; sectione anfractuum ellipticá.

The shell consists of rounded whorls, turned to the left, and ornamented partly with tubercles, partly with ribs. The former occupy the upper portion of the outer circumference, and are arranged close to each other in three rows so as to be like granular zones. The lower portion is covered with oblique, and slightly curved ribs, which in number correspond with the tubercles. The top portion of the whorls is convex, and also covered with the same number of oblique ribs, the impression of which appears on the basal portion of the next whorl, which accordingly is concave. The umbilicus is very large; the section of the whorls obliquely elliptical, somewhat higher than broad.

The septa have not been fully seen, as the only known figured specimen consists merely of the body-chamber. Traces of the last air-chamber indicate a similar disposition of the sutures to that in other *Turrilites*.

The peculiar ornamentation consisting of the three rows of tubercles, and the curved ribs are the chief distinctive marks, as compared with other known species.

Range. Ootatoor group.

Locality. Odium; in the brownish sandstone, north of the village.

HAMITES, *Parkinson*, 1811.

Shell elongated, twice reflected, without any spiral portion, mostly transversely ribbed; sutures divided into six lobes and six saddles, the ventral lobe either bi- or tri-partite; the lateral lobes bipartite.

The genus *Hamites* is readily distinguished from *Ancyloceras*, and *Anisoceras*, by the absence of any coiled portion of the shell; and by its two reflections from *Hamulina*. The difficulty, however, in determining fragments is often great, and there are unquestionably several species which up to the present have been referred to this genus, which must be transferred to other genera, when more perfect speci-

mens have been procured. Under the genus *Anisoceras*, we have already offered some considerations regarding the affinities of this and other genera, and we need only refer to these here.

The greater development of the ventral lobe in the two species here mentioned *H. problematicus* and *H.?* conf. *Meyrati*, Ooster, is our only reason for quoting these under this genus, and not among the other *Anisoceras*. The shell of both is known only from small fragments, none of which belong undoubtedly to a spiral portion of the shell. This reason may not, however, be considered unquestionably sufficient to justify this generic reference of the two forms. Better specimens must be procured, before it can be accepted as correct; we give them therefore, as doubtful.

1. HAMITES PROBLEMATICUS, *Stoliczka*, Pl. XC. Figs. 1—2.

Ham. testa compressa, transversim costata; costis partim simplicibus, partim bipartitis, ultimis ad dorsum tuberculatis, atque sæpe prope ventrem subtuberculatis. Suturis septorum sex-lobatis, lobis atque sellis bipartitis, lobo dorsali multum breviora quam laterali primo; lobo ventrali etiam brevi, bipartito.

Shell compressed, ornamented with numerous transverse ribs, of which some are single, others uniting two and two into strong tubercles at the edge of the back, and afterwards again subdividing. Sometimes also there are smaller tubercles seen on the sides nearer to the ventral region than the middle (see Fig. 1). Back broad and slightly convex, ventral region round; section oval, the species being laterally rather strongly compressed. The sutures consist of six lobes and six saddles, both bipartite; the dorsal and ventral lobes are the shorter, and of the saddles the first lateral exceeds the dorsal a little in height: the second lateral saddles are smaller. In our specimen we obtained the sutures by the use of some acid, so that they have, as figured, lost some of their fineness of subdivision.

The species, as already stated is only doubtfully placed in the genus *Hamites*. It differs from any other with which we are acquainted. The excentric lateral tubercles placed nearer to the ventral region, and the bipartite ventral lobe, distinguish the species specially from the following.

Range. Ootatoor group.

Locality. Odium: in the yellowish calcareous sandstone, several fragments have been found.

2. HAMITES, conf. MEYRATI, *Ooster*, Pl. XC. Fig. 3.

1861. *Hamites? Meyrati*, *Ooster*. Cat. Céph. des Alpes Suisses, p. 72, Pl. LVI. Figs. 2—7.

Shell laterally compressed, transversely ribbed, and with two rows of tubercles near the dorsal region, ribs being for the most part simple and perpendicular to

the axis. The Indian fossil differs from the European in this latter character, and apparently also in more perfectly retaining the same thickness throughout. The distribution of the ribs, the tubercles, and the compression of the shell are all very similar to the European species, and as we have not been able to procure more than the figured fragment, we prefer leaving this without any new specific name.

The lobes although a good deal injured are seen in outline on the other side of the figured specimen. There are six lobes and six saddles, both bipartite and much subdivided; the ventral lobe is tripartite, not bipartite as in the last species.

Range. Ootatoor group.

Locality. Odium; in the calcareous sandstone, west of the village.

HAMULINA, *D'Orbigny*, 1852.

Shell conical, prolonged, having a portion of the body chamber reflected but without touching the other portion; section of shell round or laterally compressed; ornamentation consisting generally of transverse ribs or striæ; the sutures of the septa divided into six lobes, and as many saddles.

Hamulina, as characterized by *D'Orbigny* is closely related to *Hamites* and *Ptychoceras*. It differs from the former in being only once reflected instead of twice, and from the latter in having the reflected portion of the shell separate from the other, not close together. Consequently fragments only can scarcely be distinguished from those of the other genera, and the general character or aspect of the shell is frequently the only reason for supposing it to belong to one or other of these genera. It is, for this reason, that Palæontologists have differed in their determination of these fossils. Thus *Pictet* (*Pal. Suisse. Foss. Ste. Croix*, 1861, p. 105) has withdrawn *D'Orbigny's* six species of the present genus (*Jour. de Conchyl.* 1852, III. p. 215) and placed them again under *Hamites*. Equal difficulty is met with, in comparison with the genus *Ptychoceras*, as specimens can be obtained, which in the younger stages of growth belong properly to the latter genus, while larger specimens have the reflected parts of the shell more or less widely separated.

D'Orbigny has stated that the genus *Hamulina* is confined to the Neocomien and Aptien groups. *Pictet*, however, seems to us quite justified in remarking that, while there is a possibility that this is the case, it requires still further proof. (*Pal. Suisse. Foss. Ste. Croix*, p. 78.)

We have only a single species from Southern India, which we believe to belong to this genus, *H. sublaevis*, and which has been found with *Scaphites æqualis*, and *Am. inflatus*. This limestone belongs to the lowest of the three subdivisions of the Cretaceous series, proposed by Mr. H. F. Blanford in the Trichinopoly district, but, at the same time, it does not correspond to the Neocomien of Europe, but contains several true Gault species, and others from the middle cretaceous deposits of Europe.

1. HAMULINA SUBLÆVIS, *Stoliczka*, Pl. XC. Fig. 4.

Hamul. testa compressa, interne lævigata, atque subsulcata, externe transversim obsolete-costulata; costulis lateraliter obliquis; sectione elliptice-compressa interne excavata vel plana. Suturis septorum parum incisus atque brevibus, in tota peripheria sex-lobatis; lobis angustissimis, sellis latis, bipartitis, lobo laterum in medio unico bifido, lobo laterali secundo interne posito.

Average length of largest specimen about 60 mm.

Angle of growth of cone in the dorso-ventral diameter about..... 5°.

Shell laterally compressed, elongated and reflected in a curve. The surface exhibits indistinct, oblique, costæ and striæ, which also cross the rounded back. The ornamentation is not distinctly visible, probably owing to our specimens being only casts, the internal region is smooth with a shallow groove along, which gradually disappears towards the reflected part of the shell. The section is elliptical-compressed, and on the chambered portion, excavated or flat; aperture roundish with somewhat enlarged margins. The sutures of the septa have very short divisions, they consist of six lobes, and six saddles, both bipartite, the lobes being very narrow, and the saddles broad. The first lateral lobe lies in the middle of the flanks, and the second on the interior region; the dorsal and the first lateral (reaching to the ventral region) saddles are very broad, while the ventral saddle is much narrower.

On all our specimens the greatest part is occupied by the body-chamber on either side of the reflection, only a small portion being preserved of the air-chambers, which are very close to each other. We have not seen the lower portion of the shell with the point.

Range. Ootatoor group.

Locality. Odium: in yellowish earthy limestone with *Scaphites æqualis*, Sow., *Ammonites inflatus*, Sow., and others:—a rare shell.

PTYCHOCERAS, *D'Orbigny*, 1840.

Shell elongated, lanceolate, straight, once or twice (or many times?) reflected; the siphuncle dorsal, the sutures divided into six lobes and six saddles, all of which (excepting the ventral lobe?) are bipartite.

It is difficult to fix the limits of this genus, although only a few species are as yet known. *D'Orbigny* characterized the genus as having one reflected portion of the shell quite close to the previous straight portion, and this is, or at least seems to be, the case in all young specimens. When, however, they grow to a larger size, these parts are sometimes separate from each other, as may be seen in some of the Indian specimens.

It has been already noticed by D'Orbigny (Prod. II. p. 102) that the *Ptychoceras Puzosianum*, described in the Pal. Franç. I. p. 557, pl. 137, figs. 5—7, is reflected twice. M. Ooster has described and figured another twice-reflected species from the cretaceous deposits of Switzerland, *Pty. Meyrati* (Catal. Céph. Suiss. V. part. 1861, p. 82.) Again a twice-reflected species will be described below, from the Indian rocks as *Pty. Forbesianum*, n. sp. We have, therefore, a genus, which is in the same way enrolled as an Ammonite, only that the spire is perfectly depressed in the longitudinal diameter. It would be indeed a strange case, that the shell of *Ptychoceras* should be not more than once reflected, otherwise the animal must have had large portions of it absorbed and have reformed it again of a larger size; although a partial absorption of some portions of the shell can be scarcely denied.

We have already remarked (page 166) that the prolonged and reflected portion of the shell in *Scaphites* consists only of the body-chamber, although it is necessary to admit, that the Scaphite certainly possessed a body-chamber in the young as well as in the older stages of growth. The absorption of the shell in Cephalopoda seems to be to a far greater extent, than has hitherto been ascertained, and we hope to be able to offer some further remarks on this subject.

Pictet in his catalogue of all known *Ptychoceras* (Mat. Pal. Suisse. Foss. Ste. Croix, 1861, p. 108) quotes six European species, which number is to be increased by the two described by Ooster (Cat. Céph. Suiss. part V. p. 82), to which we have to add again two Indian species, *Pty. siphon*; and *Forbesianum*; the third species from S. India, which we notice, being identical with an European form *Ptychoceras Gualtinum*, Pictet.

1. *PTYCHOCERAS SIPHO*, Forbes, Pl. XC. Figs. 5—9.

1846. *Ptychoceras siphon*, Forbes, Trans. Geol. Soc. Lond. VII. p. 118, Pl. XI. Fig. 5.

1847. *Hamites constrictus*, D'Orbigny, Voy. d. Astrolabe, Atlas, Paléon. Pl. III. Figs. 7—8.

1852. *Ptychoceras siphon*, Giebel, Fauna der Vorwelt, III. p. 288.

Pty. testa elongata, subcylindrica, lævigata, transversaliter annulate-nodosa; suturis septorum parum divisis, lobis atque sellis prope æqualibus bipartitis; lobo centrali tripartito.

Shell prolonged, gradually tapering to the posterior part, smooth. Young specimens have the reflected part close to the last portion, while in older states of growth, the two parts are separated, both with round or very nearly round sections. The surface of the shell is at first merely covered with transverse striæ of growth, and becomes afterwards undulating, being constricted at short distances and afterwards enlarged again. Towards the mouth these transverse plicæ become more numerous, closer one to the other, and appear to develop into dense transverse striæ. The reflected portion of the shell has always, close to the bending, a deep

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transverse furrow. There are six lobes and six saddles in the entire periphery: they are nearly of equal height, and are very simply divided; all (excepting the ventral lobe which is tripartite) are bipartite; the lobes in their upper, and the saddles in their lower, portions are greatly constricted. The dorsal and ventral lobes are somewhat longer than the lateral lobes.

This species must have attained a considerable length, as may be seen from the fragments of the straight portion. We have only had the opportunity of examining a few, and these incomplete, specimens from near Pondicherry, of this species, belonging to the Madras museum; and we are, therefore, unable to add anything to Prof. Forbes' notice.

Range. Valudayur group.

Locality. Near Pondicherry.

2. PTYCHOCERAS GAULTINUM, *Pictet*, Pl. XC. Fig. 10.

1847. *Ptychoceras Gaultinus*, Pictet and Roux, Moll. d. Grès Verts, p. 139. Pl. XV. Figs. 5—6.

1861. „ „ „ Pal. Suisse, Foss. Ste. Croix, p. 107.

It is unnecessary to enter into any detailed description of our specimen; the figure we give will explain more than many words. The only fragment we have was found in the yellowish calcareous sandstone near Odium, and consists of a portion of the prolonged and reflected part of the shell. The attached position of both parts, the fine ribbings on the straight part with some distant constrictions or deeper furrows, and the increasing distance of the ribs one from the other, leave scarcely any doubt as to our specimen being truly identical with the European species.

Range. Ootatoor group.

Locality. Odium.

In Europe the species was first described by Pictet from the Gault of the Perte du Rhone, and from Saxonet; afterwards fragments were found at Ste. Croix. D'Orbigny refers the species to his étage Albien. It occurs also at several other localities in the Swiss Alps. (*vide*, Ooster, Cat. Céph. Foss. des Alpes Suisses, 1861, p. 87.)

3. PTYCHOCERAS FORBESIANUM, *Stoliczka*, Pl. XC. Fig. 11.

Ptych. testa elongata, levigata, versus reflexa, partibus contiguis, sectione transversaliter elliptica, externe convexa, interne subplana vel excavata; suturis 6-lobatis, lobis atque sellis bipartitis.

The small elongate-conical shell consists of two reflected portions, which are quite close to each other. The body-chamber extends as far on the first reflected

portion as the second reflected part reaches below. The shell becomes somewhat thickened at the reflexion. The section is transversely elliptical, the outer region being convex, and the inner plane is somewhat excavated. A slight constriction is well marked close to the aperture which is itself a little enlarged. The cast is quite smooth, and, even in small parts of our specimen where the shell is well preserved, there is no appearance of ribbing.

The sutures of the septa form six narrow lobes and the same number of saddles; both are bipartite. The second lateral saddle is, in our specimen, not clearly visible, it seems to be narrower than the others, while the second lateral lobes are much larger.

The specimen figured is the only one, which has yet been found.

Range. Ootatoor group.

Locality. Moraviatoor, in earthy limestone.

BACULITES, *Lamarck*, 1799.

Shell conical, with the sides laterally compressed, or sub-cylindrical; often smooth or with transverse ribs and tubercles; the striæ of growth undulating, generally further prolonged on the dorsal than on the ventral region, and the aperture accordingly sinuate. The sutures of the septa, for the most part, form five lobes and as many saddles, both bipartite; opposite to the dorsal lobe is a ventral saddle, which is divided by a shorter or longer tripinnate lobule; the incisions of the sutures are either short or deep, but are always numerous.

The mode of growth of Baculites sometimes offers considerable difficulties in their determination, and in obtaining a good idea of the species, since perfect specimens are very seldom to be met with. The angle of growth (or of the cone) seldom exceeds 10° , and frequently there are fragments met with, which are almost truly cylindrical, judging from which, the species must have grown to a length of three or four feet. In the measurements attached to each species we have noted the angle of growth, but it is self-evident that this angle can only be taken as, to a certain extent, correct: it being by no means an exceptional case that, among these Molluscs as among the Gasteropoda, this angle varies in different stages of their growth.

The Baculites, strictly speaking, are only known from the cretaceous formation, although similar forms, and in fact, as we may call them, their ancestors, occur in the older formations also. The well-known Jurassic *Baculites acuaris* Schlotheim, from Gamelshausen in Württemberg agrees with cretaceous species in form, but its lobes and saddles are not branched; there being between these forms a similar distinction to that between *Goniatites* and *Ammonites*, in reference to the divisions of the sutures. Other shells similar in form, but of older geological

epoch, occur in the Alpine Triassic limestones near Hallstadt in Styria, as noticed by F. von Hauer under the name *Rhabdoceras*.*

From the cretaceous rocks of South India we have three species, two of which had been already described by Prof. E. Forbes namely *Baculites teres* and *vagina*, (the latter also known from Chili) and *Baculites Gaudini*, a species identical with known European forms.

1. *BACULITES TERES*, Forbes, Pl. XC. Figs. 12—13.

1846. *Baculites teres*, Forbes, Trans. Geol. Soc. Lond. VII. p. 115, Pl. X. Fig. 5.

1852. " " " Giebel, Fauna der Vorwelt, III. p. 281.

Bac. testa subcylindrica, lævigata, minutissime transversim undulate-striata; apertura lateraliter profunde sinuata, antice atque postice prolongata, partibus prolongatis rotundatis; suturis quinque-lobatis, sellis atque lobis bipartitis angustis; sellis lateralibus majoribus quam dorsalibus, sella ventrali minima.

Average length of largest specimens, about, 140 mm.

Angle of the cone not exceeding 5°; fragments nearly cylindrical.

The shell is cylindrical and smooth; undulating striæ of growth are visible on the surface, when well preserved, being on the ventral and dorsal regions strongly prolonged forward, marking the previous positions of the mouth, which is on the specimen we have figured (Pl. XC. Fig. 12.) partly preserved. The mouth is thus sinuated, and its margins somewhat enlarged. The ventral prolongation is slightly longer, both it and the dorsal prolongation having broad spoon-shaped terminations. Prof. Forbes notices certain obsolete regular longitudinal striæ, of which we have not observed any trace, although in possession of several specimens with the shells preserved. On the casts there are often only certain constrictions visible, which are obliquely undulating. The sutures exhibit five lobes round the periphery, both saddles and lobes being almost equally narrow, and bipartite; the ventral saddle is the shortest, and the lateral saddles are somewhat higher than the dorsal.

Baculites neocomiensis, D'Orb. differs greatly from this Indian fossil not only in the direction of the striæ of growth, but also in the number of the saddles. It is more nearly related to *Baculites rotundus*, Reuss, (Verst. d. Böhm. Kreide, 1845, I. p. 24, Taf. VII. f. 4) from the Pläner marl near Luschitz and Priesen in Bohemia.

Range. Valudayur group in Pondicherry, and Ootatoor group in the Trichinopoly district.

Localities. Pondicherry and Odium: not a common shell.

* Sitzungs. d. K. Akad. Wien, 1860, Vol. XLI. p. 122.

2. BACULITES VAGINA, Forbes, Pl. XC. Figs. 14—15, Pl. XCI. Figs. 1—6.

1846. *Baculites vagina*, Forbes, Trans. Geol. Soc. Lond. VII. p. 114, Pl. X. Fig. 4.
 1846. „ „ Forbes, Darwin's S. America, Pl. V. Fig. 3.
 1847. „ *Lyelli*, D'Orb. Voy. de l'Astrolabe et la Zélée I, Paléont. Pl. I. Figs. 3—7.
 1847. „ *ornatus*, D'Orb. ditto ditto ditto Pl. III. Figs. 3—6.
 1852. „ *vagina*, Giebel, Fauna der Vorwelt, III. p. 285.

Bac. testa lateraliter compressa, minutissime striata, atque tuberculata; dorso angusto, plano, interdumque apud margines subcarinato; ventre lato subplano; lateribus in juventute lævigatis, convexis, in ætate proveciore ventris ad margines, atque in medio tuberculatis; medianis tuberculis majoribus, obliquis et antice prolongatis; apertura lateraliter sinuata, in ventre parum, in dorso acute, prolongata. Septorum suturis lateraliter bilobatis; sellis atque lobis bipartitis numerosissime sed non profunde incisis, sellarum ramulis rotundatis; lobo dorsali latissimo, sella ventrali minore quam laterali.

Length of largest specimen from Pondicherry, about	35° mm.
Dorso-ventral diameter of section : thickness in middle of sides...	1.60
Thickness of dorsum : thickness of venter in same section.....	3.60
Angle of cone of the shell { in the dorso-ventral plane	6°—8°
{ in the lateral plane	4°—5°

Shell very long, compressed, gradually tapering, generally with an angle of 6°—8° until it terminates in a point. The back is narrow, plain, and on well preserved specimens with the surface carinated on either side, the ventral portion is much the broader, at first slightly rounded, and afterwards becoming more flattened. The young shell is quite smooth, so as to give an ovate section, as in Fig. 2. Pl. XCI.; after the specimen has reached a certain stage of growth, obliquely elongated tubercles begin to shew in the middle of the sides, and generally at the same time on the margins of the ventral portion. The shell is nearly equally thick in that half which lies between the middle row of tubercles, and the ventral margin, but slopes gradually to the back. The surface of the shell exhibits fine undulating striæ of growth, slightly curved on the ventral, and strongly prolonged forwards on the dorsal portions; sometimes producing on the dorsal margins undulating outlines, which are clearly visible on casts of older fragments (Fig. 4. Pl. XCI.). The mouth conforms in shape to the outline of these striæ, being excavated on the sides, and terminating on the back in a long point.

The sutures exhibit five saddles, and as many lobes round the whole periphery; both are bipartite, very numerous but not deeply divided; the branches of the saddles short and rounded; the dorsal lobe is the broadest, the first lateral is the longest, but narrower than the second, which lies on the ventral edge; the lateral saddles are the broadest, and the ventral saddle shorter than the four others. The chambers are occasionally very close to each other (Fig. 6. Pl. XCI), sometimes more distant (Fig. 3).

The foregoing description is from the specimens from near Pondicherry of which we have figured several fragments. About two miles north of Ootacod, in the Arrialoor group of the Trichinopoly district, there have been found several fragments, none of which attained the size of those from Pondicherry, but they vary so very little, that we can only consider them as a variety of *Baculites vagina*, var. *Ootacodensis*. Fragments of this variety are represented in Plate XC. Fig. 14. The lateral tubercles in this variety begin to grow at a much earlier stage, and the dorsal edge is somewhat narrower than in the many Pondicherry specimens; further, the siphuncle often lies nearer to one edge than to the other; this, however, is not constant in all specimens.

Bac. vagina, seems in India to be representative of *Bac. anceps*, Lamk. which occurs in Europe and North America. It differs from this by the tubercles on the ventral margins and also by the divisions of the sutures.

The species which E. Forbes, in Darwin's South America (Pl. 5, Fig. 2) has identified with the Indian fossil is, by American Palæontologists, considered identical with *Bac. Lyelli*, D'Orb. (Voy. d'Astrolabe, Pl. IV. Figs. 3—7,) from Chili.* The figure given by Forbes (*loc. cit.*) is not sufficiently distinct to establish any definite conclusion, but if it be the fact, that this figure of Forbes' is identical with D'Orbigny's figure of *Bac. Lyelli*, I cannot see any difference between the South American and the Indian fossils, either in the lobes, or in the shell. The only possible objection would be as to the marginal tubercles on the edge of the ventral region, but a glance at our figures will at once shew (Fig. 1.) that one fragment had attained nearly as great a diameter or breadth, at the aperture, as D'Orbigny's figure, without shewing even a trace of either lateral or ventral tubercles. Even this doubtful objection does not exist as regards D'Orbigny's second species, *B. ornatus*, which probably is from Pondicherry itself.

Range. Valudayur group, in Pondicherry; and Arrialoor group, in the Trichinopoly district.

Localities. Abundant in the blueish calcareous sandstone near Pondicherry; in the white gritty sandstone, north of Ootacod, near Arrialoor.

D'Orbigny (Prodrome, II. p. 215) gives the South American locality, Island of Guiriquina, Chili.

3. BACULITES GAUDINI, *Pictet et Campiche*, Pl. XCI. Figs. 7—10.

1861. *Baculites Gaudini*, Pictet, Mat. p. 1. Paléont. Suisse. Foss. d. Ste. Croix. p. 112, Pl. LV. Figs. 5—11.

1862. " " v. Hauer. Sitzungs. d. K. Akad. Wiss. Vienna, Vol. XLIV. p. 648.

Bac. testa cylindrica, transversim costata; costis numerosis obliquis, apud ventrem obsolete; sectione elliptica vel subrotundata; septis lateraliter bilobatis, lobis

* Gabb, Synopsis of Cretaceous fossils. Proc. Am. Philad. Soc. 1861, Vol. VIII. p. 78.

atque sellis bipartitis, lobis lateralibus longissimis, sellis dorsalibus, atque sella ventrali, minoribus.

Length of largest specimen, from Odium	160 mm.
Diameter in height of section : thickness.....	1.25
Angle of the cone of shell.....	from 6°—10°.

Shell cylindrical, ornamented with numerous transverse costæ, which are oblique, and become obsolete towards the ventral region. The section is either elliptical, or somewhat roundish. The sutures of the septa consist of five lobes and five saddles, both bipartite: the dorsal saddles are smaller than the lateral, and their inner (next to the siphuncle) branches narrower than the outer; the ventral saddle is as high as the dorsal, and deeply bipartite, by a tri-pinnate lobe; the first or upper lateral lobes as well as the lateral saddles, are the largest.

We cannot see any material difference between our Indian fossil, and those described by Pictet, and Franc. von Hauer. The form of the lobes agrees very well with Pictet's figure, while even F. v. Hauer did not consider the slight variations which he noticed sufficient to indicate another species. Our figures are taken from large fragments, but there are also some in the survey collection which correspond perfectly with the figures of Pictet, and of von Hauer.

Range. Ootatoor group.

Locality. Odium, in yellowish calcareous sandstone, not common.

Pictet quotes the species from the Grès Verts and Gault of several localities of Savoy, France and Switzerland: F. von Hauer found it in the valley of Nana (south-western Hungary) in the Nana-strata, corresponding with the Gault.

NOTES ON THE BELEMNITIDÆ AND NAUTILIDÆ OF THE S. INDIAN
CRETACEOUS ROCKS.

Before concluding with some general remarks on the entire group of the Cretaceous Cephalopoda of South India, it will be desirable to offer a few notes on the Belemnitidæ and Nautilidæ, which have been described by Mr. H. F. Blanford at the beginning of this volume. We shall therefore devote a few pages to a revision of these two families.

BELEMNITIDÆ.

The Belemnites from the cretaceous rocks of South India, are referrible, as already stated by Mr. Blanford (p. 2), to three species, as follow :—

1. BELEMNITES FIBULA, *Forbes*, p. 3.

In the compressed form, and the vascular impressions, the nearest ally among European species is *Bel. bipartitus*, Blainv. from the Neocomien, (D'Orb. Pal. Franc. Terr. Crét. 1. 45.) Specimens of this species from Castellane, when compared, shew always a more fusiform guard, with simple but very deeply marked vascular impressions, while the same in the Indian specimens are always double, although one of the furrows, usually the lower one, is stronger and deeper than the other.

2. BELEMNITES SEMICANALICULATUS, *Blainville*.

1859. *Belemnites semicanaliculatus*, Blainv. Pictet, Foss. de Ste. Croix, 101, with other references.

1851. „ *stilus*, Blanford, p. 4.

A close comparison of the Indian specimens described by Mr. Blanford, as *Bel. stilus*, with the European *Bel. semicanaliculatus*, proves that they are identical. The only character which could throw any doubt on the identity, consists in the vascular impressions which in our specimens are not unusually double, while in the European they are generally simple, being in both only slightly marked. I find, however, that similar double impressions have been observed by Mr. Duval Jouve on specimens from Castellane, of which the author says (Belem. de Castellane, 1841, 75. pl. XI.* f. 5—12.) that they do not differ in the least as regards other characters. There remains therefore no doubt that the Indian fossil belongs to *Bel. semicanaliculatus*, Blainv.

* Note.—Plate VI as usually quoted, an error caused by a misprint in this paper by M. Duval Jouve, p. 74.

The usual form from Castellane is that shewn on Plate I. Figs. 5—7. The species is not generally quoted from England; we possess, however, specimens from the lower chalk of Maidstone, Kent, which are perfectly identical with those figured in the present memoir, Pl. I. Figs. 2—4. In France, as well as in Germany and Switzerland, the species occurs in the middle strata of the cretaceous formation. D'Orbigny quotes it from the 'Aptien.' It has lately been found about the same horizon in several localities in the Bavarian Alps by Mr. Gümbel, in strata which he calls "*Gault-grün-sandstein.*" (Geogn. Besch. d. Bayerisch. Alpen. 1861, pp. 528 and 567.)

3. BELEMNITES SECLUSUS, *Blanford* (loc. cit. p. 4.),

Is a very characteristic little species to which I do not know any close ally from Europe. The description, given on p. 5, requires, however, some alterations and may be put thus :

Guard short, subfusiform, much thicker towards the posterior part and terminating with a short point, which lies nearer to the ventral or lower side. The anterior portion is thin, laterally compressed; the back flattened, so that a section is sometimes nearly quadrangular, although the dorsal region remains broader, than the ventral. The dorso-lateral furrows are very close to the upper margins, deeply marked, and extend as far as the alveolar cavity inside the guard. On the anterior portion, which forms generally one-third of the preserved guard, there are short, broad, but not deep, vascular impressions close to the ventro-lateral margins; these impressions continue, after a slightly marked interruption, on the posterior part [that is from the termination of the alveole inside] as two faintly marked furrows and extend on the ventro-lateral margins up to the end of the guard. Often they do not preserve their rectilinear direction and proceed undulating or even branching.

The species occurs at Ootatoor, but is not so common as the two former.

NAUTILIDÆ.

In the following revision of the Nautili, I have discontinued the use of the terms dorsal and ventral, and substituted for them the synonymous expressions, 'external or outer region,' and 'internal or inner region.' Although still entirely adhering to the views I have already stated on p. 44, I have done this to avoid any confusion with Mr. Blanford's statements (pp. 7—8.) It is to be regretted, however, that he did not himself retain these expressions in the sense he proposed but used them even in a perfectly opposite meaning (p. 26, line 17 from bottom.)

Nautilus crebricostatus has, by further comparison, been identified with *N. Negama*: *N. Kayeanus* has been found to be the European *N. Neocomiensis*; *N. Sphæricus*, Forbes, has been again introduced, and several alterations have been proposed in the determination of the species; *N. sublevigatus*, D'Orbigny, and *N. Fleuriausianus*, D'Orbigny, have been newly determined; and a new species, *N. lentiformis*, described.

By these alterations, the number of the Nautili from the cretaceous rocks of Southern India has been increased from 19 to 22. This is a remarkably large number, but we still hope to see it increased, if a closer examination of the country can be accomplished.

1. NAUTILUS BOUCHARDIANUS, *D'Orbigny, var.* Pl. XCII. Fig. 4.

1840. *N. Bouchardianus*, D'Orbigny, Pal. Franç. Terr. Crét. I. p. 75. pl. 13.

1859. „ „ Pictet, Pal. Suisse, Foss. Ste. Croix, p. 192, Pl. XVIII. Figs. 1—3.

2. NAUTILUS SPHÆRICUS, *Forbes*, Pls. III. IV. and V. Figs. 2, 4—6 and Pl. XCII. Fig. 3.

1846. *N. sphaericus*, Forbes, Trans. Geol. Soc. Lond. VII. p. 98.

3. NAUTILUS SUBLÆVIGATUS, *D'Orbigny, var.* Pl. V. Figs. 1 and 3.

1850. *N. sublævigatus*, D'Orbigny, Prod. II. p. 189.

1840. *N. lævigatus*, D'Orbigny, et auctorum, Pal. Franç. Terr. Crét. I. p. 84. pl. 17 (*non id.* Montagu, 1803.)

1846. ? „ „ Forbes, Trans. Geol. Soc. Lond. VII. p. 97.

These three species have been by Mr. Blanford described under the head *N. Bouchardianus*, D'Orbigny, loc. cit. p. 13, and it will be necessary to shew, whether the three abovenamed species can be in any way recognized among the numerous specimens of the Geological Survey, and the Madras, collections, and how they are to be separated.

1. *N. Bouchardianus*, D'Orbigny, as described by M.M. Pictet and D'Orbigny, has, notwithstanding its strong globosity, a very marked flattening on the sides. The greatest thickness of the shell is immediately round the umbilicus, from which there is a gradual slope towards the outer region, which itself is rounded, but is the narrowest part in a transversal section of a whorl. Of this character there are only two specimens in the Geol. Surv., and two in the Madras, collection. Fig. 4 on Pl. XCII. represents a larger specimen, shewing the chambers. None of Mr. Blanford's figures on Pls. III. IV. and V. represents a specimen of this species.

The siphon is in one specimen distinctly external and in another internally sub-central. M. Pictet does not mention an internal position of the siphuncle in any of the European specimens. As, however, these specimens do not differ in any other characters from each other and from the true European Gault fossil, I retain them provisionally as varieties of *N. Bouchardianus*, D'Orb. When better and more numerous specimens are found, I have no doubt, that this identification will be confirmed.

Range. Arrialore group.

Localities. Koloture and Arrialore in Trichinopoly; Pondicherry.

2. *Nautilus sphaericus*, Forbes, is sufficiently characterized in Mr. Blanford's description (p. 14,) so that I could give here only a repetition of facts. Although the species is amply illustrated, the Fig. 3 on Pl. XCII. will not be found useless. It is a small specimen, marked from N. W. of Odium and the only example of

the occurrence of the species in the Ootatoor group. The character of the species is well represented in the section, which being usually twice as broad as high, has the greatest thickness at about half the height and not near the centre. The umbilicus is in itself narrow, but perforated through and has all round a broad funnel-shaped depression, on the edge of which the shell attains its greatest thickness, and then forms a uniform curve to the other side, leaving in this way a very broad outer region. Some specimens are laterally somewhat flattened, and therefore in section not so broad as compared with the height. This flatness is, however, perfectly different from that of *N. Bouchardianus*, being only strictly lateral round the umbilicus to a little distance, and does not in the least influence the broadness of the outer region, while in the last quoted species, the flatness extends towards the outer region and causes its narrowness. The two species have therefore perfectly distinct characters and may be readily recognised. From specimens in the Madras Museum I have no doubt that this is the true *N. sphaericus* of Forbes, and that that distinguished palæontologist was perfectly correct, when remarking the *globosity* (not the thickness) of the shell as a difference from *N. Bouchardianus*. The fossil figured by D'Orbigny as *N. laevigatus* (Voy. de l'Astrolabe, pl. 6) belongs, I believe, judging from its spherical form, to this species.

Range. Arrialoor and Ootatoor groups.

Localities. Pondicherry, Anapaudy, Koloture, Shutanure, Shillagoody, Arrialoor, and N. W. of Odium in the Trichinopoly district.

3. NAUTILUS SUBLÆVIGATUS, *D'Orbigny*.

There are in the Survey's collection only two specimens, which we can confidently refer to this species, and which have both been figured by Mr. H. Blanford under the name of *N. Bouchardianus*. Probably Prof. Forbes meant this species, when he says, "I cannot distinguish it from *N. laevigatus*," there is, however, no specimen of it in the Madras Museum now. The two specimens, which we possess, are indeed undistinguishable in most of the principal characters. The French specimen, as figured by D'Orbigny is somewhat thinner, and D'Orbigny says also, that the siphuncle is about central, but more approaching to the external region. Our specimens agree in this respect more accurately with Sharpe's figure and descriptions of specimens from the English Chalk. (Ceph. of the Chalk, p. 11. Pl. II. Figs. 1—2.) They are somewhat thicker and the siphuncle is placed in our specimens at about $\frac{3}{7}$ th of the height of the septum, measured from the interior margin, evidently more internal than external. This is the only difference, which can be noticed between the Indian and the French specimens, and I have, therefore, no hesitation in regarding them as mere varieties, especially as they so well agree with the English fossil, described by *Sharpe*.

Range. Arrialoor group.

Localities. Arrialoor and Shillagoody in the Trichinopoly district.

Viewing thus the three species named above, we would direct the attention of our readers to the figures Fig. 1a. pl. V., Figs. 3a. and 4a. Pl. XCII. These three sections exhibit the differences very clearly. It will be seen, that the section (164)

of a whorl in *N. Bouchardianus* is parabolic or broadly elliptical in a perpendicular direction, that of *N. sphaericus* is transversely elliptical, and that of *N. sublævigatus* nearly approaches to a semicircle. The shell of *N. Bouchardianus* increases in height and thickness nearly equally, that of *N. sphaericus* more in breadth, but very gradually, the shell being originally thick; that of *N. sublævigatus* increases also more in breadth than in height, but the increase is very rapid, as the young shell is proportionally thin.

These are the reasons, which compel me to keep the above named three species as distinct, and I have thus much pleasure in doing justice to Prof. Ed. Forbes' first examination of the Indian cretaceous specimens, as I have in most cases found the statements which occur throughout the work of that most distinguished palæontologist entirely confirmed. D'Orbigny's re-arrangements of the different species from India, Europe and America, in his *Prodrome*, Vol. II., undoubtedly brought much confusion on the whole question, which confusion will remain unsettled, until some one is in a position to examine the American species again.

4. NAUTILUS CLEMENTINUS, *D'Orbigny*, p. 17.

Some of the specimens agree perfectly with the European fossils, others are, however, very much inflated with a remarkably small umbilicus. Probably we have two species, but the materials are not sufficient to prove the correctness of this opinion.

5. NAUTILUS HUXLEYANUS, *Blanford*, p. 19.

Large specimens from the Ootatoor group of the Trichinopoly district, as well as those from Pondicherry, have on the last whorl the sides remarkably flattened, which lateral compression is especially strongly marked on the body-chamber. The inner whorls of the same specimens do not shew at all this compression or at least it is hardly possible to notice it. If large specimens are broken, as I have often observed on those from Coonum, the siphuncle on the inner whorls is seen to be nearly central, [sometimes even internally subcentral] and assuming its external position only in the course of further growth. Perfectly similar cases with regard to the position of the siphuncle are to be observed in *N. sphaericus*, Forb. and others.

Besides specimens from the Ootatoor and Trichinopoly groups there are in the survey collection from Olapady and Cormapolliam of the Arrialoor group, some specimens, which agree in all characters with the former, and the species ranges, therefore, through all the three groups of the South-Indian cretaceous deposits.

6. NAUTILUS SPLENDENS, *Blanford*, p. 21.

It is very doubtful, whether the present species is essentially different from *N. Clementinus*, D'Orb. However, as the materials are very deficient, the decision must be postponed. The specimen figured on Pl. IX. is very much injured by lateral pressure. It shews on parts of the well preserved surface of the shell not only fine striæ of growth, but also spiral sulci, similar to those of *N. Clementinus*. Besides the form of the shell and of the septa the internal position of the siphun-

cle and the little internal lobe on the septa of the first whorls agree all with the characters of the latter species. The umbilicus is in the specimen, figured Pl. IX., closed, although it is certain, that lateral pressure contributed to its present state. The smaller specimen, figured on Pl. X., is a cast and shews an umbilicus; it remains, however, doubtful, whether this was closed or open on the well preserved shell. To *N. Neocomiensis* or *Sowerbianus*, D'Orb., the present form does not bear more resemblance, than to any other cretaceous or jurassic Nautilus.

Range. Ootator and Arrialoor groups.

Localities. Odium and Coothoor in Trichinopoly. From Coothoor in the Arrialoor group there is only one specimen as yet found, but it is otherwise undistinguishable.

7. NAUTILUS JUSTUS, *Blanford*, loc. cit. p. 22, Pl. X. Figs. 2—3 and Pl. XCIII. Fig. 2.

The principal character of this species consists in the rapid increase and roundness of the whorls. Since the publication of Mr. Blanford's descriptions, several specimens have been discovered in the Survey collections, all from the same locality. One of those specimens was selected for representation on Pl. XCIII., because it is not injured by lateral pressure. The inner whorls, which have been made visible by breaking the specimen, shew a very fine striation on the surface of the shell. (Fig. 2c.) This striation consists of very numerous, fine, spiral and transversal lines; the latter being far more distant and in later stages of growth being the only ones remaining. On three of our specimens portions of the mouth are preserved, which in the larger specimens is, close to its margin, deeply sulcated all round. On the sides the peristome is somewhat prolonged and on the external region it forms a marked sinuosity inward, in accordance with the striæ of growth.

In the very young shell there is on the internal region of the septa a little lobe formed, which disappears soon, as the specimen grows larger. The other characters have been already noticed by Mr. Blanford.

8. NAUTILUS VALUDAYURENSIS, *Blanford*, loc. cit. p. 23.

Although this may be a good species, it is impossible to pronounce anything about it now, the described specimen being only part of the inner volutions and even so not well preserved. The figure on Pl. XII. has been unfortunately made quite indistinct by failure in the printing, there would, however, be nothing gained by giving another figure of such a fragmentary specimen. Similar striations I have noticed in the previous species and in *N. Huxleyanus*. To which species the name *N. vorticosus* (p. 23, 4th line from below) refers, I was not able to find out!

9. NAUTILUS FLEURIAUSIANUS, *D'Orbigny*, var. Pl. XCIV. Fig. 1.

1840. *Nautilus Fleuriausianus*, D'Orbigny, Pal. Franç. cré. I., p. 82, pl. 15.

Naut. testa discoidea, lateraliter subcompressa, lævigata, haud umbilicata; apertura ovate-elongata; septis flexuosis atque numerosis; siphunculo interno, circumter apud $\frac{1}{3}$ altitudinis septorum posito.

(166)

Largest diameter of the figured specimen	100 mm.
Outer whorl : whole diameter (considered as 1.)	0.60
Width of umbilicus : whole diameter {	
on the preserved shell.....	0.00
on the cast	0.07
Thickness of the section : height	0.06
Distance of the siphuncle from the inner margin : the height of the septum	0.30

Shell discoid, compressed; whorls considerably increasing in height; surface smooth; umbilicus closed, when the shell is well preserved: casts have a small umbilicus; margins of the septa flexuous, very close; there being on the last whorl 23 chambers. The section of the whorls is ovate, rather prolonged, the broadest near the centre of the shell and strongly indented by the preceding whorl. The siphuncle is internally placed at about $\frac{1}{3}$ rd of the height of the septum, measured from the inner margin.

Nautilus Fleuriausianus is very well characterised by the lateral compression and narrowness of the whorls at the outer periphery. The Indian specimen differs from the French only in having a far greater number of septa, and as all the other characters agree well, we have no hesitation in noting it as a variety of D'Orbigny's species.

Sharpe's figure (Cephalop. of the English Chalk, p. 16, Pl. VI. Fig. 3) of *N. Fleuriausianus* seems to differ markedly in the roundness of the outer periphery, and it is difficult to say whether it really belongs to the same species. Sharpe's suggestion of an identity of the present species with *N. Sowerbyanus*, D'Orb. is equally open to much doubt, as the latter species has a rather large umbilicus, and strongly sinuous septa, especially near the centre. These characters are undoubtedly of far greater value, than the number of septa.

Range. Ootatoor group.

Locality. Odium; only a single specimen has been as yet obtained from the calcareous sandstones, a little to the north of the village.

D'Orbigny described his species at first from the 'Grès Vert' of several localities of France. In the Prodrôme (II. p. 144) he places the species in the 'Cénomannien' and unites it with *N. triangularis*, Montfort, for reasons, which he does not give and which it is impossible to discover from the accounts of these two, apparently quite distinct, forms.

10. NAUTILUS LENTIFORMIS, *Stoliczka*, Pl. XCIII. Fig. 1.

Naut. testa discoidea, lentiforme, lævigata, transversim minutissime striate-sulcata, non umbilicata; septis circiter duodecem in uno circuitu; marginibus septorum simplicibus fere rectis; apertura ovata; siphunculo externo, apud $\frac{2}{3}$ altitudinis septorum posito.

Diameter of largest specimen from Pondicherry	2.30 mm.
Outer whorl : whole diameter (considered as 1.)	0.72
Thickness of section : height	0.87
Distance of the siphuncle from the inner margin of the septum : height	0.65

Shell discoid, lentiform, thickest near the centre and gradually sloping towards the outer periphery. The inner whorls are rather inflated; surface of the shell apparently smooth, but when well preserved very fine transverse sulci are visible; umbilicus closed by a callous mass; septa about twelve to one whorl, simple and nearly straight, somewhat curved forward on the outer region; [the lateral curve of the septa in Fig. 1. being due to a stronger erosion of the surface;] siphuncle externally placed, nearly at two-thirds of the height of the septum, measured from the inner margin.

The remarkable orbicular form distinguishes this species readily from all others, which occur in the southern cretaceous rocks. It does not even shew much similarity to any other known Nautilus, the form being that of a globose Ammonite.

Range. Trichinopoly and Arrialore group in Trichinopoly district; (?) Valudayur or Arrialore group near Pondicherry.

Localities. There are only four specimens of this species as yet known. One, a very large specimen, is labelled "Pondicherry" and it is uncertain, whether it comes from the upper Arrialore, or from the lower Valudayur beds; I think the first supposition more probable. The other specimens are respectively from Andoor and Anapady of the Trichinopoly group, and from Coothoor of the Arrialore group, which latter locality is, however, very close to the boundary of the two last mentioned groups.

11. NAUTILUS DANICUS, *Schlotheim*; Blanford, loc. cit. p. 24.

So far as the existing figures of *N. danicus*, (vide Trans. Geol. Soc. Lond. V. Pl. XVIII. Figs. 4-7) allow an opinion to be formed, the Indian fossil does not vary from the European, except in the usually greater thickness of the whorls. The siphuncle is either central or somewhat below the centre, internally, so that it appears to perforate the convex side of the septa either a little above or between the prominent sinuosities of the lateral septal margins. This latter character distinguishes such fragments readily from those of *N. serpentinus*, Blanford, which is otherwise very similar.

12. NAUTILUS SERPENTINUS, *Blanford*, loc. cit. p. 25, Pl. XII. Fig. 1 and Pl. XCII. Fig. 2.

The Survey collection possesses nothing more of this species, than the fragment, which has been figured by Mr. Blanford. As, however, the figures on Pl. XII. are very indistinct, we have given another view (Pl. XCII. Fig. 2) of the convex side of a septum, on which the internal position of the siphuncle is exhibited, at the same time shewing the roundness of the whorls.

13. NAUTILUS OOTATOORENSIS, *Stoliczka*, Pl. XIII.

1862. *Naut. Forbesianus*, Blanford, loc. cit. p. 26, Pl. XIII.

D'Archiac describes (Groupe nummulitique de l'Inde, 1853, p. 338, Pl. XXXIV. Fig. 12,) a *N. Forbesi* from the nummulitic rocks of the Punjab. The mere difference of inflexion in a name cannot be regarded as a sufficient distinction and I therefore propose instead of the former denomination by Mr. Blanford that of (168)

N. Ootatoorensis, as this species is essentially characteristic for the Ootatoor group, while the other species with strong angular margins of the septa belong to the Arrialoor group.

To the localities already quoted by Mr. Blanford, is to be added *Olapaudy*, from which a large specimen of 90 mm. lies before us. The surface of the shell, which is on this specimen partly preserved, shews a very fine striation; the striæ being laterally strongly flexuous and bent backwards on the outer region.

14. NAUTILUS ANGUSTUS, *Blanford*, l. c. p. 27, Pl. XIV. Figs. 1—2.

„ „ „ Var. Pl. XCIII. Fig. 4.

The typical species of *N. angustus*, Blanf. is characterized by its strong lateral compression, smoothness of the shell, laterally strongly sinuous septa, and externally eccentric siphuncle. The Survey collection possesses another somewhat different specimen, which, however, want of more and better material compels us to regard, provisionally, as a variety of the former; it is figured on Pl. XCIII. This specimen has a somewhat inflated, smooth shell, a small umbilicus, laterally strongly sinuous septa and an externally eccentric siphuncle. The greater thickness of the shell distinguishes this form from *N. angustus*. With regard to the umbilicus it is uncertain, whether *N. angustus* had one on the preserved shell; the figured cast shews clearly an umbilicus. The form and number of the septa and the position of the siphuncle coincide perfectly with the typical species, which is the principal reason, that we note the form in question as a variety of the said species in preference to giving a new name. We know from other species, as *N. Bouchardianus*, D'Orb. (Vide Pictet, loc. cit.) *N. neocomiensis* and others that the thickness of the shell is often subject to great variation and a similar case may exist here.

The specimen was found somewhere near Coothoor in the Arrialoor group, while the first described specimen of *N. angustus* is from the Ootatoor group.

15. NAUTILUS FORMOSUS, *Blanford*, loc. cit. p. 28.

In all its principal characters this species approaches remarkably *N. Sausseureanus*, Pictet, [Foss. d. Grès Verts, p. 17, Pl. I. Fig. 3]; the materials on both sides are, however, not sufficient to pronounce their identity and a decision must be deferred.

16. NAUTILUS ELEGANS, *D'Orbigny*, loc. cit. p. 29.

The Indian specimens agree well with the European, and the external position of the siphuncle can be often noticed on fragments in our collection. There is no doubt, that *N. elegans*, D'Orb. occurs in the middle cretaceous deposits of Germany; the specimens are, however, generally badly preserved casts, and lead easily to mistakes with other similar species. It is indeed of very little value to quote the names of such doubtful materials, the accurate determination of which we can scarcely ever expect.

17. NAUTILUS NEOCOMIENSIS, *D'Orbigny*, Pl. XVI. Figs. 5, 6, Pl. XVII. Figs. 1, 2, Pl. XVIII. Figs. 1 and 2, Pl. XXI. Fig. 2.

1840. *Nautilus Neocomiensis*, *D'Orbigny*, Pal. Franç. Terr. crét. I. p. 74, Pl. XI.

1859. " " *Pictet*, Mat. p. l. Paléont. Suiss. Foss. Ste. Croix. p. 128, Pl. XV.

1861. " *Kayeanus*, *Blanford*, loc. cit. p. 31.

Mr. Blanford has already (loc. cit. p. 32) remarked that the Indian fossil, which he calls *N. Kayeanus*, is most closely allied to *N. Neocomiensis*, *D'Orb.* A comparison of actual specimens of both the European and Indian fossils, leaves no doubt with regard to the supposed question of identity. Since *Pictet* gave us figures of some specimens, which are quite as much inflated as most of ours, there remains hardly one character of difference between both. *Pictet's* specimens exhibit generally a smaller number of septa, about 15 to one whorl, while the Indian specimens shew about 20. With regard to this point, however, they agree perfectly with *D'Orbigny's* original figure of this species, and an equal number is to be observed on specimens from Escragnolles, the typical locality of *D'Orbigny's* species. The flexuous form of the margins of the septa, which *Pictet* remarks as distinguishing it from *N. pseudo-elegans*, is also well seen in all our specimens of both species respectively.

From *N. crebricostatus*, *Blanf.*, which is the same as *N. Negama*, *Blanf.*, the present species altogether differs as regards the form of the septa. *N. Neocomiensis* is confined in Europe to the "Neocomien" of France and Switzerland. (*Pictet*, loc. cit. p. 131). *Sharpe's* identification of a specimen from the lower Chalk seems to be doubtful, his figure shewing more relation to *N. radiatus*, *Sow.*

So far as Mr. Blanford's subdivisions of the South-Indian cretaceous rocks have been made, we have *N. Neocomiensis* in the same beds as *Am. Rouyanus*, *dispar*, &c., but on the other side associated with *Am. Rotomagensis*, *inflatus*, and others.

18. NAUTILUS PSEUDO-ELEGANS, *D'Orb.*, *Blanford*, loc. cit. p. 33, and Pl. XCIII. [Fig. 3.

To exhibit the position of the siphuncle we give an additional figure on Plate XCIII. It will be seen clearly from this figure, that the siphuncle is eccentric, rather approaching to the inner margin of the septa. The same position of the siphuncle has been observed on two other specimens from Odium, quite in accordance with *D'Orbigny's* original figure; and, as all the other characters of both agree well, there is hardly any doubt left as to the identity of the Indian with the European fossil. It remains only to notice, that on the inner margins of the first whorls there is a little lobe present, which disappears soon, as the specimen becomes larger.

Naut. pseudo-elegans is known from the lower cretaceous beds of Germany, France, and England. *Abich* found it in corresponding beds of the Caucasus (*Vergl. Geol. Grundzüge*, 1858, p. 129).

19. NAUTILUS NEGAMA, *Blanford*, Pl. XX. Fig. 2, Pl. XXI. Figs. 1 and 3, Pl. XXII. Pl. XCIV. Fig. 2.

1861. *Nautilus crebricostatus*, *Blanford*, loc. cit. pp. 35--37.

After repeated examination we are unable to distinguish specifically between *N. Negama* and *N. crebricostatus* and we retain for the species the former name, as it was previously given. Both are identical with regard to the form of the shell and the septa, as will be seen by a close comparison of the figures referred to.

Mr. *Blanford* states (loc. cit. p. 36,) that the shell of *N. crebricostatus* differs from that of *N. Negama* in being more compressed towards the umbilicus. This is indeed, the case with the specimen figured on plate XXII; however, when I had broken the specimen, it became evident that this compression of the shell was chiefly due to a lateral pressure, which is here so considerable, that the shape of the inner whorls can hardly be traced out. In consequence of this pressure the umbilicus appears to be narrower in *N. crebricostatus*, than in *N. Negama*. As regards the ribbing it must be remarked, that the ribs appear always more distant and coarser on the cast, than on the preserved surface of the shell: the former being the case in *N. crebricostatus*, the latter in *N. Negama*. The form of the margins of the septa, namely their slight lateral curve but strong prolongation on the external region, is in both exactly the same, and this is undoubtedly the most important character of the species, and distinguishes it readily from *N. neocomiensis* or *pseudo-elegans*, D'Orb.

Indeed, the form of the septa of Nautili is, we believe, always one of the principal characters of a species and deserves more attention than it usually receives. It is a part of the shell, which is essentially connected with the animal and, so far as experience goes, generally in a lesser degree subjected to variation than other parts. We see, for instance, in several species, that the form and especially the ornamentation of the shell vary greatly during the time of growth; even the siphuncle changes its place, while the septa remain more constant; their number, however, is very different, although the variation usually retains certain limits. This is very easily understood in following the history of the animal, inasmuch as one specimen may grow much more quickly than another.

With regard to this last mentioned point we would direct attention to another specimen of *N. Negama*, of which a figure is given on Plate XCIV. This specimen, from Odium, although perfectly agreeing in form and septa with *N. Negama* has only 12 chambers to one whorl, while in other specimens their number increases to 20. Another still, a smaller specimen from near Ootatoor, possesses 14 chambers to one whorl.

The siphuncle seems to vary considerably: it is either central or somewhat externally eccentric. Figure 2a on Plate XCIV represents a sectional view of the whorls, for which purpose the specimen had been broken: it shews the siphuncle to be more centrally placed on the inner than on the outer whorls, where it is rather close to the outer region. Another peculiarity is seen on this specimen, namely the very fine reticulate striation of the young shell, of which an enlarged

portion is shewn in Fig. 2*b*. Finally on Fig. 2*a* a very small lobe is seen, formed on the internal margins of the septa, which lobe, however, disappears soon, as the specimen attains a certain size, which varies in different specimens as well as in different species.

Range. Ootatoor group.

Localities. Sirgumpore, Ootatoor, and Odium in the Trichinopoly districts; seems not to be common.

NAUTILUS CREBRICOSTATUS, *Blanford*, loc. cit. p. 36, is identical with *N. NEGAMA*, *Blanf.*

20. NAUTILUS TRICHINOPOLITENSIS, *Blanford*, loc. cit. p. 37, Pl. XXIII. Pl. XXIV. Figs. 1—2, Pl. XXV. Fig. 3.

The umbilicus is in this species sometimes closed, but always with a distinct funnel-shaped depression; other specimens are distinctly umbilicated, even when the shell is preserved.

The species is characterized by its lateral compression, the laterally strongly sinuous septa and the external siphuncle.

21. NAUTILUS ROTA,* *Blanford*, loc. cit. p. 38, Pl. XXIV. Fig. 3, Pl. XXV. Figs. 1—2 (*non* Fig. 3.)

Fig. 3 on Plate XXIV. shews the ornamentation of the shell very clearly. The ribbing is indeed lateral also, as is seen by the connection of the furrows on their entire length, although the ribs are generally more strongly marked on and quite close to the outer region and also usually round the umbilicus. All the specimens (8 in number) in the Survey collection have a distinctly open umbilicus with perpendicular walls, when the shell is well preserved; the only exception quoted by Mr. H. Blanford (*vide* p. 39) is represented in Fig. 3, Pl. XXV; the exposure of the septa proved, however, this specimen to be *N. Trichinopolitensis* and not *N. rota*.

Range. Arrialoor [not Ootatoor] group.

22. NAUTILUS PONDICHERRIENSIS, *Blanford*, loc. cit. 39.

The single specimen, described by Mr. Blanford, has unfortunately been somewhere mislaid. It looks evidently somewhat different from the other cretaceous species, although much certainty cannot be expected from such a fragment, as that figured.

* On page 12 the species is by mistake quoted as *N. rotæ*.

GENERAL REMARKS ON THE CEPHALOPOD FAUNA OF THE CRETACEOUS FORMATIONS OF THE SOUTH OF INDIA.

A general review of the whole Cephalopod fauna, described in the preceding pages, fully justifies our statement that it is very rich, and in variety and number of species equal, if not superior, to any local European fossil fauna. Nearly all known cretaceous genera belonging to this order are represented, the genus *Ammonites*, however, being much more numerous than the others.

In the accompanying tabular list, (vid. Appendix) all the Cephalopoda are arranged in the order generally adopted by Palæontologists, with references to the descriptions and figures in the present memoir, and also to the localities and groups to which they belong in India, as well as to the localities where the same species, if identical, may occur in Europe or elsewhere.

At the commencement of our labours (see p. 44, *supra*) we briefly expressed our views regarding the genus *Ammonites*, and we are glad to say, that the examination of the whole fauna of the Cephalopoda has not led to any alteration in them. It would, probably, have been difficult to find an opportunity better adapted for making new groups in this genus, than that presented in the study of the South-Indian cretaceous fauna. And it may perhaps be desirable to explain why we have not treated these *Ammonites* as might have been expected by some Palæontologists. With the exception of adopting the group *Lævigati*, proposed by the late eminent Ed. Forbes, we have not added one single group which was not already known and accepted in Europe. And we believe with good reason.

We entirely agree with others in the opinion that the present grouping of *Ammonites* is insufficient, and we have frequently had occasion to remark this in the notes introductory to each group. But we have also more than once noticed, that we do not see any advantage to be gained by separating a number of species, as the groups could hardly be less numerous than the species themselves.

A division of the genus is almost universally recognized as necessary; and the question as it presents itself now is, Will a certain, or any, number of groups (for things are increasing rapidly*) satisfy the pressing wants of the Naturalist, or will it not? We have little hesitation in saying, It will: but then another question at once arises, When? A sufficient number of groups may satisfy the demands of classification, but this number would be perfectly equal to that of the genera, which we should have to establish, as has been attempted some time since. There is no reason why in one family of the Mollusca we should adopt views which are not only different from, but which are contrary to, the rules recognized with regard to the other families of the same class. The only justifiable plan, therefore, which can reduce the Cephalopoda to the same standard as the other families among the Mollusca, will be the establishment of *genera*. And for this reason we have avoided introducing any new groups. There is no more fear of applying the term

* Vide Seebach's Hannoversche Jura, &c.

genus unjustly or improperly in this case, than there was in the case of other families.

Another objection to their separation, based on the consideration that so long as we have them all together, we can more easily trace the relations and origin of species, is not difficult to answer. It is on the contrary, as we believe, this very bringing them together, which prevents the special study and analysis of the different characters. The old doctrine *divide et impera* is just as applicable in this branch of science as in politics. It was the separation of the Mollusca into genera and species which, more than anything else, helped to increase our knowledge of this class. If any one establishes a new species or genus, he is compelled to endeavour at least to specify its characters as fully as possible, and to explain as well as he can its differences and resemblances with other species or genera. With repeated efforts of this kind, the time has, we believe, now gone by when naturalists believed species and genera to be constant and invariable. It is this which has called all our species into existence. And where by a careful analysis we have shewn that several of these species can properly be united for the benefit of science, under one generic name, we do this with good reason. This junction into one genus of several varieties, when subsequently justified by further research, then appears in a perfectly different light. It is no real loss of work at first to separate, and then to unite again, because it is sometimes impossible to ascertain the proper value of characters until they have been fully specified. In every case, however, it is necessary that we acknowledge some definite views with regard to the different degrees of classification. It is well known that a definition of the term 'species' is very difficult, principally because it has a value in one class of animals different from what it has in others. It is, in fact, a term only for our own convenience, although absolutely necessary if we desire to classify natural objects. The distinction does not exist in nature in a strictly invariable sense, although it must always be strongly supported by the facts of nature. And thus the term 'species' must have certain acknowledged limits, which limits, however, cannot be accepted as fixed, but have, for the most part, to be determined in individual cases. And this is no doubt a matter of much delicacy and will depend much upon the author's views.*

To return to our immediate subject. Taking the fauna described in the preceding pages as a whole, it is undoubtedly truly Cretaceous, as that series is known in Europe, or in other parts of the world. But it offers at the same time in its special character a few remarkable peculiarities. The total number of species described is 148. In the different genera these are distributed thus, 3 Belemnites : 22 Nautili : 93 Ammonites : 3 Scaphites : 11 Anisoceras : 1 Helicoceras : 6 Turrilites : 2 Hamites : 1 Hamulina : 3 Ptychoceras : and 3 Baculites.

* If *species* of Ammonites are made on such an easy scale, as has lately, I am afraid, been done by my friend Prof. Oppel, in his Palæont. Mittheilungen, we shall soon have descriptions of single specimens instead of species!

As we have already made some remarks on each genus separately, there remains but little to say now. The *Belemnites* and *Nautili* do not differ in general characters from the European representatives of the same genera, excepting that among the latter genus there is a remarkable prevalence of species with sinuated septa. The *Ammonites*, from the number of *Cristati*, *Rotomagenses*, *Mamillati*, and *Ligati*, retain a decidedly cretaceous character, but other groups also are represented which are as yet unknown in the cretaceous deposits of Europe. The *Armati*, *Macrocephali*, and *Planulati*, are for the most part only Jurassic forms: the *Lævigati* recall much some species of the Liassic *Falciferi*; and the *Globosi* have, up to the present, been noted only from the Trias. The occurrence of members of this last named group is the most peculiar feature among these cretaceous Ammonites, because they agree so well with true Alpine Triassic species.

The *Scaphites* and *Turrilites* belong nearly all to European species. The *Anisoceras* are uncommonly numerous. Regarding this and the following genera I must refer to the remarks I have already made. They are all Cretaceous forms.

Throughout our memoir, the subdivisions of the South-Indian cretaceous rocks as laid down by Mr. H. F. Blanford, (Mem. Geol. Surv. India, Vol. IV.) have been adopted. These, in ascending order, are; in the Trichinopoly district, the Ootatoor, Trichinopoly and Arrialoor groups; and, in the neighbourhood of Pondicherry, the Valudayur and Arrialoor groups. Taking the Ootatoor and the Valudayur as one, or the lower division, the 148 species are distributed among the different subdivisions as follows: the lower group contains by far the greatest number, viz. 98: the middle 10: the upper 19. The lower and middle have only 4 species in common: the lower and upper 7: the middle and upper 6: and only three species occur through all the subdivisions of the series. From these numbers we see that each of the groups has a certain number of species belonging peculiarly to it, and that the admixture is in all cases not large, and very probably a more rigid examination of the rocks will still further reduce the number of species common to more subdivisions than one.

We now come to the question, What relation, or what similarity does the South-Indian cretaceous fauna present to that known from Europe or elsewhere? Of the total number of 148 Cephalopoda, there are 38 identical with species known from other countries, besides a few others, which are doubtfully so. This is more than one-fourth of the whole fauna, and affords, therefore, ample grounds for comparison. These 38 species are thus represented in the different genera, and groups of beds. There are 1 Belemnite; 8 Nautili; 19 Ammonites; 2 Scaphites; 6 Turrilites; 1 Ptychoceras; and 1 Baculite. With respect to the beds, there are, of these 38 species, 25 from the lower; 4 from the middle; 6 from the upper, subdivisions; and 1 common to the lower and middle; and 1 common to the lower and upper groups. In Europe of these 38 identical species, 3 species occur in the Neocomian; 32 in the middle, and 2 in the upper cretaceous deposits; while 1 is common to the lower and middle divisions. The three Neocomian species all belong in India to the Ootatoor group. Of the 32, which in Europe are middle

cretaceous, 22 occur, in India, in the Ootatoor or Valudayur groups; 4 in the Trichinopoly; 4 in the Arrialoor; 1 in the Ootatoor and Trichinopoly; and 1 in the Ootatoor and Arrialoor. The two European upper-cretaceous forms occur, in India, as well, exclusively in the Arrialoor group.

Now considering these numbers of the several genera of the Cephalopoda, we see that the few upper and lower cretaceous species (5 in all) are of small importance as against the large number of 'middle cretaceous' forms. Among these latter, there are only the Nautili, which exhibit some irregularities, inasmuch as 3 European 'middle cretaceous' species occur in India in the upper division. All the rest of the known middle cretaceous forms, together with the three Neocomian, occur in the lower groups in India. And among these we see fossils of the widest distribution in all the known cretaceous deposits of the world, therefore truly characteristic species.

From these facts, we now deduce this general conclusion; that the lowest cretaceous group, or what is in Europe generally called the Neocomian, is, as a separate or independent group, wanting among the South-Indian cretaceous deposits; and that only a very few remnants of its fauna are indicated in the higher divisions. The lowest cretaceous deposits which occur in South India have an undoubtedly 'middle cretaceous' character; and agree particularly well with the European Gault, as I have already had occasion to remark more than once during the course of our labours. Our readers are doubtless aware, that similar conclusions have been arrived at by Geologists both in America and Africa, namely, that the European Neocomian does not exist in those countries; and that equally, the uppermost cretaceous strata (or D'Orbigny's *etage Danien*) are either very slightly indicated, or are wanting altogether. The fauna of the Trichinopoly and of the Arrialoor groups is by no means so rich as that of the other groups, and does not, up to the present, offer sufficient materials for similarly definite conclusions.

We prefer to leave this matter here. Further speculation would either prove little, or might be very incorrect. The detailed examination of the entire fauna, (which is now in progress) will doubtless enable us to give a more satisfactory account of its character, and of the respective ages of the different groups.

APPENDIX.

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Tabular list of all species described in preceding pages, with references to page and plate; localities, and groups where found—and to European or other non-Indian localities where known species have occurred.

No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
		Page	Plate and Fig.	Locality.	Group.	Locality.	Group.	
<i>BELEMNITIDÆ.</i>								
<i>BELEMNITES.</i>								
1	<i>fibula, Forbes,</i>	3 201	I. 13-42. II. 5-7.	Valudayur? Ootatoor; Moravia- toor; Odium.	Valudayur? Ootatoor.			
2	<i>semicanaliculatus,</i> <i>Blainville,</i> (<i>stilus, Blanford,</i>)	4 201	I. 1-12. II. 1-4.	Ootatoor; Moravia- toor; Odium.	Ootatoor.	France; England; Germany; Switzerland.	Aptien and middle cre- taceous; lower Chalk.	
3	<i>seclusus, Blanford,</i>	4 202	I. 43-51. II. 8.	Ootatoor.	Ootatoor.			
<i>NAUTILIDÆ.</i>								
<i>NAUTILUS.</i>								
4	<i>Bouchardianus, D'Or-</i> <i>bigny, var.</i>	203	XCII. 4.	Kolature; Arrialoor; Pondicher- ry.	Arrialoor.	France; Switzerland.	Gault.	
5	<i>sphæricus, Forbes,</i>	13 203	III. IV. & V. 2 & 4-6. XCII. 3.	Pondicher- ry; Olapaudy; Kolature; Shutanwee; Arrialoor. N. W. of Odium.	Arrialoor, and Ootatoor,			
6	<i>sublævigatus, D'Or-</i> <i>bigny, var.</i>	204	V. 1, 3.	Arrialoor; Shillagoody.	Arrialoor.	France; Switzerland; England.	Turonien: upper and lower Chalk:	
7	<i>Clementinus, D'Orbig-</i> <i>ny,</i>	17 205	VI., VII. 1-2.	Arrialoor; Karapaudy; Mulloor; Coothoor.	Arrialoor.	France; Switzerland; England; Germany.	Gault.	
8	<i>Huxleyanus, Blanford,</i>	19 205	VII. 3, 4. VIII. 1-3. IX. 1-4.	Serdamun- galum; Garudamun- galum; Anapaudy; Kolature; Shutanure; Monglepau- dy; Coonum; Andoor; Poothoor; Cormapol- liam; Puravoy; Olapaudy.	Arrialoor; Trichinopo- ly; and Ootatoor.			

No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
		Page	Plate and Fig.	Locality.	Group.	Locality.	Group.	
9	NAUTILUS,— <i>contd.</i> <i>splendens</i> , <i>Blanford</i> ,	21 205	IX. 5, X. 1.	Odium. Coothoor.	Ootatoor. Arrialoor.			
10	<i>justus</i> , <i>Blanford</i> ,	22 206	X. 2-3. XCIII. 2.	Odium.	Ootatoor.			
11	<i>Valudayurensis</i> , <i>Blanford</i> ,	23 206	XII. 2-3.	Valudayur.	Valudayur.			
12	<i>Fleuriausianus</i> , <i>D'Orbigny</i> , var.	206	XCIV. 1.	Odium.	Ootatoor.	France, England?	Gres Vert; lower Chalk?	
13	<i>lentiformis</i> , <i>Stoliczka</i> ,	207	XCIII. 1.	Pondicher- ry; Andoor; Anapady.	Arrialoor, Trichinopo- ly.			
14	<i>Danicus</i> , <i>Schlotheim</i> ,	24 208	X., XI. 4.	Ninnyoor; Mooticoor- chy; Plauntho- ray; Sudarampet.	Arrialoor.	France. Fæxoe. Rügen.	Danien.	
15	<i>serpentinus</i> , <i>Blanford</i> ,	25 208	XII. 1.	Rayapoo- thapakham	Arrialoor.			
16	<i>Ootatoorensis</i> , <i>Stoliczka</i> ,	26 208	XIII.	Odium; Moravia- toor; Puravay; Olapady.	Ootatoor.			
17	<i>angustus</i> , <i>Blanford</i> ,	27 209	XIV. 1-2. XCIII. 4.	Odium; Coothoor:	Ootatoor; Arrialoor.			
18	<i>formosus</i> , <i>Blanford</i> ,	28 209	XIV. 3-4 & XV.	Karapady; Mulloor; Kurribiem; Veraghoor; Olapady.	Arrialoor.	...	...	Allied to <i>N. Saussu- reanus</i> , Pictet.
19	<i>elegans</i> , <i>D'Orbigny</i> ,	29 209	VIII. 4. XVI. 1-4.	Serdamun- gulum; Andoor; Shutanure; Anapady.	Trichinopo- ly.	Europe, and N. America.	Middle cre- taceous.	
20	<i>neocomiensis</i> , <i>D'Orbigny</i> ,	31 210	XVI. 5-6. XVII. 1-2. XVIII. 1-2. XXI. 2.	Ootatoor; Kauray; Penengoor; Odium; Puravoy.	Ootatoor.	France, Switzerland. England.	Neocomien. lower Chalk?	
21	<i>pseudo-elegans</i> , <i>D'Orbigny</i> ,	33 210	XVII. 3. XVIII. 3. XIX. XX. 1. XCIII. 5.	Ootatoor, Odium.	Ootatoor.	France, England, Germany, Switzerland. Kaukasus.	Lower Cre- taceous.	
22	<i>Negama</i> , <i>Blanford</i> ,	35, 37: 211	XX. 2. XXI. 1, 3. XXII. & XCIV. 2.	Sirgumpore; Ootatoor; Odium.	Ootatoor.			
23	<i>Trichinopolitensis</i> , <i>Blanford</i> .	37 212	XXIII. XXIV. 1, 2. XXV. 3.	Kolature; Arrialoor; Mulloor.	Arrialoor.			

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No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
		Page	Plate and Fig.	Locality.	Group.	Locality.	Group.	
24	NAUTILUS,— <i>contd.</i> <i>rota</i> , <i>Blanford</i> ,	38 212	XXIV. 3. XXV. 1-2.	Arrialoor; Karapady; Mulloor.	Arrialoor.			
25	<i>Pondicherriensis</i> , <i>Blanford</i> ,	39 212	XXV. 4.	Valudayur.	Valudayur.			
AMMONITIDÆ.								
1. CRISTATI.								
AMMONITES.								
26	<i>Blanfordianus</i> , <i>Stoliczka</i> ,	46	XXVI.	Karapady; Vylapady.	Arrialoor.			
27	<i>inflatus</i> , <i>Sowerby</i> ,	48	XXVII. XXVIII. XXIX. XXX. 1-3.	Ootatoor; Moravia- toor; Odium.	Ootatoor.	Europe and America.	Middle Cre- taceous.	
28	<i>Candollianus</i> , <i>Pictet</i> ,	51	XXX. 4.	Ootatoor.	Ootatoor.	Switzerland.	Gres Vert.	
29	<i>propinquus</i> , <i>Stoliczka</i> ,	53	XXXI. 1-2.	Ootatoor.	Ootatoor.			
30	<i>subtricarinatus</i> , <i>D'Orbigny</i> ,	54	XXXI. 3.	Kurribiem; Kolakonut- tom; Seeranut- tom; Poothoor; Karapady.	Trichinopo- ly.	France. Germany.	Senonien; middle Cre- taceous.	
31	<i>obesus</i> , <i>Stoliczka</i> ,	55	XXXII. 1.	Odium.	Ootatoor.			
32	<i>Ootatoorensis</i> , <i>Stoliczka</i> ,	56	XXXII. 2.	Odium.	Ootatoor.			
33	<i>serrato-carinatus</i> , <i>Stoliczka</i> ,	57	XXXII. 3.	Garudamun- galum;	Trichinopo- ly.			
34	<i>corruptus</i> , <i>Stoliczka</i> ,	58	XXXVI. 2.	Cullpady.	Ootatoor.			
2. CLYPEIFORMES.								
35	<i>Siva</i> , <i>Forbes</i> ,	59	XXXIII. 3.	Valudayur.	Valudayur.			
3. LÆVIGATI.								
36	<i>sugata</i> , <i>Forbes</i> ,	60	XXXII. 4-6. XXXIII. 1-2.	Anapady; Andoor; Alundana- puram; Olapady; Kolature; Vylapady; Kolakonut- tom; Coonum; Kovil; Karapady; Murvanoor; Veraghoor.	Trichinopo- ly and Arrialoor.			
37	<i>Gardeni</i> , <i>Baily</i> ,	61	XXXIII. 4.	Karapady; Arrialoor; Poodoor.	Arrialoor; Trichinopo- ly?	S. Africa; Lemberg, Austria (?)	Middle Cre- taceous.	
38	<i>Rembda</i> , <i>Forbes</i> ,	63	XXXIII. 5.	Pondicherry	Valudayur.			

No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
		Page	Plate and Fig.	Locality.	Group.	Locality.	Group.	
	AMMONITES,— <i>contd.</i>							
	4. PULCHELLI.							
39	<i>idoneus, Stoliczka,</i>	64	XXXIV. 1.	Andoor.	Trichinopoly.			
40	<i>rotalinus, Stoliczka,</i>	65	XXXIV. 2.	Odium.	Ootatoor.			
	5. ROTOMAGENSES.							
41	<i>Rotomagensis, De-france,</i>	66	XXXIV. 3-5. XXXV. XXXVI. f. 1. XXXVII. 1-3.	Odium ; Coonum ; Ootatoor ; Vylapaudy.	Ootatoor ; Trichinopoly (?)	Europe, (through-out) ; America ; Africa ; Caucasus country.	Middle Cretaceous strata.	
42	<i>Coleroonensis, Stoliczka.</i>	71	XXXVII. 4-6.	Coonum.	Ootatoor.	...	...	Resembles <i>A. hippocastanum</i> , Sharpe.
43	<i>harpax, Stoliczka,</i>	72	XXXVIII. 2.	Odium ; Coonum.	Ootatoor.			
44	<i>navicularis, Mantell,</i>	73	XXXIX. 1. XXXIX. 2-4.	Odium ; Kolakonuttum ; Coonum.	Ootatoor.	England ; France.	Lower Chalk Cénomannien.	
45	<i>ornatissimus, Stoliczka,</i>	75	XL.	Odium.	Ootatoor.			
46	<i>meridionalis, Stoliczka,</i>	76	XLI.	Odium.	Ootatoor.	...	...	Probably identical with <i>A. Cunningtoni</i> , Sharpe.
47	<i>Medlicottianus, Stoliczka,</i>	77	XLIII. 1.	Odium.	Ootatoor.			
48	<i>tropicus, Stoliczka,</i>	78	XLIII. 2.	Odium.	Ootatoor.			
	6. MAMILLATI.							
49	<i>morpheus, Stoliczka,</i>	80	XXXVIII. 1.	Odium.	Ootatoor.			
50	<i>Mantelli, Sowerby,</i>	81	XLI. 2-3. XLII.	Odium ; Monglepau- dy ; Coonum ; Kullay ; Moravia- toor.	Ootatoor.	Europe, Caucasus country.	Cénomannien and Gault.	
51	<i>vicinalis, Stoliczka,</i>	84	XLIV.	Odium.	Ootatoor.	...	...	Allied to <i>A. Saxbii</i> , Sharpe.
52	<i>dispar, D'Orbigny,</i>	85	XLV. 1-3.	Moravia- toor.	Ootatoor.	Switzerland ; France ; Hungary.	Cénomannien and Gres vert.	
53	<i>argonautiformis, Stoliczka,</i>	87	XLVI. 1-2.	Moravia- toor.	Ootatoor.			
54	<i>crotaloides, Stoliczka,</i>	88	XLVI. 3.	Moravia- toor.	Ootatoor.			

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No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
		Page	Plate and Fig.	Locality.	Group.	Locality.	Group.	
	AMMONITES,— <i>contd.</i>							
	7. DENTATI.							
55	Guadaloupæ, <i>Römer</i> ,	90	XLVII. 1-2. XLVIII. 1.	Anapaudy ; Kolature ; Serdamun- galum ; Alundana- pooram.	Trichinopo- ly.	Texas.	Middle Cre- taceous.	
56	Orbignyianus, <i>Geinitz</i> ,	92	XLVIII. 2.	Moravia- toor.	Ootatoor.	Germany.	Middle Cre- taceous.	
57	Andoorensis, <i>Stoliczka</i> ,	94	XLVII. 3.	Andoor.	Trichinopo- ly.			
58	Largilliertianus, <i>D'Or- bigny</i> ,	94	XLIX. 1.	Odium.	Ootatoor.	England ; France.	Lower Chalk Cénomam- nien.	
59	subobtectus, <i>Stoliczka</i> ,	96	XLIX. 2.	Odium.	Ootatoor.	...	...	Allied to <i>Am. obtec- tus</i> , Sharpe.
60	Cunliffei, <i>Forbes</i> ,	97	L. 3.	Pondicher- ry.	Valudayur.			
61	crassitesta, <i>Stoliczka</i> ,	98	L. 1-2.	Coonum ; Monglepau- dy.	Ootatoor.			
62	conciliatus, <i>Stoliczka</i> ,	99	L. 4. LI. 1.	Monglepau- dy.	Ootatoor.			
63	Ushas, <i>Stoliczka</i> ,	100	LI. 2.	Odium.	Ootatoor.			
	8. NODOSOCOS- TATI.							
64	Footeanus, <i>Stoliczka</i> ,	101	LII. 1-2.	Odium.	Ootatoor.			
	9. ARMATI.							
65	Menu, <i>Forbes</i> ,	103	LII. 3-4.	Pondicher- ry ; Anapaudy ; Arrialoor ; Comarapol- liam.	Valudayur(?) Trichinopo- ly ; Arrialoor.			
	10. FLEXUOSI.							
66	Egertonianus, <i>Forbes</i> ,	104	LIII. 1-4.	Pondicher- ry ; Arrialoor.	Valudayur ; Arrialoor.			
67	Ganesa, <i>Forbes</i> ,	106	LIV. 2.	Pondicher- ry.	Valudayur.			
	11. ANGULICOS- TATI.							
68	Tweenianus, <i>Stoliczka</i> ,	107	LIV. 1. LV.	Arrialoor ; Anapaudy.	Arrialoor ; Trichinopo- ly.			
69	Ootacodensis, <i>Sto- liczka</i> ,	109	LIV. 3-4. LVI. LVII.	Ootacod ; Cumalypoo- ram.	Arrialoor.	Limbourg.	Upper Cre- taceous.	
	12. HETERO- PHYLLI.							
70	Varuna, <i>Stoliczka</i> ,	111	LVIII. 1.	Odium. Pondicher- ry ;	Ootatoor. Valudayur.			

No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
		Page	Plate and Fig.	Locality.	Group.	Locality.	Group.	
	AMMONITES,—contd.							
71	Indra, <i>Forbes</i> ,	112	LVIII. 2.	Valudayur.	Valudayur.			
72	improvisus, <i>Stoliczka</i> ,	113	LVIII. 4.	Odium.	Ootatoor.			
73	sub-alpinus, <i>D'Orbigny</i> ,	114	LVIII. 3.	Penangoor.	Ootatoor.	France ; Switzerland.	Gault.	
74	Surya, <i>Forbes</i> ,	115	LVIII. 5.	Pondicher- ry ;	Valudayur.			
75	Velledæ, <i>Michelin</i> ,	116	LIX. 1-4.	Odium ; Ootatoor ; Arrialoor.	Ootatoor ; Arrialoor.	Throughout all Europe. Caucasus.	Middle Cre- taceous : Neocomien.	
76	Rouyanus, <i>D'Orbigny</i> ,	117	LIX. 5-7.	Odium ; Pondicher- ry.	Ootatoor ; Valudayur.	Europe.	Neocomien.	
77	diphylloides, <i>Forbes</i> ,	119	LIX. 8-11.	Odium ; Pondicher- ry.	Ootatoor ; Valudayur.			
78	Yama, <i>Forbes</i> ,	120	LIX. 12.	Odium ; Pondicher- ry.	Ootatoor ; Valudayur.			
79	inanis, <i>Stoliczka</i> ,	121	LIX. 13-14.	Odium.	Ootatoor.			
	13. GLOBOSI.							
80	Rudra, <i>Stoliczka</i> ,	122	LX.	Odium.	Ootatoor.			
81	Xetra, <i>Stoliczka</i> ,	124	LXI.	Odium.	Ootatoor.			
82	Telinga, <i>Stoliczka</i> ,	125	LXII.	Odium.	Ootatoor.			
	14. MACROCE- PHALI.							
83	Deccanensis, <i>Stoliczka</i> ,	126	LXIII. 1.	Karapaudy.	Arrialoor.			
84	Arrialoorensis, <i>Sto- liczka</i> ,	126	LXIII. 2-4.	Karapaudy ; Arrialoor.	Arrialoor.			
85	Koluturensis, <i>Sto- liczka</i> ,	127	LXIV. 1. LXIV. 3.	Arrialoor. Koluture.	Trichinopo- ly.			
86	Brahminicus, <i>Sto- liczka</i> ,	128	LXIV. 2.	Veraghoor?	Arrialoor ?			
	15. LIGATI.							
87	peramplus, <i>Mantell</i> ,	130	LXV. 1-2.	Anapaudy.	Trichinopo- ly.	Through all Europe.	Middle Cre- taceous.	
88	Vaju, <i>Stoliczka</i> ,	132	LXV. 3.	Anapaudy, Garuda mungalum.	Trichinopo- ly.			
89	Denisonianus, <i>Sto- liczka</i> ,	133	LXV. 4. LXVI. LXVI. a.	Odium. Illpagoody ; Anapaudy.	Ootatoor. Trichinopo- ly.			
90	planulatus, <i>Sowerby</i> ,	134	LXVII. LXVIII.	Odium ; Ootatoor ; Anapaudy ; Karapaudy ; Arrialoor.	Ootatoor. Trichinopo- ly. Arrialoor.			
91	Bhima, <i>Stoliczka</i> ,	137	LXIX. 1-3.	Odium ; Moravia- toor.	Ootatoor.			
92	Bhavani, <i>Stoliczka</i> ,	138	LXIX. 4-7.	Serdamun- galum ; Ootacod.	Trichinopo- ly ; Arrialoor.			

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No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
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93	<i>Madrasinus, Stoliczka,</i>	139	LXX. 1-3.	Karapady ; Mulloor ; Vylapady.	Arrialoor.			
94	<i>Kandi, Stoliczka,</i>	140	LXX. 4.	Koluture.	Arrialoor (?)			
95	<i>Kalika, Stoliczka,</i>	140	LXX. 5.	Ootacod.	Arrialoor.			
96	<i>Æmilianus, Stoliczka.</i>	141	LXX. 6-8.	Karapady ; Mulloor.	Arrialoor.			
97	<i>Beudanti, Brongniart,</i>	142	LXXI. 1-4. LXXII.	Odium ; Moravia- toor.	Ootatoor.	Europe ; Africa.	Gault.	
98	<i>Durga, Forbes,</i>	143	LXXI. 5-7	Odium ; Moravia- toor ; Pondicher- ry.	Ootatoor ; Valudayur.			
99	<i>alienus, Stoliczka,</i>	144	LXXIII. 1-2.	Odium.	Ootatoor.			
100	<i>Timotheanus, Mayor,</i>	146	LXXIII. 3-6.	Odium ; Moravia- toor ; Penangoor ; Serdamun- galum ; Andoor.	Ootatoor ; Trichinopo- ly.	France ; Switzerland ; Hungary.	Gault ; Grès Vert.	
101	<i>latidorsatus, Michelin,</i>	148	LXXIV. 1-4.	Odium ; Moravia- toor.	Ootatoor.	France ; Switzerland ; Hungary.		
102	<i>Garuda, Forbes,</i>	149	LXXIV. 5.	Pondicher- ry.	Valudayur.			
103	<i>involutus, Stoliczka,</i>	150	LXXV. 1.	Odium.	Ootatoor.			
104	<i>Madraspatanus, Blan- ford,</i>	151	LXXV. 2.	Pondicher- ry.	Valudayur ; Ootatoor.			
105	<i>revelatus, Stoliczka,</i>	152	LXXV. 3.	Odium.	Ootatoor (?)			
106	<i>Cala, Forbes,</i>	153	LXXV. 4.	Shutanure ; Pondicher- ry.	Ootatoor ; Valudayur.			
107	<i>Sacya, Forbes,</i>	154	LXXV. 5-7. LXXVI.	Odium ; Moravia- toor.	Ootatoor.			
108	<i>Kayei, Forbes,</i>	156	LXXVII. 1-2.	Pondicher- ry ; Penangoor ; Odium.	Valudayur ; Ootatoor.			
109	<i>Cliveanus, Stoliczka,</i>	157	LXXVII. 3.	Moravia- toor ; Odium.	Ootatoor.			
110	<i>Moraviatoorensis, Sto- liczka,</i>	158	LXXVII. 4.	Moravia- toor ; Anapady.	Ootatoor. Trichinopo- ly.			
111	<i>Paravati, Stoliczka,</i>	158	LXXVII. 5-6.	Garudamun- galum.	Trichinopo- ly.			
112	<i>papillatus, Stoliczka,</i>	159	LXXVII. 7-8.	Moravia- toor.	Ootatoor.			
113	<i>pacificus, Stoliczka,</i>	160	LXXVII. 9.	Vencatara- mapooram. Camarapol- liam.	Arrialoor.			

No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
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114	Theobaldianus, <i>Stoliczka</i> ,	161	LXXVIII. 1-3.	Serdamungalum ; Shutanure ; Andoor ; Coonum ; Kolakonut- tum ; Kolature ; Olapaudy ; Anapaudy ; Ootacod.	Trichinopoly ; Arrialoer.			
	17. FIMBRIATI.							
115	Marut, <i>Stoliczka</i> ,	162	LXXIX. 1.	Odium.	Ootatoor.			
116	Brahma, <i>Forbes</i> ,	163	LXXIX. 2-4.	Pondicherry ; Ootacod.	Valudayur ; Arrialoer.			
117	Vishnu, <i>Forbes</i> ,	164	LXXIX. 5.	Pondicherry.	Valudayur.			
118	Mahadeva, <i>Stoliczka</i> ,	165	LXXX.	Moravia- toor.	Ootatoor.			
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119	æqualis, <i>Sowerby</i> ,	167	LXXXI. 4-6.	Odium.	Ootatoor.	Europe.	Middle Cre- taceous.	
120	obliquus, <i>Sowerby</i> ,	168	LXXXI. 1-3.	Odium ; Pondicherry.	Ootatoor ; Valudayur ?	Europe.	Middle Cre- taceous.	
121	Kingianus, <i>Stoliczka</i> ,	169	LXXXI. 7.	Odium.	Ootatoor.			
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122	armatum, <i>Sowerby</i> ,	172	LXXXI. 8-10. LXXXII.	Odium ; Moravia- toor.	Ootatoor.	Europe.	Middle Cre- taceous.	
123	Oldhamianum, <i>Stoliczka</i> ,	175	LXXXIII. 1-4. XCII. 1.	Penangoor.	Ootatoor.			
124	angulatum, <i>Stoliczka</i> ,	176	LXXXIV.	Odium.	Ootatoor.			
125	undulatum, <i>Forbes</i> ,	177	LXXXV. 6.	Pondicherry.	Valudayur.			
126	tenuisulcatum, <i>Forbes</i> ,	177	LXXXIV. 14-16.	Pondicherry ; Olapaudy.	Valudayur ; Arrialoer.			
127	rugatum, <i>Forbes</i> ,	178	LXXXV. 13.	Pondicherry.	Valudayur.			
128	sp.	179	LXXXV. 19.	Pondicherry.	Valudayur ?			
129	sub-compressum, <i>Forbes</i> ,	179	LXXXV. 7.	Pondicherry ; Odium.	Valudayur ; Ootatoor.			
130	large-subcatum, <i>Forbes</i> ,	180	LXXXV. 8-9.	Pondicherry.	Valudayur.			
131	Indicum, <i>Forbes</i> ,	181	LXXXV. 1-5.	Pondicherry ; Odium.	Valudayur ; Ootatoor.			
132	Nereis, <i>Forbes</i> ,	182	LXXXV. 17-18.	Pondicherry ; Odium.	Valudayur ; Ootatoor.			

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No.	GENERA AND SPECIES.	REFERENCES.		INDIAN.		NOT INDIAN.		REMARKS.
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133	HELICOCERAS. <i>indicum</i> , <i>Stoliczka</i> ,	184	LXXXVI. 1-2.	Veraghoor.	Arrialoor.			
134	TURRILITES. <i>Bergeri</i> , <i>Brongniart</i> ,	185	LXXXVI. 3-6.	Odium.	Ootatoor.	Europe.	Gault.	
135	<i>Gressleyi</i> , <i>Pict. and Campiché</i> ,	186	LXXXVII. 1-5.	Odium ; Moravia- toor.	Ootatoor.	Savoy and Switzerland.	Gault.	
136	<i>tuberculatus</i> , <i>Bosc.</i>	187	LXXXVII. 6-8.	Odium.	Ootatoor.	Europe.	Gault.	
137	<i>costatus</i> , <i>Lamarck</i> ,	188	LXXXVII. 9-10. LXXXVIII. 1-2.	Odium.	Ootatoor.	Europe.	Middle Cre- taceous.	
138	<i>Brazoensis</i> , <i>Roemer</i> ,	189	LXXXVIII. 3.	Moravia- toor.	Ootatoor.	Texas.	Middle Cre- taceous.	
139	<i>Cunliffeanus</i> , <i>Stoliczka</i> ,	190	LXXXIX.	Odium.	Ootatoor.			
140	HAMITES. <i>problematicus</i> , <i>Sto- liczka</i> ,	191	XC. 1-2.	Odium.	Ootatoor.			
141	conf. <i>Meyrati</i> , <i>Ooster</i> ,	191	XC. 3.	Odium.	Ootatoor.			
142	HAMULINA. <i>sublævis</i> , <i>Stoliczka</i> ,	193	XC. 4.	Odium.	Ootatoor.			
143	PTYCHOCERAS. <i>sipho</i> , <i>Forbes</i> ,	195	XC. 5-9.	Pondicher- ry.	Valudayur.			
144	<i>Gaultinum</i> , <i>Pictet</i> ,	195	XC. 10.	Odium.	Ootatoor.	Switzerland and Savoy.	Gault.	
145	<i>Forbesianum</i> , <i>Stoliczka</i> ,	195	XC. 11.	Moravia- toor.	Ootatoor.			
146	BACULITES. <i>teres</i> , <i>Forbes</i> ,	197	XC. 12-13.	Pondicher- ry ; Odium.	Valudayur ; Ootatoor.			
147	<i>vagina</i> , <i>Forbes</i> ,	198	XC. 14. 15. XCI. 1-6.	Pondicher- ry ; Ootacod.	Valudayur ; Ootatoor.			
148	<i>Gaudini</i> , <i>Pictet</i> ,	199	XCI. 7-10.	Odium.	Ootatoor.			



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"	12 " 15					
"	17 " 30		"	acuminatis	"	subsiniatis
"	19 between lines 12 and 13		insert	Pl. VI. figs. 2.2a,	specimen from	Olapaudy, Trichinopoly.
"	23 lines 17 and 18		for	lines &c.	read	inch, lines &c.
"	30 " 3 and 20		"	distinct	"	distant
"	30 " 8		"	Nautili	"	Mantell
"	37 " 28		after	situated	insert	externally
"	39 " 6		for	Ootatoor group.	read	Arrialoor group.
"	62 " 34		"	Gervillianus	"	Gevrillianus
"	70 " 11		"	Cenomamien	"	Cénomamien
"	78 " 3 from bottom		"	20-flexuosis,	"	20, flexuosis,
"	" 1 "		"	incisis,	"	incisis.
"	107 " 15 "		"	Fig. 3.	"	Fig. 1.
"	129 " 21		"	Group 14.	"	Group 15.
"	137 " 3		"	XLIÏ.	"	LXIX.
"	154 " 2 from bottom		"	multiplexa	"	multiplexus
"	160 " 20		"	uturis	"	Suturis
"	162 " 31		"	All belong to	"	All occur chiefly in
"	168 " 8		"	figures 2 and 3	"	figures 5 and 6
"	169 " 23		"	Rugen	"	Rügen.
"	174 " 17		"	identical.	"	identical, viz.
"	174 " 34		"	Pl. 82,	"	Pl. 81,
"	187 " 5 from bottom		"	quadiserialibus	"	quadriserialibus

In the Explanations of Plates.

Pl.	LXIV.	line 1	for	DECCANENSIS	read	ARRIALOORENSIS
"	LXXXV.	" 1	"	INVOLUTUS	"	INVOLVULUS
"		" 11	"	COLA	"	CALA
"	LXXXIV.	" 7	"	siphonal saddle, and cd	"	middle of
"	LXXXVI.	" 6	"	Figs. 6—7.	"	Figs. 6—8.





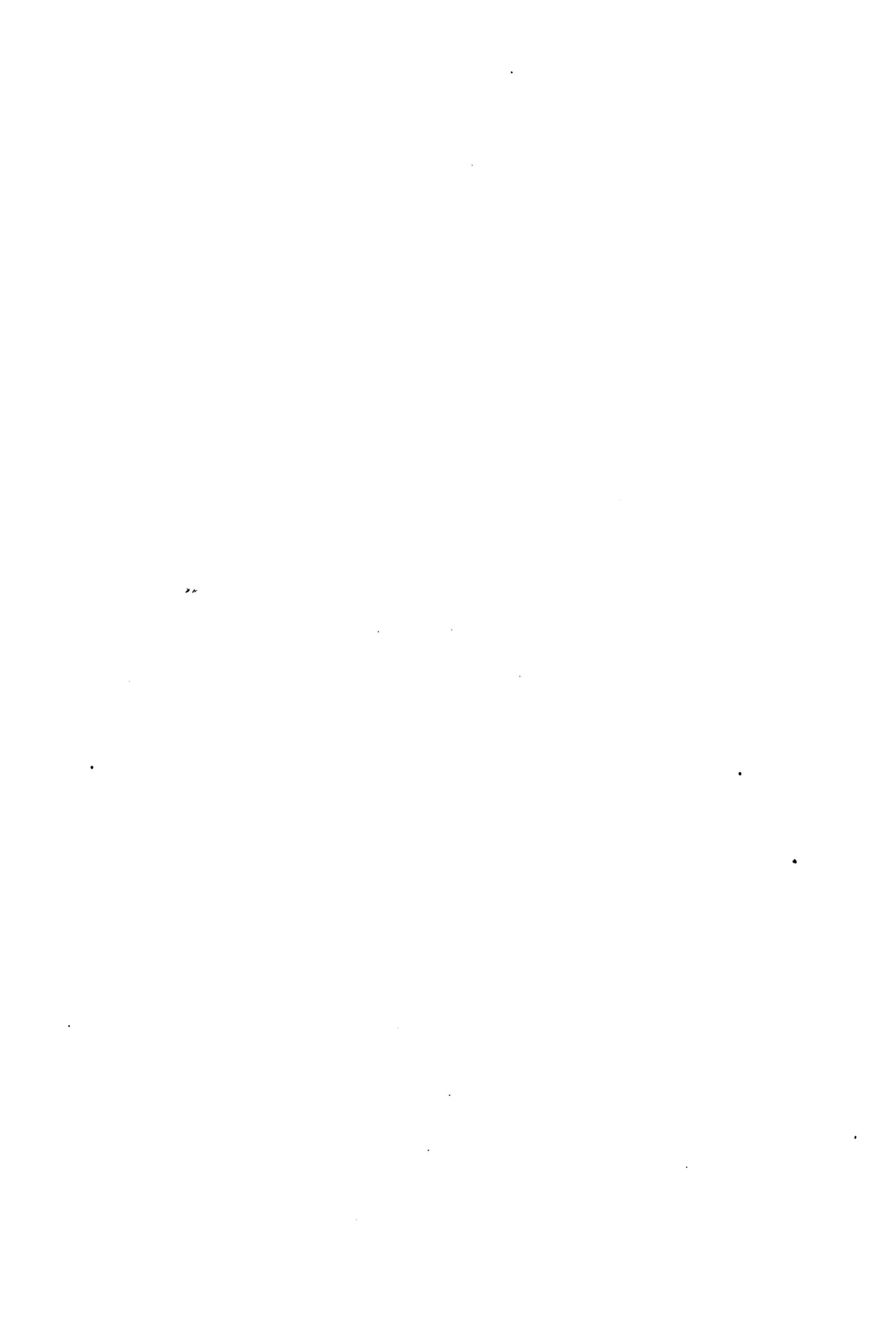
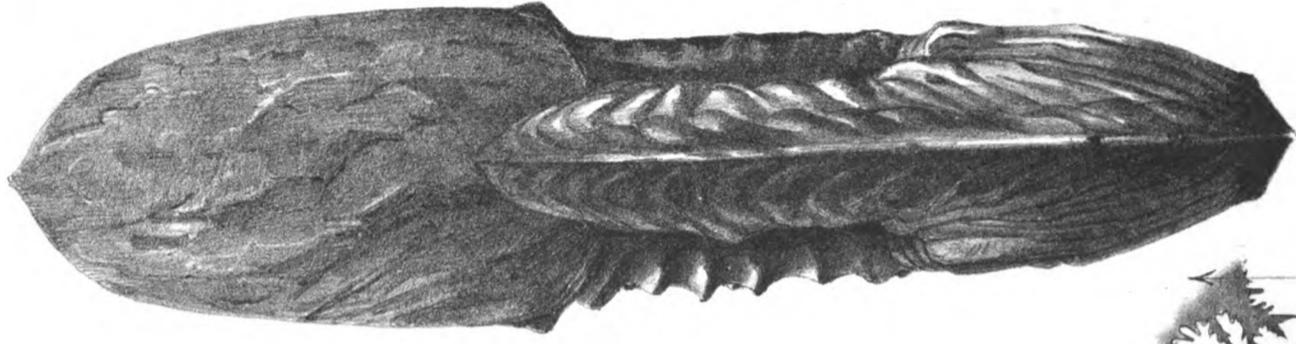


PLATE XXVI.

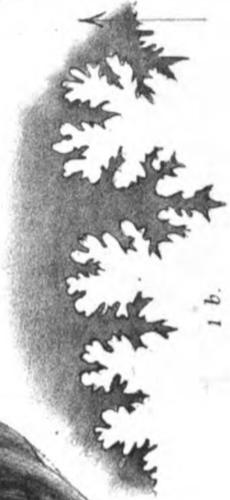
- Fig. 1. AMMONITES BLANFORDIANUS, *Stoliczka*, page 46: Fig. 1, side view; Fig. 1.a. front view;
Fig 1.b. sutures from same specimen;
from Karapaudy, Trichinopoly.
- Fig. 2. " " " " " "
Filed sutures from a small specimen of
same species, from same locality.
Arrialoor Group. In Geol. Surv. Collec-
tion.



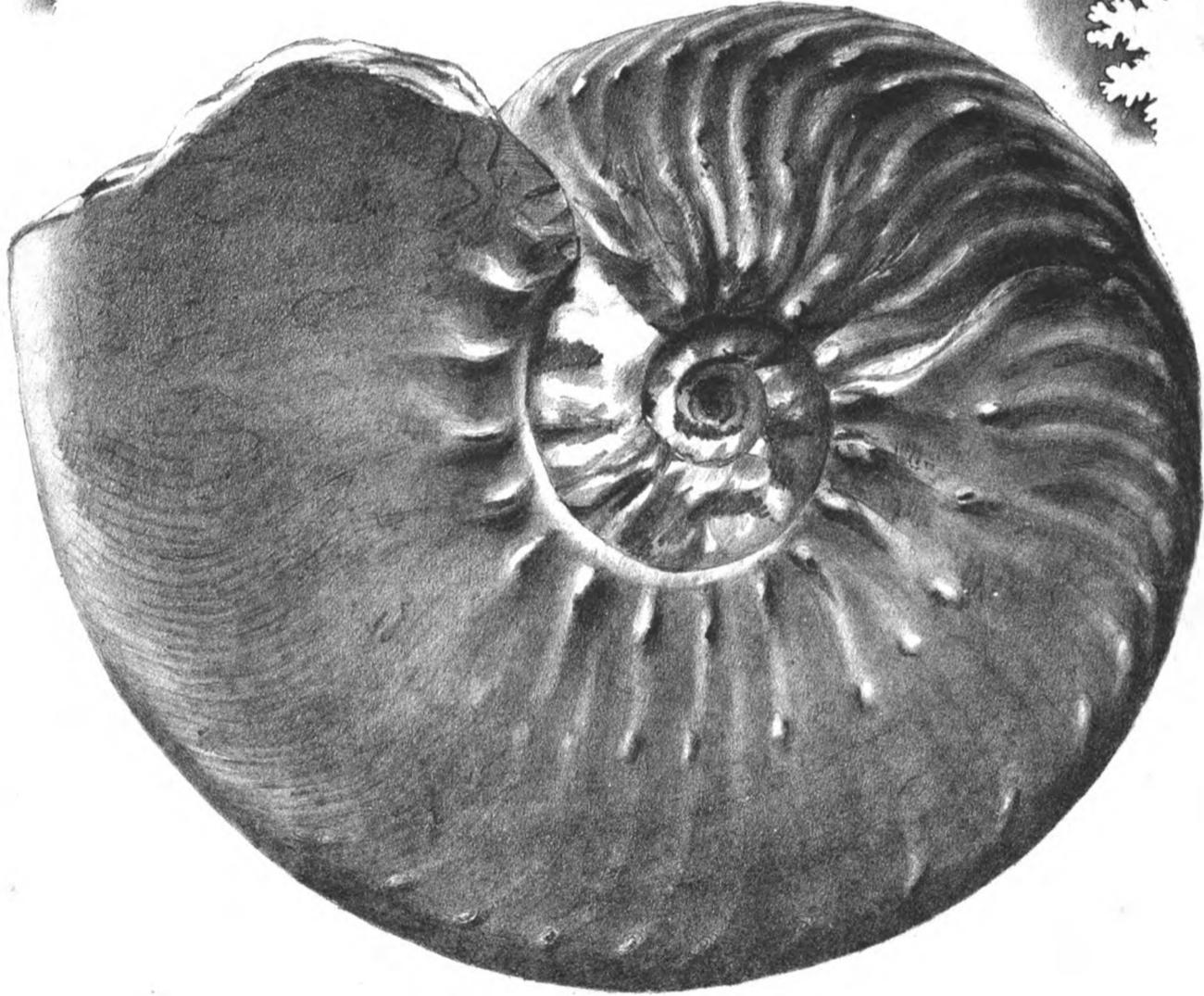
1 a.



2.



1 b.



1.

Calcutta.

T. Oldham delin.

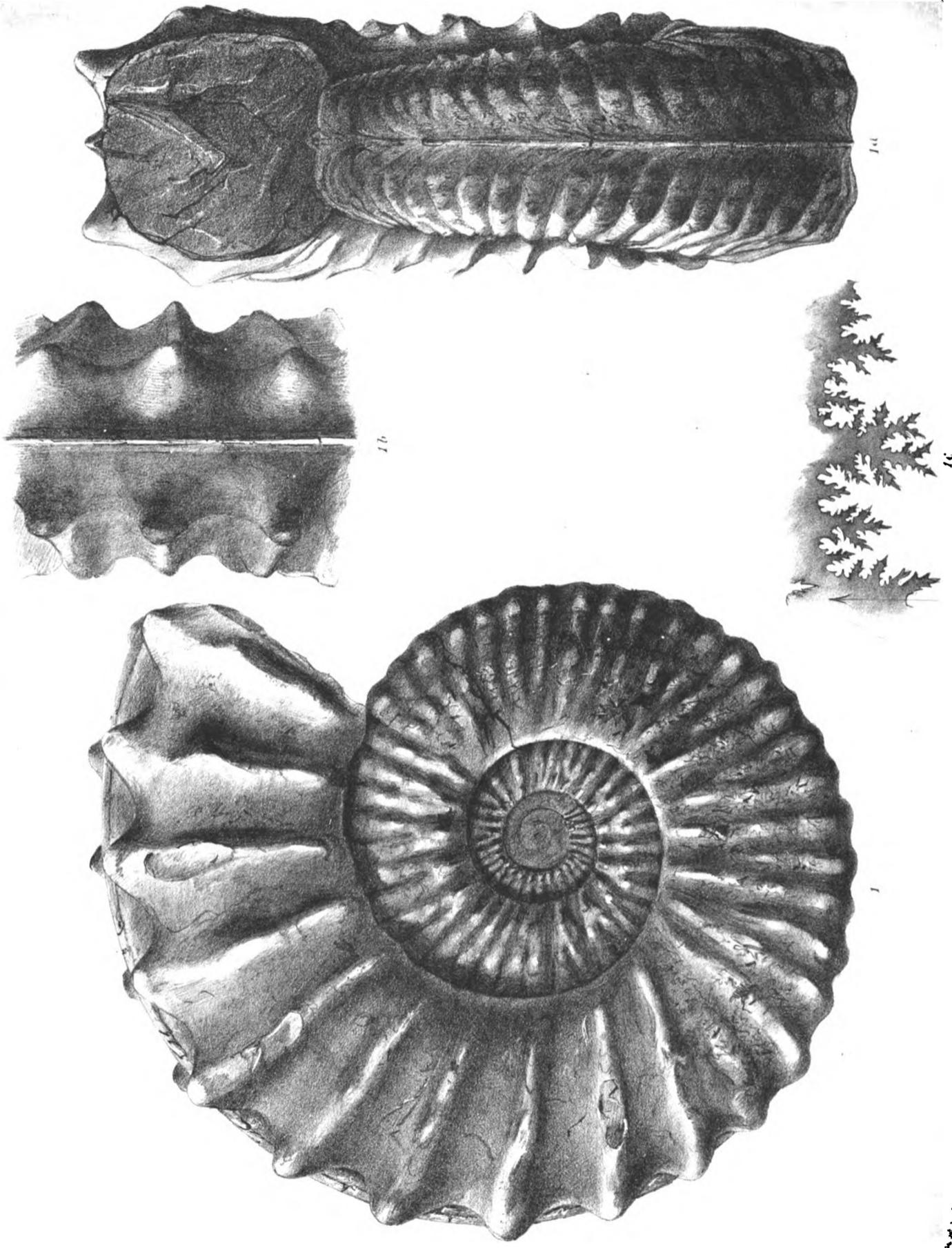
H. J. Frazer lith.





PLATE XXVII.

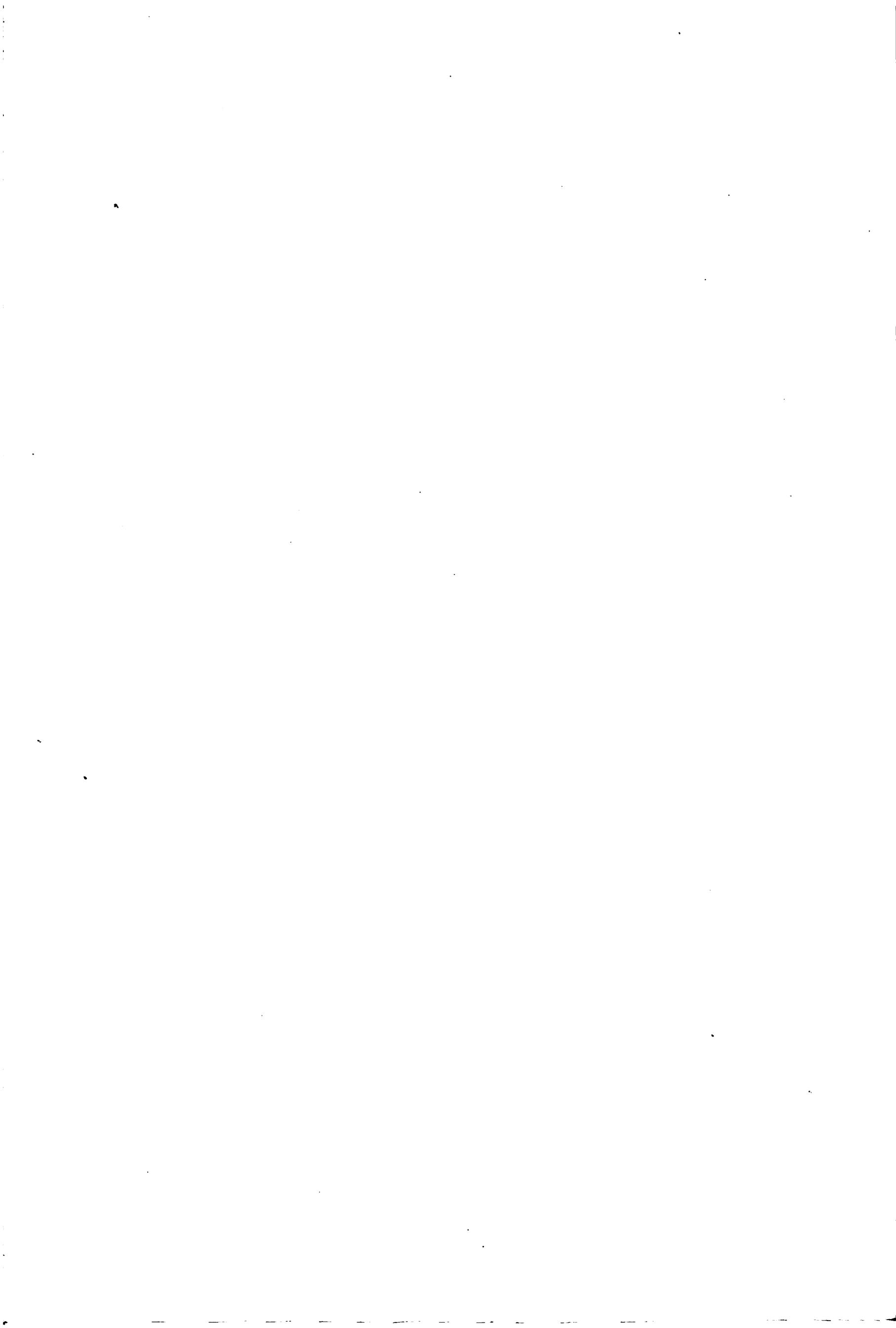
AMMONITES INFLATUS, *Sowerby*, page 48 : Fig. 1, side view ; Fig. 1.a. front view ;
Fig. 1.b. back view of part of the body chamber.
Fig. 1.c. outline of septum.
From Odium, Trichinopoly. *Ootatoor group*.
Geol. Surv. Collection.



H. L. Frazer Lith.

T. Oldham direct.

Calcutta.



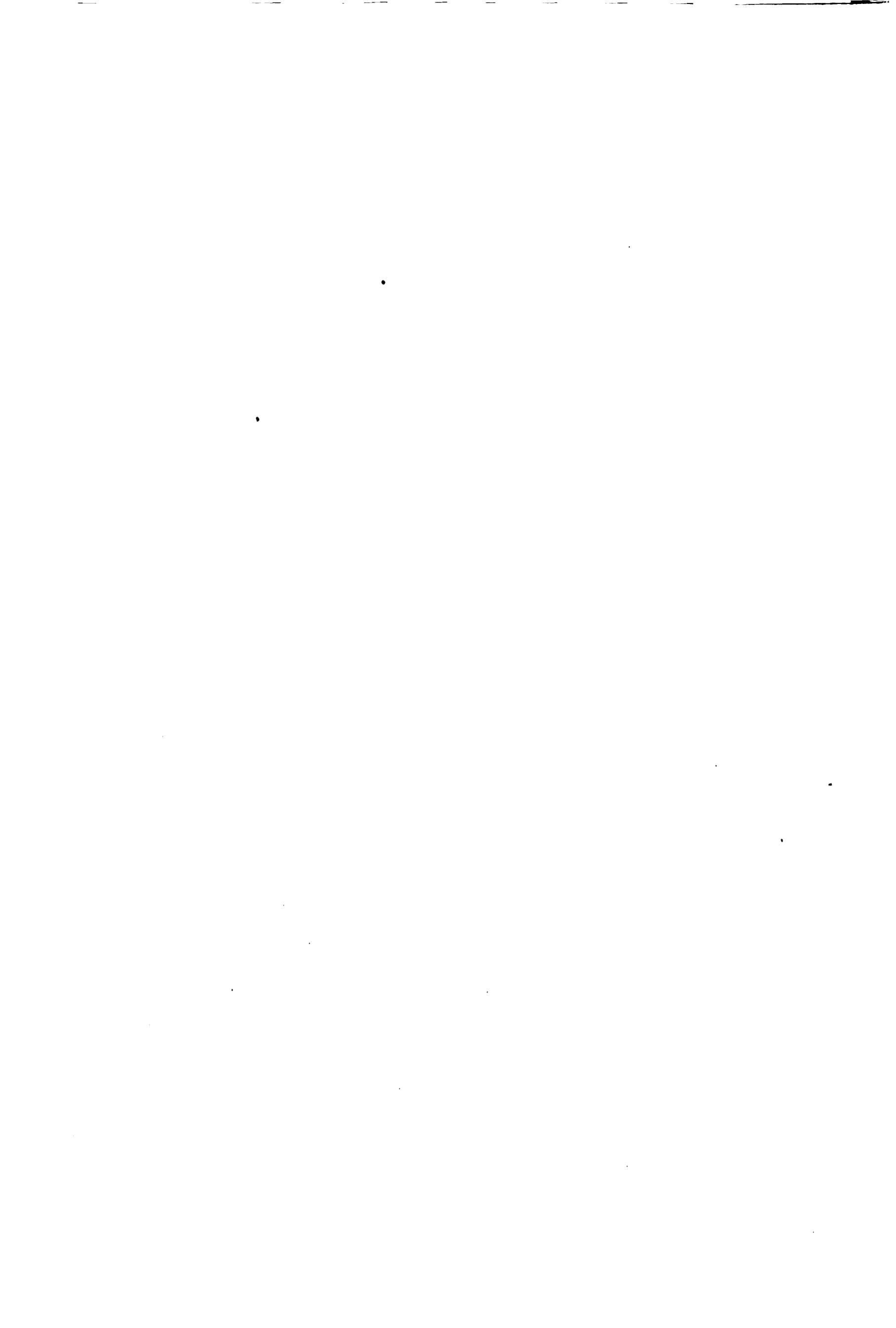


PLATE XXVIII.

AMMONITES INFLATUS, *Sowerby*. Var. II. p. 49 : A nearly full grown, sub-compressed specimen
with distinct tubercles, from Moraviatoor, Trichinopoly.

Ootatoor group.

Geol. Surv. Collection.



H. L. Frazer Lith.

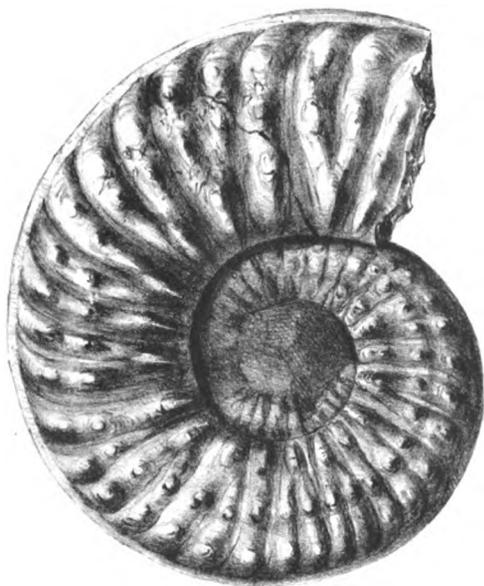
T. Oldham direx^t

Calcutta.



PLATE XXIX.

- Fig. 1. AMMONITES INFLATUS, *Sowerby*. Var. II. page 49: Fig. 1, side; Fig. 1.a. front; and
Fig. 1.b. back view of specimen from N. E. of Ootator.
- Fig. 2. " " " Var. I. p. 49. Section of a small specimen from Odium.
- Fig. 3. " " " Var. II. p. 49. Section of a fragment from Moraviator.
- Fig. 4. " " " Side view of portion of the outer whorl of Var. III.
page 50; Fig. 4.a. section of the same fragment.



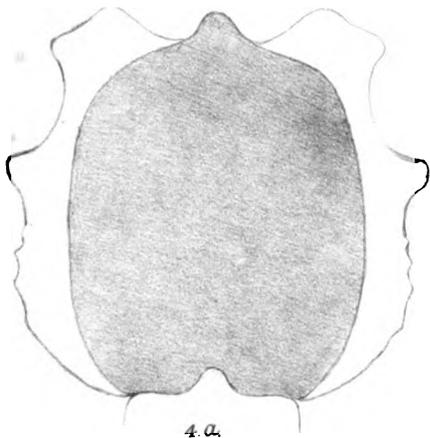
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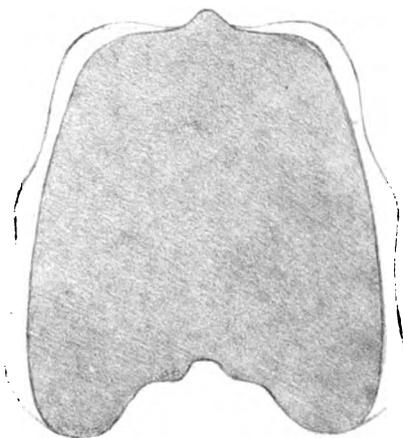
1 a.



1 b.



4 a.



3.



2.



4.

PLATE XXX.

- Fig. 1. *AMMONITES INFLATUS*, *Sowerby*. Var. II. p. 50. Sutures taken from the inner whorls of a large specimen from Moraviatoor, Fig. 1.a, sutures from the last whorl of the same specimen.
- Fig. 2. „ „ „ Perfect sutures from the fragment figured Pl. XXIX.
- Fig. 3. „ „ „ Remarkably small sutures, from the specimen figured, Pl. XXIX. Fig. 1.
- Fig. 4. *AMMONITES CANDOLLIANUS*, *Pictet*, p. 51 : Fig. 4, side ; Fig. 4.a. back ; Fig. 4.b. front view, and Fig. 4.c. sutures of the only specimen procured. From Ootatoor, Trichinopoly, *Ootatoor group*.
Geol. Surv. Coll.
- Fig. 5. *AMMONITES*, *sp. indeter.* Page 52 : Fig. 5, side view, Fig. 5.a. section, of a fragment from Ootatoor, Trichinopoly. *Ootatoor group*.
Geol. Surv. Coll.

Note. On page 50, line 12, from bottom, *for* and *l.b. read* and *l* ;

„ „ 11; „ „ „ Fig. a. „ Fig. 1.

„ „ 11. „ „ „ Fig. b. „ Fig. 1.a.

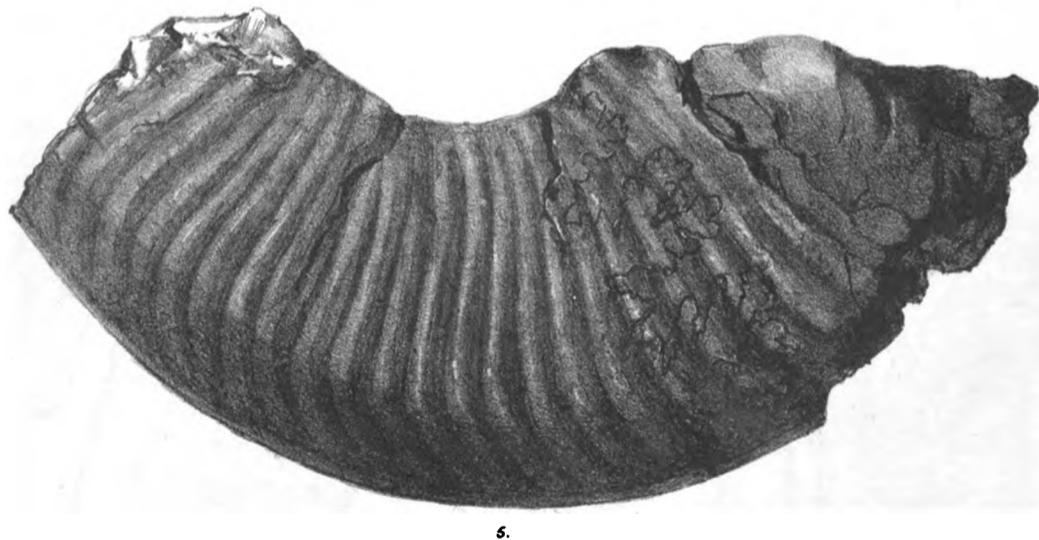
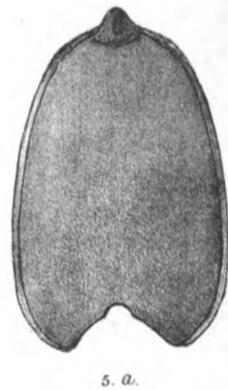


PLATE XXXI.

- Fig. 1. AMMONITES PROPINQUUS, *Stoliczka*. Page 53: Fig. 1, side view; Fig. 1.a. front view; and Fig. 1.b. sutures from the same specimen, taken from a filed surface. From East of Ootatoor, Trichinopoly. *Ootatoor group*.
Geol. Surv. Coll.
- Fig. 2. „ „ „ Perfect sutures, taken from a larger specimen from same locality.
- Fig. 3. AMMONITES SUB-TRICARINATUS, *D'Orbigny*. Page 54: Fig. 3, side view; 3.a. back view of portion of outer whorl; 3.b. section from outer whorl to centre of shell; 3.c. sutures taken from penultimate whorl. From Kurribiem, Trichinopoly, *Trichinopoly group*.
Geol. Surv. Coll.



1.



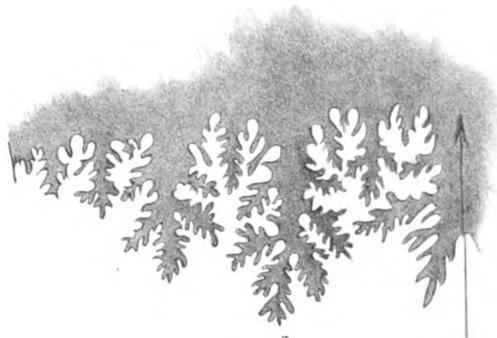
1 a.



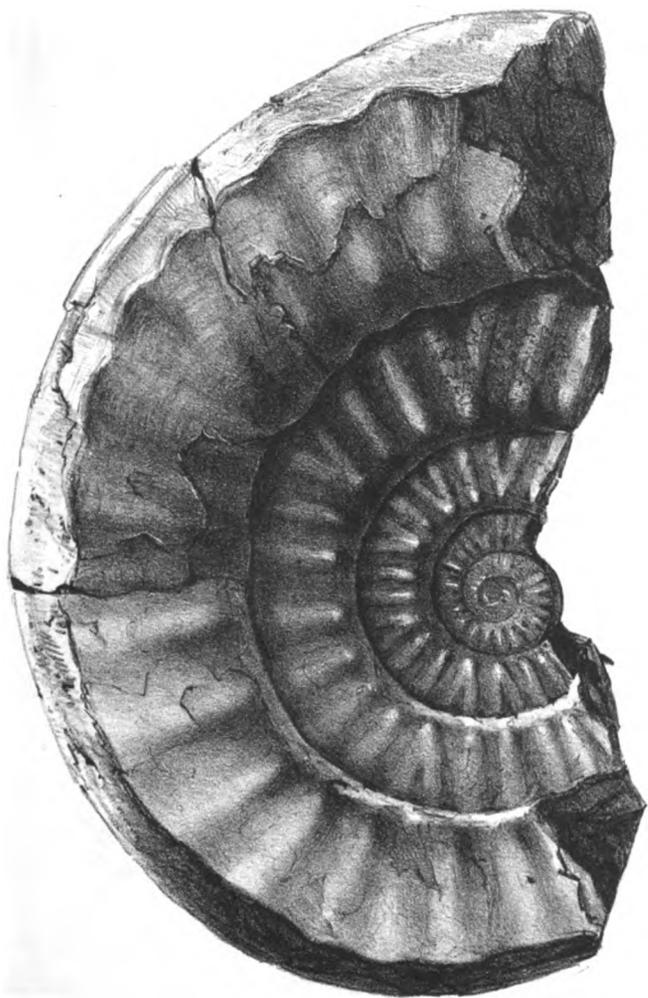
3 c.



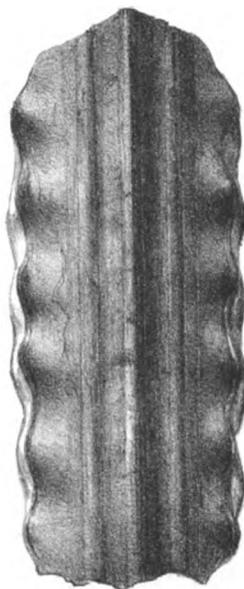
1 b.



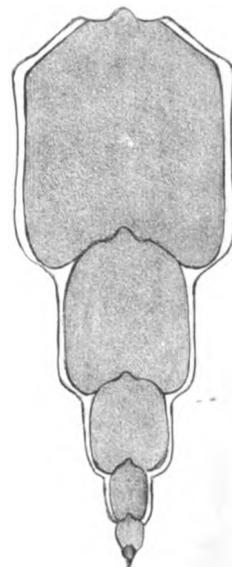
2.



3.



3 a.



3 b.

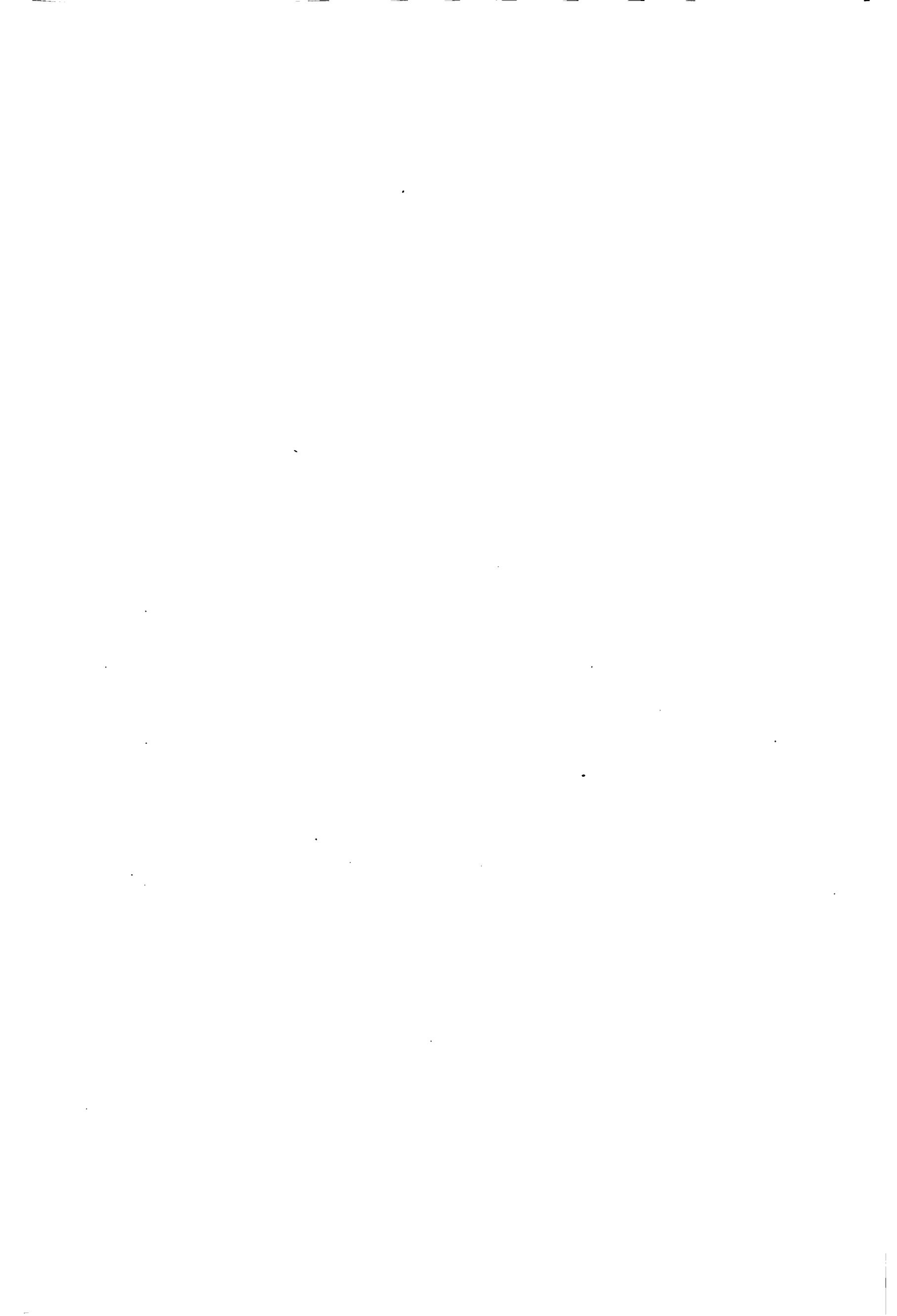


PLATE XXXII.

- Fig. 1. AMMONITES OBESUS, *Stoliczka*, p. 55. Fig. 1. side, 1.a. front view; 1.b. outlines of a septum, obtained by filing. N. E. of Odium; *Ootatoor-group*; Geol. Survey Collection.
- Fig. 2. AMMONITES OOTATOORENSIS, *Stoliczka*, p. 56. Fig. 2. side, 2.a. front view, 2.b. outlines of two septa; the lines on both ends signifying the umbilical sutures, and those next to these the edges of the umbilicus. Odium, *Ootatoor-group*, Geol. Surv. Collection.
- Fig. 3. AMMONITES SERRATO-CARINATUS, *Stoliczka*, p. 57. Fig. 3. side, 3.a. front view. Garudamungalum, *Trichinopoly-group*. Geol. Surv. Collection.
- Fig. 4. AMMONITES SUGATA, *Forbes*, p. 60. Front view of a thick specimen, from Andoor.
- Fig. 5. " " " " Side view of a specimen, from Andoor.
- Fig. 6. " " " " Front view of a compressed variety from Kolakottum; all from the *Trichinopoly-group*. Geol. Surv. Collection.



1.a



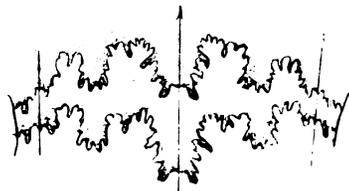
1



2



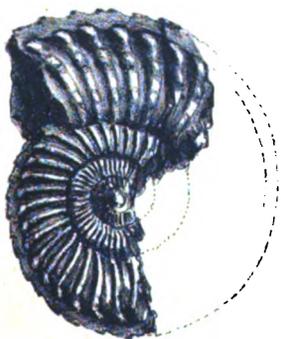
2.a



2.b



1.b



3



3.a



4



5



6

H.L. Frøzer Lith.

T Oldham dirext

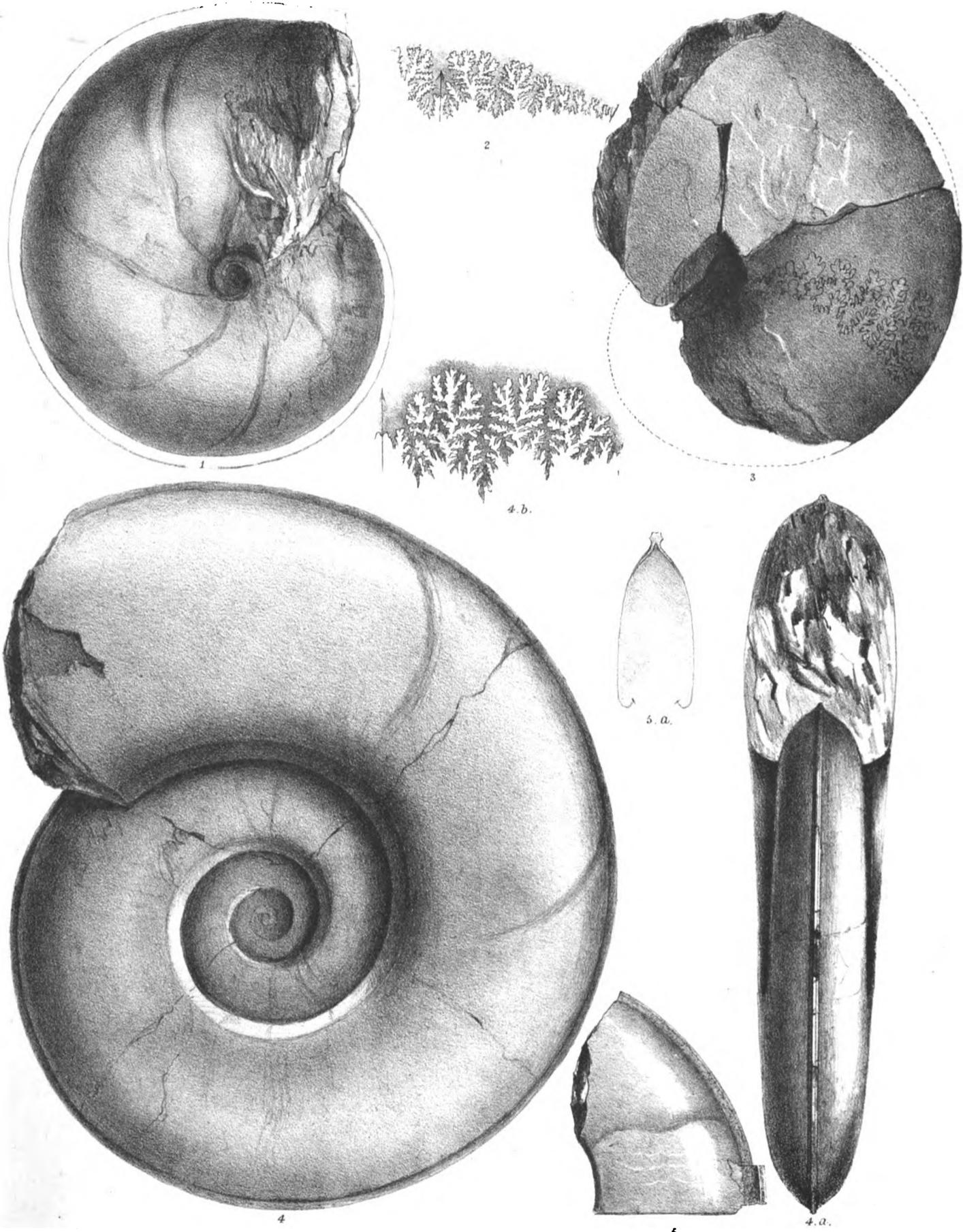
Calcutta.





PLATE XXXIII.

- Fig. 1. *AMMONITES SUGATA*, *Forbes*, p. 60. Side view of one of the largest specimens from Kola-
konuttum.
- Fig. 2. „ „ „ „ 61. Outline of a septum from a specimen from Andoor ;
both *Trichinopoly-group*. Geol. Surv. Collection.
- Fig. 3. *AMMONITES SIVA*, *Forbes*, p. 59. Fragmentary specimen from Valudayur, of the *Valu-
dayur-group*, shewing the septa ; Madras Museum
Collection.
- Fig. 4. *AMMONITES GARDENI*, *Baily*, p. 61. Fig. 4. side, 4.a. front-view, 4.b. outline of a sep-
tum ; Arialoor, *Arialoor-group*. Geol. Surv. Col-
lection.
- Fig. 5. *AMMONITES REMBDA*, *Forbes*, p. 63. Twice enlarged figures ; 5. side view of a fragment,
shewing one flexuous furrow on the cast and on
the lower part a portion of shell with the keel ;
5.a. section of this fragment, the inner line on
the top marking the cast ; Valudayur, *Valudayur-
group* ; Madras Museum Collection.



H L. Frazer Lith.

T Oldham dirext

Calcutta.

PLATE XXXIV.

- Fig. 1. *AMMONITES IDONEUS*, *Stoliczka*, p. 64. Fig. 1. and 1.a. side views, 1.b. front view, 1.c. back view, 1.d. outline of a septum, enlarged three times; Andoor, *Trichinopoly-group*. Geol. Surv. Collection.
- Fig. 2. *AMMONITES ROTALINUS*, *Stoliczka*, p. 65. Fig. 2. side, 2.a. front view; Odium, *Ootatoor-group*. Geol. Surv. Collection.
- Fig. 3. *AMMONITES ROTOMAGENSIS*, *DeFrance*, p. 66. Young, perfect specimen of the *subcompressed* variety, from S. E. of Odium, p. 68.
- Fig. 4. " " " " Young, nearly perfect specimen of the typical form, from Odium, p. 68.
- Fig. 5. " " " " Nearly perfect specimen of the *compressed* variety from Odium, p. 69.
- All from the *Ootatoor-group*. Geol. Surv. Collection.



1.



1.a.



1.b.



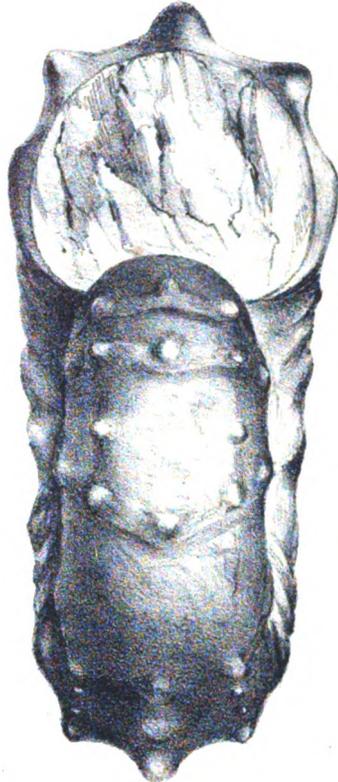
1.c.



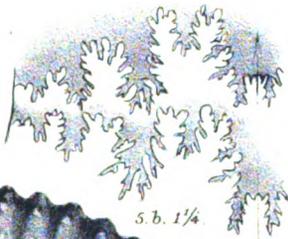
1.d 1/2



2



2.a.



5.b. 1/4



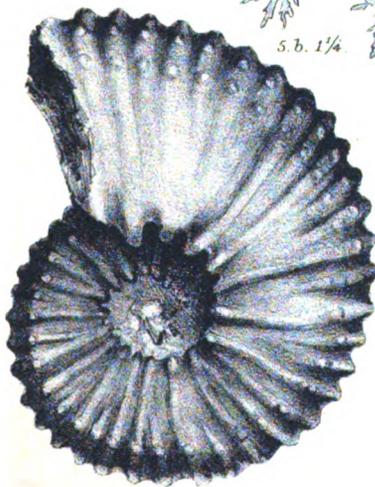
4.b.



3.



3.a.



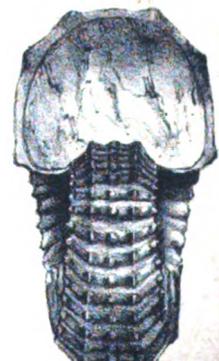
5



5.a.



4

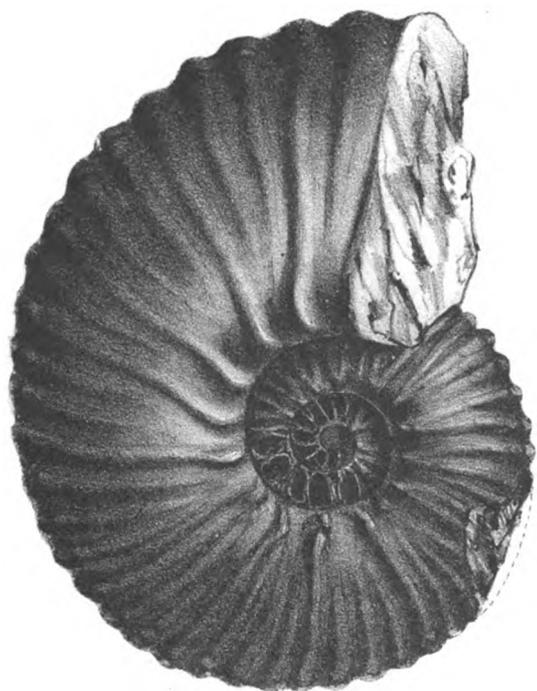


4.a.

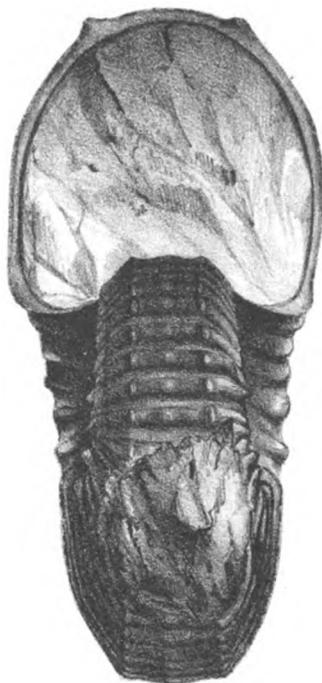


PLATE XXXV.

- Fig. 1. AMMONITES ROTOMAGENSIS, *Defrance*. A middle aged, perfect specimen from S. E. of Odium ; sub-compressed variety ; p. 68.
- Fig. 2. „ „ „ A young specimen of the inflate variety ; p. 68, from N. W. of Moonglepandy.
- Fig. 3. „ „ „ Large specimen, containing only the air-chambers, from S. E. of Odium ; typical form ; p. 68.
- All from the *Ootatoor-group*. Geol. Surv. Collection.



1.



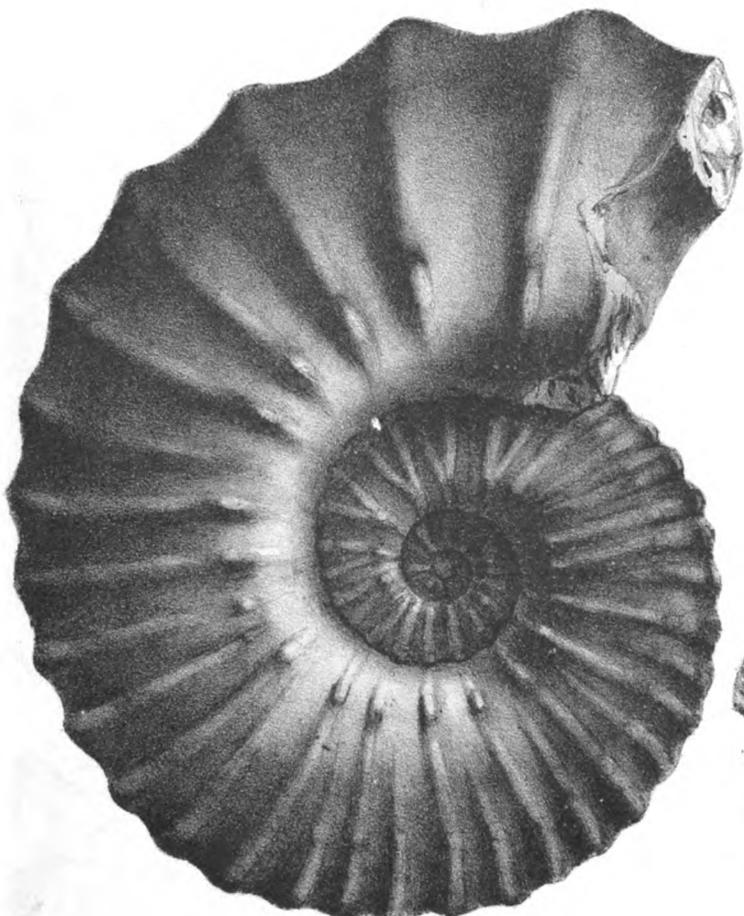
1. a.



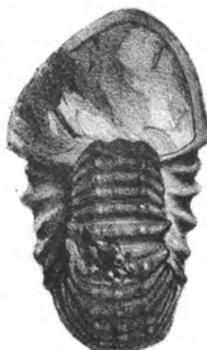
2.



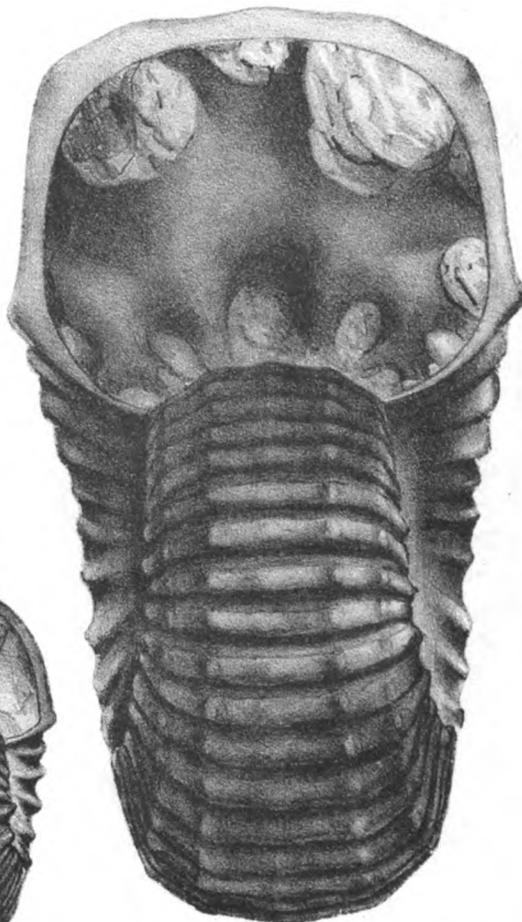
2. a.



3.



3. l.



3. a.

H.L. Frazer Lith.

T. Oldham direct.

Calcutta

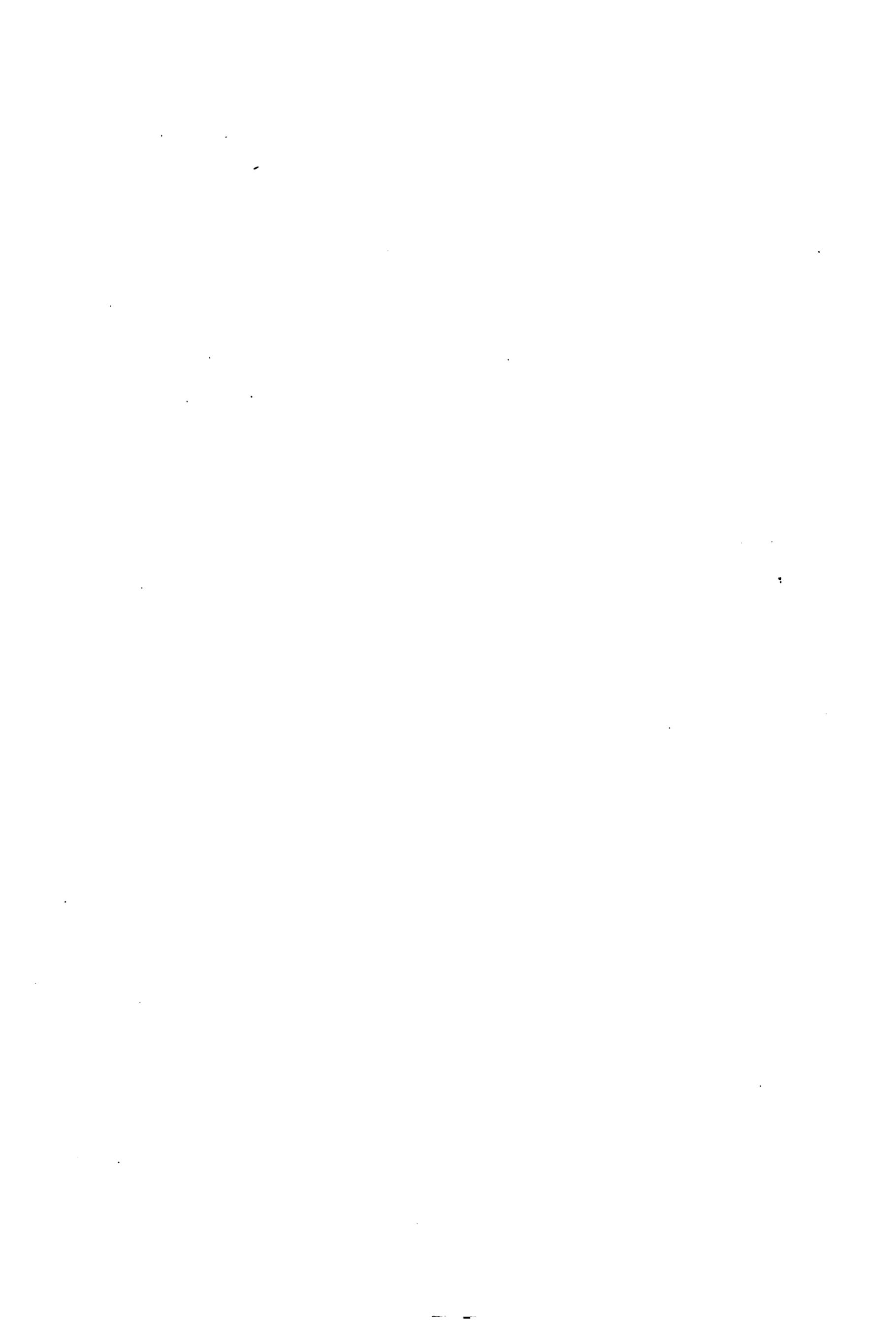
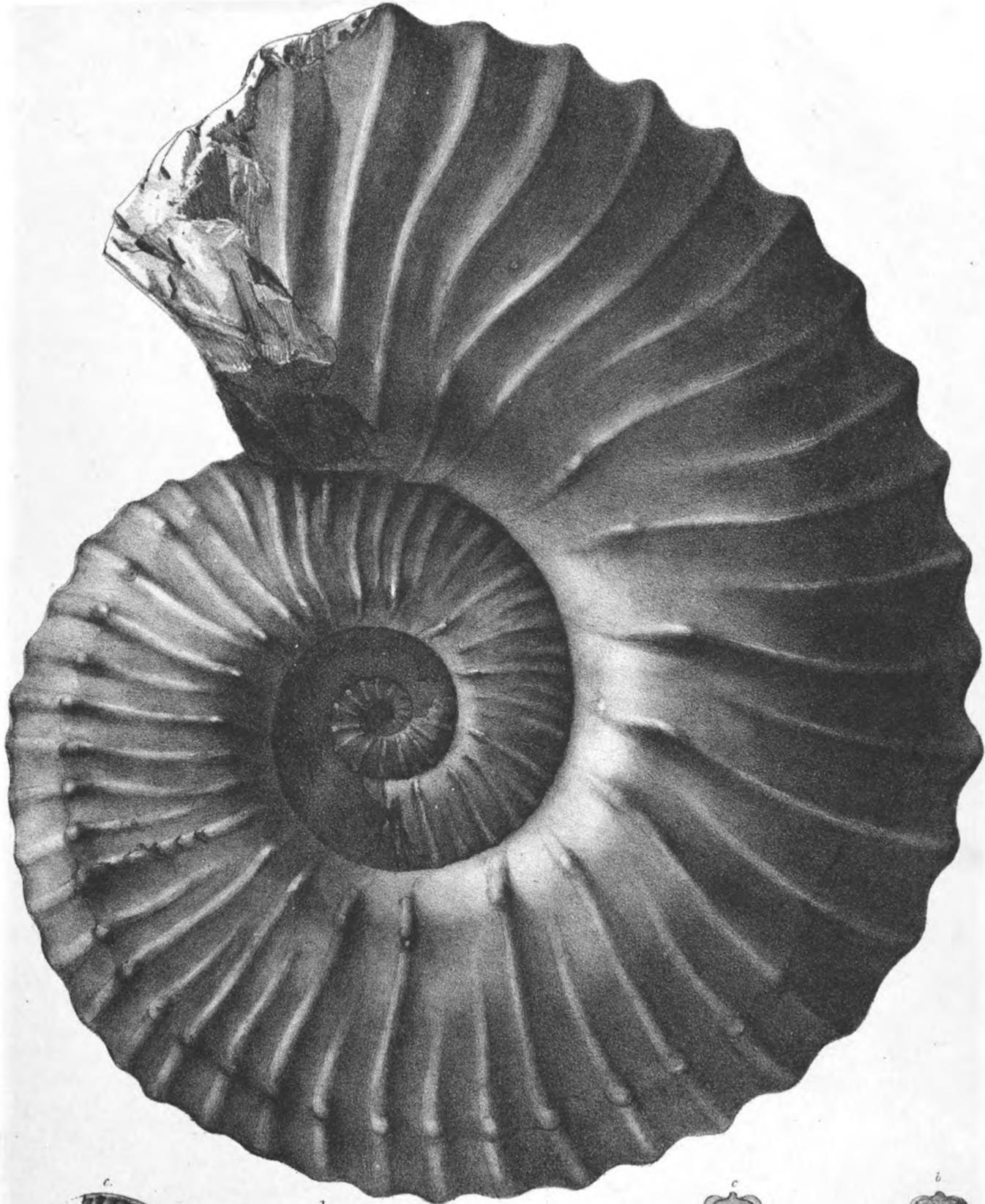




PLATE XXXVI.

- Fig. 1. AMMONITES ROTOMAGENSIS, *Defrance*, p. 66. A nearly full grown specimen from S. E. of Odium ; *Ootatoor-group*. Geol. Surv. Collection.
- Fig. 2. AMMONITES CORRUPTUS, *Stoliczka*, p. 58. Fig. 2. side view ; 2a. front view on the plane of *ab* ; 2b. section on the plane *ac* ; 2c. outlines of two sutures of a septum ; Cullpaudy, *Ootatoor-group*. Geol. Surv. Collection.



1



H.L. Frazer lith.

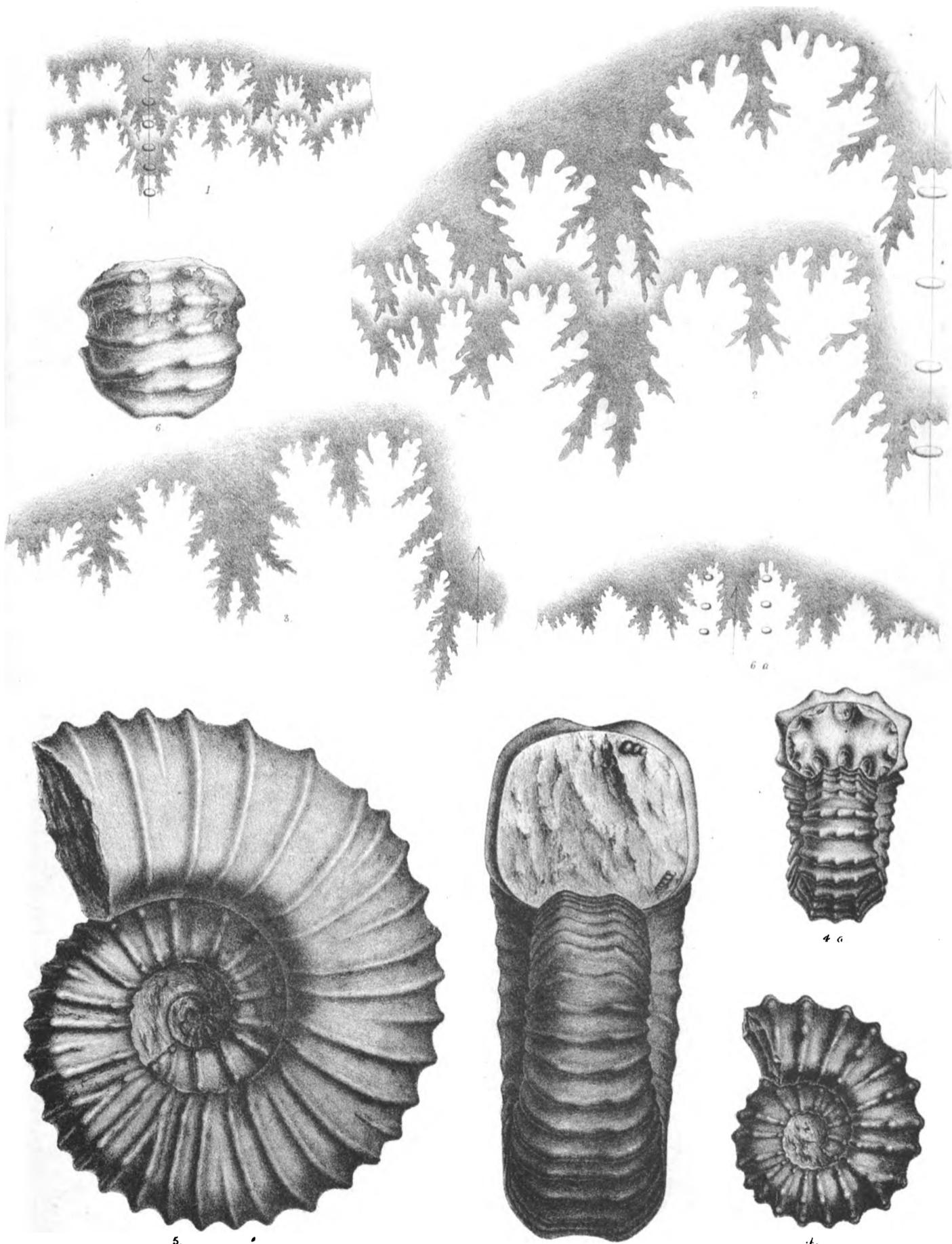
T. Oldham d'Alex'

Calcutta.



PLATE XXXVII.

- Fig. 1. *AMMONITES ROTOMAGENSIS*, *Defrance*, p. 69. Outlines of a septum of the figured specimen, Pl. XXXV. Fig. 1.
- Fig. 2. " " " " Sutures of the large specimen, Pl. XXXVI. Fig. 1.
- Fig. 3. " " " " Outlines of large specimen of the inflate variety, from Odium.
- Fig. 4. *AMMONITES COLEROONENSIS*, *Stoliczka*, p. 70. From Odium, regular grown specimen.
- Fig. 5. " " " " Large specimen from Coonum, shewing the depressed middle of the back with some irregularity in the ribs.
- Fig. 6. " " " " A fragment taken from a specimen from Coonum, with marked irregularity of the ribs, while on the inner whorls of the same specimen they are quite regular; also to shew the position of the narrow dorsal saddles; 6.a. outlines of a septum.
- All from the *Ootatoor-group*. Geol. Surv. Collection.



A. W. Lawder Lith.

T. Oldham direct.

Calcutta.

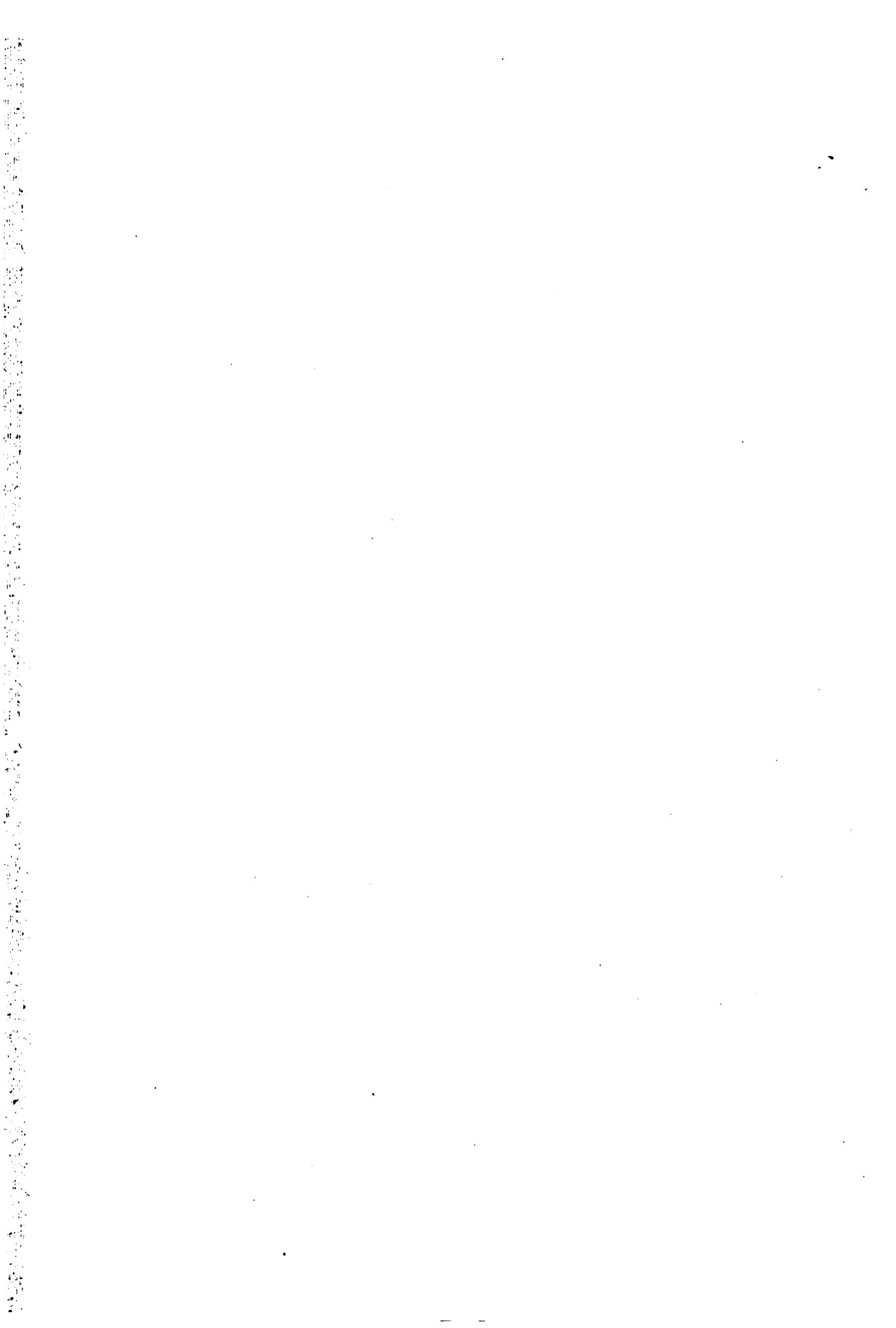
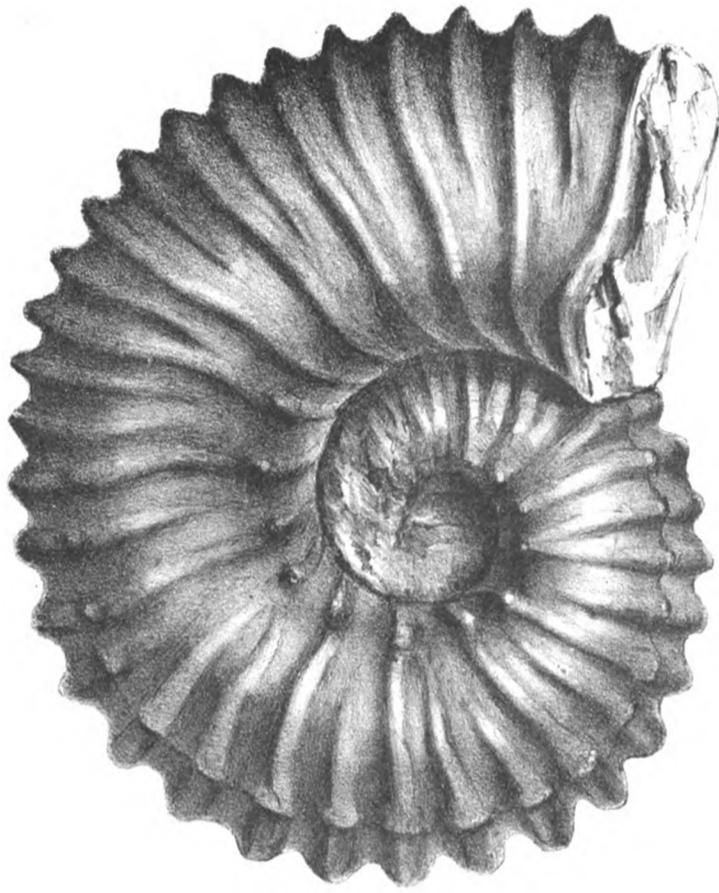




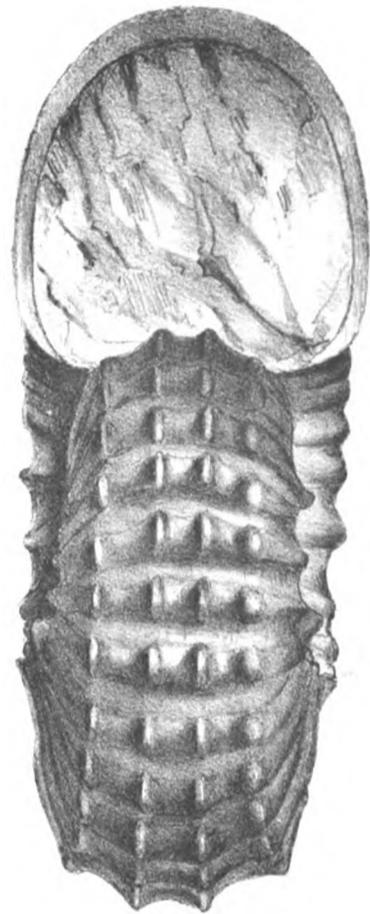
PLATE XXXVIII.

Fig. 1. *AMMONITES MORPHEUS*, *Stoliczka*, p. 80, Fig. 1. side, 1.a. front view; 1.b. outlines of a septum, from the same specimen, shewing the position relatively to the dorsal tubercles of the shell, in calcareous sandstone near Odium; *Ootatoor-group*; Geol. Surv. Collection.

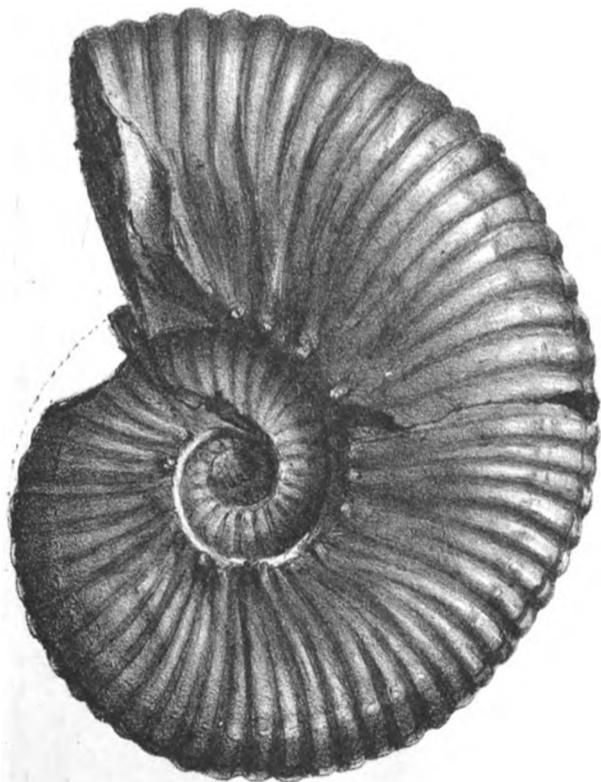
Fig. 2. *AMMONITES HARPA*X, *Stoliczka*, p. 72, side and front view of a compressed variety, in calcareous sandstone near Odium, *Ootatoor-group*, Geol. Surv. Collection.



1.



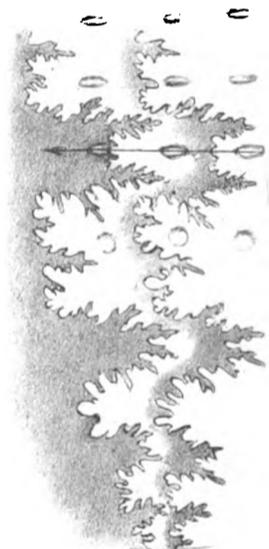
1 a.



2.



2 a.



1 b.

H. S. Frazer Lith.

T. Oldham direct.

Calcutta



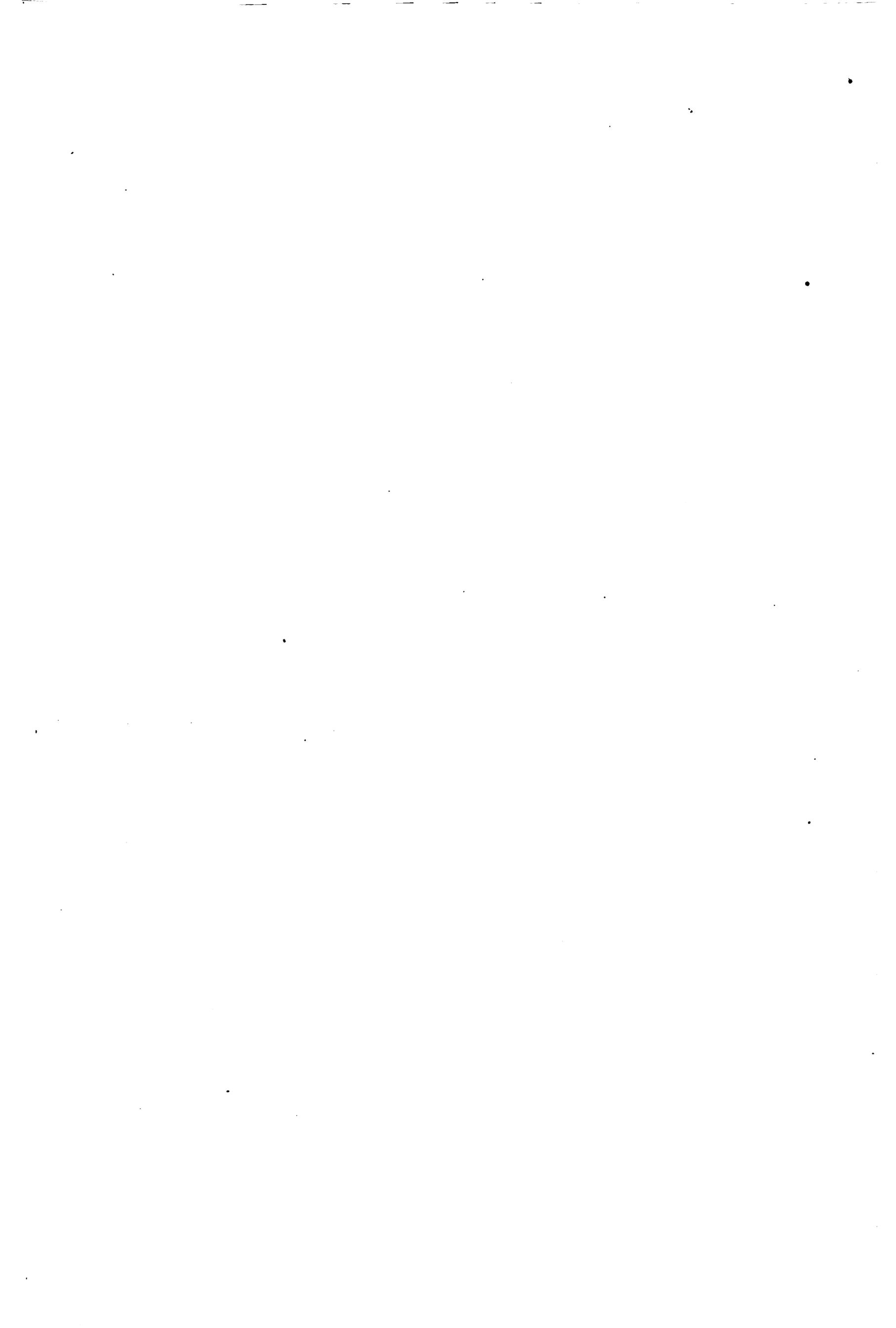
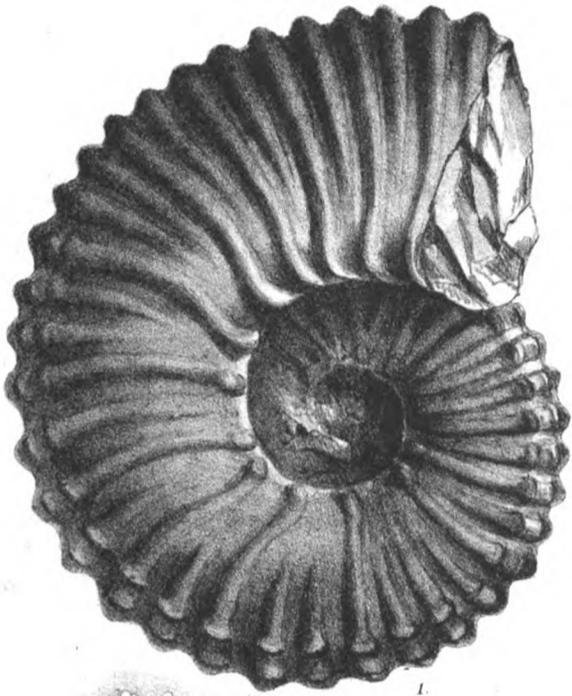


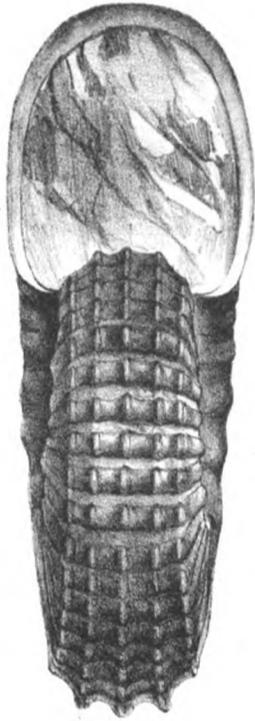
PLATE XXXIX.

- Fig. 1. *AMMONITES HARPA*X, *Stoliczka*, p. 72, Fig. 1. side, 1.a. front view, 1.b. outline of a septum; in a limy sandstone W. of Odium, near Moraviatoor; *Ootatoor-group*; Geol. Surv. Collection.
- Fig. 2. *AMMONITES NAVICULARIS*, *Mantell*, p. 73, 2. side, 2.a. front view, 2.b. outlines of a septum from the same; Odium.
- Fig. 3. " " " side view of a large specimen with very strong ribs; from the gritty sandstones near Odium.
- Fig. 4. " " " outline of a septum of a large specimen from the calcareous sandstone W. of Odium, near to Moraviatoor.

All belong to the *Ootatoor-group*, in the Geol. Surv. Collection.



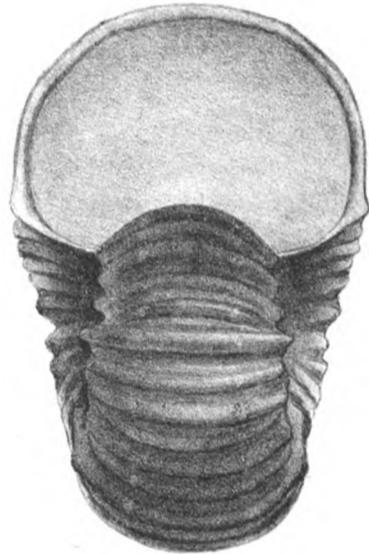
1.



1 a.



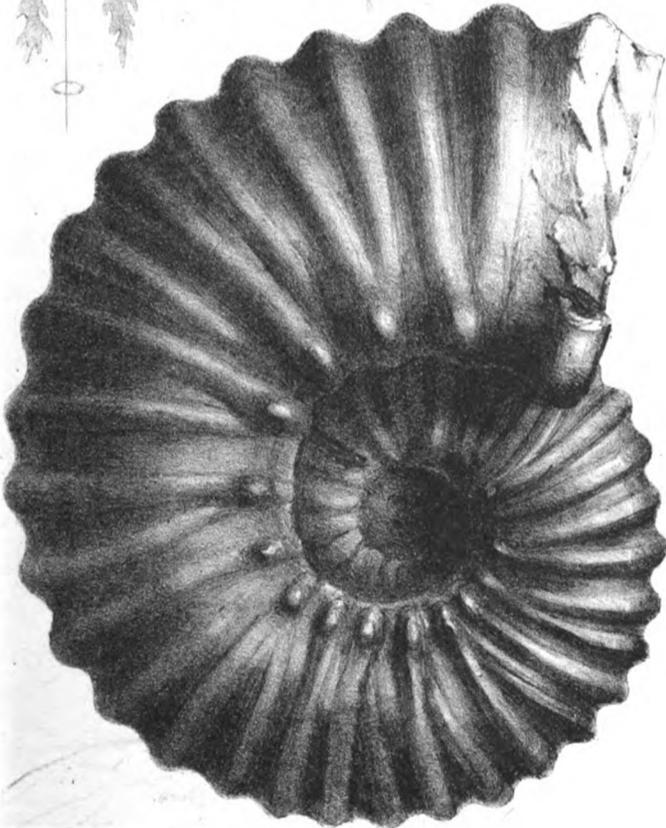
1 b.



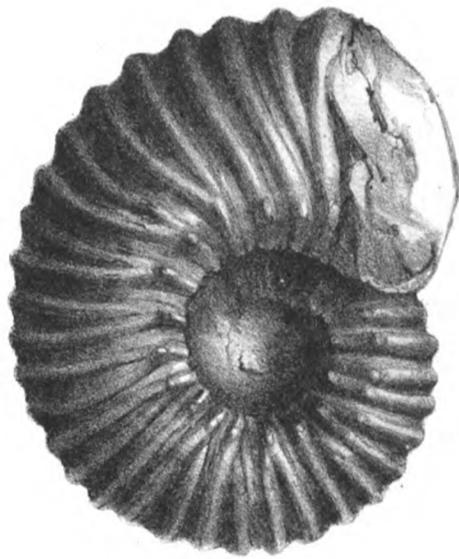
2 a.



2 b.



3.

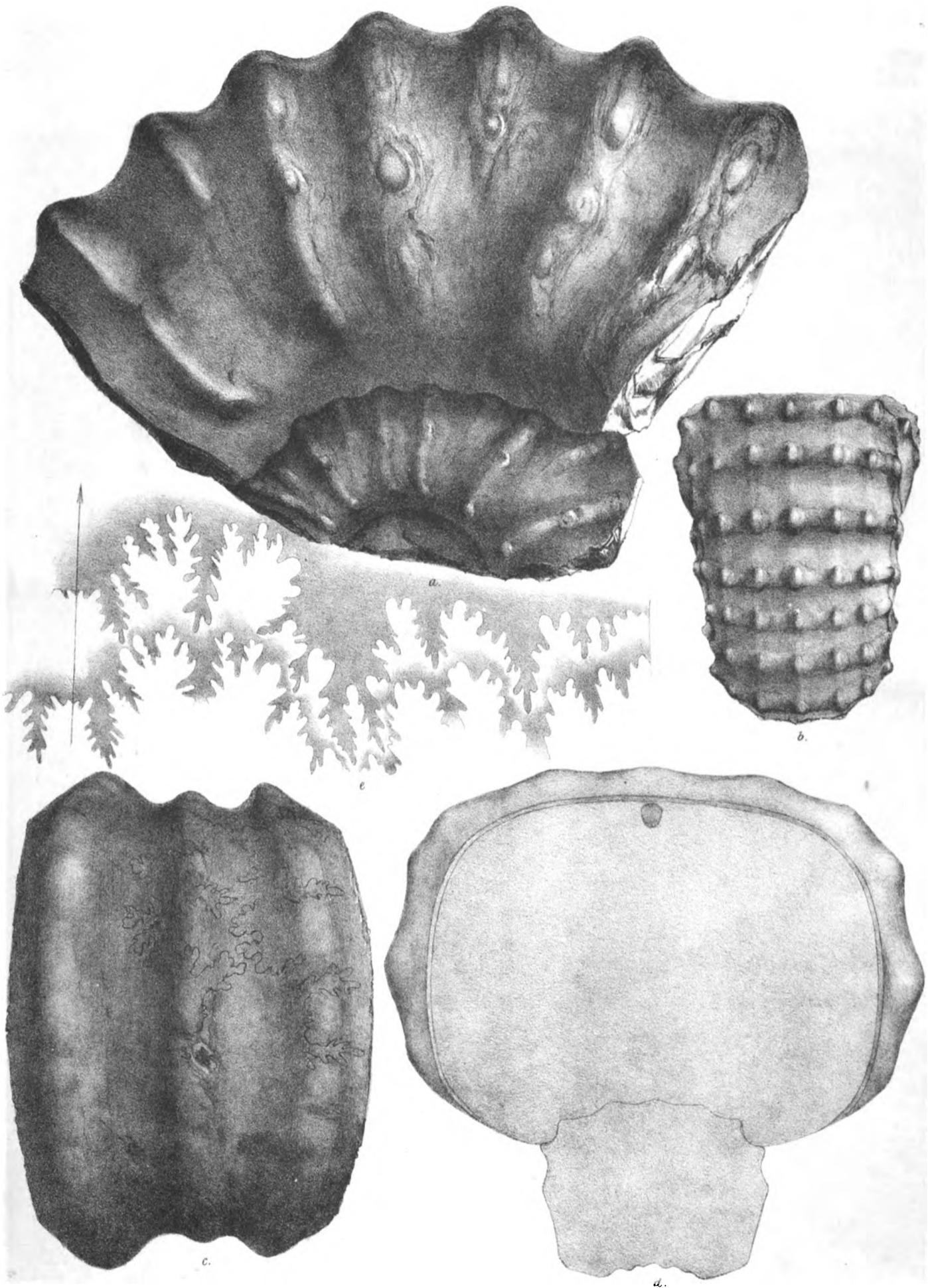


2



PLATE XL.

AMMONITES ORNATISSIMUS, *Stoliczka*, p. 75, side view of a fragment of two whorls; *b*, back view of the inner, and *c*, back view of a portion of the outer, whorl to show the gradual changes in the ornamentation; *d*, view of the section of *a*; *e*, sutures of a septum, obtained by having filed off the surface of the shell. Odium; *Ootator* group; Geol. Surv. Collection.



H.L. Frazer Lith.

T. Oldham direct.

Calcutta



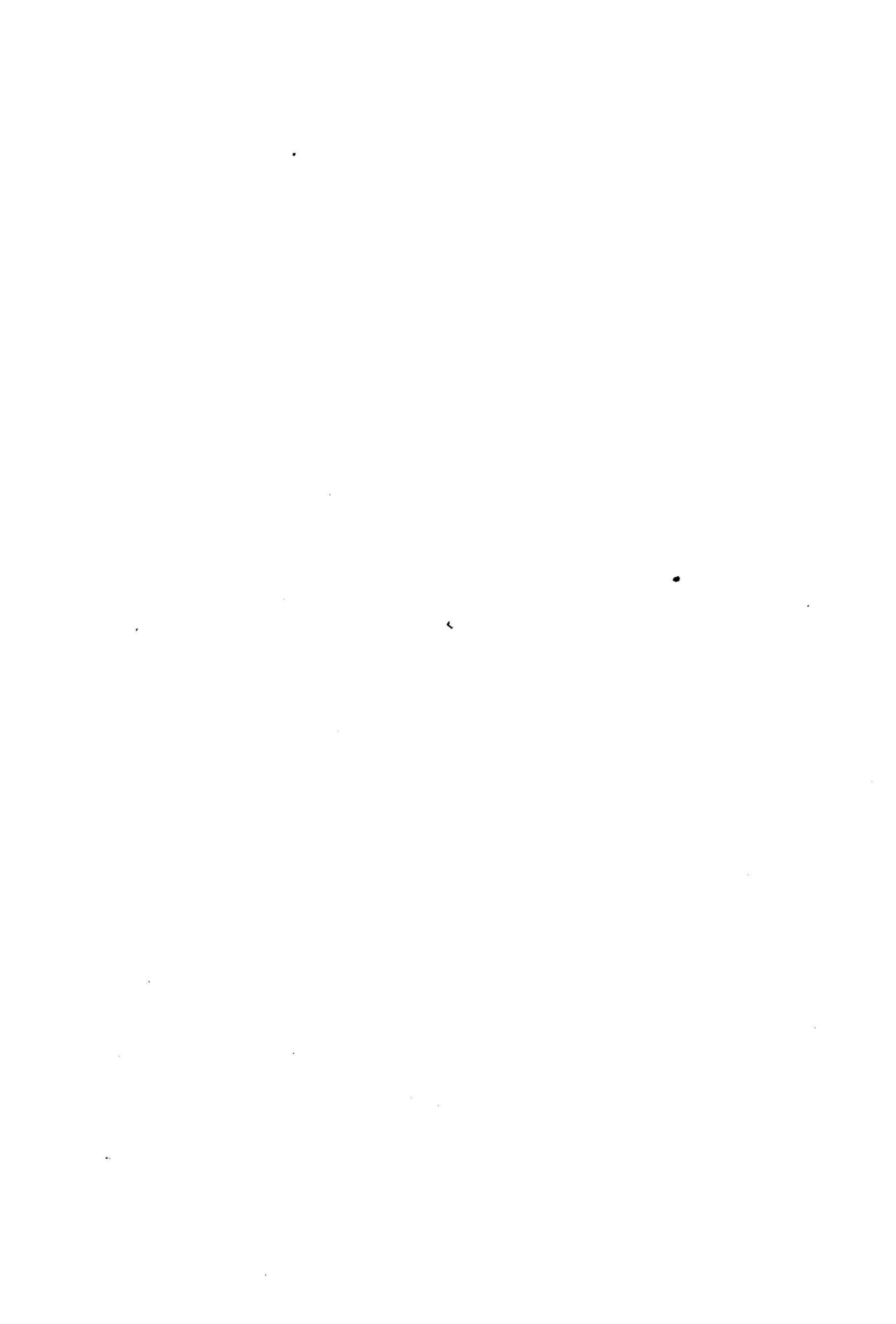
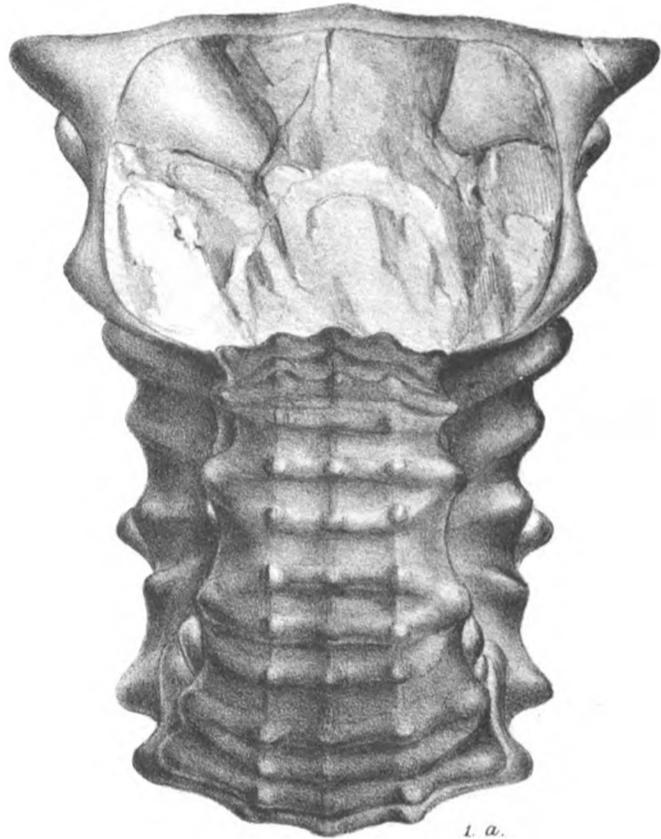


PLATE XII.

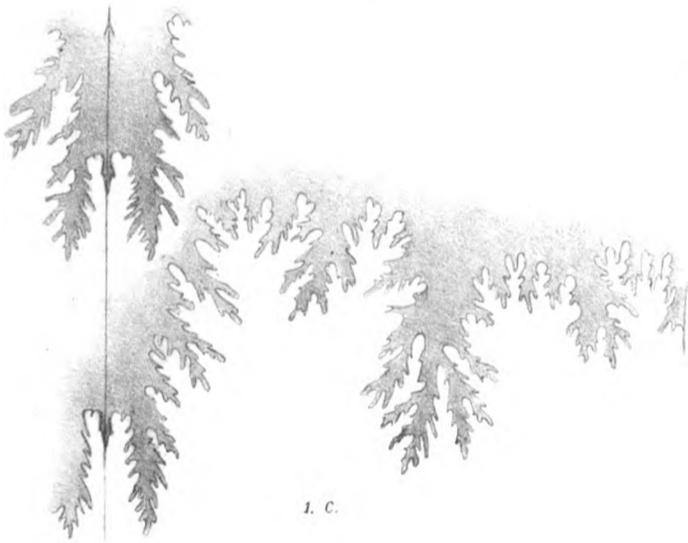
- Fig. 1. *AMMONITES MERIDIONALIS*, *Stoliczka*, p. 76, 1, and 1*a*, side and front view; 1*b*, back view of a portion of the outer whorl; 1*c*, sutures of the same specimen. Odium, *Ootatoor group*, Geol. Surv. Coll.
- Fig. 2. *AMMONITES MANTELLI*, *Sowerby*, p. 81, very young specimen with distinct tubercles and no intermediate ribs.
- Fig. 3. " " " " " a very regular form, with the air-chambers only, in Fig. 3*b*, the small circles along the dorsal saddle signify the tubercles on the edge of the back of the same specimen, the peripheral line is the suture of the umbilicus. All specimens from Odium; *Ootatoor group*: Geol. Surv. Coll.



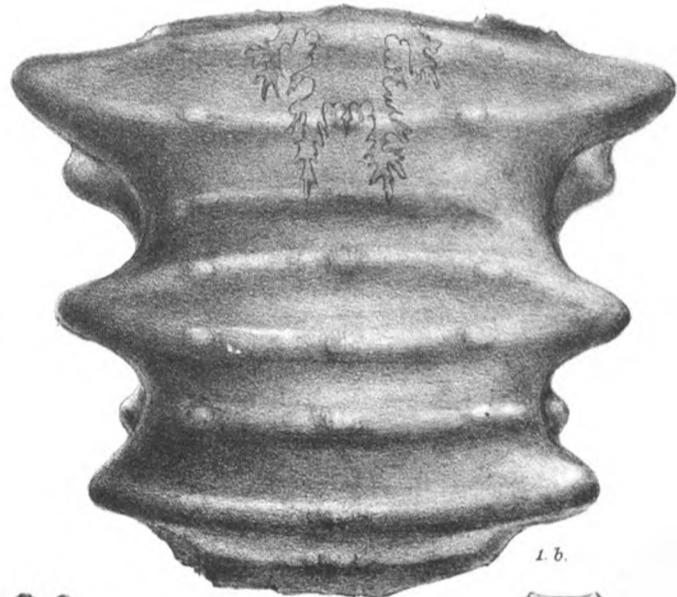
1



1 a.



1 c.



1 b.



2



2 b



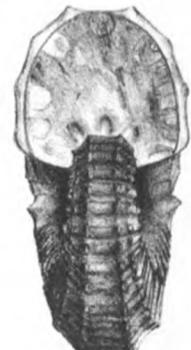
2 a.



3



3 b.



3 a.

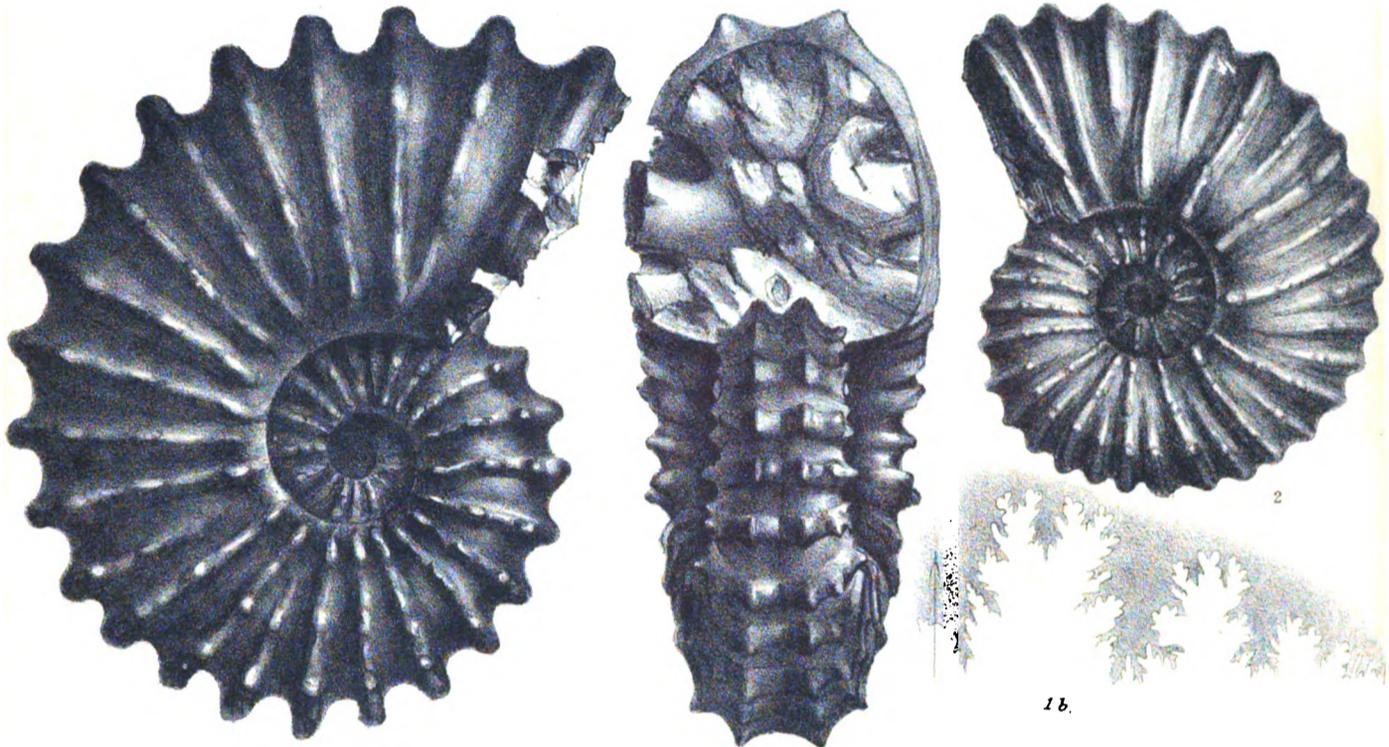
H.L. Frazer Lith.

T. Oldham direx^t

Calcutta.

PLATE XLII.

- Fig. 1. AMMONITES MANTELLI, *Sowerby*, p. 81, specimen with sharp tubercles and rapid increase of the whorls in height and thickness.
- Fig. 2. „ „ „ side view of a specimen, mostly like the European forms found in France and Germany.
- Fig. 3. „ „ „ a rather compressed variety, nearly complete, the largest specimen in the Indian collection. All specimens from Odium : *Ootatoor group* ; Geol. Surv. Collection.

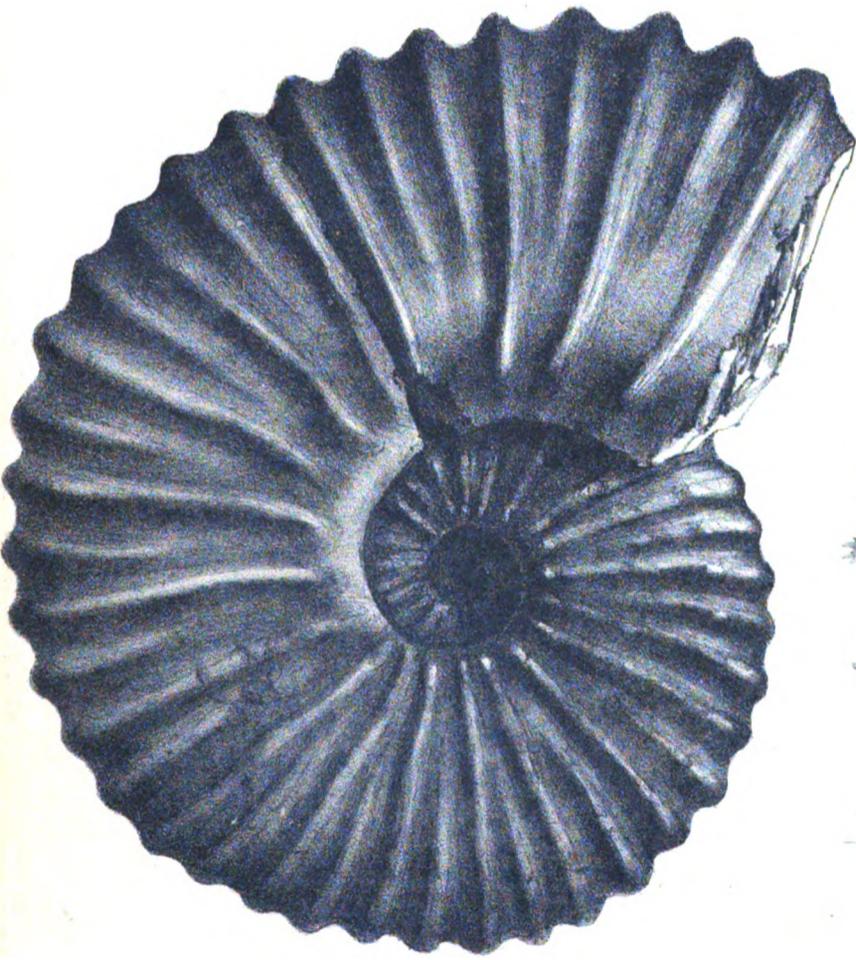


1.

1 a.

1 b.

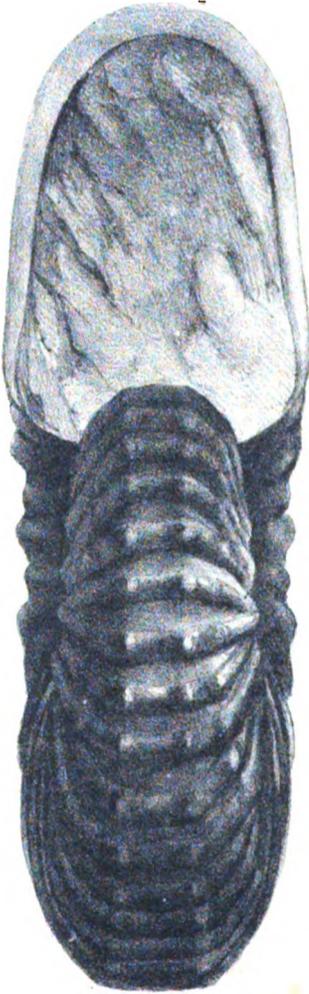
2



3.



3 b.



3 a.

H. L. Frazer Lith.

T. Oldham direx^t

Calcutta

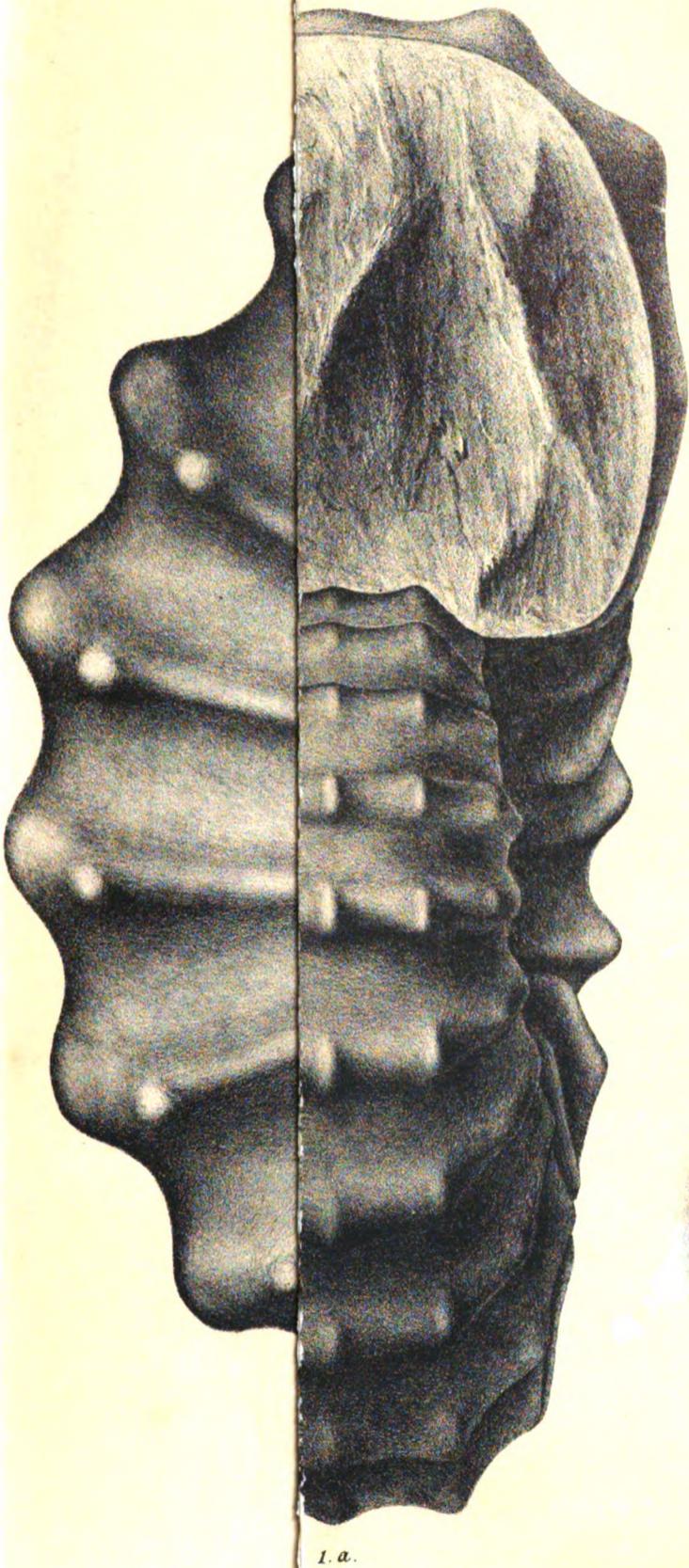




PLATE XLIII.

Fig. 1. AMMONITES MEDLICOTTIANUS, *Stoliczka*, p. 77, large specimen, natural size, 1 and 1a, side and front view; 1b, sutures of a septum, the dotted line signifying the edge, and the continued line on the periphery the suture of the umbilicus. Odium; *Ootatoor group*; Geol. Surv. Collection.

Fig. 2, AMMONITES TROPICUS, *Stoliczka*, p. 78, 2, and 2a, side and front view; 2b, suture of a septum, three times enlarged; from Odium: *Ootatoor group*; the only specimen in the Geol. Surv. Collection.



1. a.



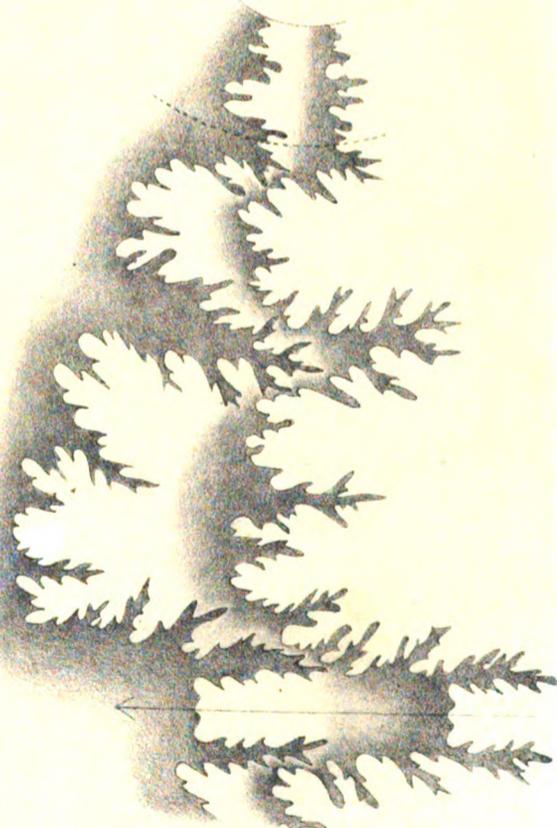
2. b. 4/3



2.



2. a.



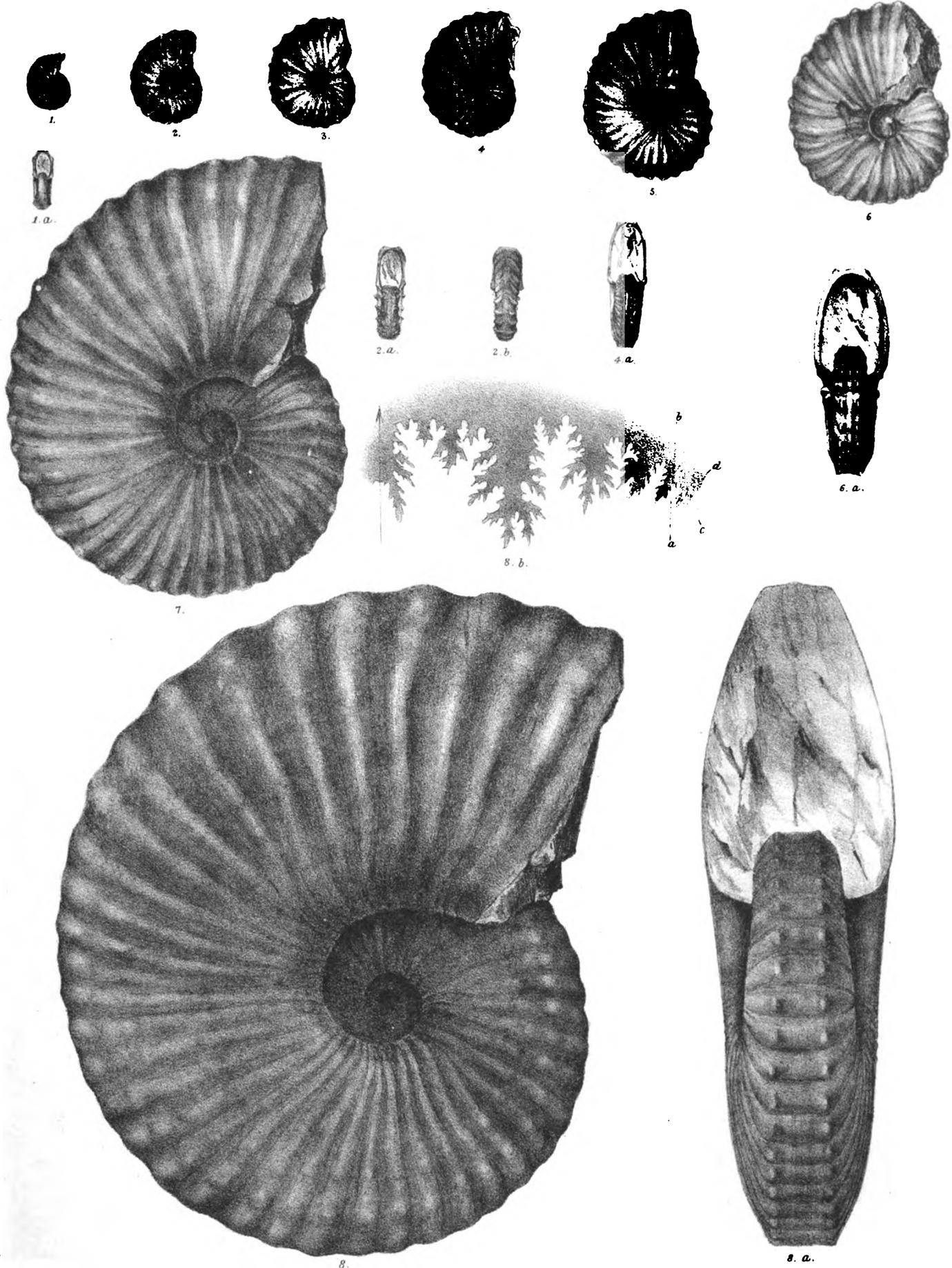
1. b.



PLATE XLIV.

- Fig. 1. *AMMONITES VICINALIS*, *Stoliczka*, p. 84. A very young specimen, partly shewing the smooth embryonal whorls.
- Fig. 2. „ „ 2. 2.a. 2.b. Side, front, and back views shewing the rare occurrence of ribs united without any remarkable tubercles.
- Fig. 3. „ „ A specimen a little larger in size.
- Fig. 4. „ „ 4. 4.a. Side and front views of a numerously ribbed young shell, on which the ribs die out on the edge of the back.
- Fig. 5. „ „ A larger specimen of same variety.
- Fig. 6. „ „ A more inflate variety.
- Fig. 7. „ „ A large specimen with air-chambers only.
- Fig. 8. „ „ 8. 8.a. A specimen with body chamber, the largest specimen (excepting fragments) in the collection: the tubercles on the ribs become gradually obsolete towards the mouth. 8.b. Sutures of the same specimen, the dotted line *ab* marking the edge, and the continuous line *cd* the suture, of the umbilicus.

All specimens from Odium: *Ootatoor group*. Geol. Surv. Collection.



H. L. Frazer Lith.

T. Oldham direx.

Calcutta.

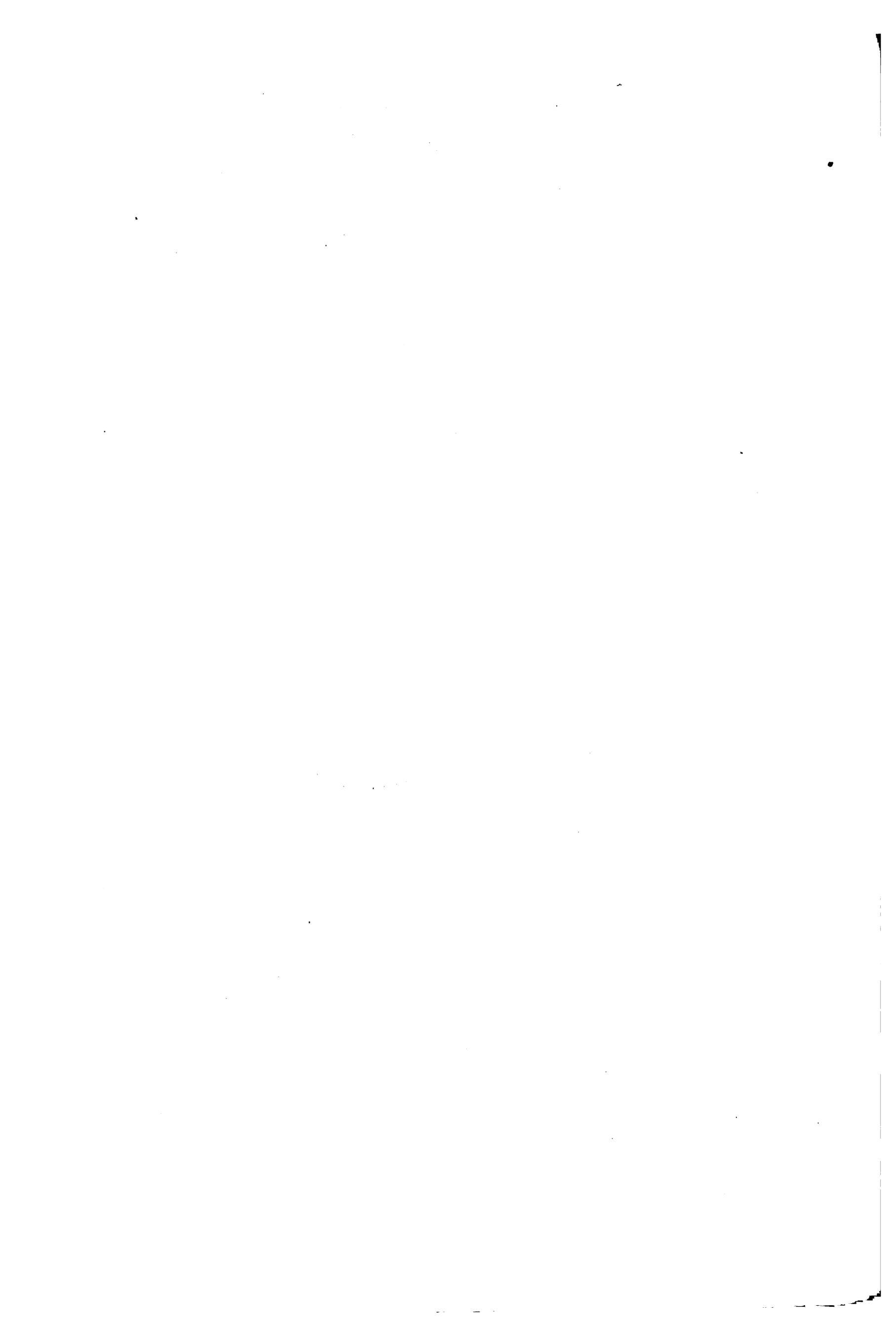
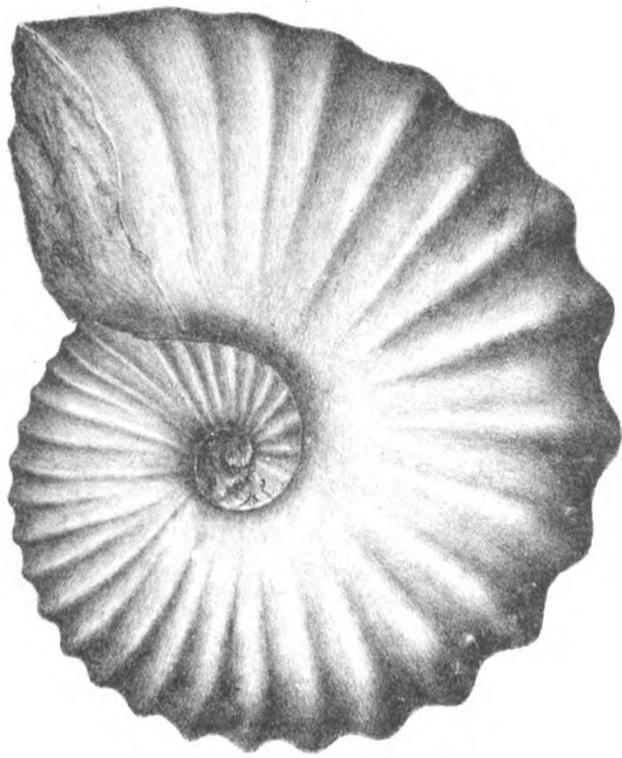




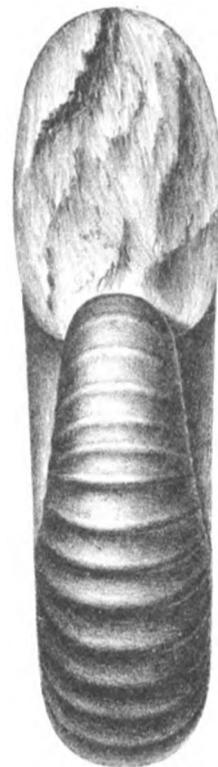
PLATE XLV.

- Fig. 1. AMMONITES DISPAR, *D'Orbigny*, p. 85. A perfect and full-grown specimen, *i.e.* the sutures of two septa very close together, being taken near the body-chamber.
- Fig. 2. „ „ An inflate variety.
- Fig. 3. „ „ Front view of the inner whorls of a large specimen, like Fig. 1. to shew the tubercles on the edge of the back in the first stage of growth.

All from Moravia: *Ootator* group. Geol. Surv. Collection.



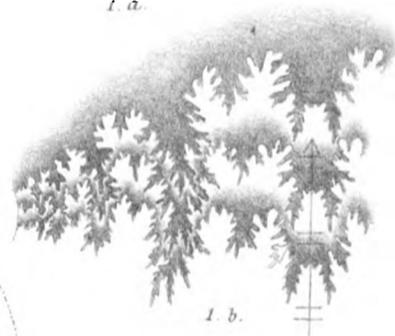
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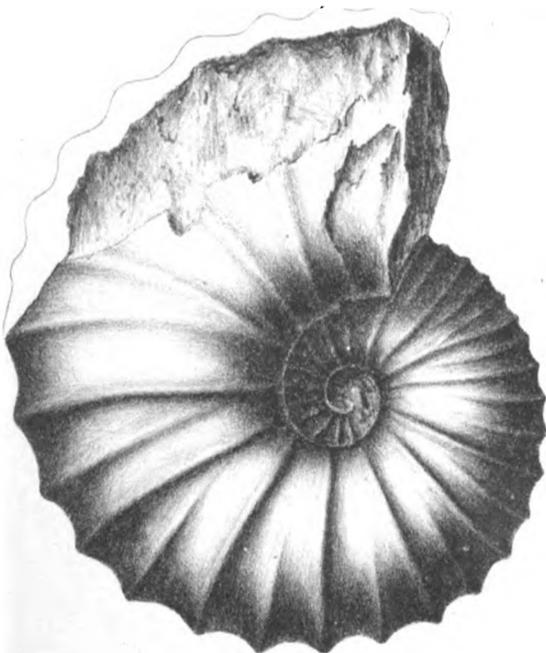
1. a.



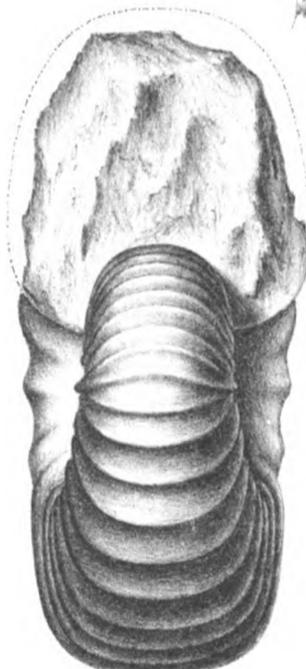
2. b.



1. b.



2.



2. a.



3.

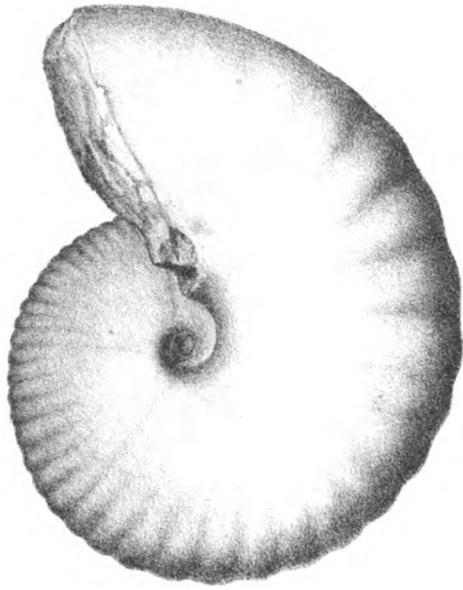
A W. Lawder Lith.

T. Oldham direx^t

Calcutta.

PLATE XLVI.

- Fig. 1. AMMONITES ARGONAUTIFORMIS, *Stoliczka*, p. 87. A complete specimen, Fig. 1.*b.* sutures of a septum, the line $a\beta$ signifying the suture, and $\gamma\delta$ the edge of the umbilicus.
- Fig. 2. „ „ Side and front views of the inner whorls of another specimen. Moraviatoor: *Ootatoor group*. Geol. Surv. Collection.
- Fig. 3. AMMONITES CROTALOIDES, *Stoliczka*, p. 88. Side, front and back views, 3.*b.* shews the gradual change from an angular to a roundish form of the back: 3.*c.* the sutures of a septum, $a\beta$ being the suture and $\gamma\delta$ the edge of the umbilicus. From Moraviatoor: *Ootatoor group*. Geol. Surv. Collection.



1.



1. a.



2. a.



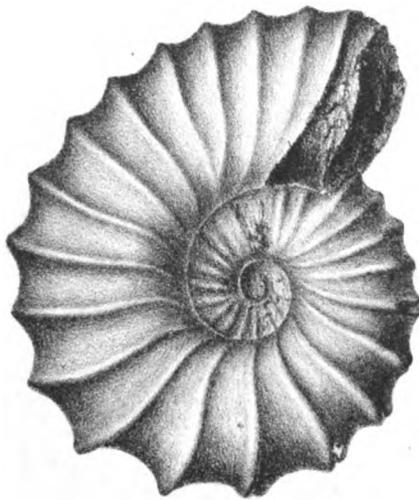
1. b.



3. c.



2.



3.



3. a.



3. b.



PLATE XLVII.

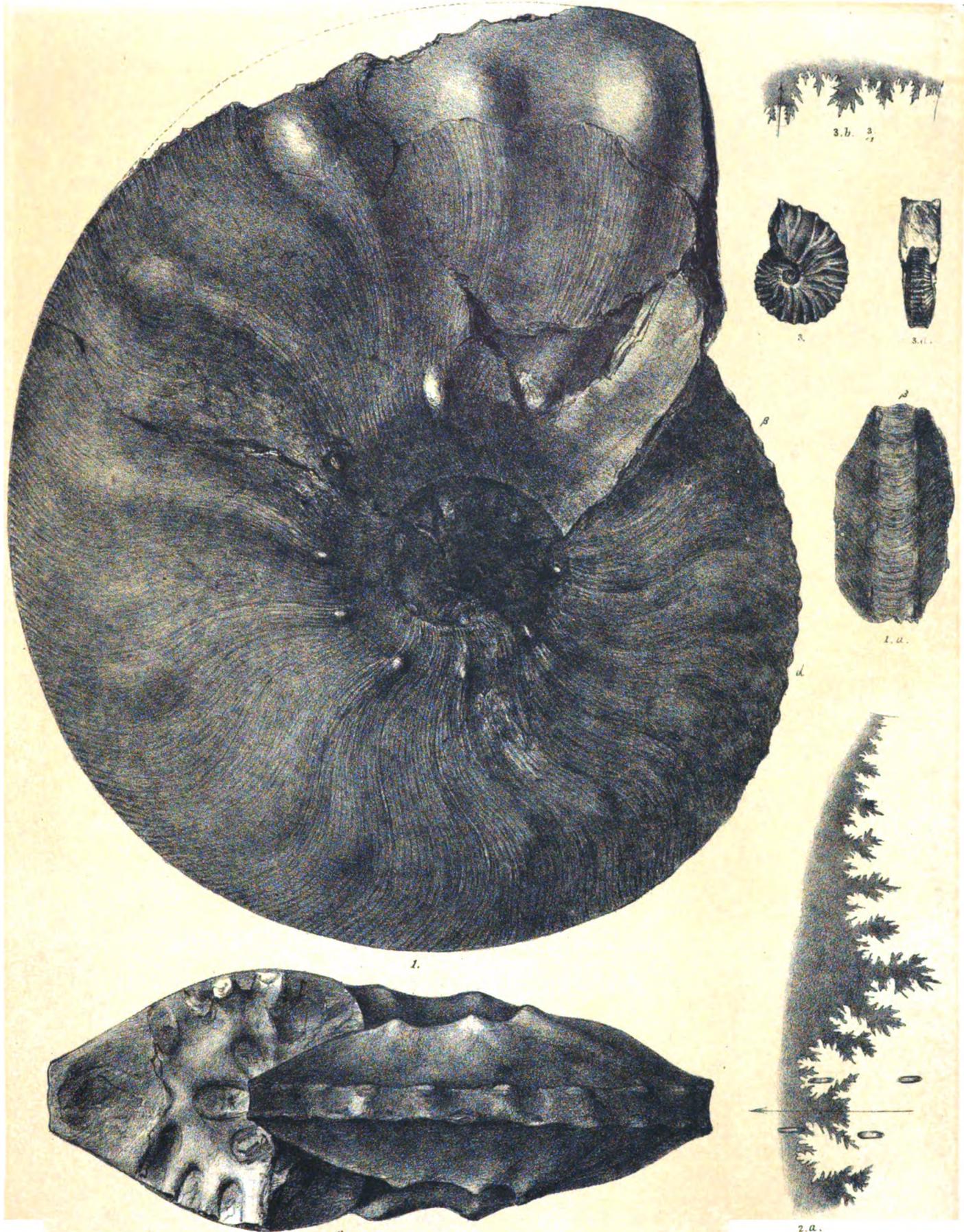
Fig. 1. AMMONITES GUADALOUPE, *Roemer*, p. 90. Side view of a nearly perfect specimen with shell preserved: 1.a. A portion of the front view, to shew the alternation of the ribs, and the direction of the striæ of growth.

Fig. 2. . . „ . . . „ p. 90. Front view of a young thick specimen, a cast: 2.a. suture of a septum of the same.

Both specimens from near Anapaudy, *Trichinopoly group*. Geol. Surv. Collection.

Fig. 3. AMMONITES ANDOORENSIS, *Stoliczka*, p. 93. Side and front views and sutures of the same specimen, drawn three times the natural size.

From Andoor: *Trichinopoly group*. Geol. Surv. Collection.



H.L. Frazer Lith.

T. Clānam direx'

Calcutta

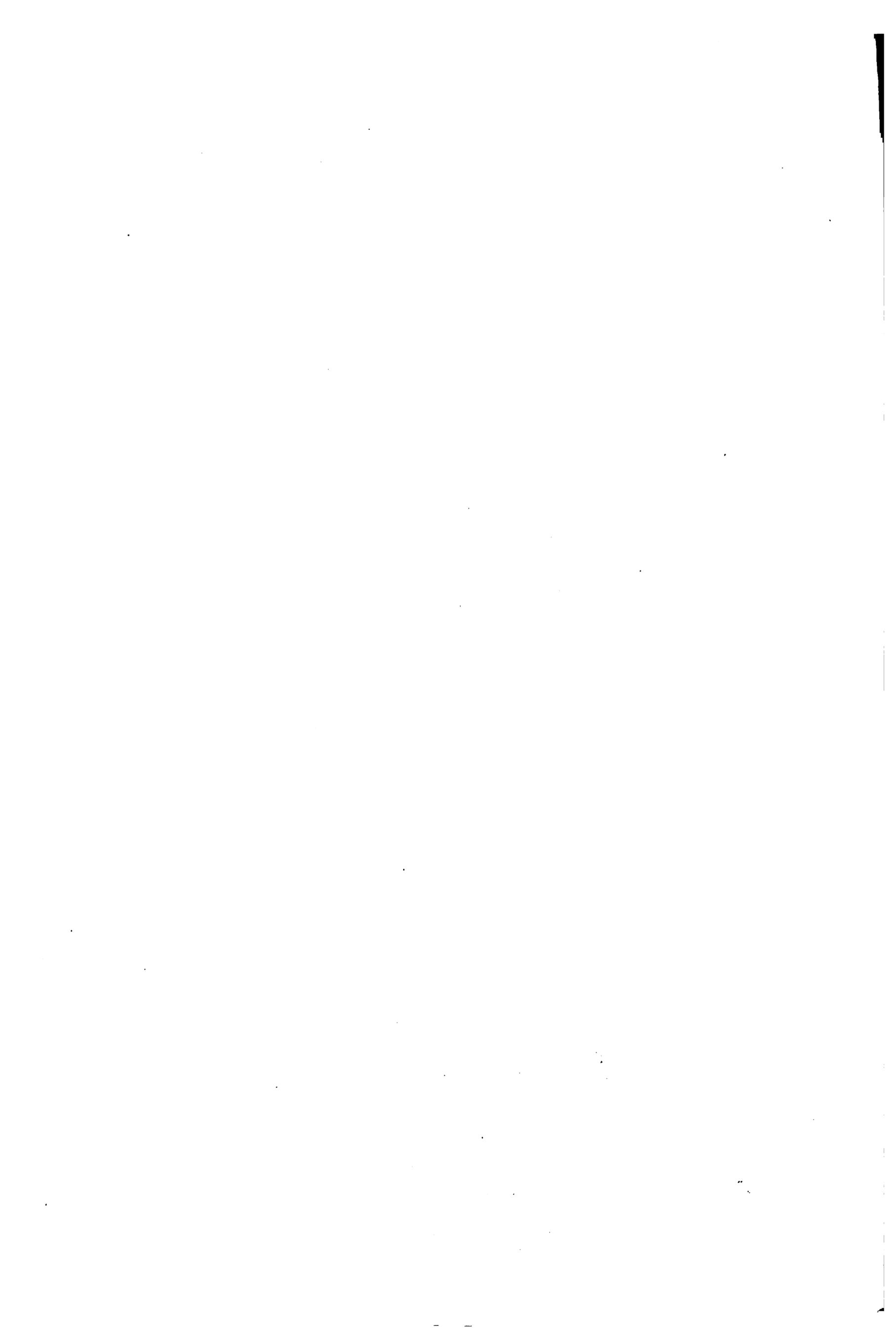


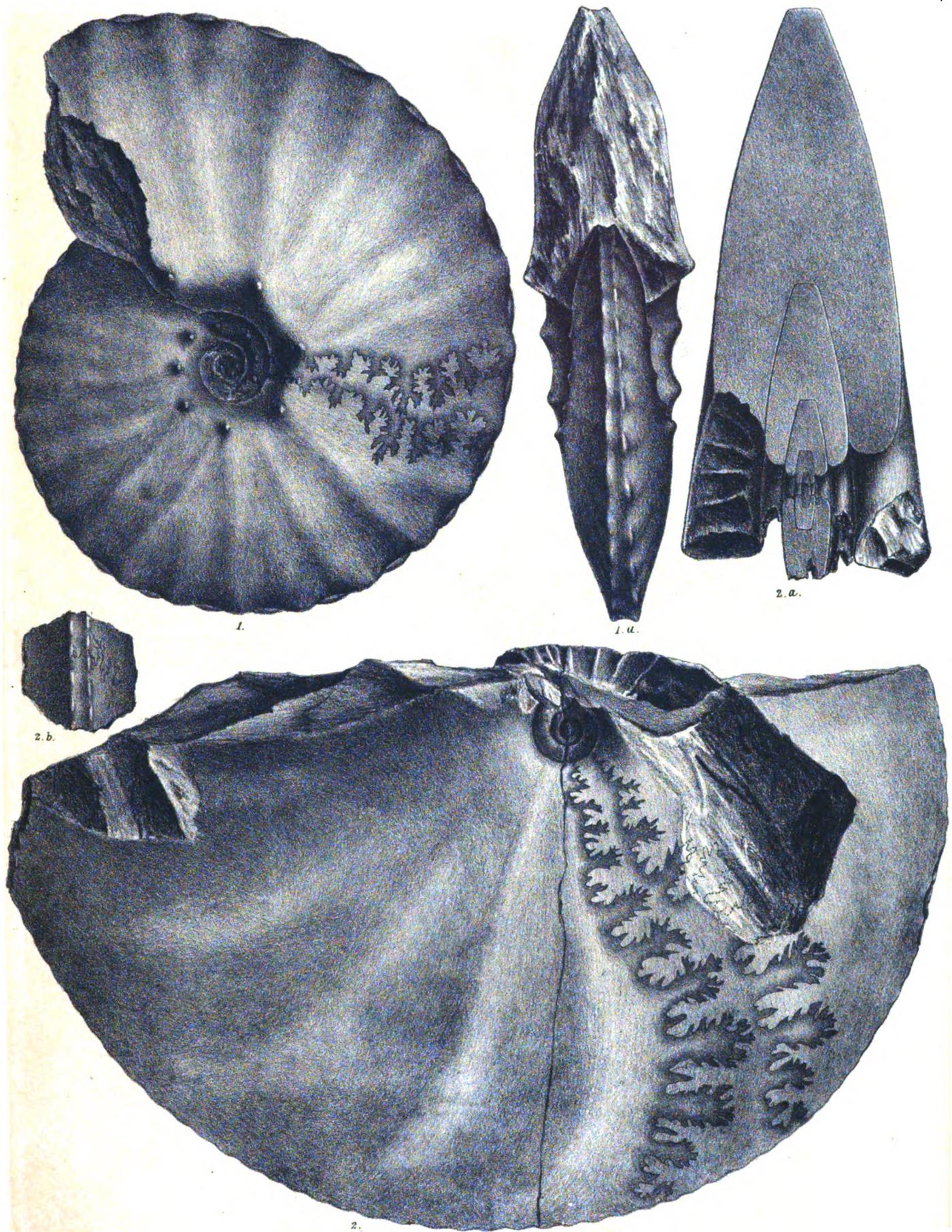


PLATE XLVIII.

Fig. 1. AMMONITES GUADALOUPE, *Roemer*, p. 90. Side and front view shewing also the complete sutures of a septum; a very much compressed variety, from north of Serdamungalum, on the boundary of the *Trichinopoly* and *Arrialoor* groups. Geol. Surv. Collection.

Fig. 2. AMMONITES ORBIGNYANUS, *Geinitz*, p. 92. Side view of a large fragment, being a cast with sutures visible; 2.a. the section of outer and inner whorls taken along the line $a\beta$ in Fig. 2; 2.b. a portion of the back view, shewing the alternation of the peripheral tubercles.

From Moraviatoor: *Ootatoor* group. Geol. Surv. Collection.



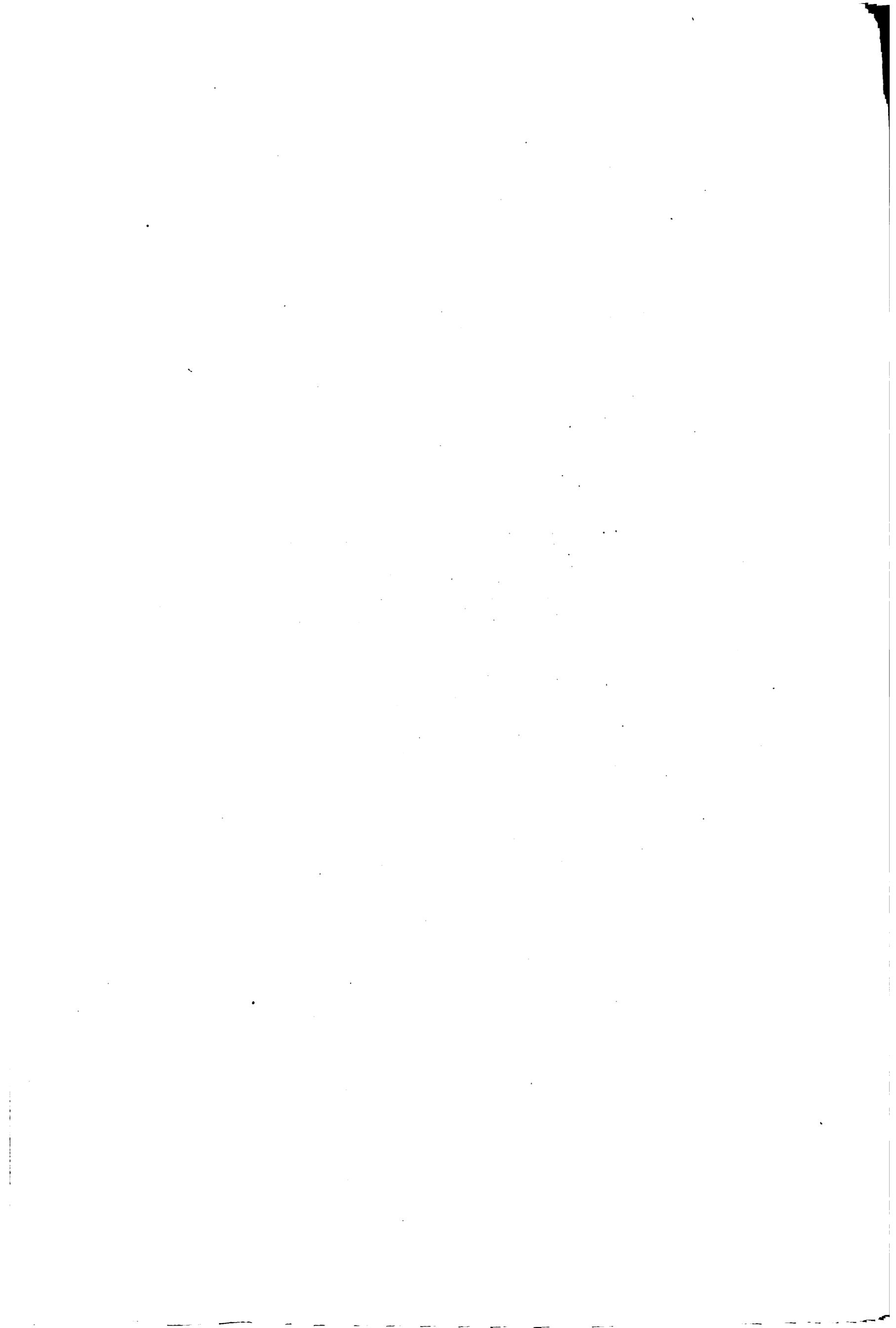


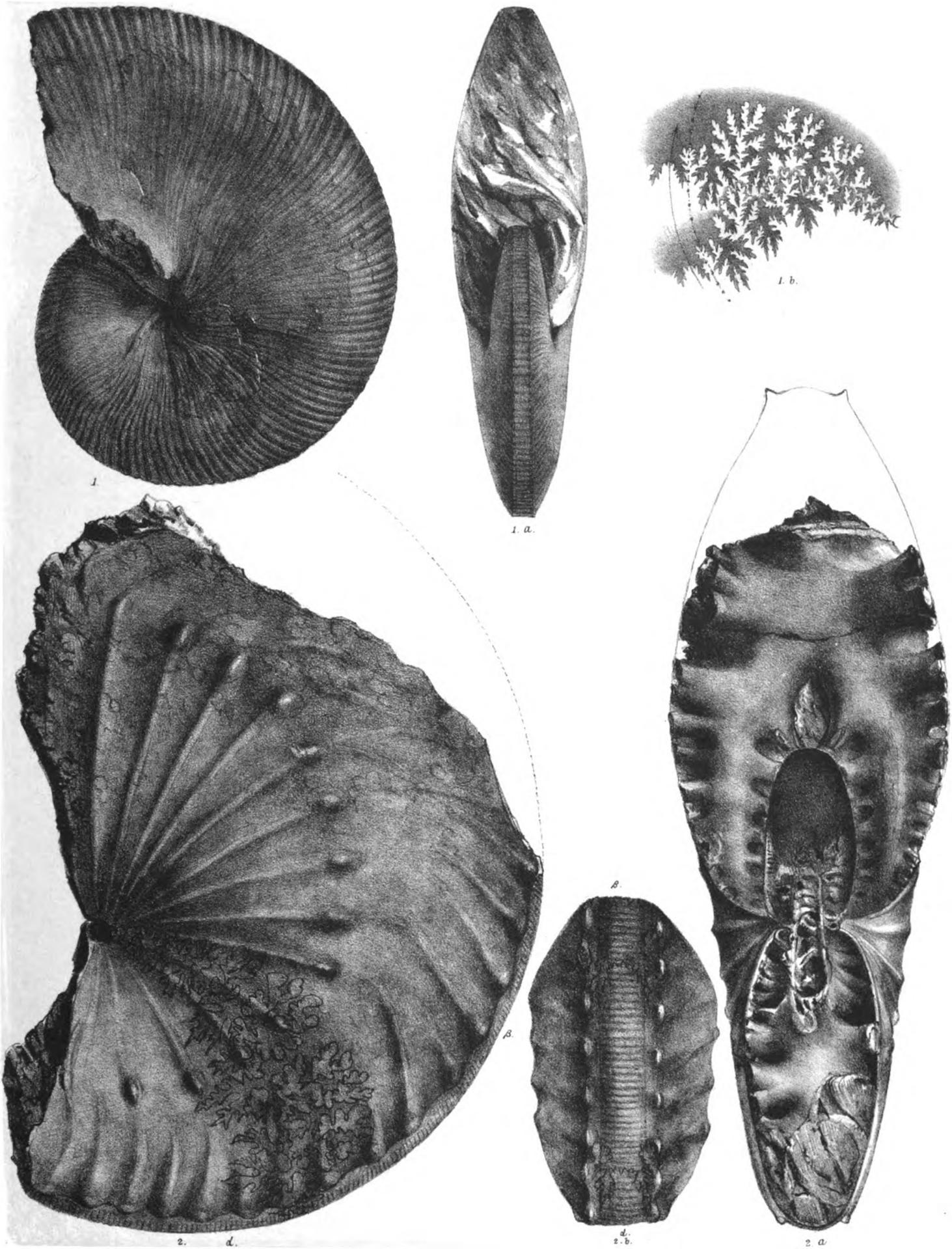


PLATE XLIX.

Fig. 1. AMMONITES LARGILLIERTIANUS, *D'Orbigny*, p. 94. Side and front views, and outline of a septum; the arrow to the left signifies the direction of the siphuncle, and the dotted line next to this the tubercles on the edge of the back. Odium: *Ootatoor* group. Geol. Surv. Collection.

Fig. 2. AMMONITES SUBOBTECTUS, *Stoliczka*, p. 96, 2. 2.a. Side and front views of a fragmentary specimen, a cast; 2.b. portion of the back shewing the numerous ribs, and at the same time the dorsal lobe and their distance each from the other.

Odium: *Ootatoor* group. Geol. Surv. Collection.



H. L. Frazer Lith.

T. Oldham direx^t

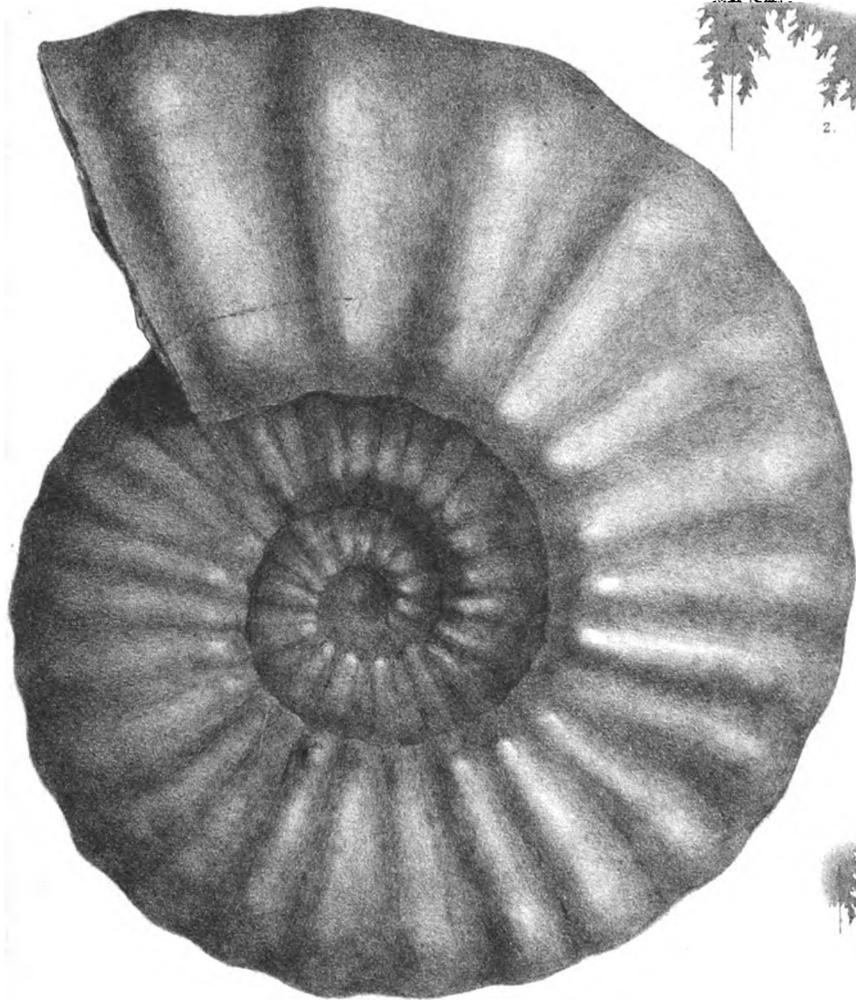
Calcutta





PLATE L.

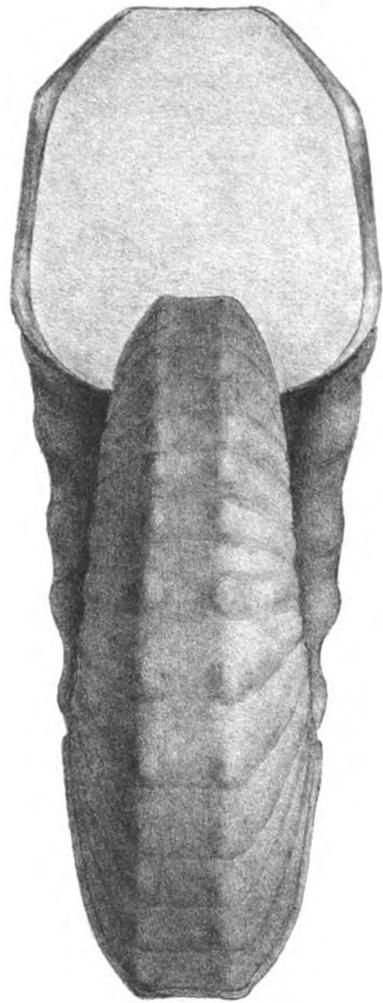
- Fig. 1. AMMONITES CRASSITESTA, *Stoliczka*, p. 98, 1. 1.a. Side and front views.
- Fig. 2. „ „ Outline of septum of another specimen; both from the neighbourhood of Odium. *Ootatoor group*. Geol. Surv. Collection.
- Fig. 3. AMMONITES CUNLIFFEI, *Forbes*, p. 97, 3. Side view, natural size: 3.a. 3.b. enlarged three times 3.c. outline of a septum, also enlarged three times.
From Pondicherry: *Valudayur group*; Madras Museum Collection.
- Fig. 4. AMMONITES CONCILIATUS, *Stoliczka*, p. 99, 4, 4.a. Views of the inner whorls of a large specimen with very strong umbilical tubercles, and some alternate ones on the back.
From neighbourhood of Odium: *Ootatoor group*. Geol. Surv. Collection.



1.



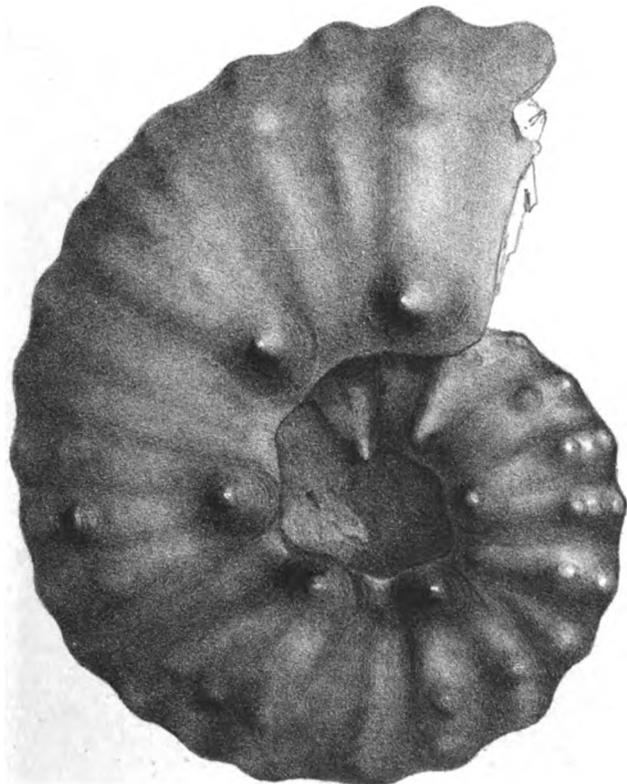
2.



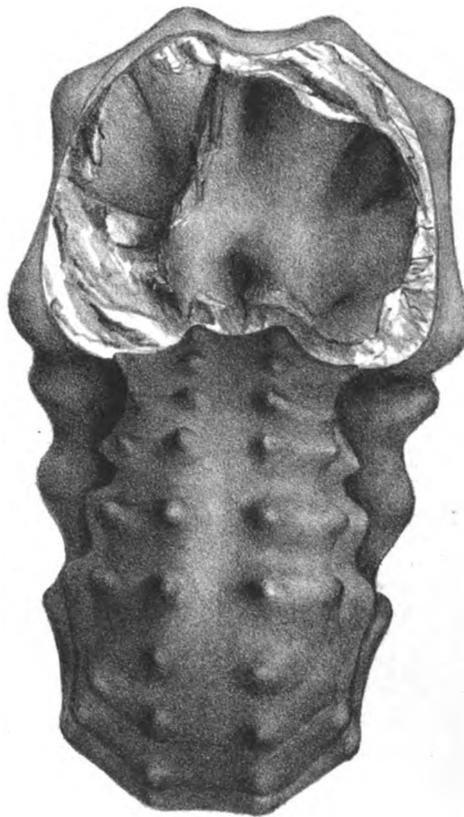
1. a.



3 c.



4.



4. a.



3. b.



3.



3. a.

H. L. Frazer Lith.

T. Oldham direct

Calcutta.



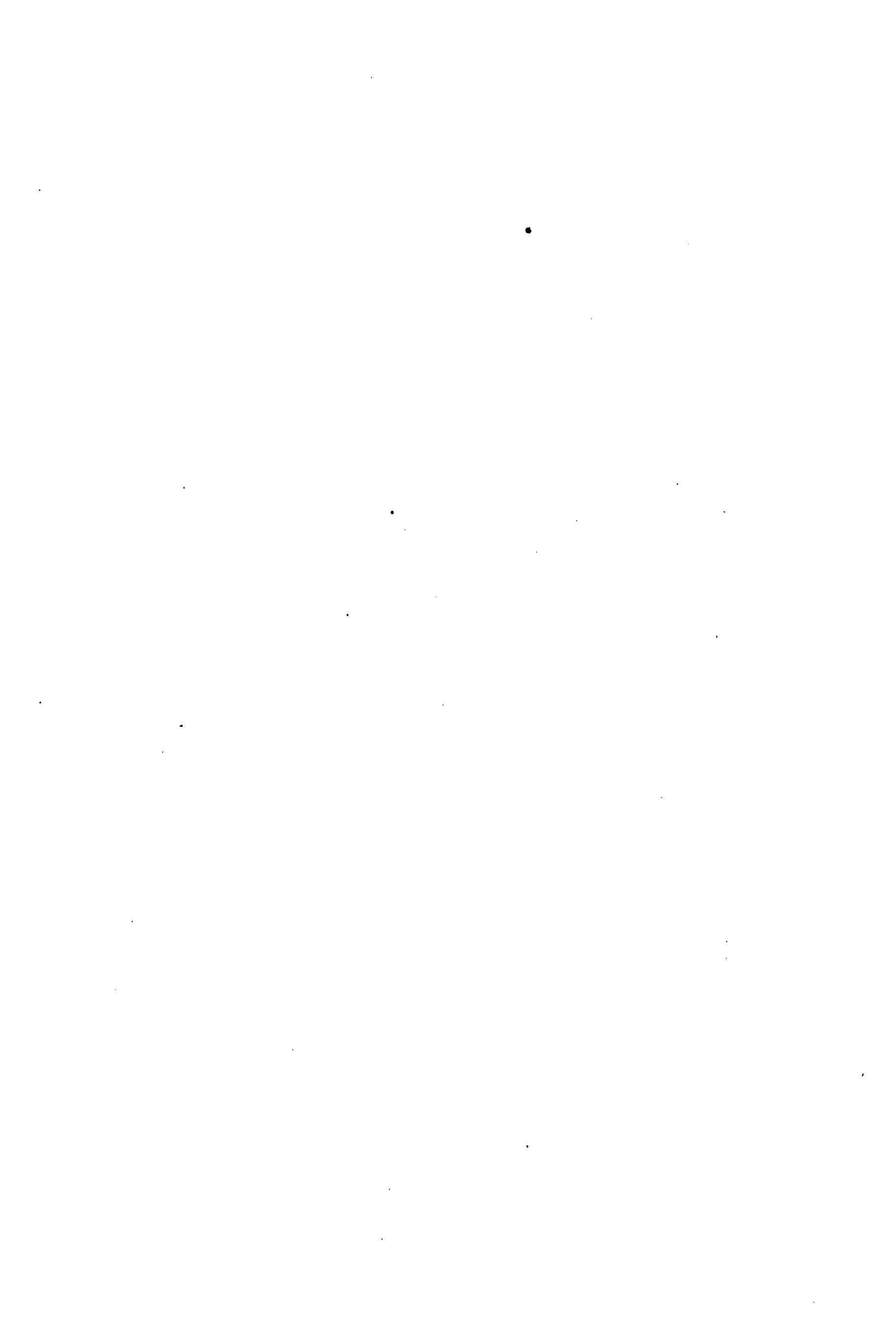


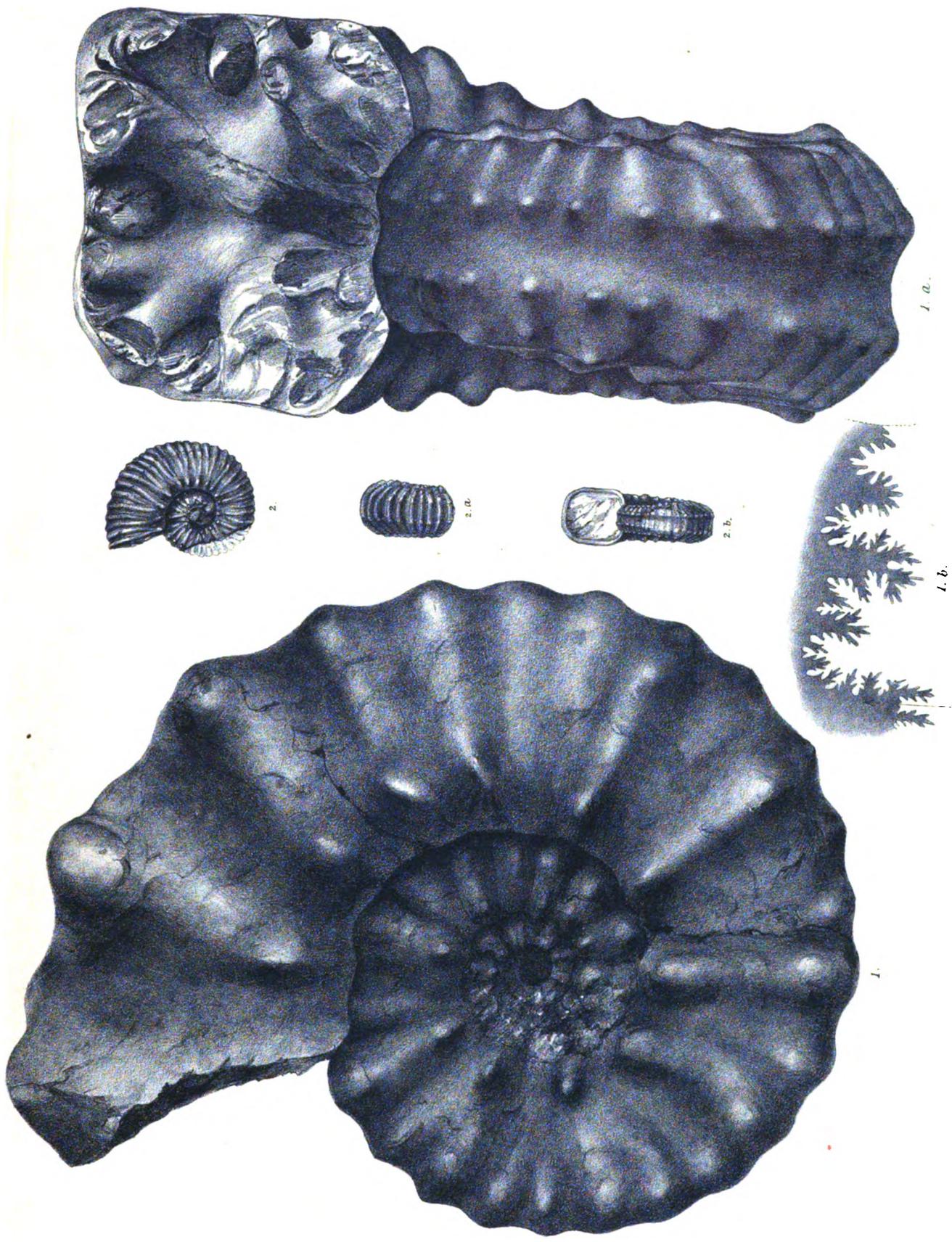
PLATE LI.

Fig. 1. AMMONITES CONCILIATUS, *Stoliczka*, p. 99, 1. 1.a. Side and front views of a large specimen, 1.a shews some irregularity in the position and size of the tubercles on the inner and outer whorls: 1.b. is the outline of a septum of the same specimen.

From Monglepaudy: *Ootatoor group*. Geol. Surv. Collection.

Fig. 2. AMMONITES USHAS, *Stoliczka*, p. 100, 2, 2.b. Side and front views, a break on one side in the shell being restored in outline: 2.a. view of a portion of the outer whorl to shew the gradual obliteration of the dorsal tubercles.

From Odium: *Ootatoor group*. Geol. Surv. Collection.



H. L. Frazer Lith.

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Calcutta

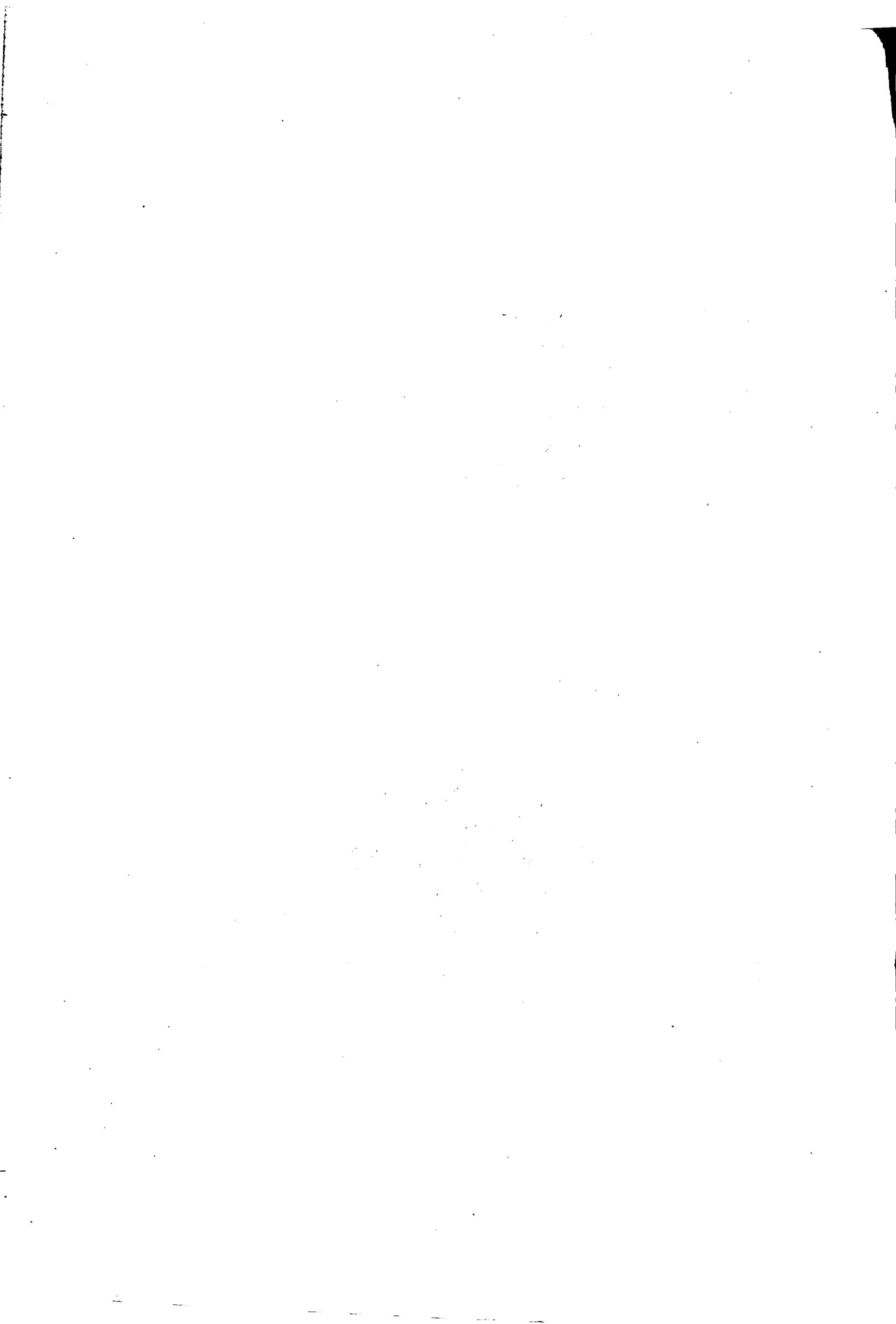




PLATE LII.

- Fig. 1. AMMONITES FOOTEANUS, *Stoliczka*, p. 101. Fig. 1. and 1*a.* side and front views, two-thirds of the natural size; 1*b.* front view of a few of the inner whorls, the larger specimen having been broken for the purpose and then cemented together again, 1*c.* outlines of a septum of the same specimen, the rings shewing the position of the tubercles to the lobes.
- Fig. 2. „ „ — 2. and 2*a.* side and front views of a part of a very large specimen.
Both specimens from N. of Odium; *Ootatoor group*, Geol. Surv. Collection.
- Fig. 3. AMMONITES MENU, *Forbes*, p. 103, 3. and 3*a.* side and front views of a small specimen; the dorsal tubercles not developed; 3*b.* thrice enlarged outline of a septum of the same; Anapandy; *Trichinopoly group*, Geol. Surv. Collection.
- Fig. 4. „ „ — 4. and 4*a.* side and front views of a complete specimen, the most perfect known; from Pondicherry; *Valudayur group*, Madras Museum Collection.

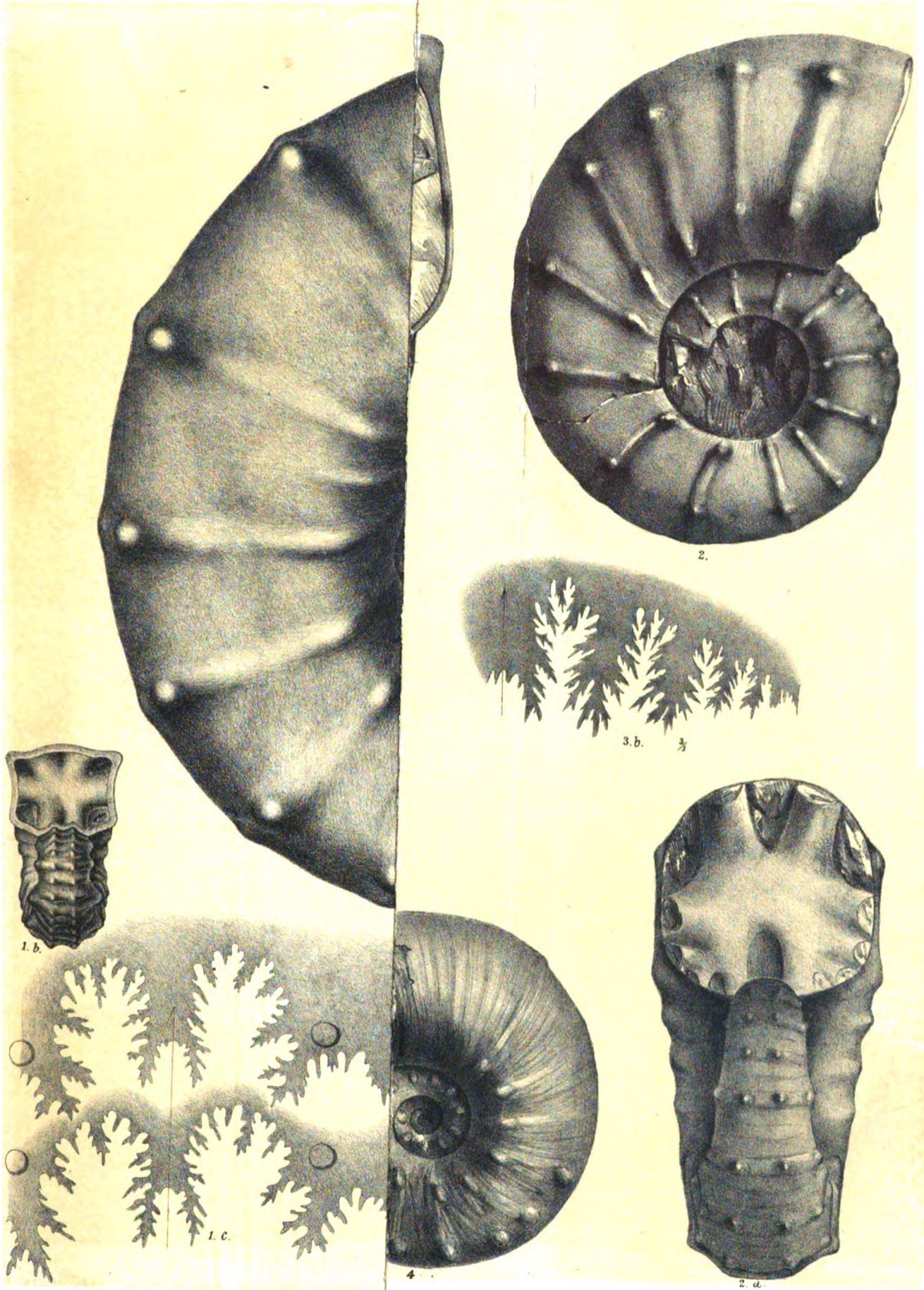
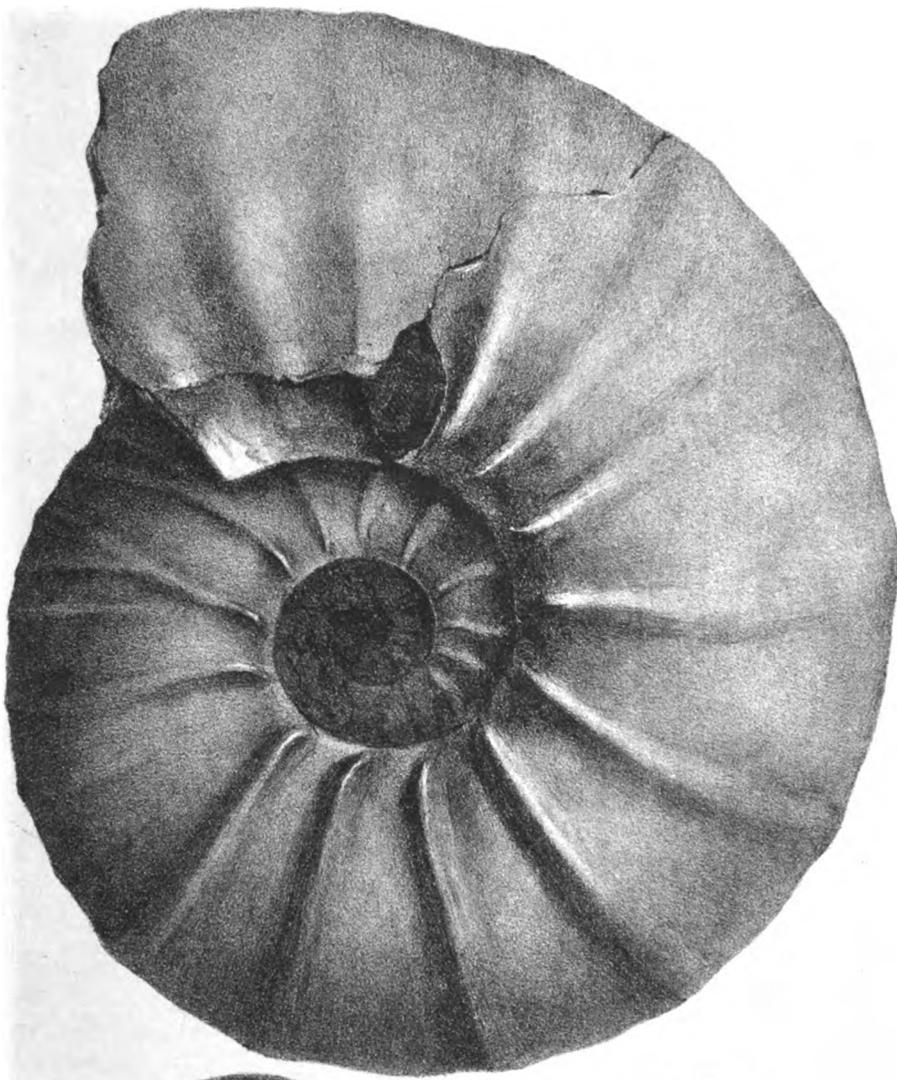




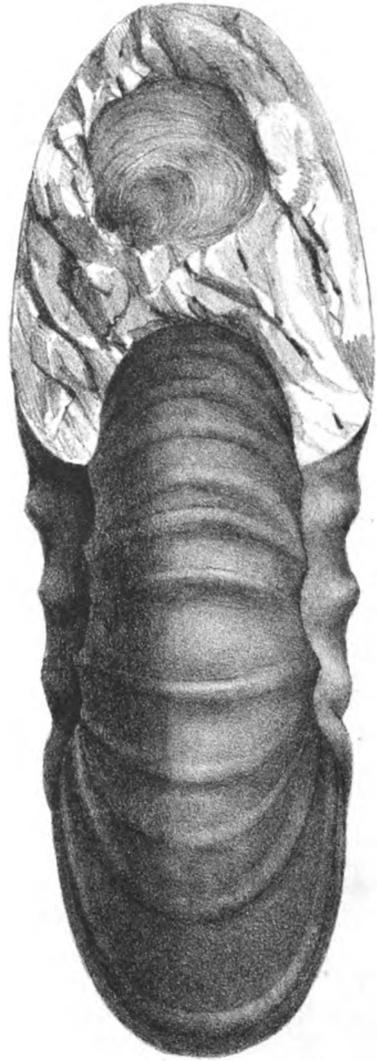


PLATE LIII.

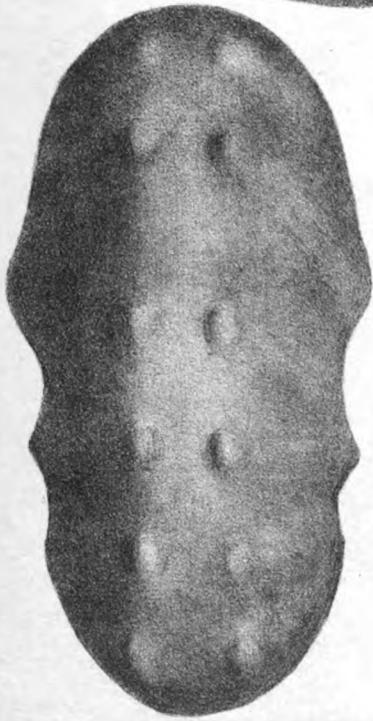
- Fig. 1. AMMONITES EGERTONIANUS, *Forbes*, p. 104. 1. side, 1.a. front views of a large specimen from *Arrialoor*; *Arrialoor group*, Geol. Surv. Collection.
- Fig. 2. „ „ — p. 104. 2. back-view of a fragment from Pondicherry, to shew the rare occurrence of dorsal tubercles; 2.a. outline of a septum; the portion not shaded is restored; *Valudayur group*; Madras Museum Collection.
- Fig. 3. „ „ — outline of a septum of a small specimen from Pondicherry.
- Fig. 4. „ „ — p. 104. 4. side view of a compressed variety (*Am. Chrishna*, *Forb.*), partly restored in outline, 4.a. view of the section of the two last whorls; from Pondicherry; *Valudayur group*; Madras Museum Collection.



1



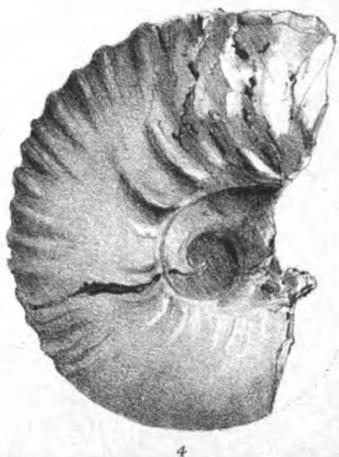
1. a.



2



4. a.



4



3



2. a.

H. L. Frazer Lith.

T. Oldham direx^t

Calcutta.

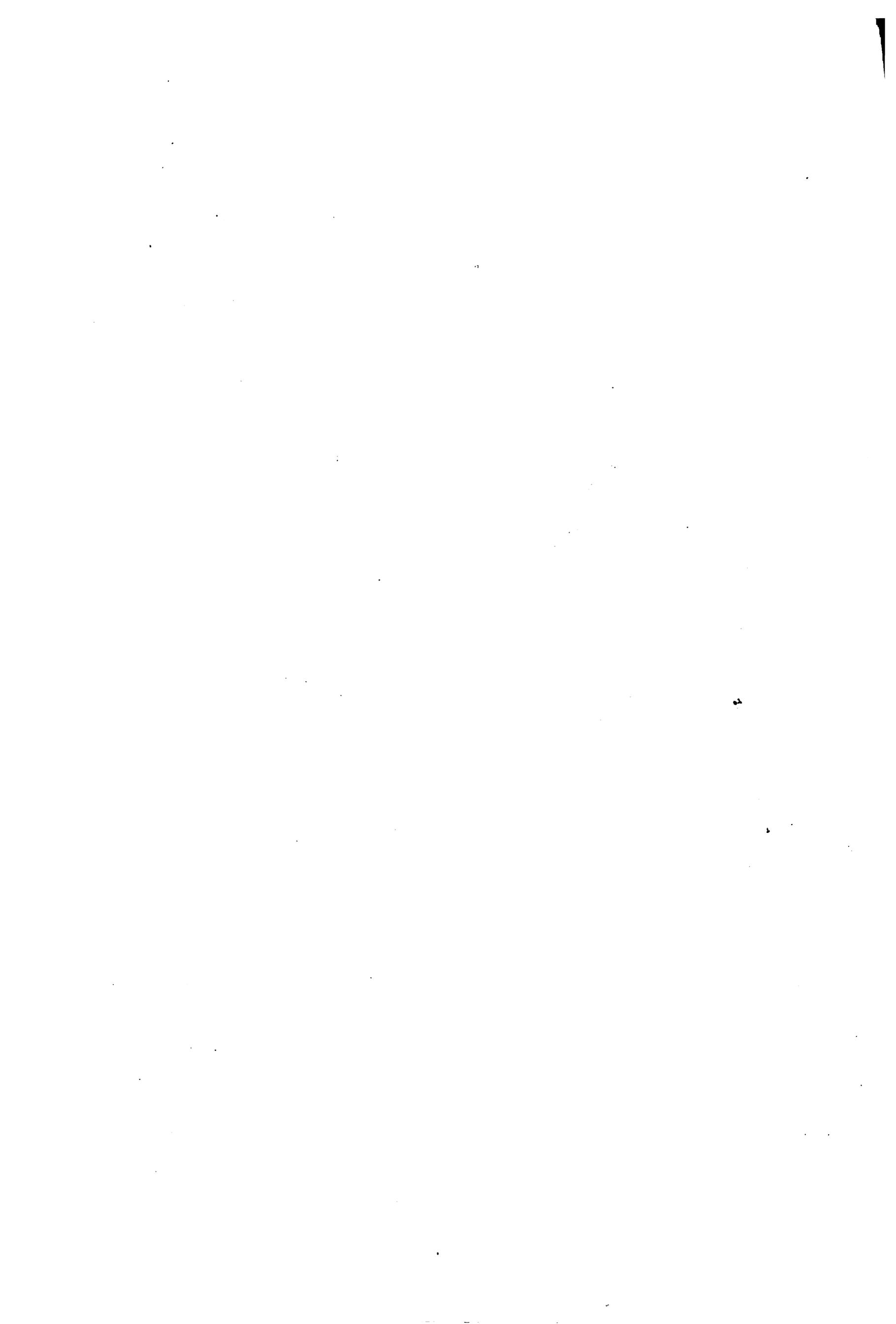
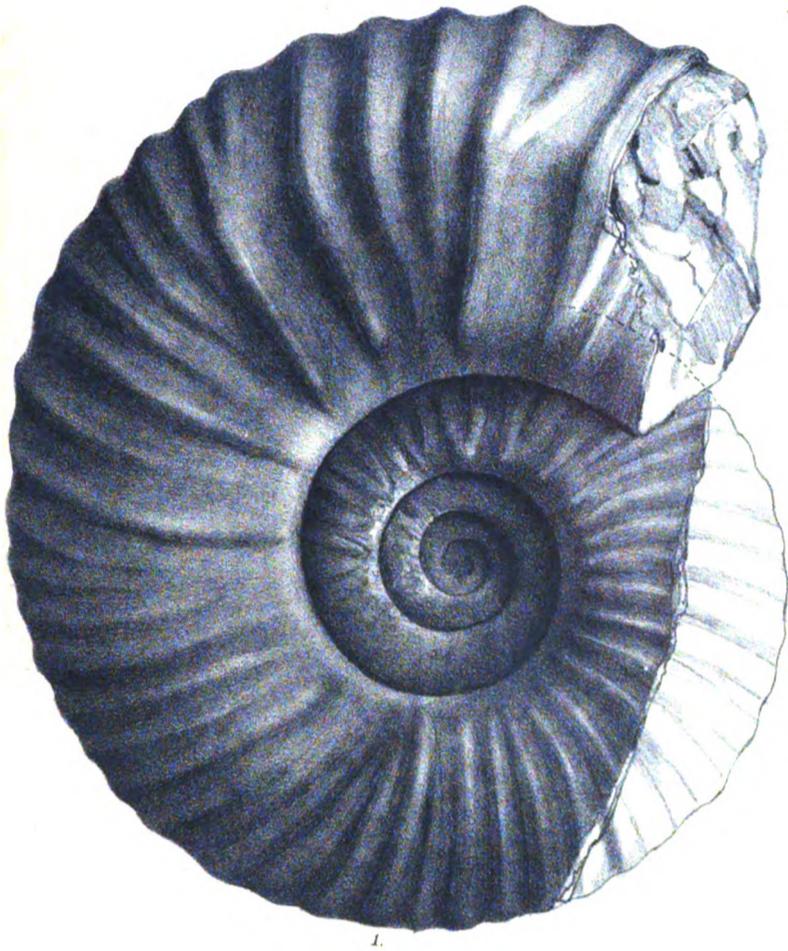


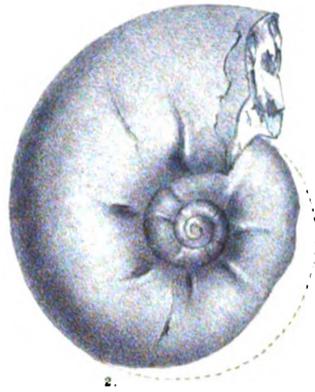


PLATE LIV.

- Fig. 1. AMMONITES TWEENIANUS, *Stoliczka*, p. 107. 1. side view of an inflated variety, partly restored in outline, 1.a. section of the two last whorls, shewing the amount of involution, 1.b. outline of a septum; N. of Anapandy; *Trichinopoly group*; Geol. Surv. Collection.
- Fig. 2. AMMONITES GANESA, *Forbes*, p. 106, 2. and 2.a. side and front view, partly restored in outline; 2.b. outline of a septum of the same; Pondicherry, *Valudayur group*; Geol. Surv. Collection.
- Fig. 3. AMMONITES OOTACODENSIS, *Stoliczka*, p. 109, young specimen with ribs on the back partly preserved, a cast.
- Fig. 4. „ „ *Stoliczka*, p. 109, 4. and 4.a. side and front views of a remarkably smooth specimen, partly with the shell-surface; both specimens from Ootacod. N. of *Arrialoore*; *Arrialoore group*; Geol. Surv. Collection.



1.



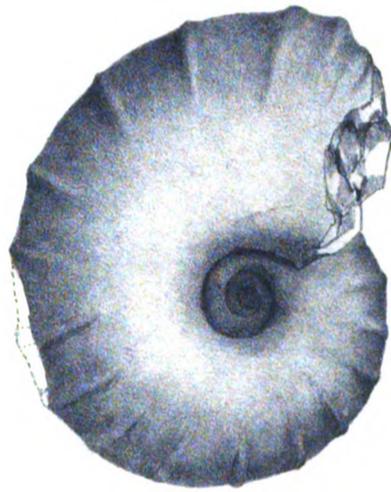
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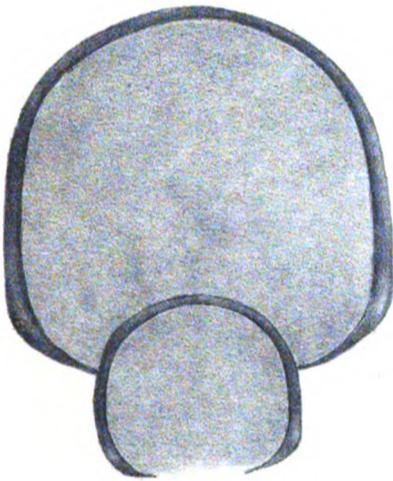
2 a.



2 b.



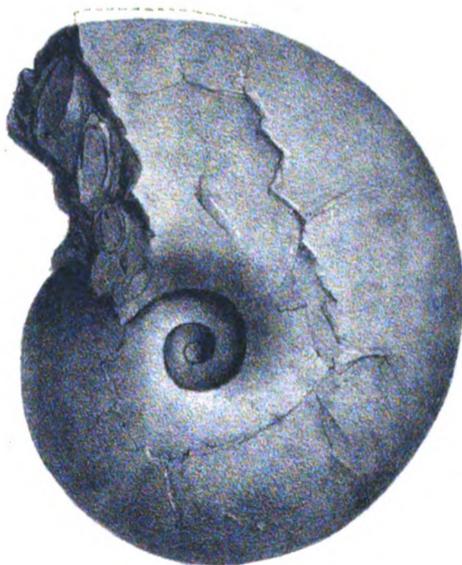
3.



1 a.



1 b.



4.



4 a.

H. L. Fraser Lith.

T. Oldham direx^t

Calcutta.

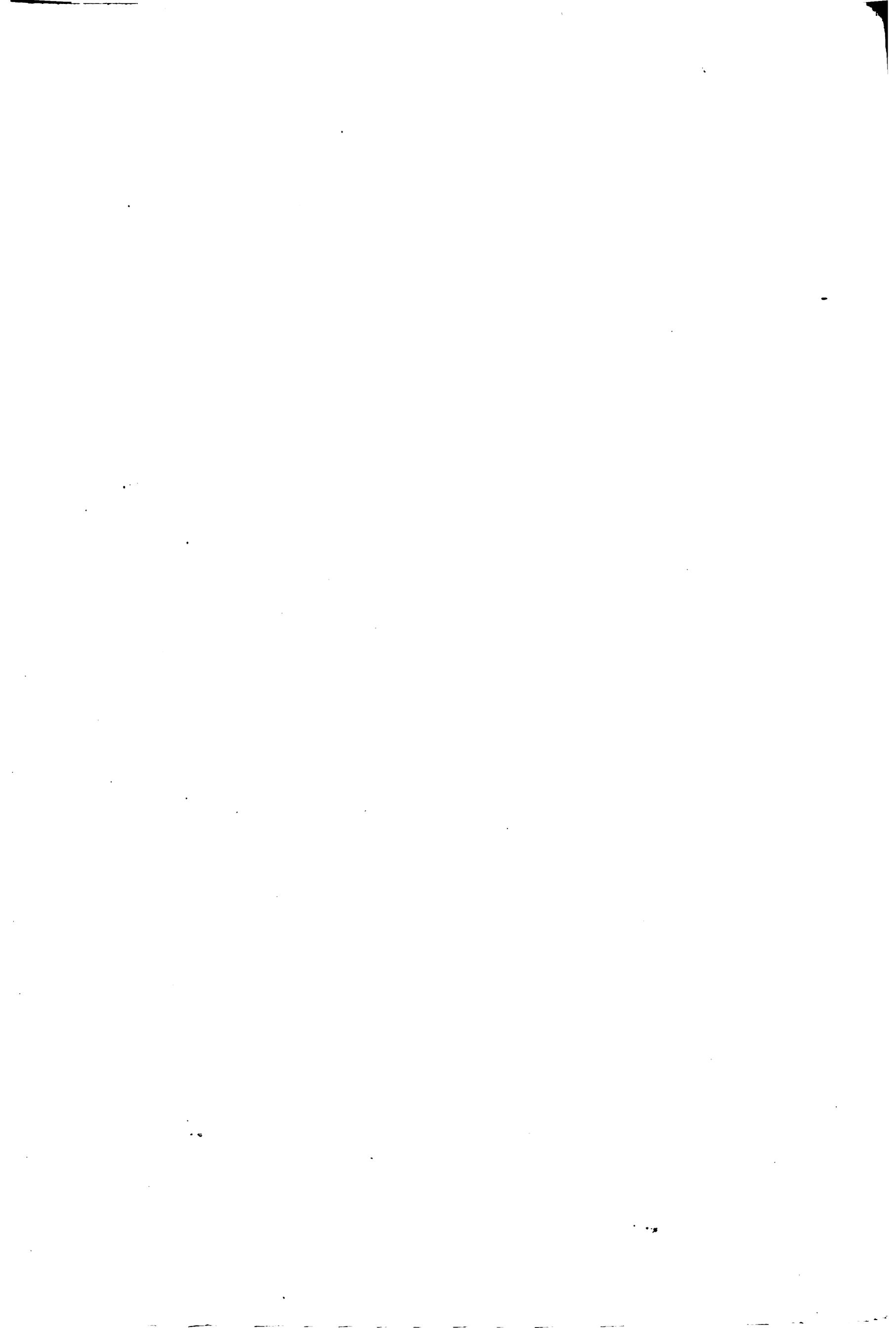
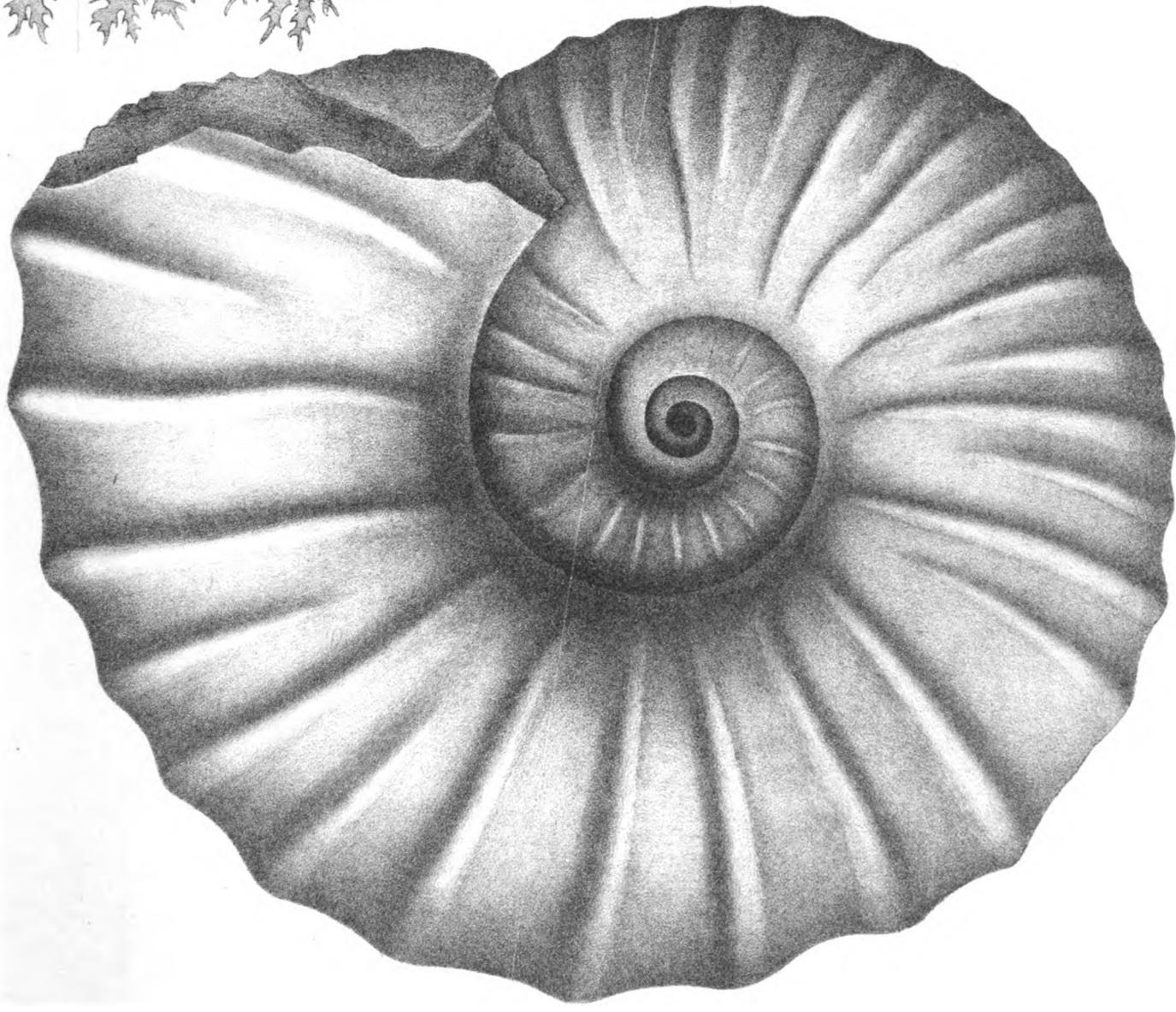


PLATE LV

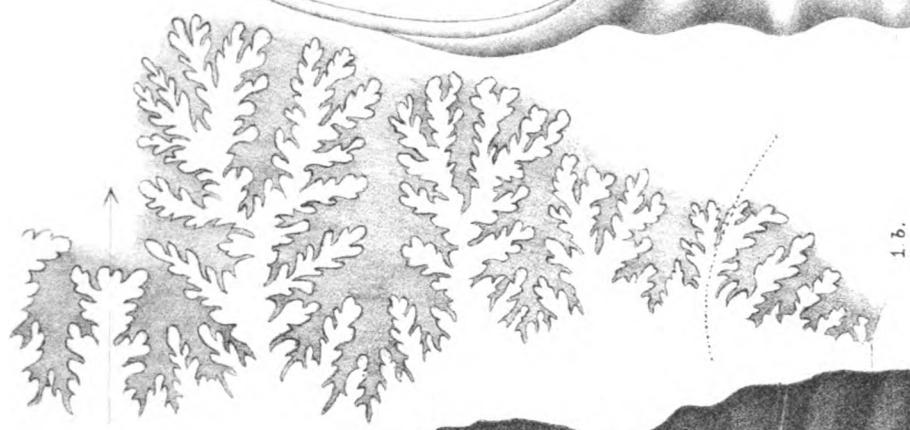
Fig. 1. AMMONITES TWEENIANUS, *Stolicka*, p. 107 ; 1, and 1a, side and front views, 1b outline of a septum, the dotted line indicating the edge of the umbilicus ; in gritty sandstone from Arrialoor, Trichinopoly district.

Arrialoor group ; Geol. Surv. Collection.

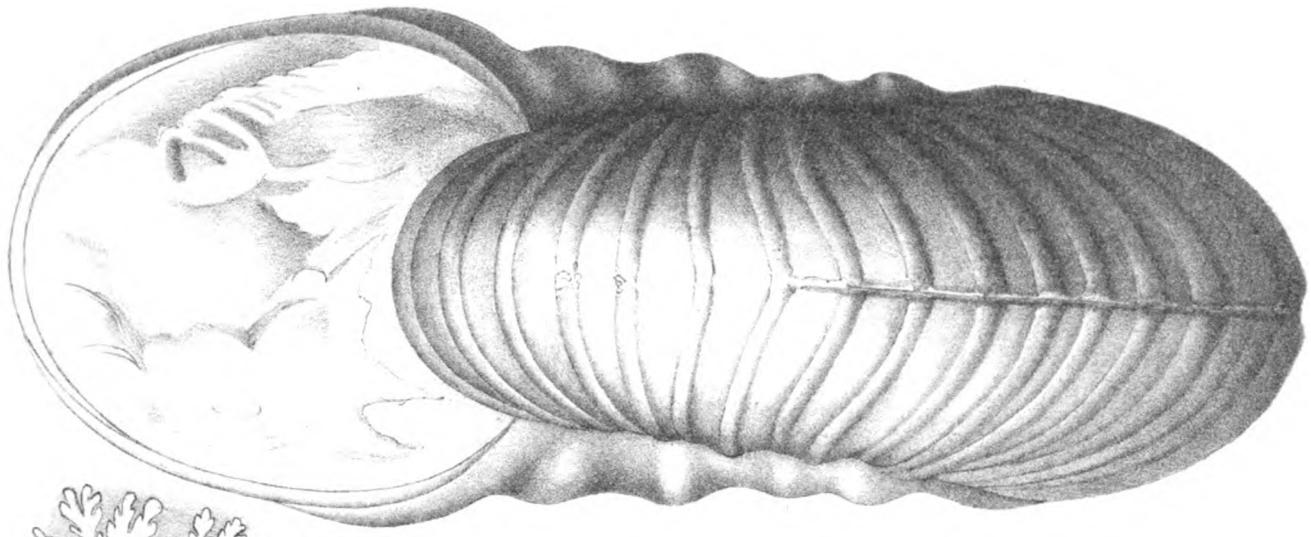


1

Nilkunt Das, Litho



1.b.



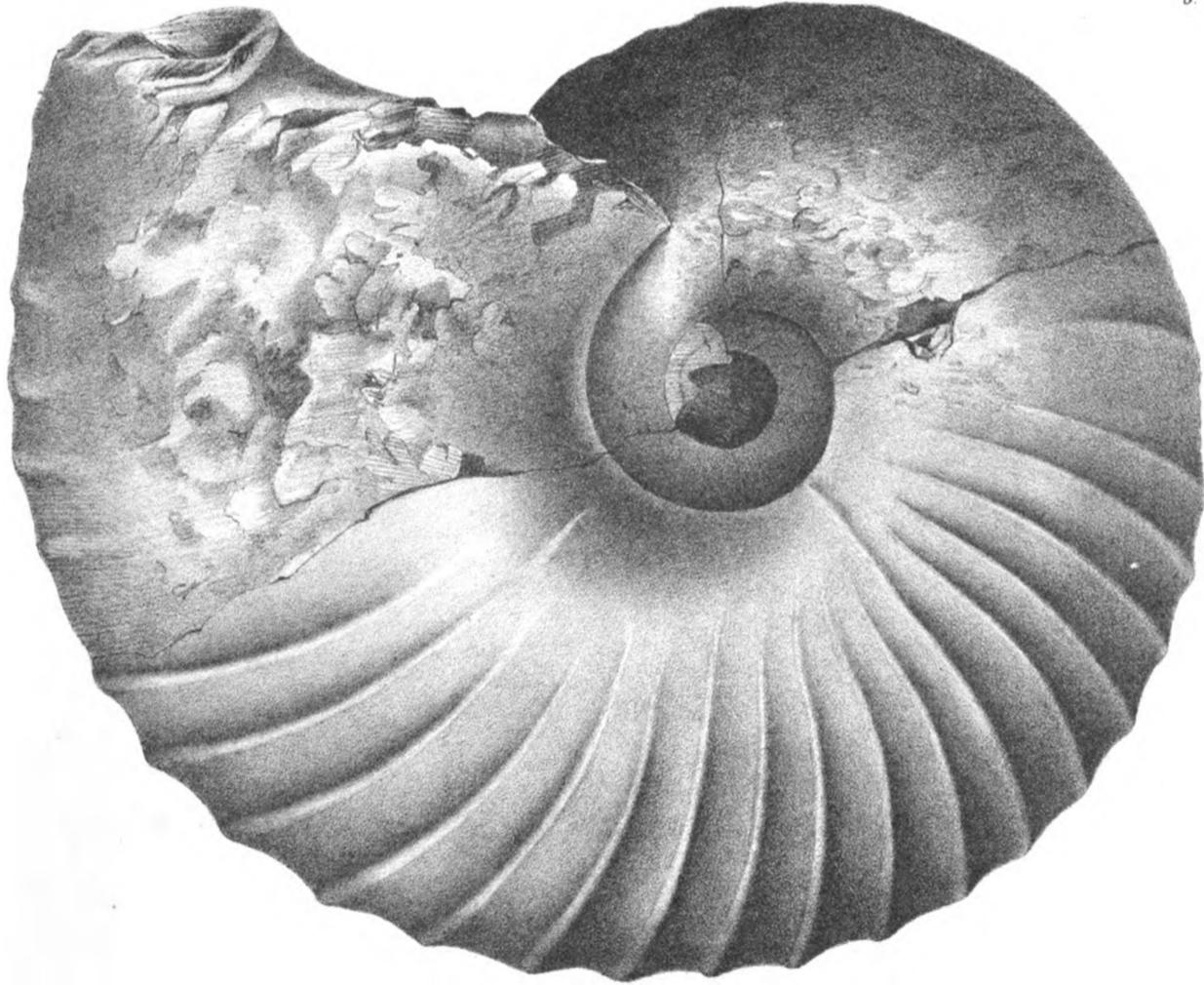
1 a

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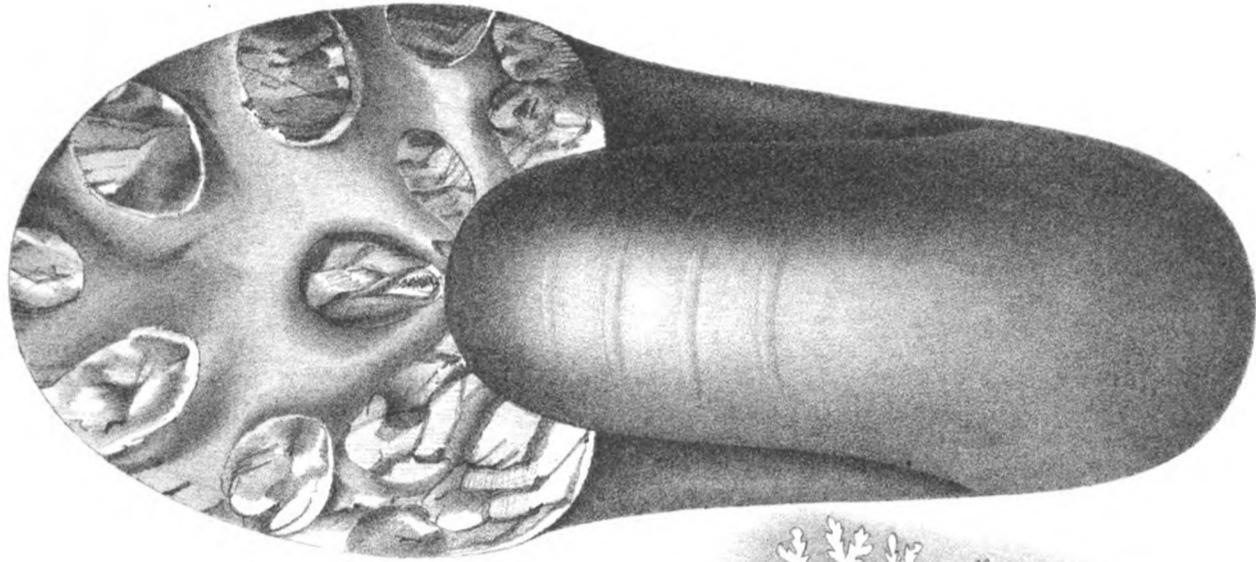
PLATE LVI.

Fig. 1. AMMONITES OOTACODENSIS, *Stoliczka*, p. 109; 1, and 1*a*, side and front views; the ribbing in the side view, Fig. 1, is partly restored from another fragmentary specimen with the shell preserved on it; 1*b*, outline of a septum, *a-b* being the edge of the umbilicus, *c-d* the umbilical line; from Ootacod, Trichinopoly district.
Arrialore group; Geol. Surv. Collection.



1.

Nilkunt Das, Lith.



3. a.



1 b.

Printed at Geol. Survey Office.



PLATE LVII.

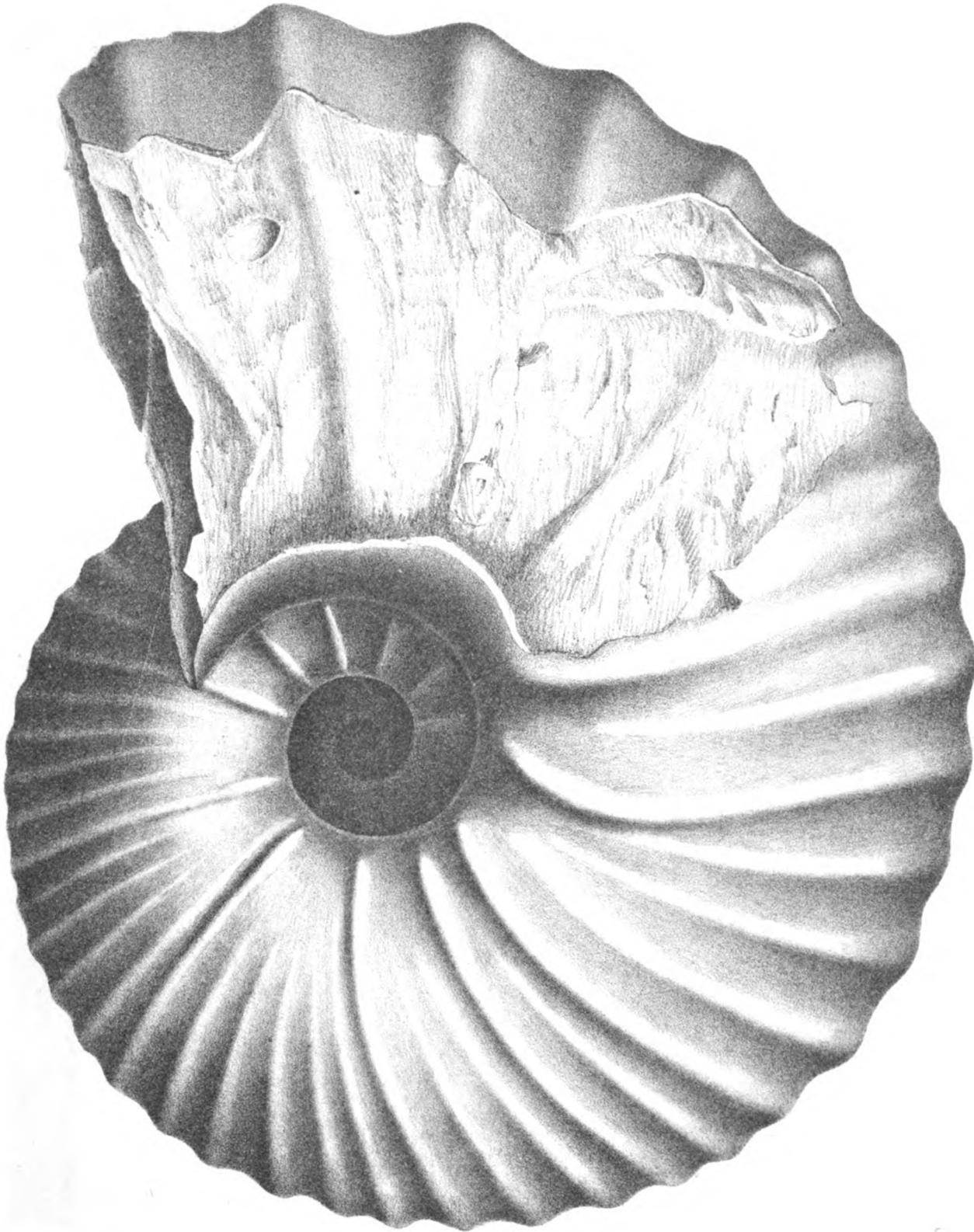
AMMONITES OOTACODENSIS, *Stoliczka*, p. 109; side view of an inflated variety, two-thirds of natural size, from Ootacod, Trichinopoly district.

Arrialoor group; Geol. Surv. Collection.

C R E T A C E O U S R O C K S S . I N D I A .

Geol. Surv. of India.

Pl. LVII.



Nilkunt Das, Lith.

Printed at Geol. Survey Office.





PLATE LVIII.

Fig. 1. AMMONITES VARUNA, *Forbes*, p. 111; 1, and 1*a*, side and front views; 1*b*, side view of the same, three times the natural size; 1*c*, outline of a septum, enlarged three times; from W. of Odium, Trichinopoly district.

Gotatoor group; Geol. Surv. Collection.

Fig. 2. AMMONITES INDBA, *Forbes*, p. 112; 2, and 2*a*, side and front views; 2*b*, outline of a septum from another specimen; from Verdoor, near Pondicherry.

Valudayur group; Geol. Surv. Collection.

Fig. 3. AMMONITES SUB-ALPINUS, *D'Orbigny*, p. 114; 3, 3*a*, side and front views; 3*b*, outline of a septum; from Penangoor, Trichinopoly district.

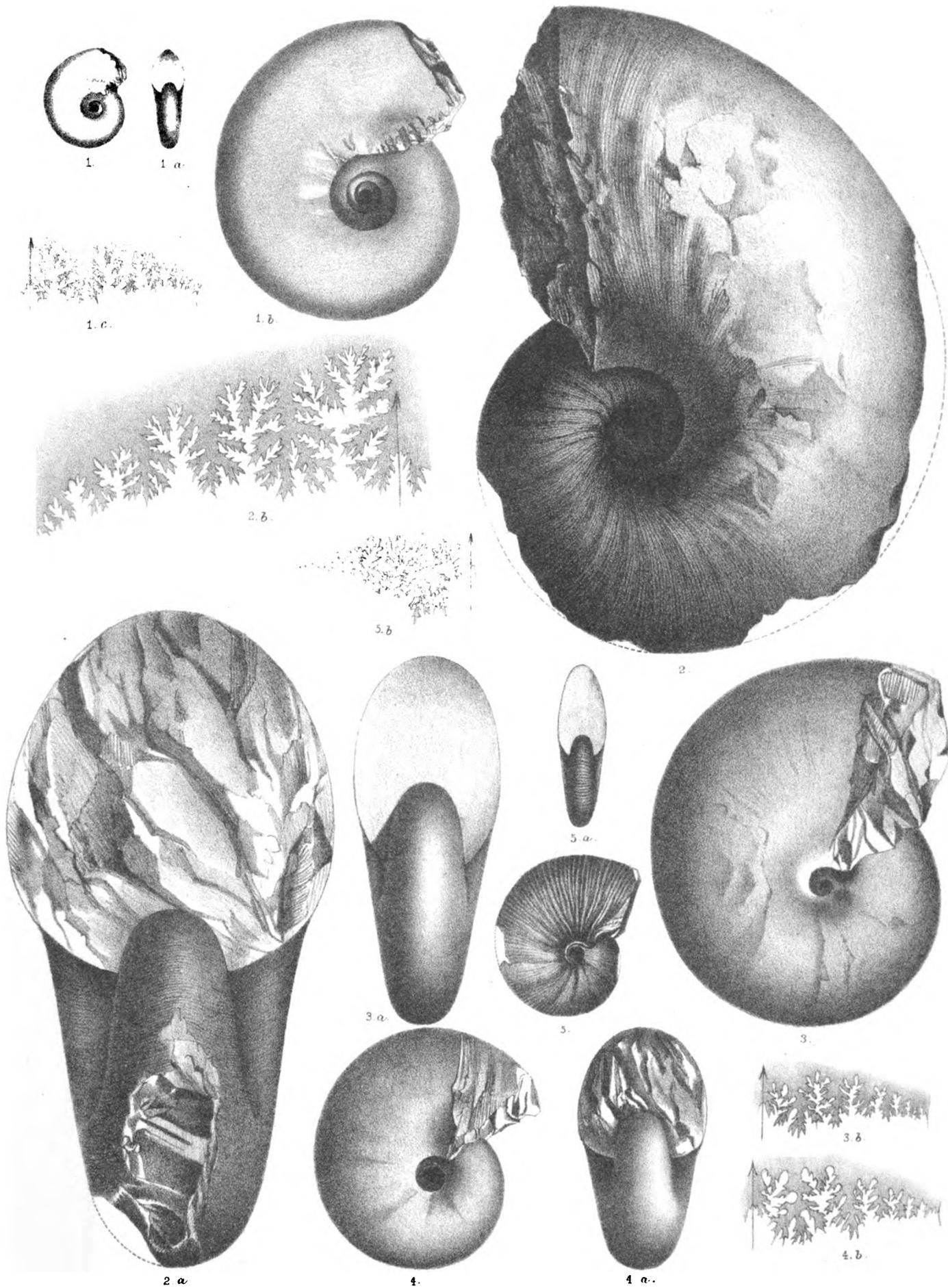
Ootatoor group; Geol. Surv. Collection.

Fig. 4. AMMONITES IMPROVISUS, *Stoliczka*, p. 113; 4, and 4*a*, side and front views; 4*b*, outline of a septum; from Odium, Trichinopoly district.

Ootatoor group; Geol. Surv. Collection.

Fig. 5. AMMONITES SURYA, *Forbes*, p. 115; 5, and 5*a*, side and front views; 5*b*, outline of a septum of a larger specimen; from Pondicherry.

Valudayur group; Madras Museum.



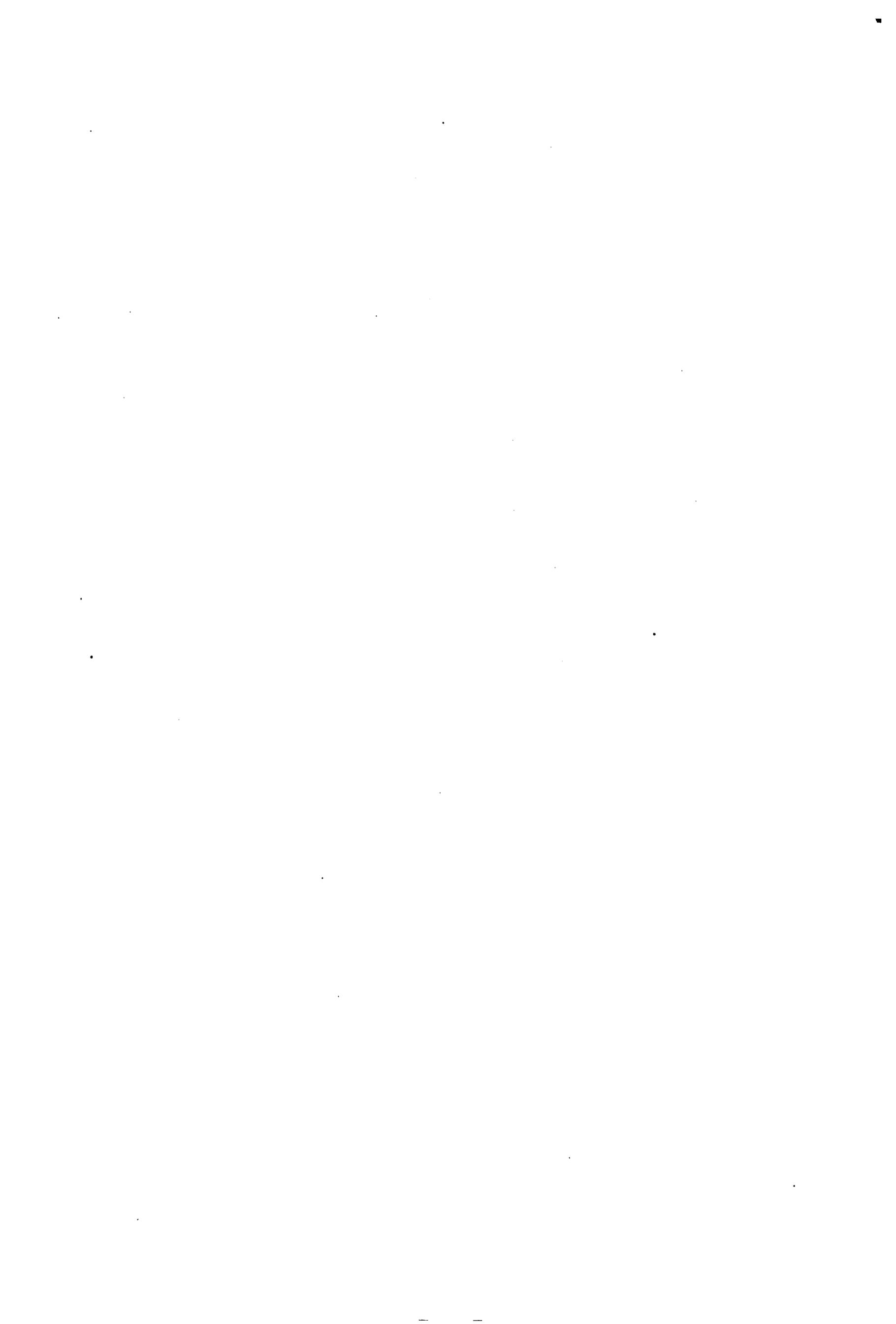




PLATE LIX.

- Fig. 1. AMMONITES VELLEDE, *Michelin*, p. 116; 1 and 1a, side and front views of a very young specimen, a cast from Odium, Trichinopoly district.
- Fig. 2. " " 2 and 2a, side and front views of a larger specimen, mostly with the shell preserved; from Ootatoor.
- Fig. 3. " " Outline of a septum of a fragmentary specimen from Odium.
- Fig. 4. " " 4 and 4a, side and front views of an inflated variety from Ootatoor, Trichinopoly district.
- All specimens are from the *Ootatoor group*; Geol. Surv. Collection.
- Fig. 5. AMMONITES ROUYANUS, *D'Orbigny*, p. 117; 5 and 5a, side and front views of a cast specimen from Odium, Trichinopoly district. *Ootatoor group*; Geol. Surv. Collection.
- Fig. 6. " " Back view with a portion of the striated shell preserved, from the same locality.
- Fig. 7. " " Outline of a septum from another specimen of the same locality.
- Fig. 8. AMMONITES DIPHYLLOIDES, *Forbes*, p. 119; 8 and 8a, side and front views of a very young specimen with preserved shell, from Pondicherry. *Valudayur group*; Geol. Surv. Collection.
- Fig. 9. " " Outline of a septum of another small specimen from Pondicherry; enlarged three times.
- Fig. 10. " " 10 and 10a, side and front views, with small portions of the shell preserved; from Odium, Trichinopoly district. *Ootatoor group*; Geol. Surv. Collection.
- Fig. 11. " " Outline of a septum, taken from a specimen from Poodoor, Trichinopoly district. *Ootatoor group*; Geol. Surv. Collection.
- Fig. 12. AMMONITES YAMA, *Forbes*, p. 120; 12 and 12a, side and front views of a cast; 12b, outline of a septum; from Coonum, Trichinopoly district. *Ootatoor group*; Geol. Surv. Collection.
- Fig. 13. AMMONITES INANIS, *Stoliczka*, p. 121; 13 and 13a, side and front views of a cast from Poodoor, Trichinopoly district. *Ootatoor group*; Geol. Surv. Collection.
- Fig. 14. " " 14 and 14a, side and front views of a cast, 14b, outline of a septum from the same; Odium, Trichinopoly district. *Ootatoor group*; Geol. Surv. Collection.

N. B.—The umbilical suture is marked with $\alpha\beta$, the edge of the umbilicus with $\gamma\delta$.

CRETACEOUS ROCKS S. INDIA.

Geol. Surv. of India.

PL LIX.



Nilkunt Das, Lith^d

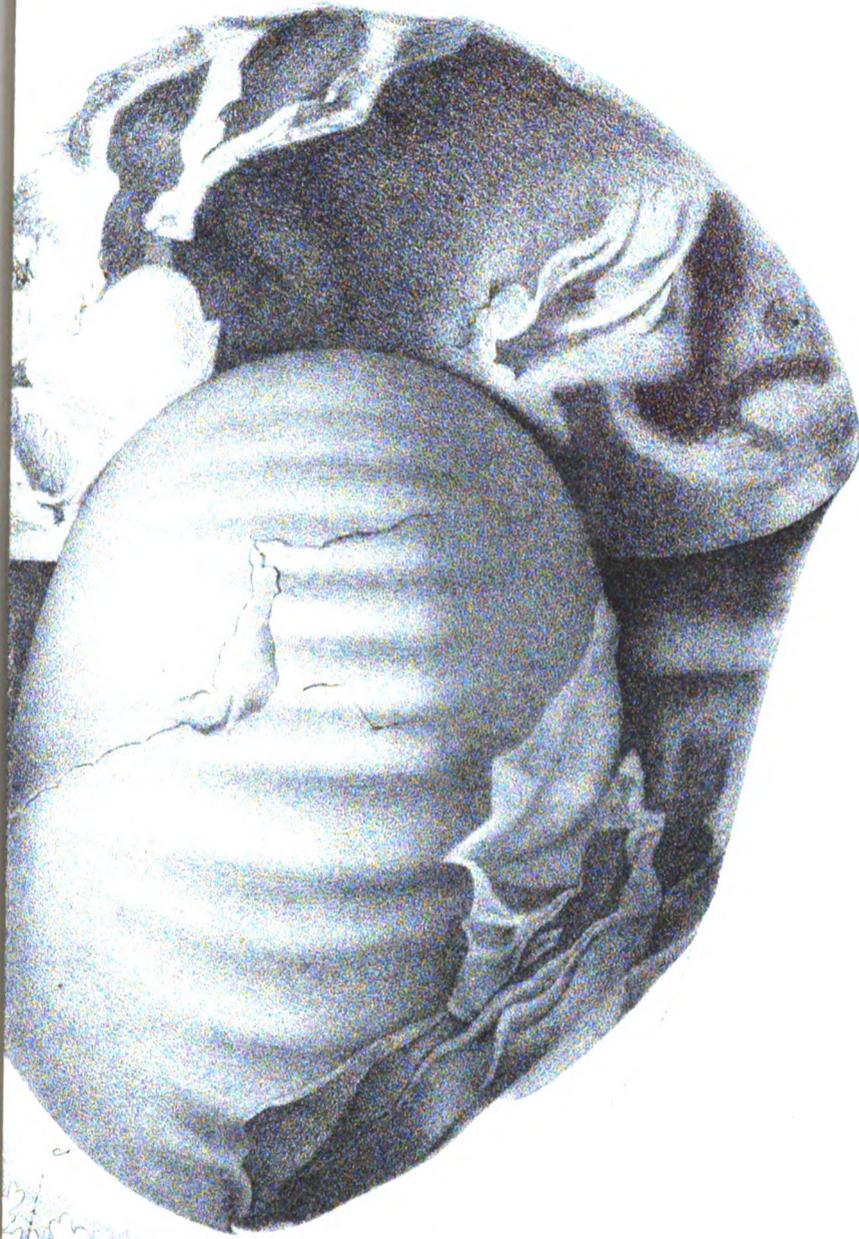
Printed at Geol. Survey Office.





PLATE LX.

Fig. 1. AMMONITES RUDRA, *Stoliczka*, p. 122; 1 and 1a, side and front views of a cast, natural size; 1b, outline of a septum of the same, $\alpha \beta$ is the umbilical suture, $\gamma \delta$ the edge of the umbilicus; from Odium, Trichinopoly district. *Ootaloor group*; Geol. Surv. Collection.

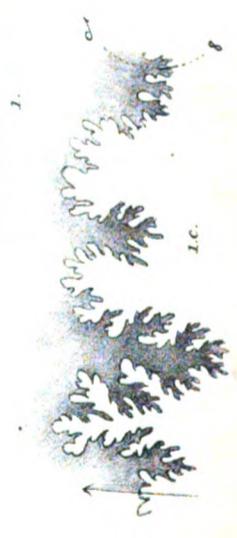
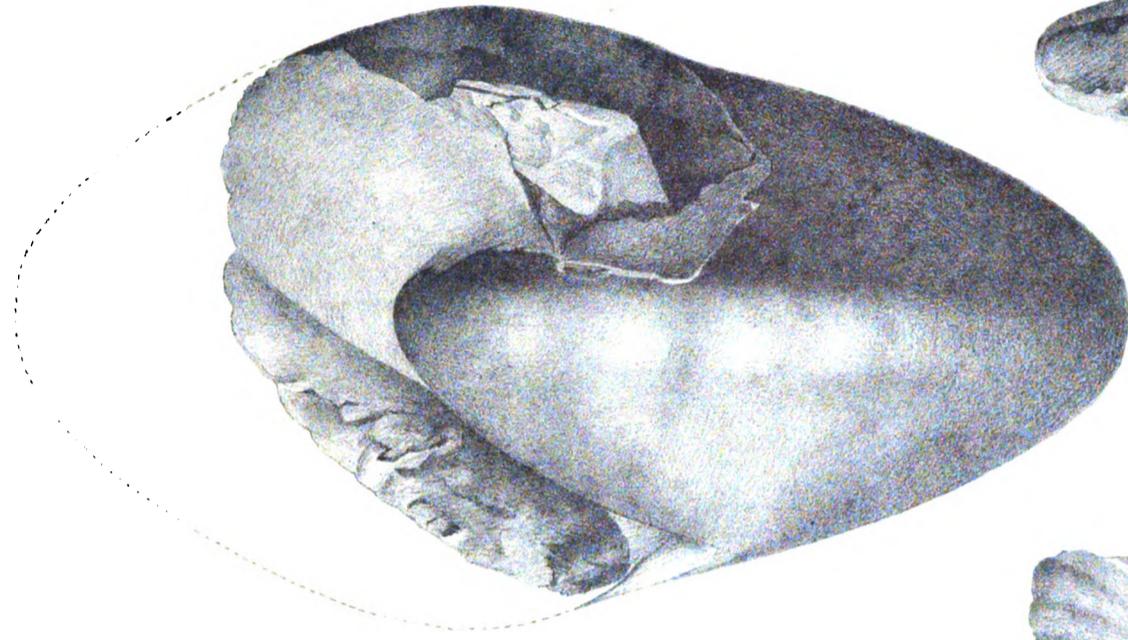
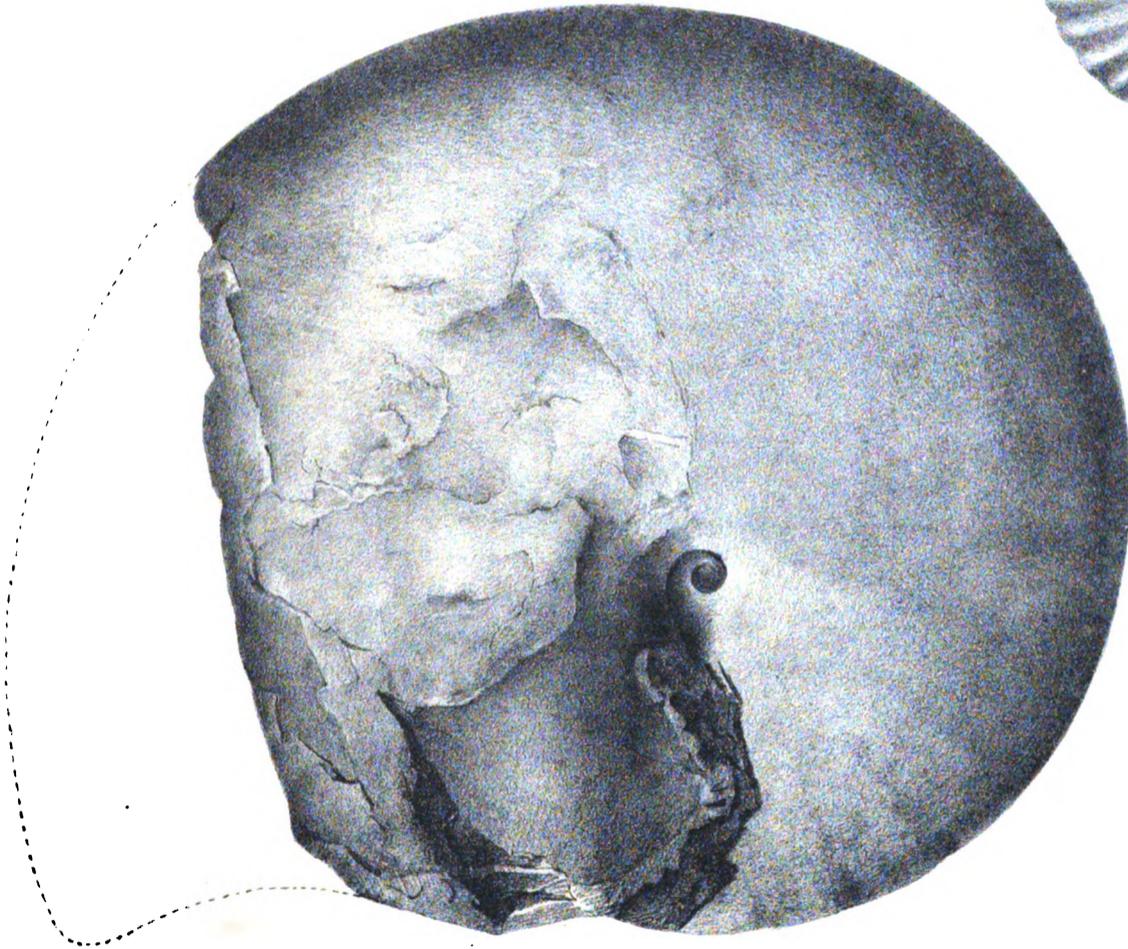


c
s
1 a
s
x



PLATE LXI.

- Fig. 1. AMMONITES XETRA, *Stoliczka*, p. 124; 1 and 1a, side and front views, the specimen has the mouth partly preserved; 1c, outline of a septum, $\gamma \delta$ marking the edge of the umbilicus.
- Fig. 2. „ „ Side and front views of a young and ribbed specimen.
Both specimens are from the neighbourhood of Odium; *Ootatoor* group, Geol. Surv. Collection.



F. Sunkel Lith.

T. Olliver direct.

Calcutta.



PLATE LXII.

Fig. 1. AMMONITES TELINGA, *Stoliczka*, p. 125. Side and front views of a nearly perfect specimen.

Fig. 2. „ „ „ Outlines of a septum from another specimen.

Both are from Odium; *Ootatoor group*; Geol. Surv. Collection.

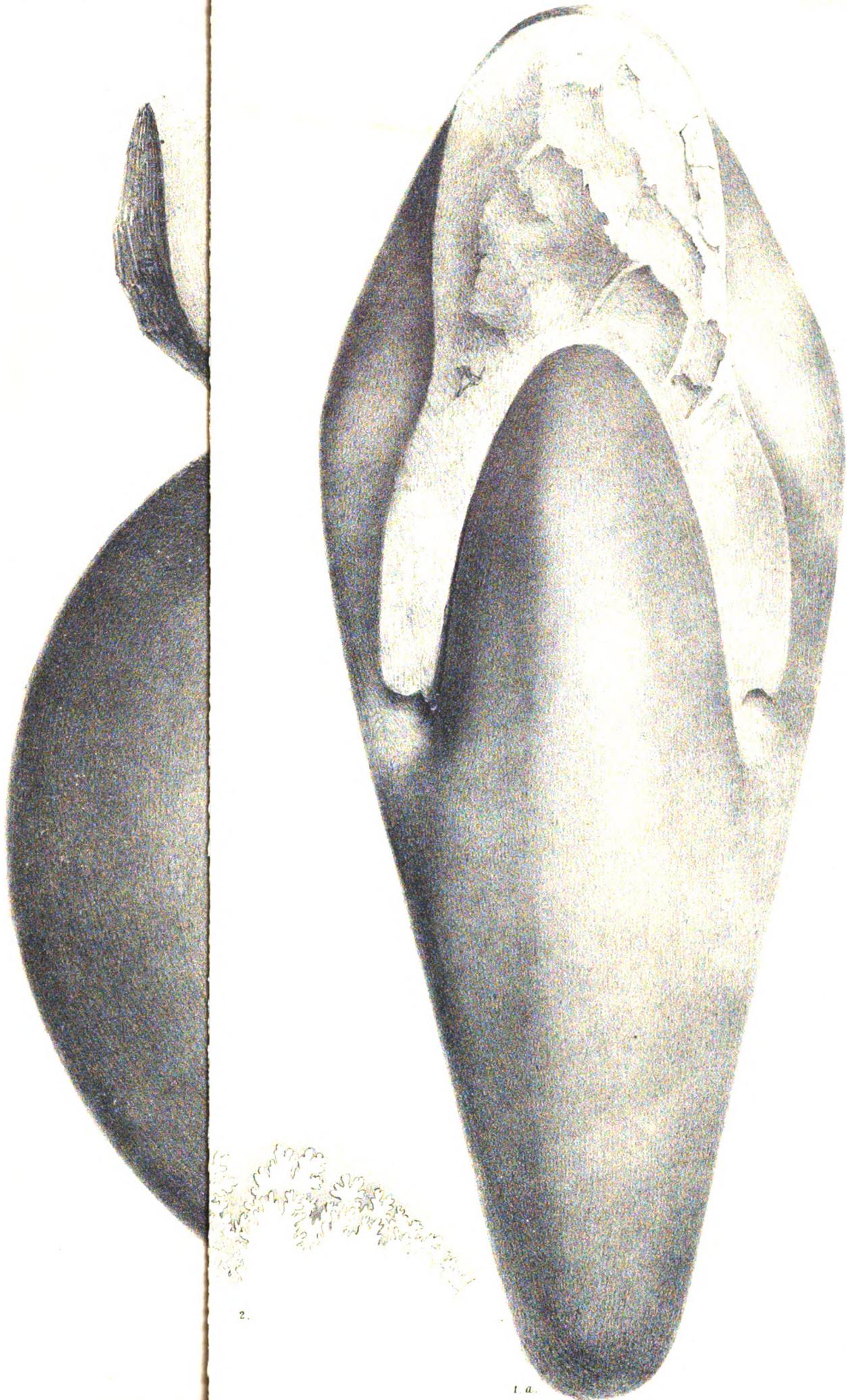
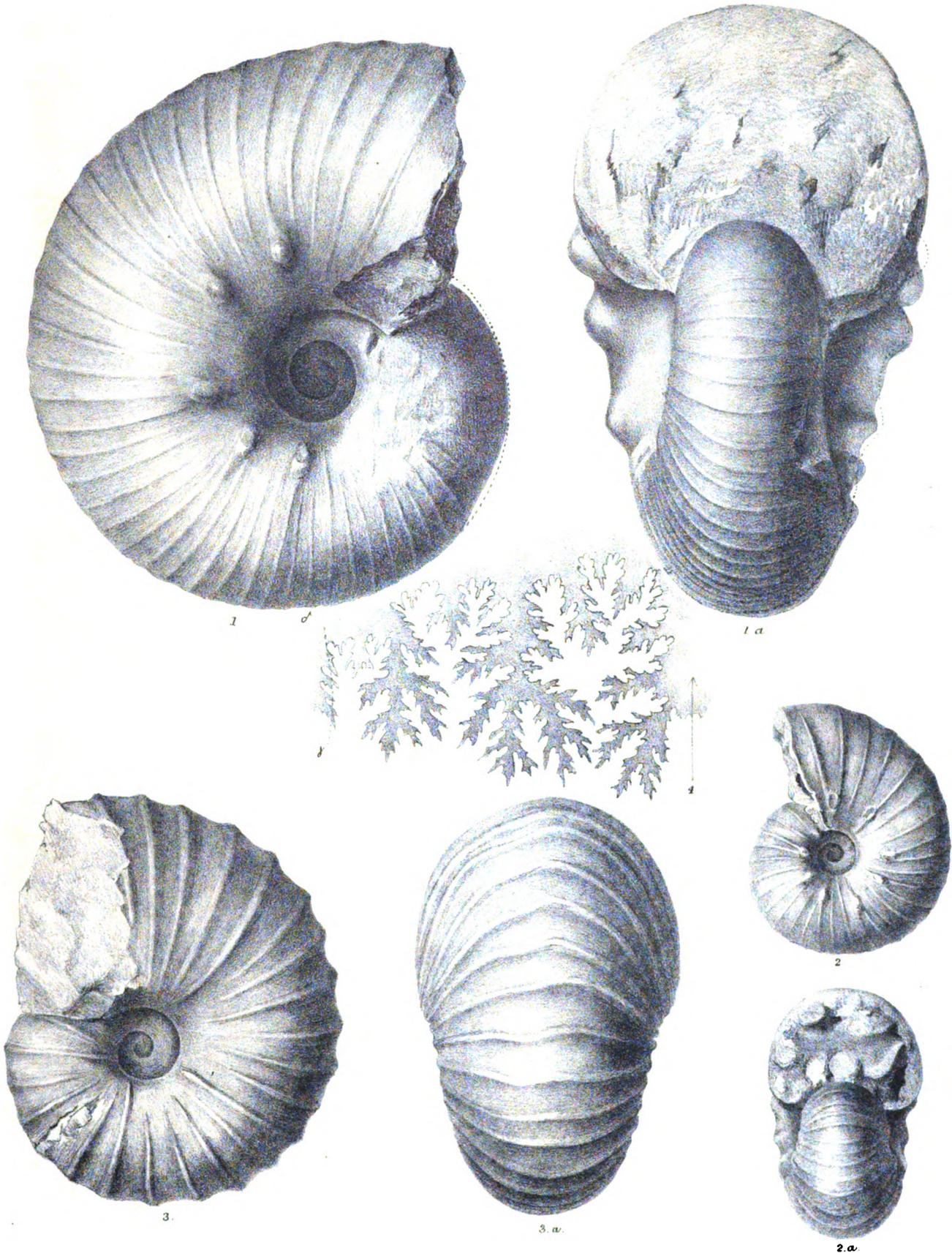






PLATE LXIII.

- Fig. 1. AMMONITES DECCANENSIS, *Stoliczka*, p. 126 ; side and front views ; from Karapaudy,
Arrialoor group ; Geol. Surv. Collection.
- Fig. 2. AMMONITES ARRIALOORENSIS, *Stoliczka*, p. 126. Side and front views of a young specimen.
- Fig. 3. " " " Side and back view of a more grown and inflated
specimen ; in fig. 3a some of the irregularities
in the bending of the ribs are visible.
- Fig. 4. " " " Outline of a septum of a large specimen ; $\gamma \delta$
indicating the edge of the umbilicus.
- All specimens from the neighbourhood of Arria-
loor ; *Arrialoor group* ; Geol. Surv. Collection.



E. Sunkel Lich

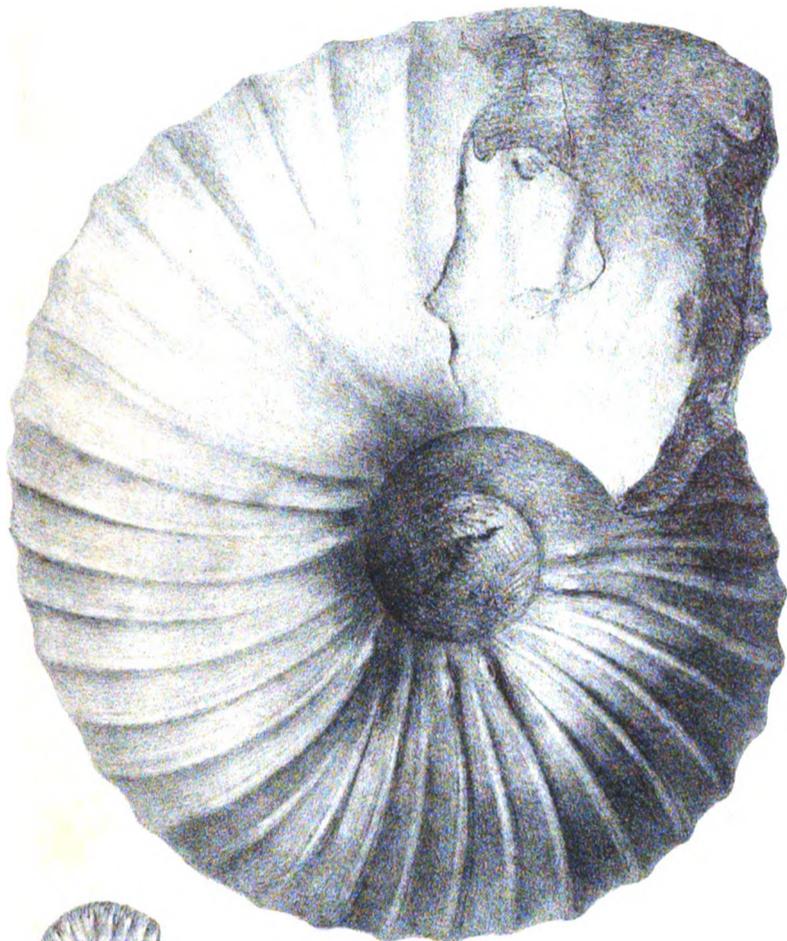
F. Oldham direct

Calcutta

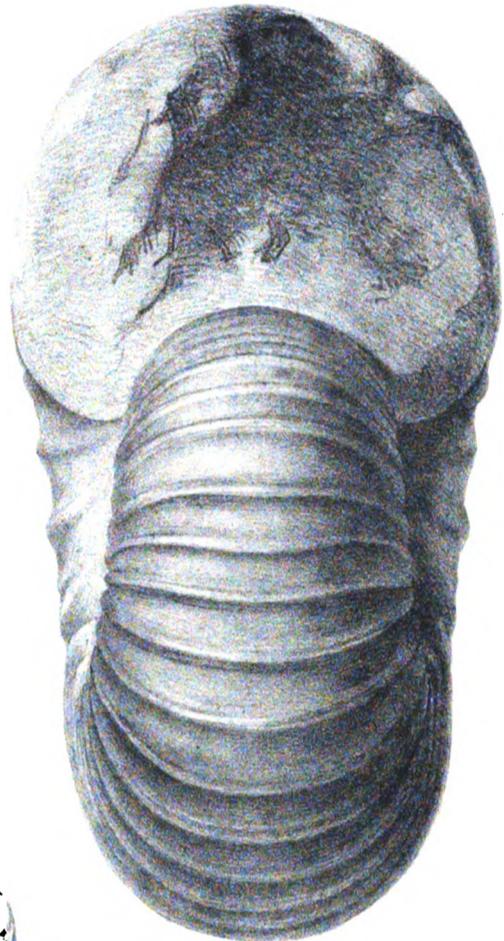


PLATE LXIV.

- Fig. 1. AMMONITES DECCANENSIS, *Stoliczka*, p. 126; side and front views of a large specimen with rounded whorls and a somewhat larger umbilicus; Karapaudy; *Arrialoor group*; Geol. Surv. Collection.
- Fig. 2. AMMONITES BRAHMINICUS, *Stoliczka*, p. 128. 2 and 2*a*, side and front views; 2*b*, three-times enlarged outline of a septum, $\alpha\beta$ indicating the umbilical suture, $\gamma\delta$ the edge of the umbilicus; Veraghoor? *Arrialoor group*; Geol. Surv. Collection.
- Fig. 3. AMMONITES KOLUTURENSIS, *Stoliczka*, p. 127, 3 and 3*a*, side and front views; 3*b*, outline of a septum, $\alpha\beta$ the umbilical suture, $\gamma\delta$ the edge of umbilicus; Koluture, *Trichinopoly group*, Geol. Surv. Collection.



1



1a.



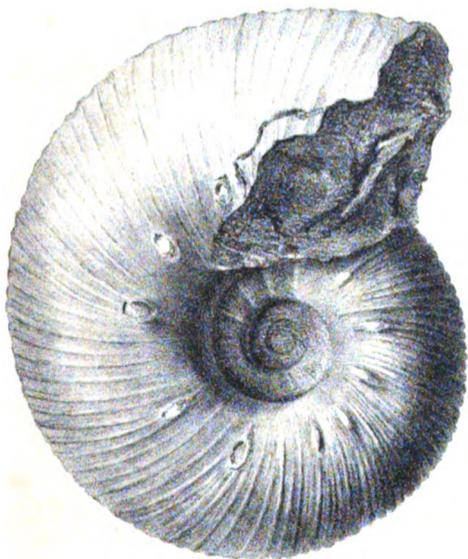
2



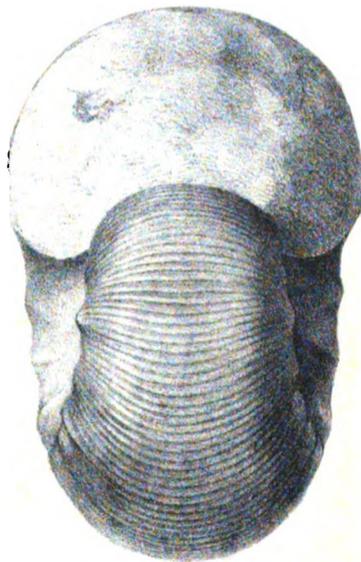
2a.



2b.



3



3a.



3b.

E. Sunkel lith.

T. Oldham direct.

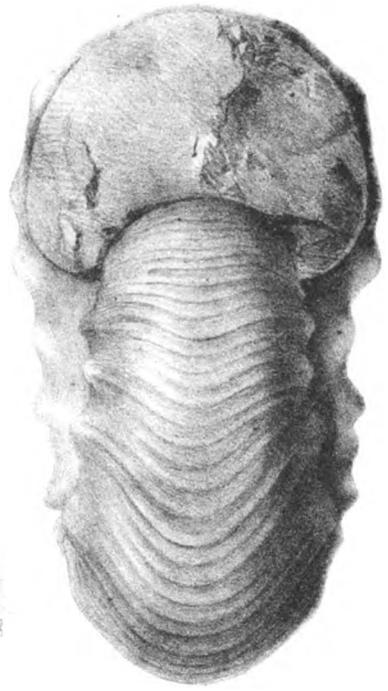
Calcutta.

PLATE LXV.

- Fig. 1. AMMONITES PERAMPLUS, *Mantell*, p. 130, side and front views and outline of a septum; the dotted line indicating the edge of the umbilicus.
- Fig. 2. „ „ side and front views of a young specimen.
both specimens from Anapaudy, *Trichinopoly group*, Geol. Surv. Collection.
- Fig. 3. AMMONITES VAJU, *Stoliczka*, p. 132, side and front views and outline of a septum, the dotted line indicating the edge of the umbilicus; N. W. of Anapaudy, *Trichinopoly group*, Geol. Surv. Collection.
- Fig. 4. AMMONITES DENISONIANUS, *Stoliczka*, p. 133, side and front views of a variety with thicker whorls and less bent ribs; N. of Anapaudy; *Trichinopoly group*; Geol. Surv. Collection.



1



1 a



1 b



2



3



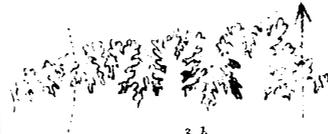
3 a



2 a



4



3 b



4 a

E. Sunkel Lith.

T. Oldham Jurer

Calcutta.

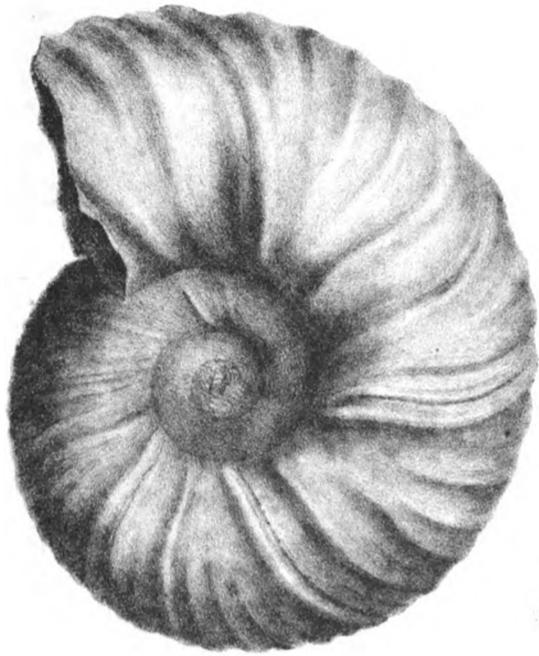






PLATE LXVI.

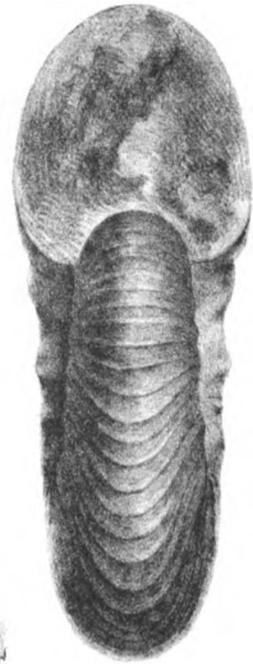
- Fig. 1. AMMONITES DENISONIANUS, *Stoliczka*, p. 133, side and front views and outline of a septum, the dotted line indicating the edge of the umbilicus. This is a variety with much bent ribs ; N. of Serdamungalum, *Trichinopoly group*, Geol. Surv. Collection.
- Fig. 2. " " " side and front views of a specimen with a somewhat wider umbilicus ; N. W. of Ootacod, *Arrialoor group*, Geol. Surv. Collection.



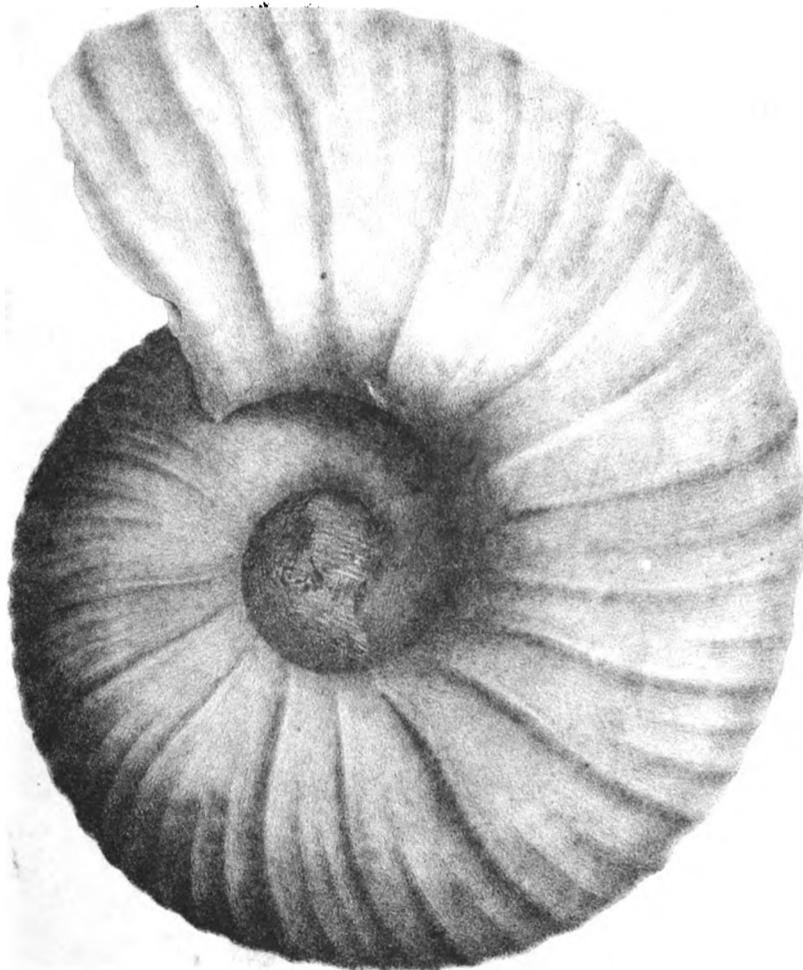
1.



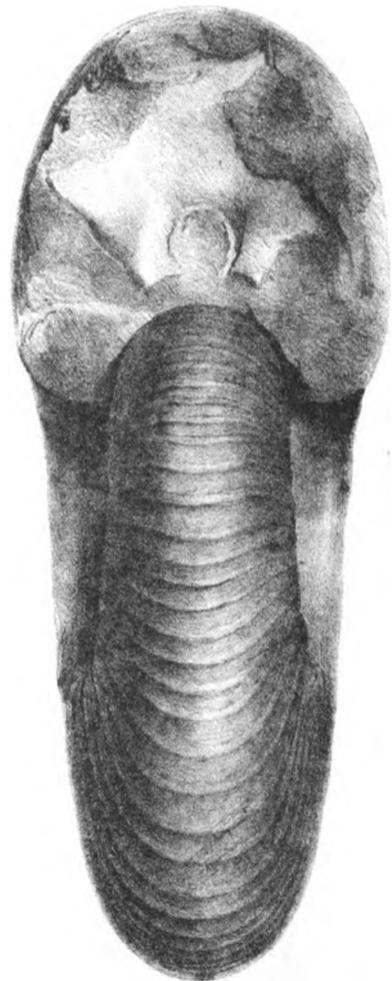
1.b.



1.a.



2.



2.a.

K. Saxeel Lith.

T. Oldham direct.

Calcutta.

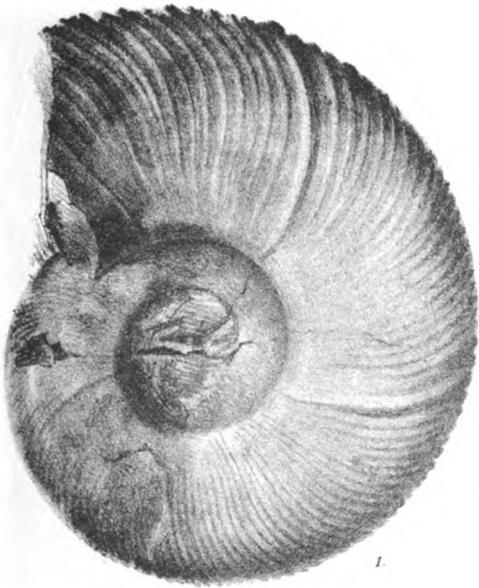




PLATE LXVII.

- Fig. 1. AMMONITES PLANULATUS, *Sowerby*, p. 134, side and front views and outline of a septum ; variety with numerous and fine ribs ; Andoor, *Trichinopoly group*, Geol. Surv. Collection.
- Fig. 2. „ „ side and front views of a cast specimen, a similar figure to *Am. Griffithii*, *Sharpe*, loc. cit. N. E. of Odium, *Ootatoor group*, Geol. Surv. Collection.
- Fig. 3. „ „ side and front views of a coarser ribbed and larger specimen, 3 *b* the outline of a septum. *Anapaudy*, *Trichinopoly group*, Geol. Surv. Collection.

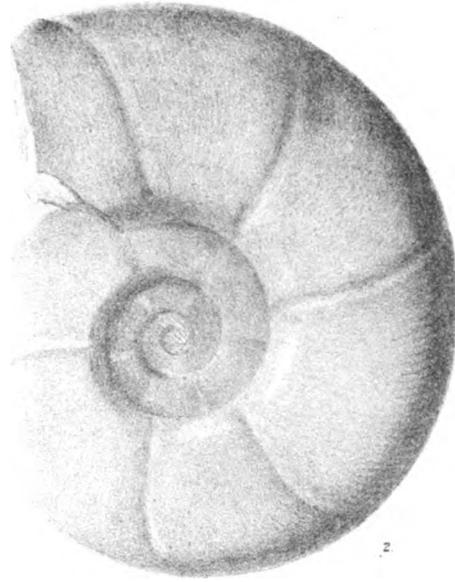
N. B. The dotted lines indicate the edge of the umbilicus and the continued lines the umbilical suture.



1.



1a.



2.



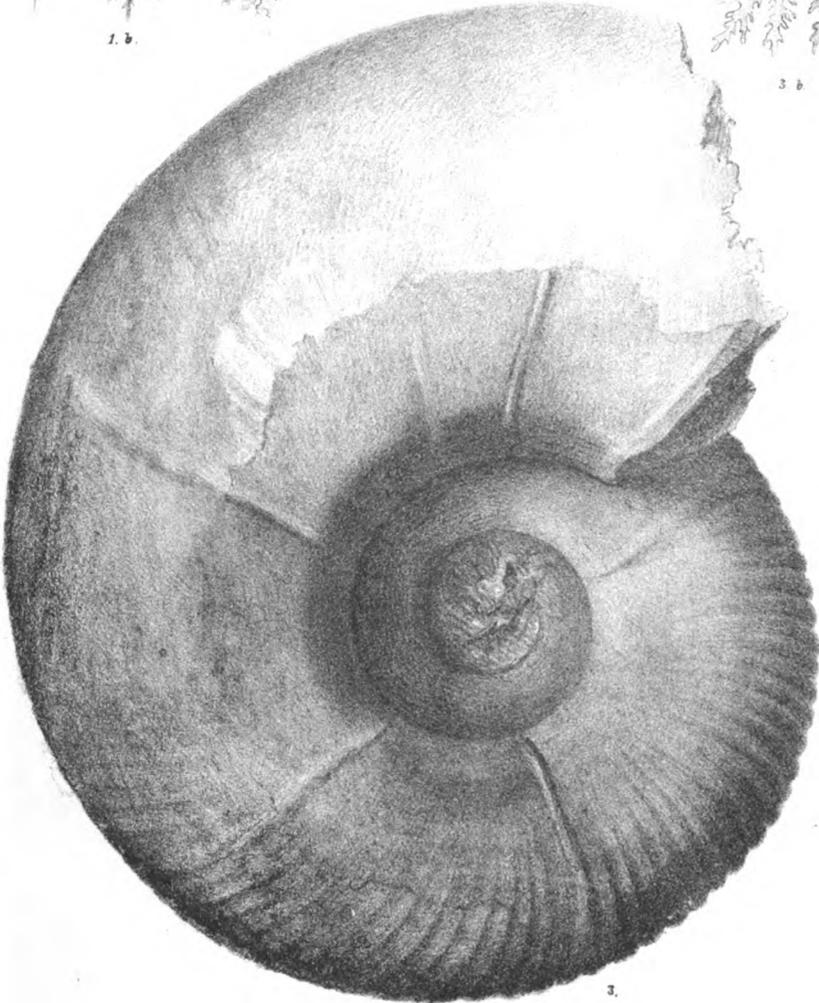
2a.



1b.



2b.



3.



3a.

E. Sunkel Lith.

T. Oldham direct.

Calcutta.



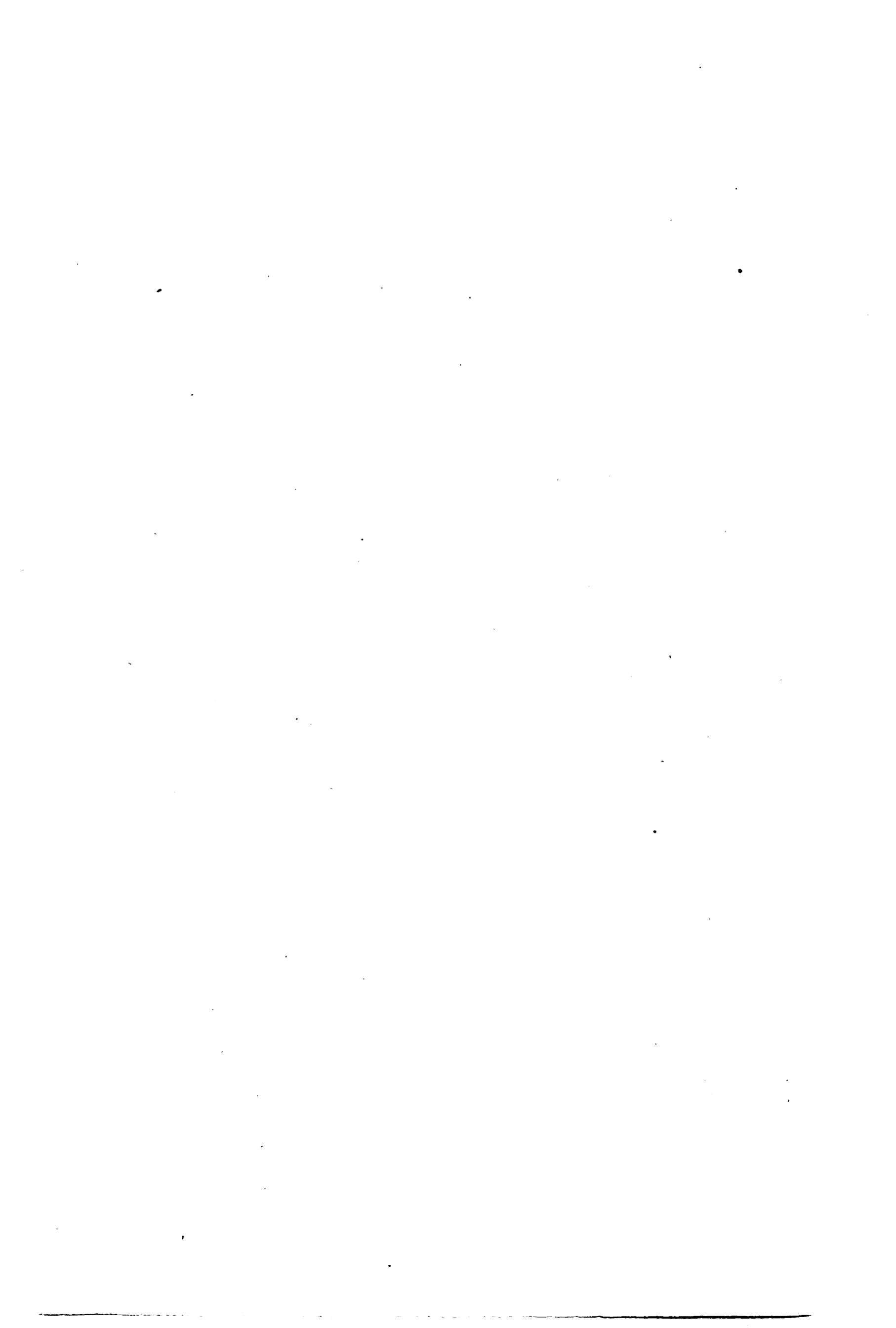
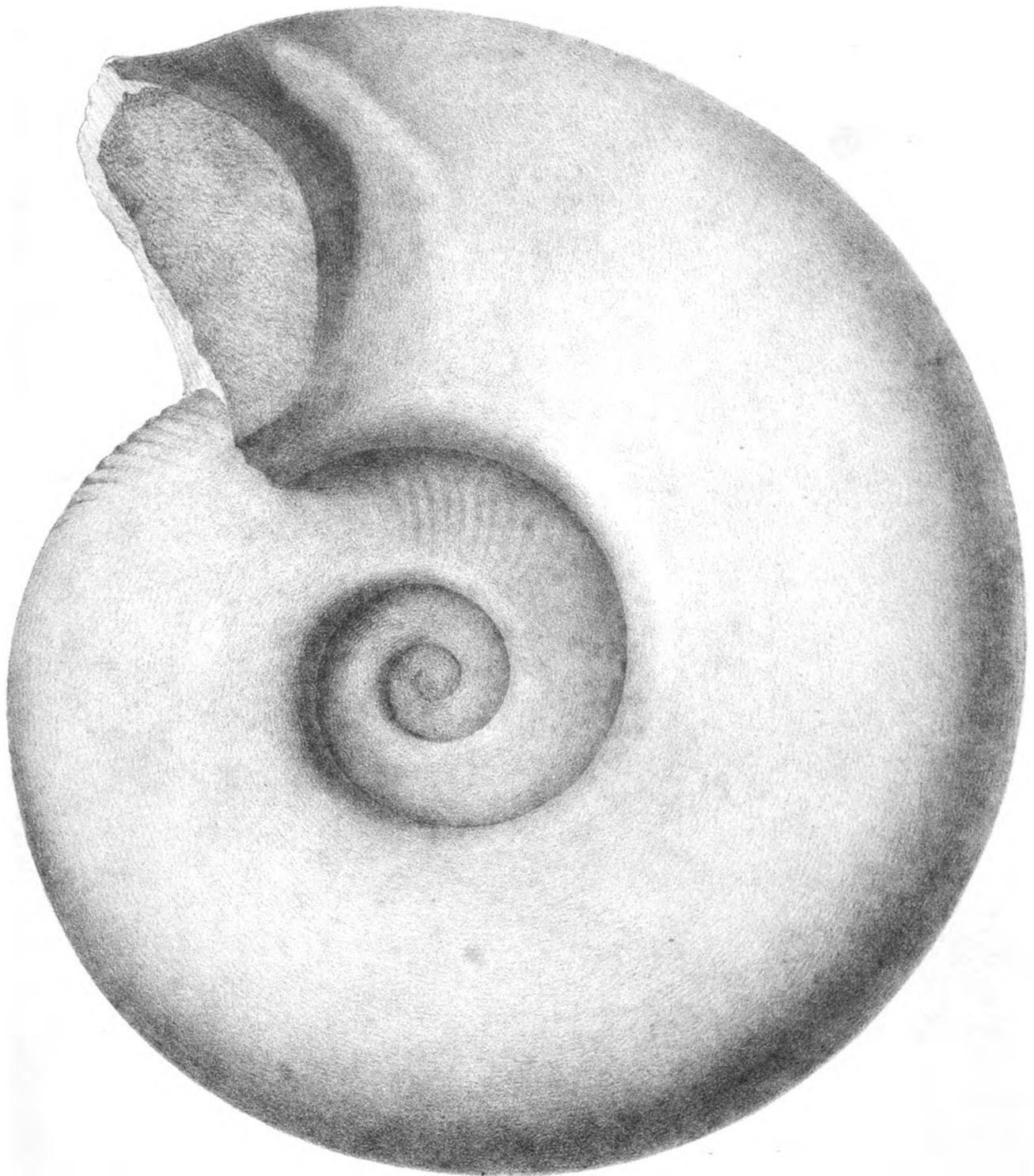
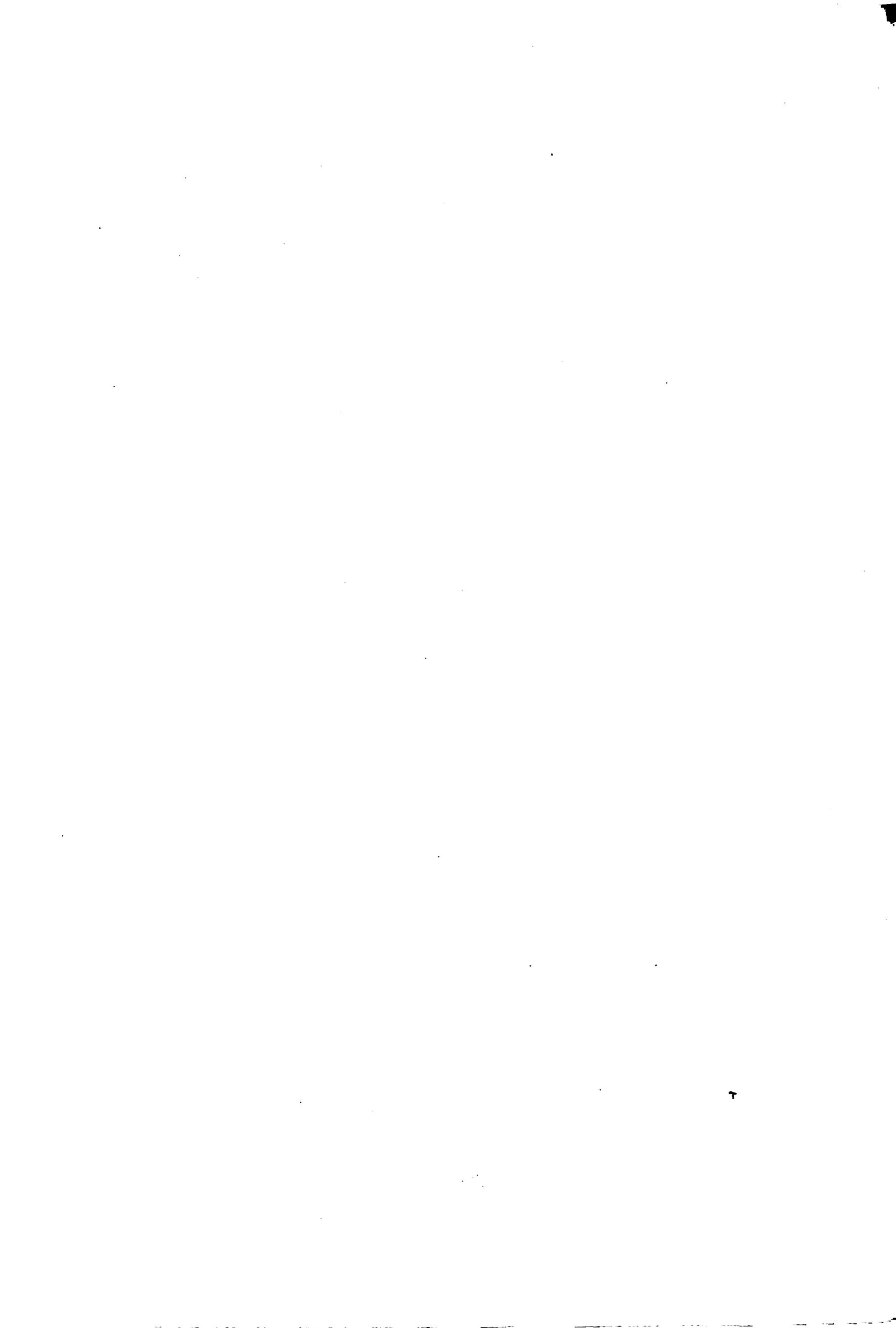


PLATE LXVIII.

AMMONITES PLANULATUS, *Sowerby*, p. 134, side view of a large cast specimen with preserved mouth; the figure is reduced to two fifths of the natural size; from the neighbourhood of Anapady, *Trichinopoly* group; Geol. Surv. Collection.



1



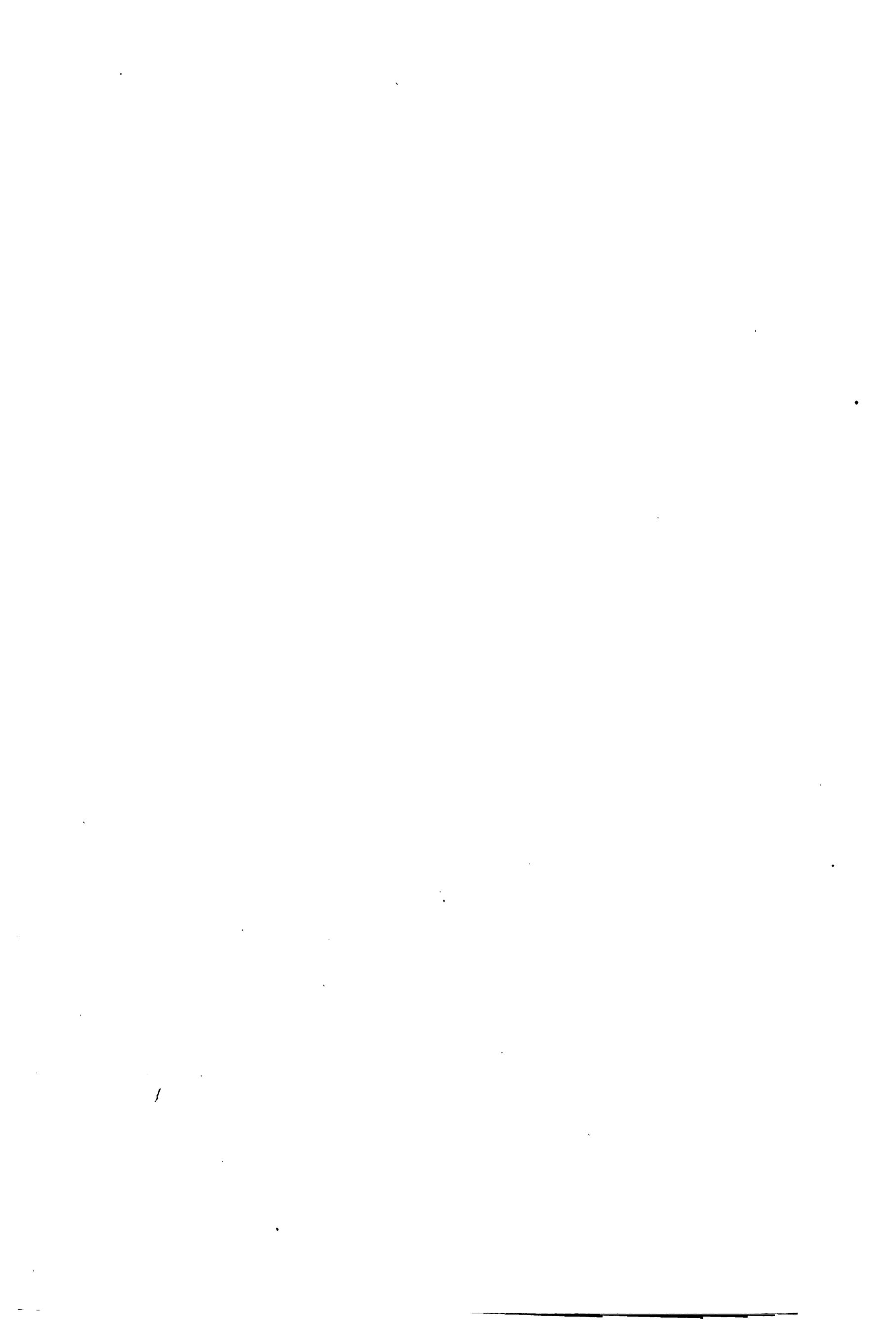


PLATE LXIX.

Fig. 1. AMMONITES BHIMA, *Stoliczka*, p. 137, side and front views of a cast, containing the air-chambers only.

Fig. 2. „ „ „ 2 and 2a, side and front views of a larger specimen, with the greater part of the body whorl and with portions of the shell, on which the fine striæ of growth are visible ; 2b, outline of a septum.

Fig. 3. „ „ „ outline of a septum of a smaller specimen.

All specimens from Morraviatoor, *Ootatoor group* ; Geol. Surv. Collection.

Fig. 4. AMMONITES BHAWANI, *Stoliczka*, p. 138, side and front views of a thicker variety ; S. of Serdamungalum.

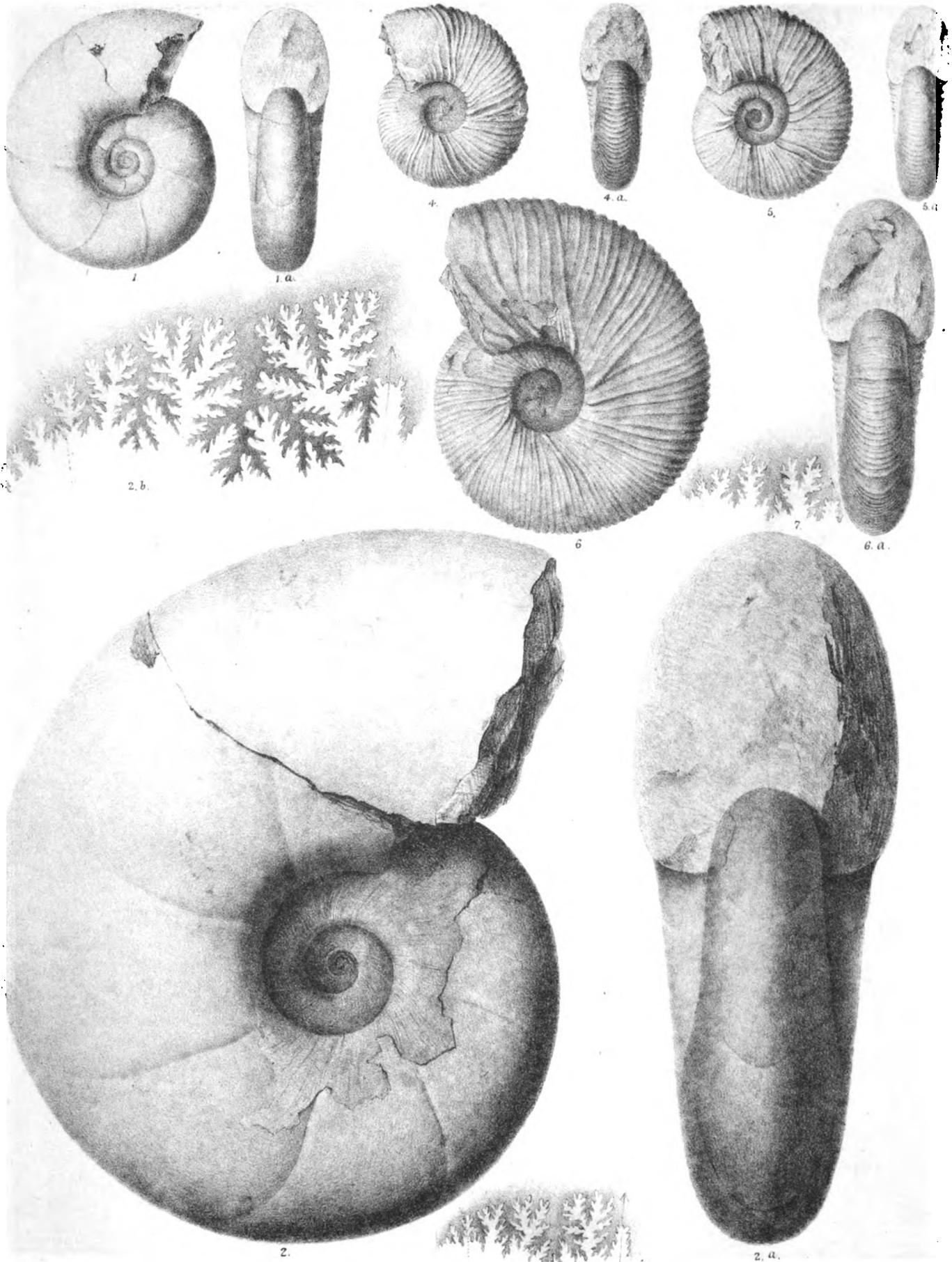
Fig. 5. „ „ side and front views of a more compressed variety ; S. E. of Anapady.

Fig. 6. „ „ side and front views of the most compressed specimen in our collection ; near Serdamungalum.

Fig. 7. „ „ outline of a septum ; S. of Serdamungalum.

All specimens from the *Trichinopoly group* ; Geol. Surv. Collection.

N. B. The dotted line indicates in all cases the edge of the umbilicus and the continuous line the umbilical suture.



E. Sunkel Lith.

T. Oldham direct.

Calcutta.



PLATE LXX.

Fig. 1. AMMONITES MADRASINUS, *Stoliczka*, p. 139, side and front views of a large specimen from Vylapaudy.

Fig. 2. „ „ „ side view of a smaller and still more compressed specimen.

Fig. 3. „ „ „ outline of a septum, γ δ indicating the edge of the umbilicus.

The last two specimens are from the neighbourhood of Karapaudy, and all come from the *Arrialoor group* ; Geol. Surv. Collection.

Fig. 4. AMMONITES KANDI, *Stoliczka*, p. 140, side and front views : N. E. of Kolature ; *Arrialoor group* ; Geol. Surv. Collection.

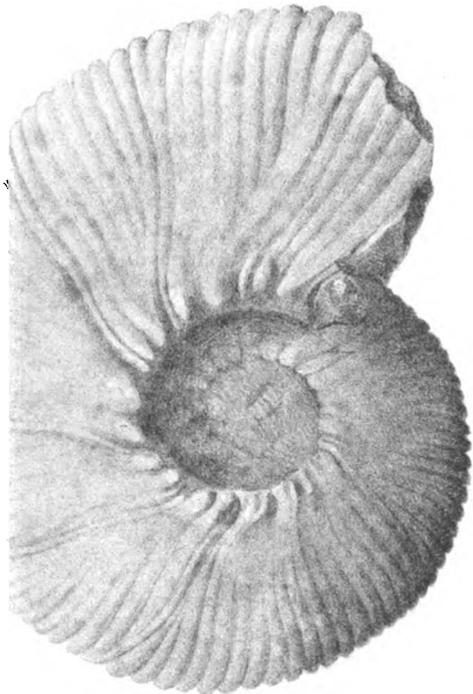
Fig. 5. AMMONITES KALIKA, *Stoliczka*, p. 140, side and front views : Ootacod ; *Arrialoor group* ; Geol. Surv. Collection.

Fig. 6. AMMONITES ÆMILIANUS, *Stoliczka*, p. 141, side and front views of a very young and finely striated specimen.

Fig. 7. „ „ ditto, of a larger, apparently full grown specimen.

Fig. 8. „ „ outline of a septum from another specimen, γ δ indicating the edge of the umbilicus.

All from the neighbourhood of Karapaudy ; *Arrialoor group* ; Geol. Surv. Collection.



1.



1 a.



3.



2.



4.



4 a.



5 a.



5.



7.



7 a.



6.



6 a.



8.

E. Sunkel Lith.

T. Oldham drex'

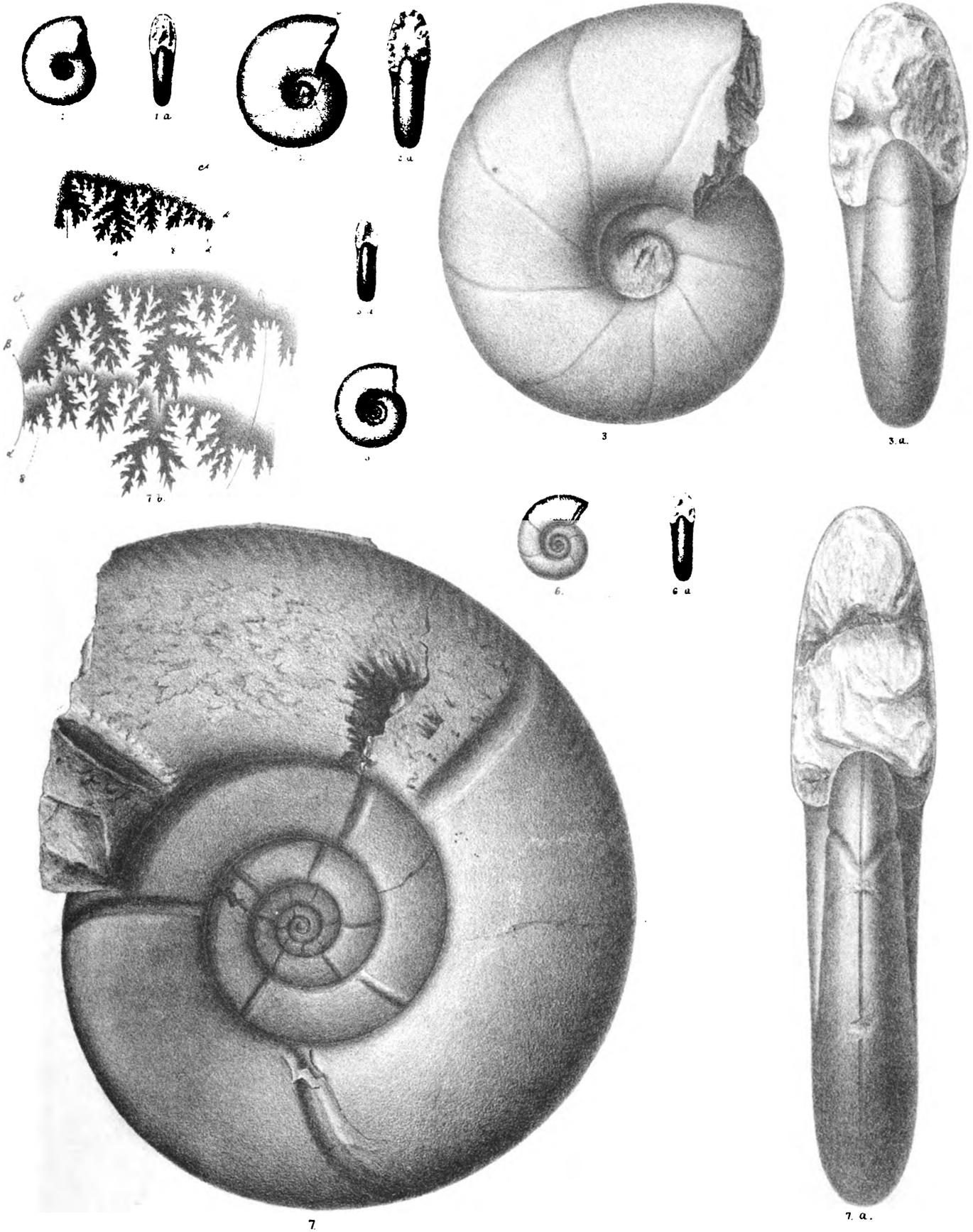
Calcutta.



PLATE LXXI.

- Fig. 1. AMMONITES BEUDANTI, *Brongniart*, p. 142, side and front views of a young specimen with shell preserved, from Pondicherry, *Valudayur group*.
- Fig. 2. „ „ side and front views of a cast.
- Fig. 3. „ „ side and front views of a specimen in the Madras Museum Collection.
- Fig. 4. „ „ Outline of a septum ;
- The last three specimens are from Odium, *Ootatoor group*.
- Fig. 5. AMMONITES DURGA, *Forbes*, p. 143, young specimen with the shell preserved, from Pondicherry, *Valudayur group*.
- Fig. 6. „ „ small specimen, a cast from Odium, *Ootatoor group*.
- Fig. 7. „ „ 7 and 7*a*, side and front views of a large grown specimen with traces of ribs on the outer periphery, 7*b*, outlines of a septum, from Odium, *Ootatoor group*; Geol. Surv. Collection.

N. B. $\alpha \beta$ indicates the umbilical suture, and $\gamma \delta$ the edge of the umbilicus.



A. W. Lawder Lith.

T. Oldham direct

Calcutta





PLATE LXXII.

- Fig. 1. AMMONITES BEUDANTI, *Brongniart*, p. 143, side view of the largest specimen in our collection, the figure is reduced to two-fifths of the actual measurement ; from Odium, *Ootatoor group*.
- Fig. 2. „ „ outline of a septum of a specimen from the same locality ; natural size ; Geol. Surv. Collection.

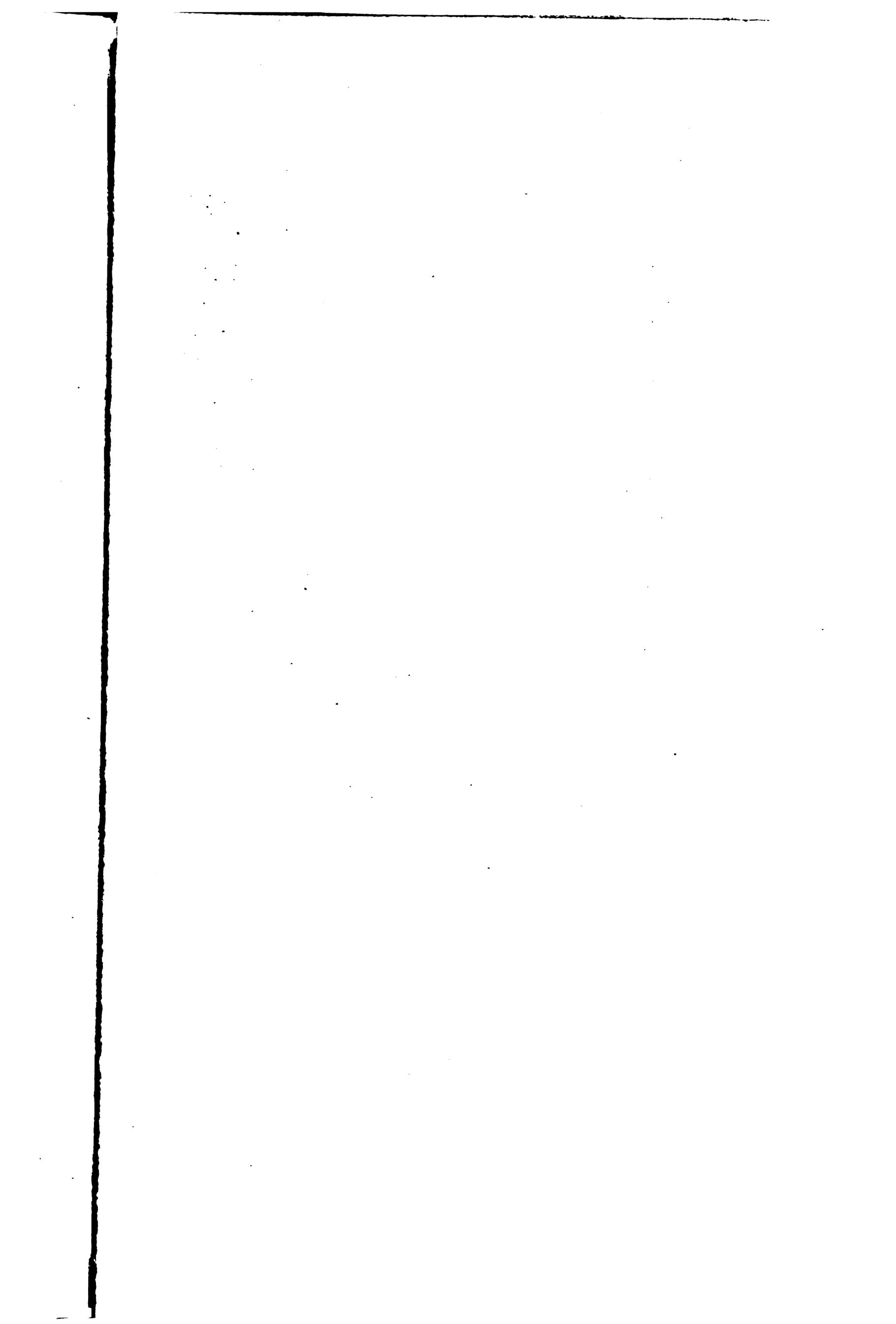


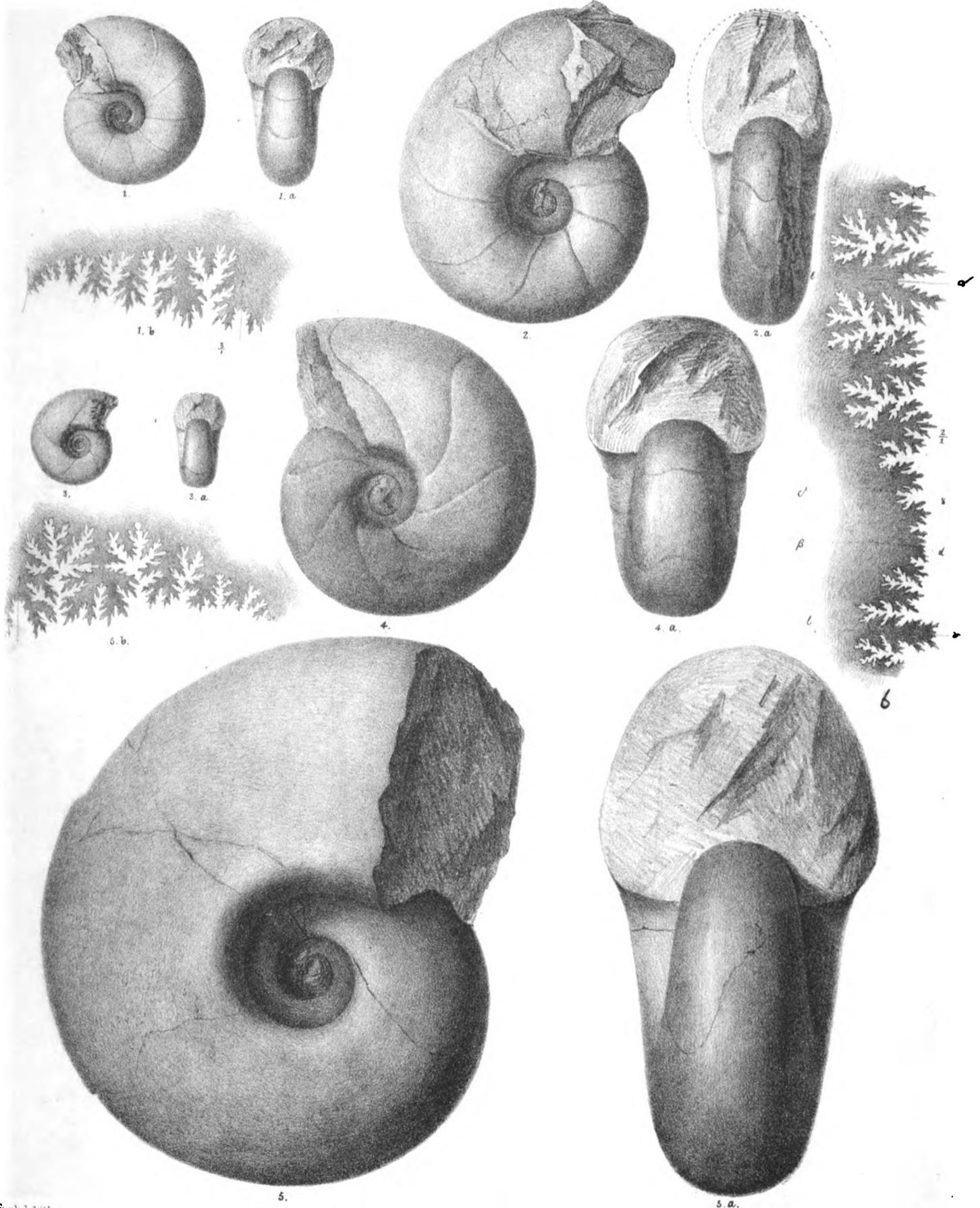




PLATE LXXIII.

- Fig. 1. **AMMONITES ALIENUS**, *Stoliczka*, p. 144, 1 and 1*a*, side and front views of a young specimen with much rounded whorls, 1*b*, outline of a septum, enlarged three times.
- Fig. 2. " " side and front views of a larger specimen with the greater portion of the body-whorl, the true section of which is indicated in 2*a* by a dotted line.
- Both specimens are from Odium ; *Ootatoor group* ; Geol. Surv Collection.
- Fig. 3. **AMMONITES TIMOTHEANUS**, *Mayor*, p. 146, side and front views of a young specimen, a cast.
- Fig. 4. " " side and front views of a somewhat larger grown specimen, a cast from Odium ; the chief object of this figure is to shew the direction of the transverse furrows.
- Fig. 5. " " 5 and 5*a*, side and front views of the largest specimen ; hardly a trace of the transverse furrows is visible, 5*b*, outline of a septum of the same.
- Fig. 6. " " outline of a septum in the entire circuit of the whorl, *dl* indicating the siphonal saddle, *vl* the ventral lobe, α β the umbilical suture and γ δ the edge of the umbilicus.

All specimens from the neighbourhood of Odium, *Ootatoor group* ; Geol. Surv. Collection.



E. Sunkel Lith.

T. Oldham direx^t

Calcutta.



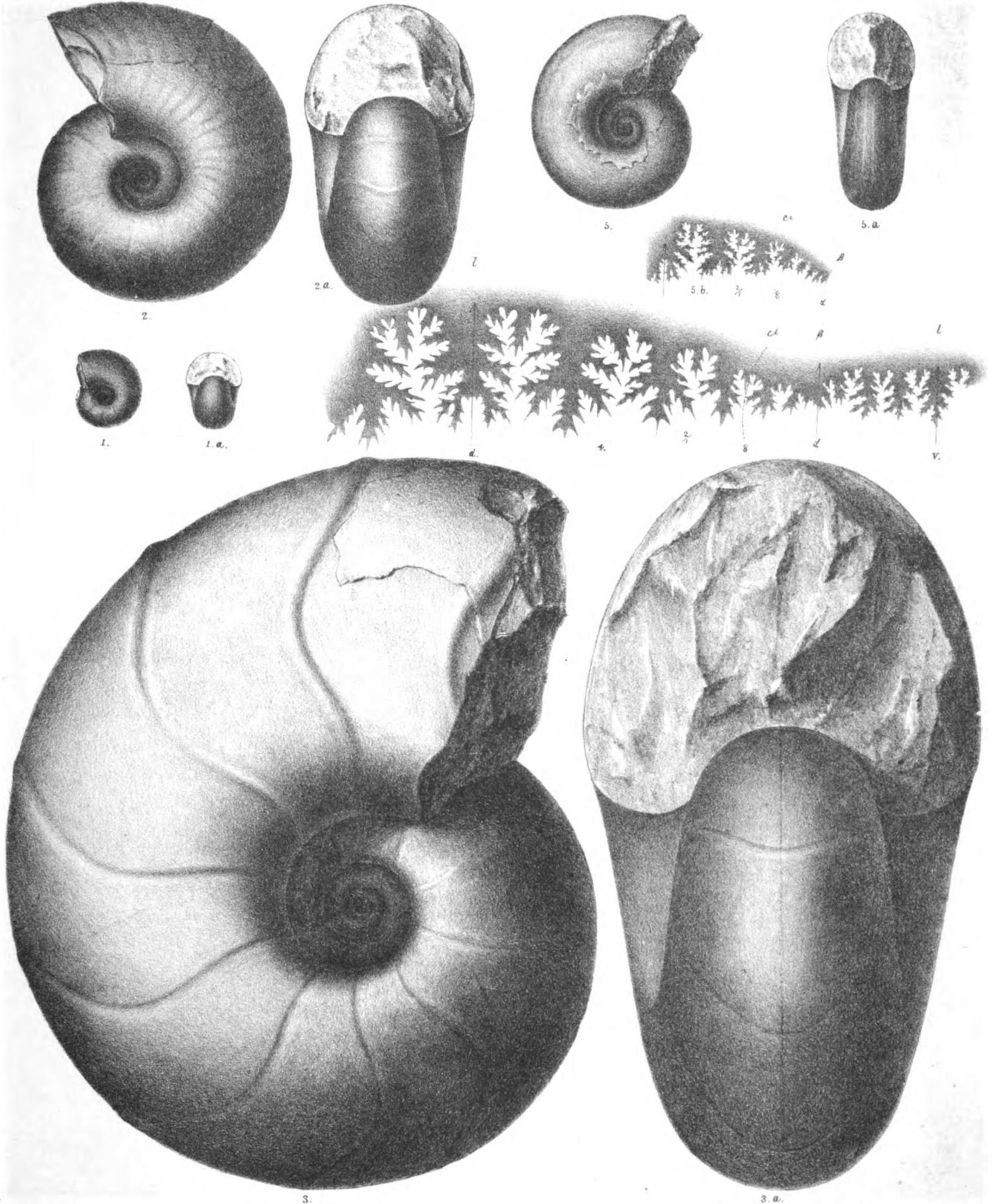


PLATE LXXIV.

- Fig. 1. *AMMONITES LATIDORSATUS*, *Michelin*, p. 148, side and front views of a very young specimen, the edge of the umbilicus in which is quite sharp.
- Fig. 2. „ „ side and front views of a middle size specimen with numerous slight ribbings in place of the striæ of growth.
- Fig. 3. „ „ side and front views of a large specimen, a cast, on which the transverse furrows are especially distinct.
- Fig. 4. „ „ outline of a septum all round the whorl, *dl* indicates the siphonal saddle, *vl* the ventral lobe, *a β* the umbilical suture, *γ δ* the edge of the umbilicus; the figure is enlarged twice the actual measurement.

All specimens are from the neighbourhood of Moraviatoor, *Ootatoor group*; Geol. Surv. Collection.

- Fig. 5. *AMMONITES GARUDA*, *Forbes*, p. 149, 5 and 5*a*, side and front views, 5*b* twice enlarged outline of a septum; *a β* umbilical suture, *γ δ* edge of umbilicus; Pondicherry; *Valudayur group*; Madras Museum Collection.



A.W. Lawder Lith.

T. Oldham del.

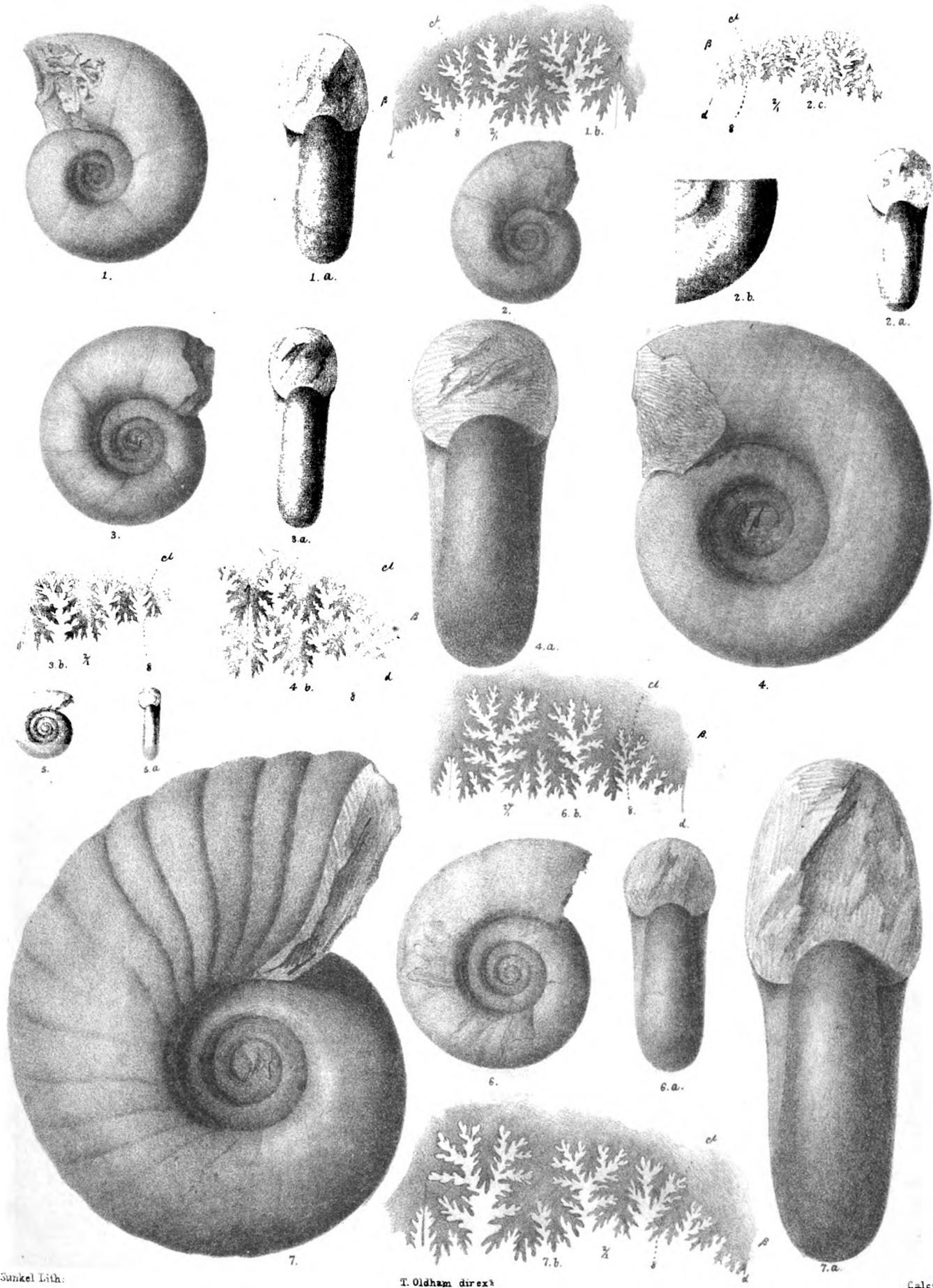
Calcutta



PLATE LXXV.

- Fig. 1. *AMMONITES INVOLUTUS*, *Stoliczka*, p. 150. Fig. 1 *b*, shews the outline of a septum enlarged to twice the actual measurement. Odium: *Ootatoor group*; Geol. Surv. Collection.
- Fig. 2. *AMMONITES MADRASPATANUS*, *Blanford*, p. 151. Fig. 2 *b*, shews a portion of the whorls enlarged to twice the measurements, to shew the fine striation more distinctly. Fig. 2 *c*. is also twice enlarged. Neighbourhood of Odium; *Ootatoor group*; Geol. Surv. Collection.
- Fig. 3. *AMMONITES REVELATUS*, *Stoliczka*, p. 152. In Fig. 3 *b*, the outline has been enlarged to twice the actual measurements. Shutanure: *Ootatoor group*; Geol. Surv. Collection.
- Fig. 4. *AMMONITES COLA*, *Forbes*, p. 153. A cast; the striation on the inner whorl has been restored from another specimen, with the shell. South of Shutanure: *Ootatoor group*; Geol. Surv. Collection.
- Fig. 5. *AMMONITES SACYA*, *Forbes*, p. 154. A young specimen, a cast only from the yellowish sandstones near Odium.
- Fig. 6. " " Regular form, with the air chambers only; from Odium.
- Fig. 7. " " A complete specimen, the inner whorls of which have been restored from an entire cast. From earthy limestone near Odium. All from the *Ootatoor group*. Geol. Surv. Collection.

N. B.— α β always indicate the umbilical suture, and γ δ the edge of the umbilicus; the arrow is in the place of the Siphon.



E. Sunkel Lith.

T. Oldham direct

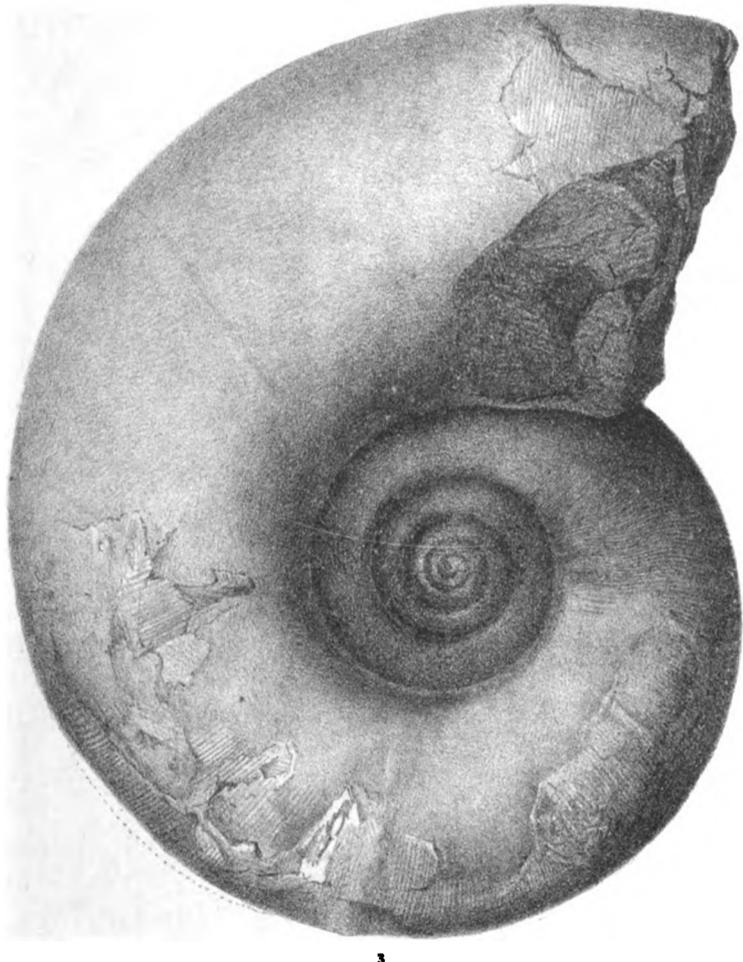
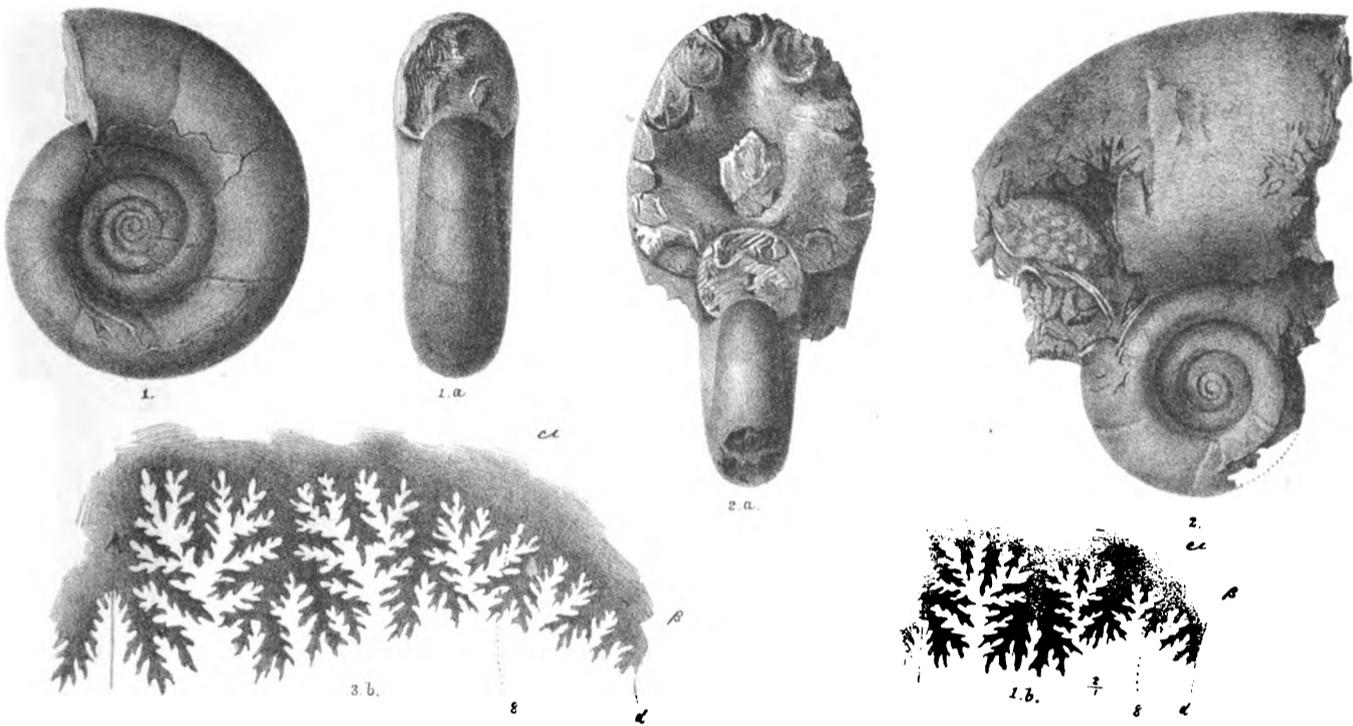
Calcutta.





PLATE LXXVI.

- Fig. 1 AMMONITES SACYA, *Forbes*, p. 154. var *multiplexus*; with a large number of inner whorls, and a portion of the body whorl.
- Fig. 2. „ „ A fragmentary specimen shewing, in Fig. 2a, the difference in the section of the outer and inner whorls.
- Fig. 3. „ „ A large specimen containing the air-chambers only, with numerous fine striæ, and a few distant sulci, indicating stages of growth.
- All the specimens are from the neighbourhood of Odium; *Ootatoor* group; Geological Survey Collection.
- $\alpha \beta$ indicates the umbilical suture, and $\gamma \delta$ the edge of the umbilicus.



E. Sunkel lith.

T. Oldham direx.

Calcutta.

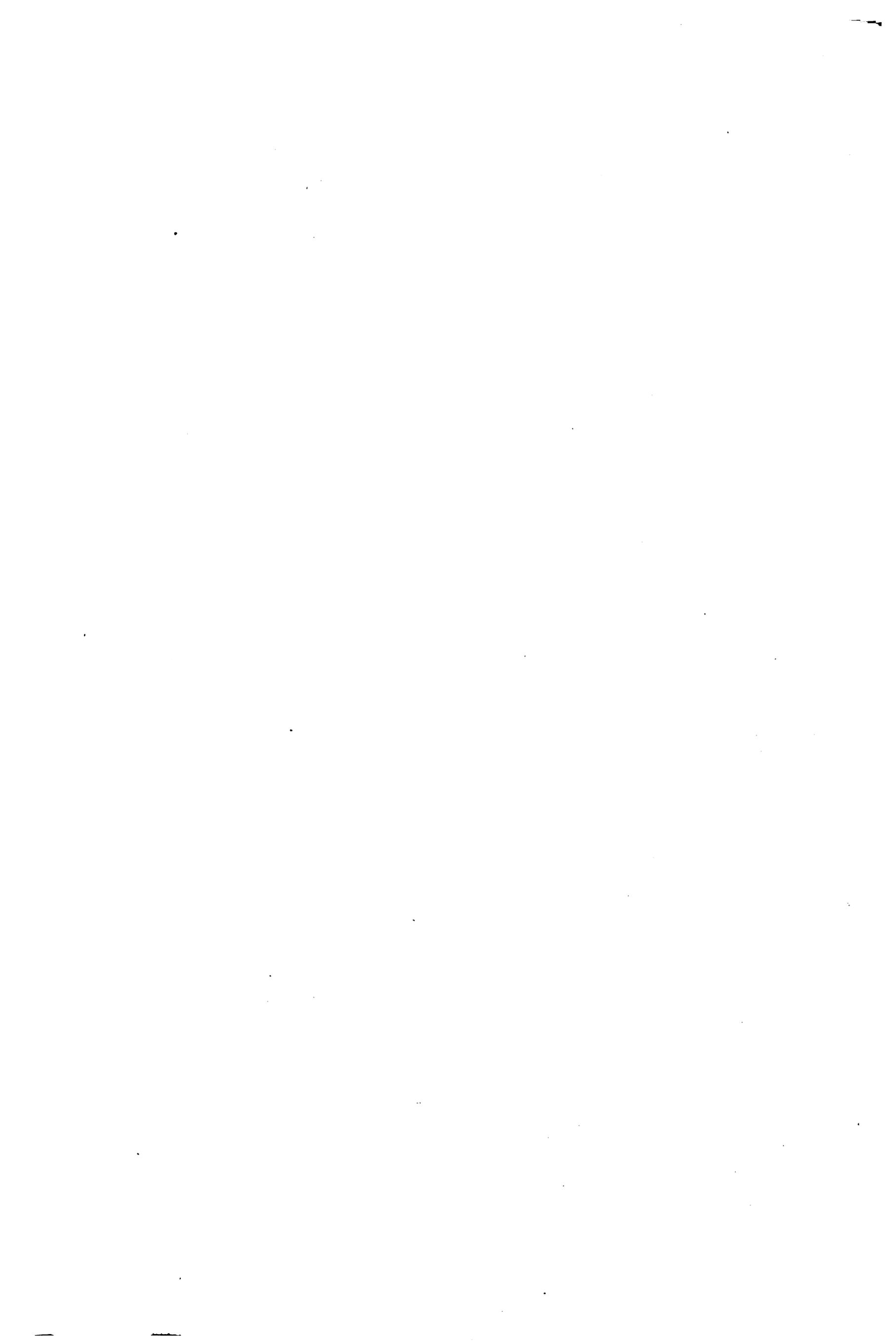
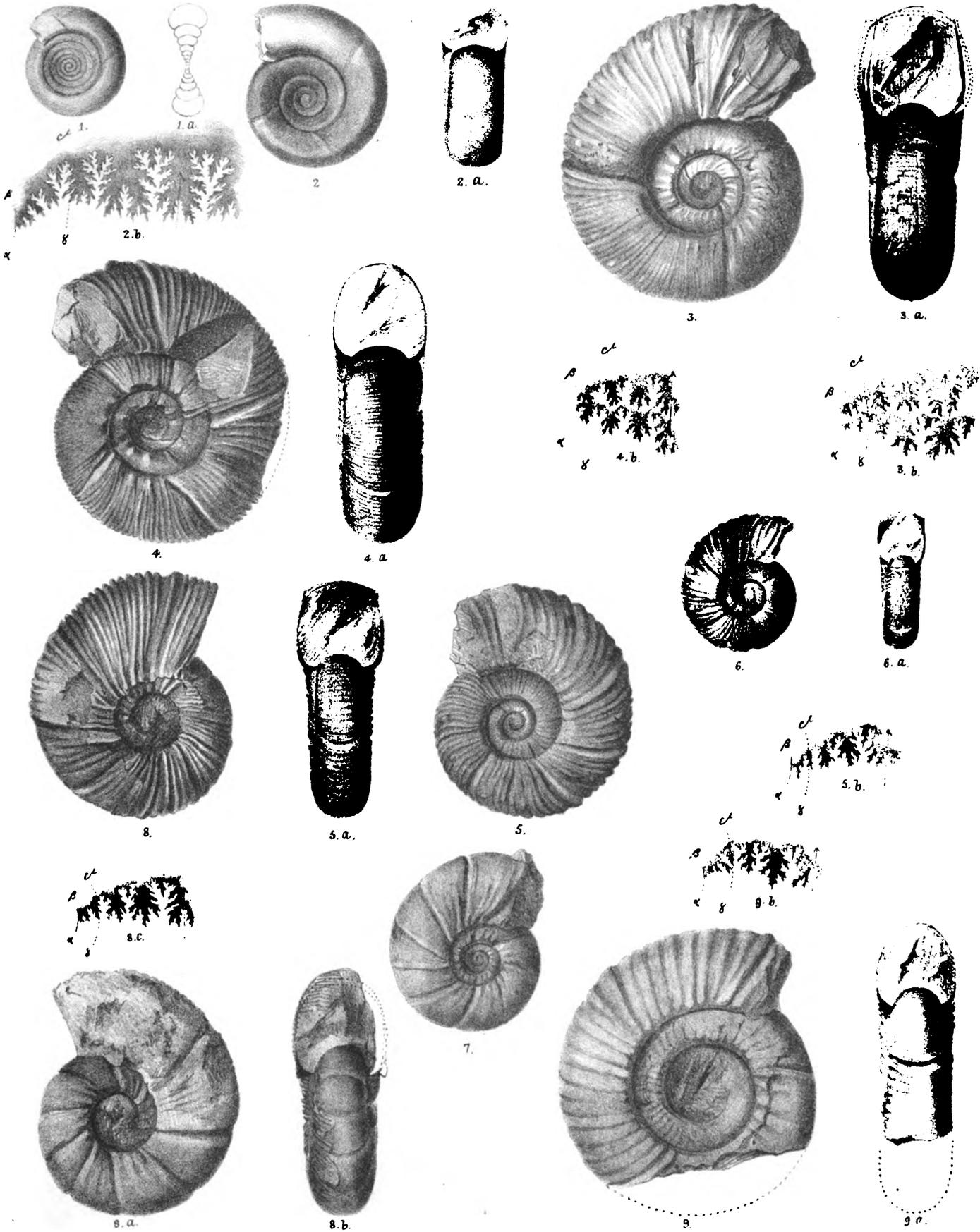




PLATE LXXVII.

- Fig. 1. AMMONITES KAYEI, *Forbes*, p. 156. A small specimen with a great number of whorls; from Odium.
- Fig. 2. „ „. A larger specimen with a smaller number of whorls. In Fig. 2*b* the outline has been enlarged three times. From Odium; *Ootatoor group*; Geological Survey Collection.
- Fig. 3. AMMONITES CLIVEANUS, *Stoliczka*, p. 157. The eccentricity of the siphuncle is seen in Fig. 3*a*. From near Moraviatoor; *Ootatoor group*; Geological Survey Collection.
- Fig. 4. AMMONITES MORAVIATOORENSIS, *Stoliczka*, p. 158. A larger and a smaller specimen from Garudamungalum; *Trichinopoly group*; Geological Survey Collection.
- Figs. 5—6. AMMONITES PARAVATI, *Stoliczka*, p. 158. A larger and a smaller specimen from Garudamungalum; *Trichinopoly group*; Geological Survey Collection.
- Figs. 7—8. AMMONITES PAPILLATUS, *Stoliczka*, p. 159, Fig. 7, a cast shewing numerous transverse sulci; Fig. 8, a specimen with the shell partly preserved; Fig. 8*a* the same specimen viewed from the other side and devoid of the shell. From Moraviatoor; *Ootatoor group*; Geological Survey Collection.
- Fig. 9. AMMONITES PACIFICUS, *Stoliczka*, p. 160. A cast from Vencataramapooram; *Arriuloor group*; Geological Survey Collection.

$\alpha \beta$ indicates the umbilical suture and $\gamma \delta$ the edge of the umbilicus.



E. Sunkel Lith.

T. Oldham direx^t

Calcutta.





PLATE LXXVIII.

Fig. 1. AMMONITES THEOBALDIANUS, *Stoliczka*, p. 161. Side view of a specimen with the shell preserved.

Fig. 2. „ „ A cast, specimen containing the air-chambers only.

Fig. 3. „ „ A nearly complete cast of the largest specimen known.

All the specimens are from the neighbourhood of Anapady ;
Trichinopoly group ; Geological Survey Collections.



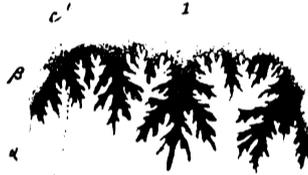
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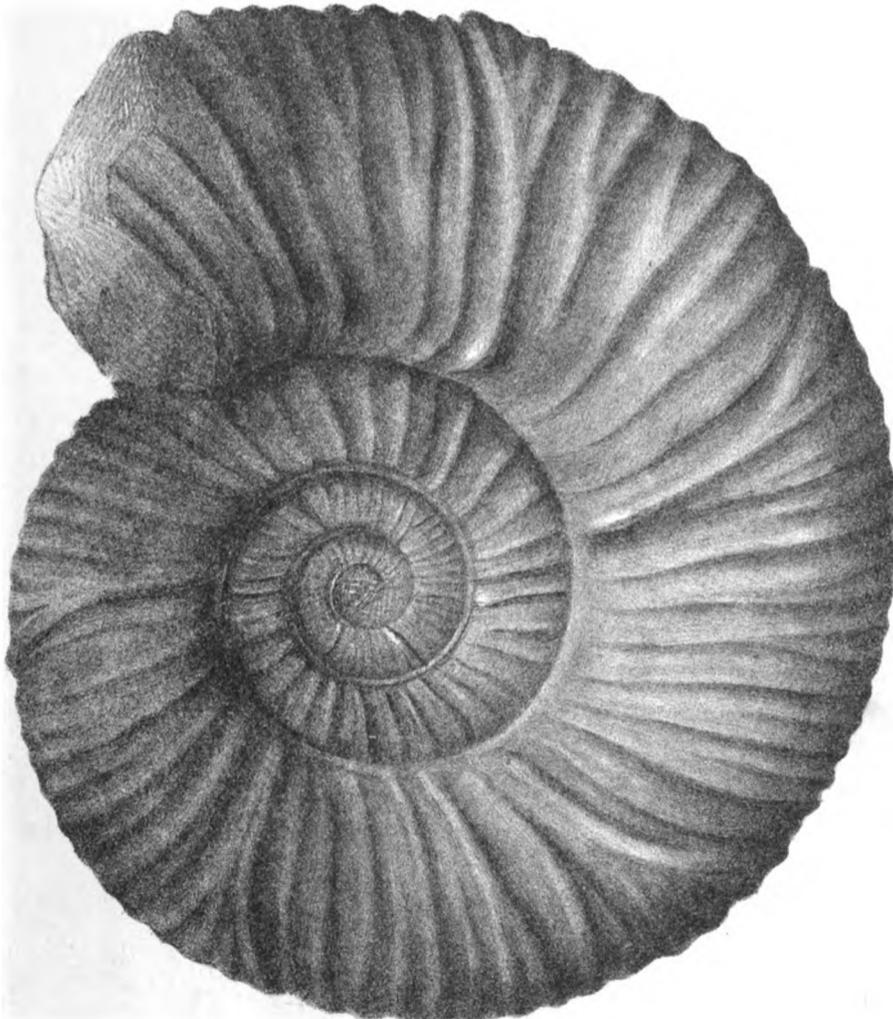
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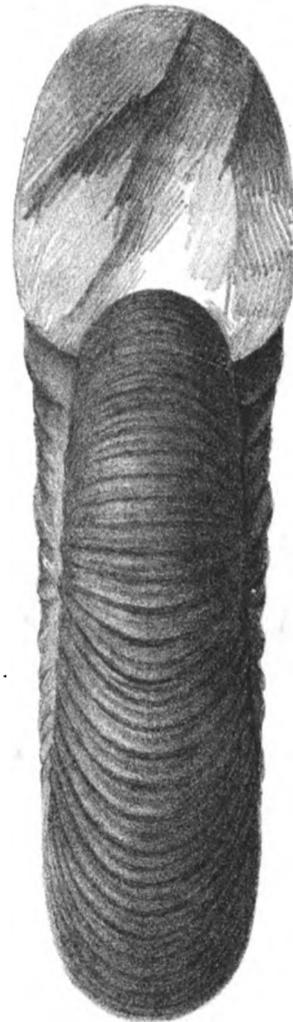
1



2. b.



3.



3. a.

E. Sunkel Lith.

T. Oldham del.

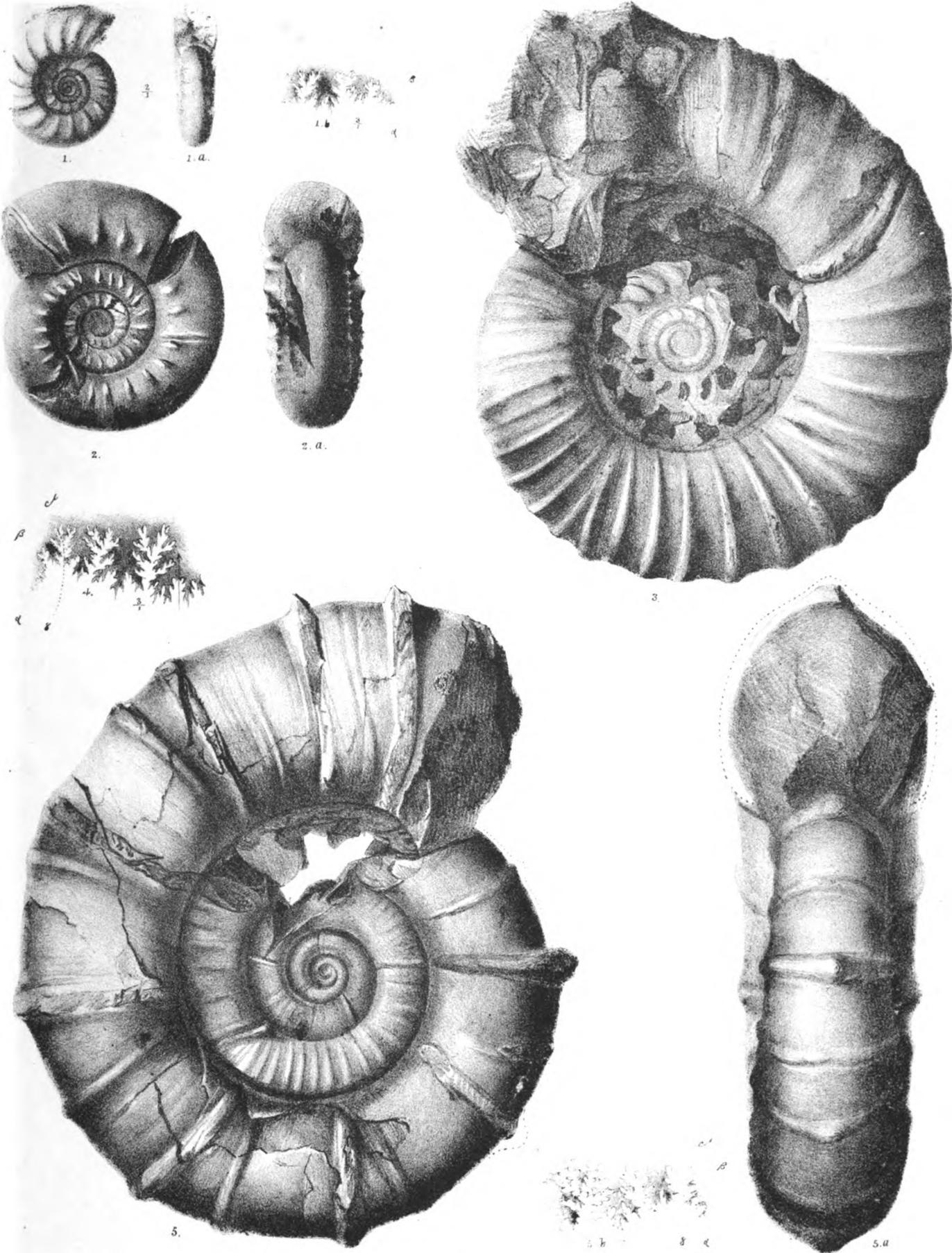
Calcutta.



PLATE LXXIX.

- Fig. 1. AMMONITES MARUT, *Stoliczka*, p. 162. From Odium, *Ootatoor group*, Geological Survey Collection.
- Fig. 2. AMMONITES BRAHMA, *Forbes*, p. 163. A young specimen with the shell preserved, containing the air-chambers only.
- Fig. 3. „ „ Side view of a large specimen, the inner whorls being, however, chiefly broken away.
- Fig. 4. „ „ Outline of a septum of a small specimen, enlarged three times.
- All these specimens are from near Pondicherry; *Valudayur group*: from the Madras Museum Collection.
- Fig. 5. AMMONITES VISHNU, *Forbes*, p. 164. Side and front view of a nearly complete specimen, with the shell, from near Pondicherry, *Valudayur group*. Madras Museum Collection.

$\alpha \beta$ indicates the umbilical suture, and $\gamma \delta$ the edge of the umbilicus.



E. Conker: Lith.

T. Oldham d. rex.

Oldham d. rex.





PLATE LXXX.

Fig. 1. AMMONITES MAHADEVA, *Stoliczka*, p. 165. Fig. 1, and 1a, side and front views; and 1b outline of a septum of a large specimen from Moraviatoor; *Ootatoor group*: Geological Survey Collection.

F

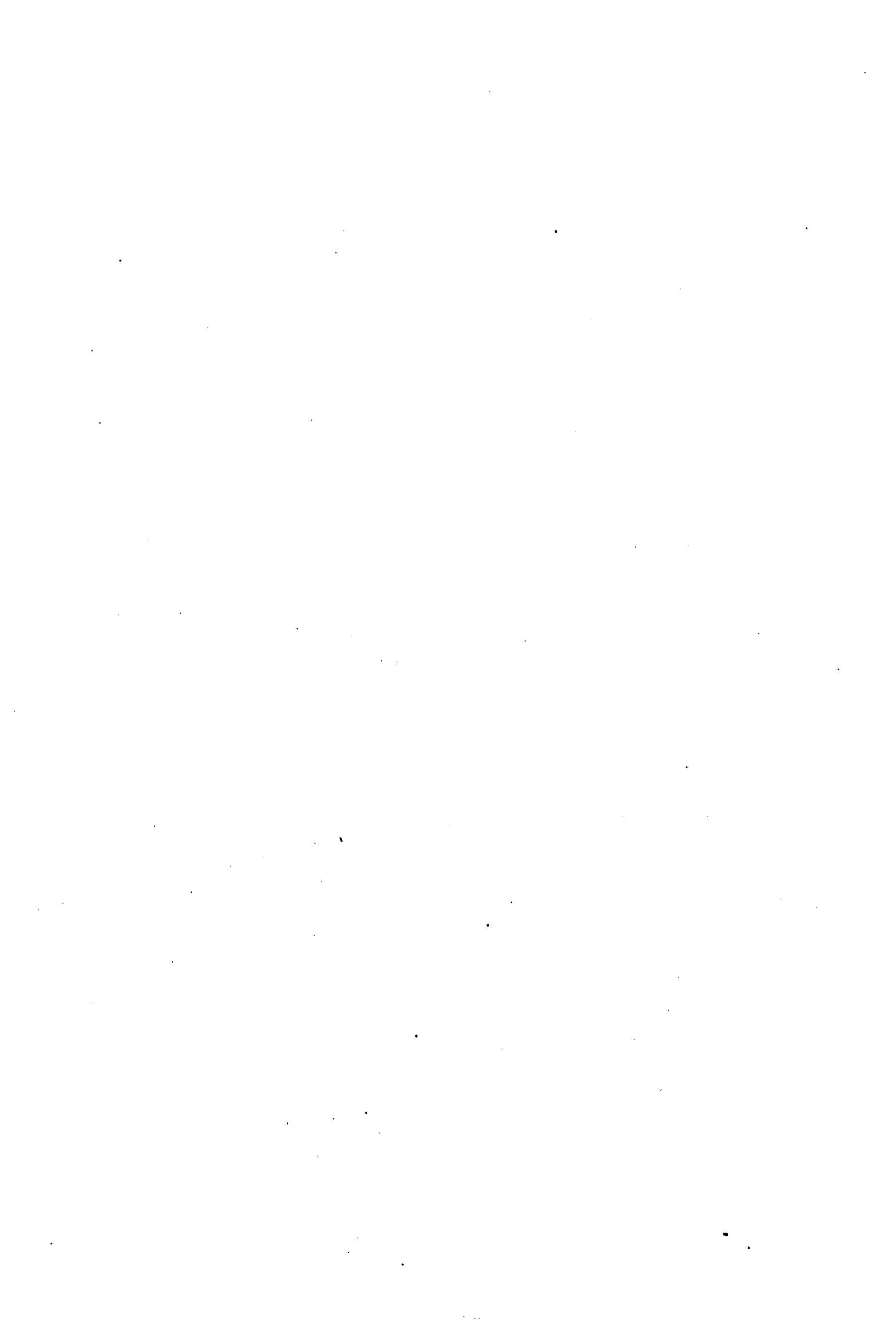
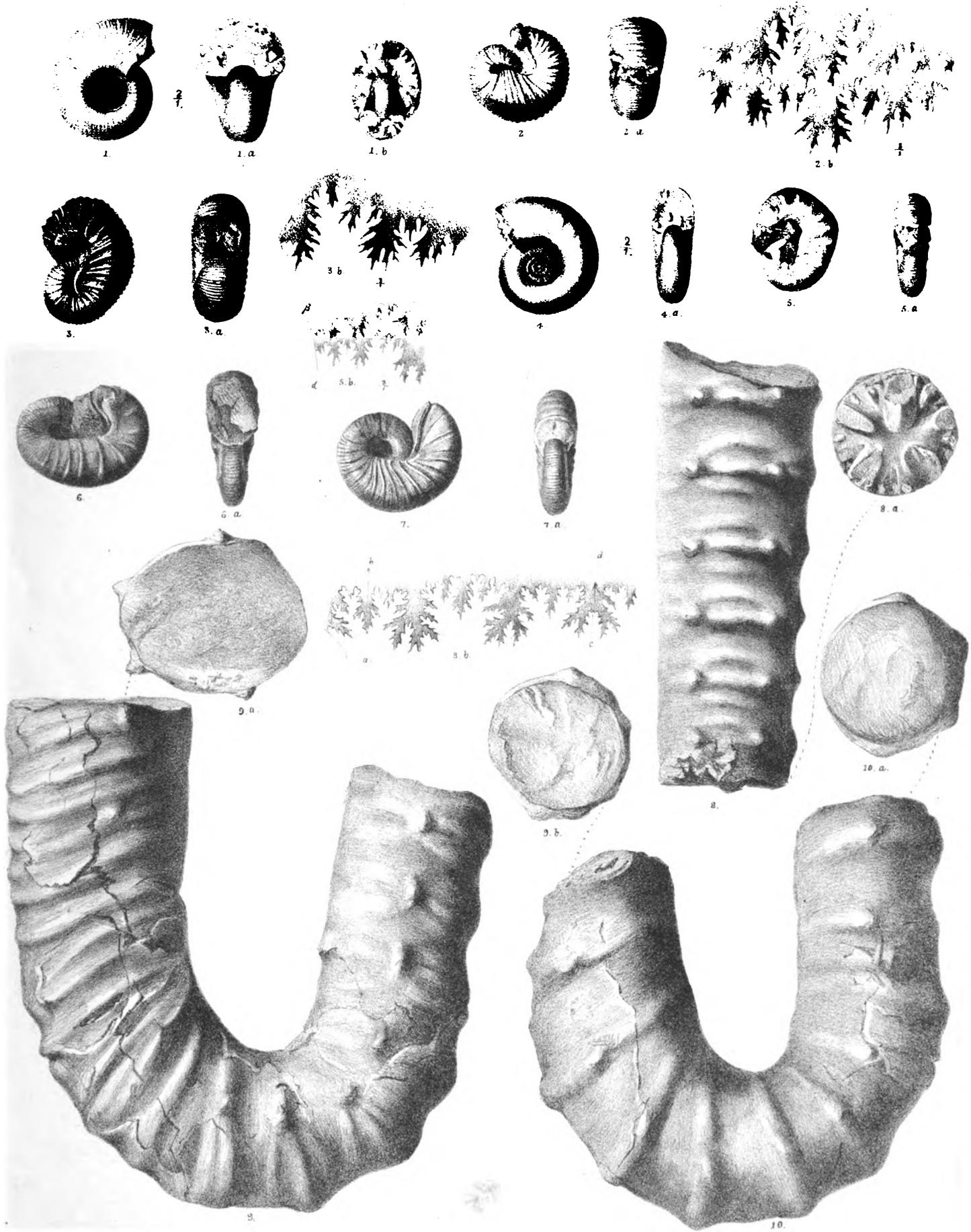


PLATE LXXXI.

- Fig. 1. SCAPHITES OBLIQUUS, *Sowerby*, p. 168. Figs. 1, and 1*a*, side and front views of the inner whorls of twice the natural size; Fig. 1*b*, front view of the same of natural size.
- Fig. 2. „ „ Figs. 2, and 2*a*, side and front views of a small but rather inflated specimen; Fig. 2*b* outlines of one septum, enlarged three times.
- Fig. 3. „ „ Figs. 3, and 3*a*, side and front views of a somewhat compressed and larger specimen. Fig. 3*b* outline of a septum, exposing a broader dorsal saddle: enlarged three times.
- Fig. 4. SCAPHITES ÆQUALIS, *Sowerby*, p. 167. Figs. 4, and 4*a*, side and front views of the inner volutions, of twice the actual measurements.
- Fig. 5. „ „ Figs. 5, and 5*a*, side and front views, and 5*b* outlines of one septum enlarged three times.
- Fig. 6. „ „ Figs. 6, and 6*a*, side and front views of a large specimen.
- Fig. 7. SCAPHITES KINGIANUS, *Stoliczka*, p. 169. Figs. 7, and 7*a*, side and front views of a complete specimen.
- Fig. 8. ANISOCERAS ARMATUM, *Sowerby*, sp. p. 172. A portion of the shell of the upper bent portion; 8*a* section at the smaller end: 8*b* outline of a septum; *ab* indicating the internal or ventral lobe, and *cd* the siphonal or dorsal saddle.
- Fig. 9. „ „ Side view of the upper bent portion of the shell; 9*a* and 9*b* being views of the sections at the terminations. (N. B.—The dotted line under 9*b* is not correctly placed.)
- Fig. 10. „ „ Side view of another fragment with fewer and more simple ribs; 10*a* a sectional view.

All the figured specimens are from the neighbourhood of Odium; *Ootatoor* group: Geological Survey Collection.



E. Sunkel Lith.

T. Oldham direct.

C. G. ...

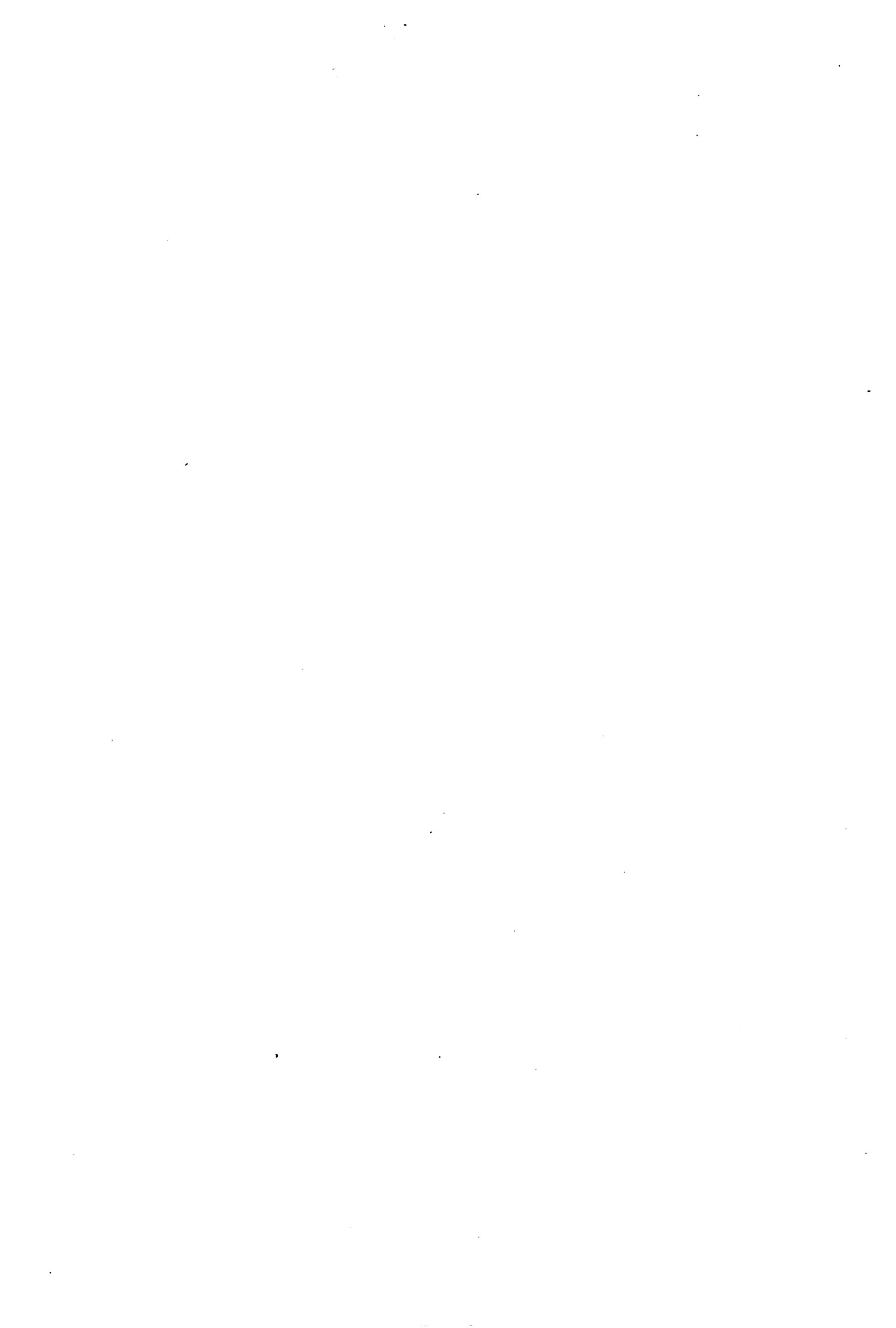


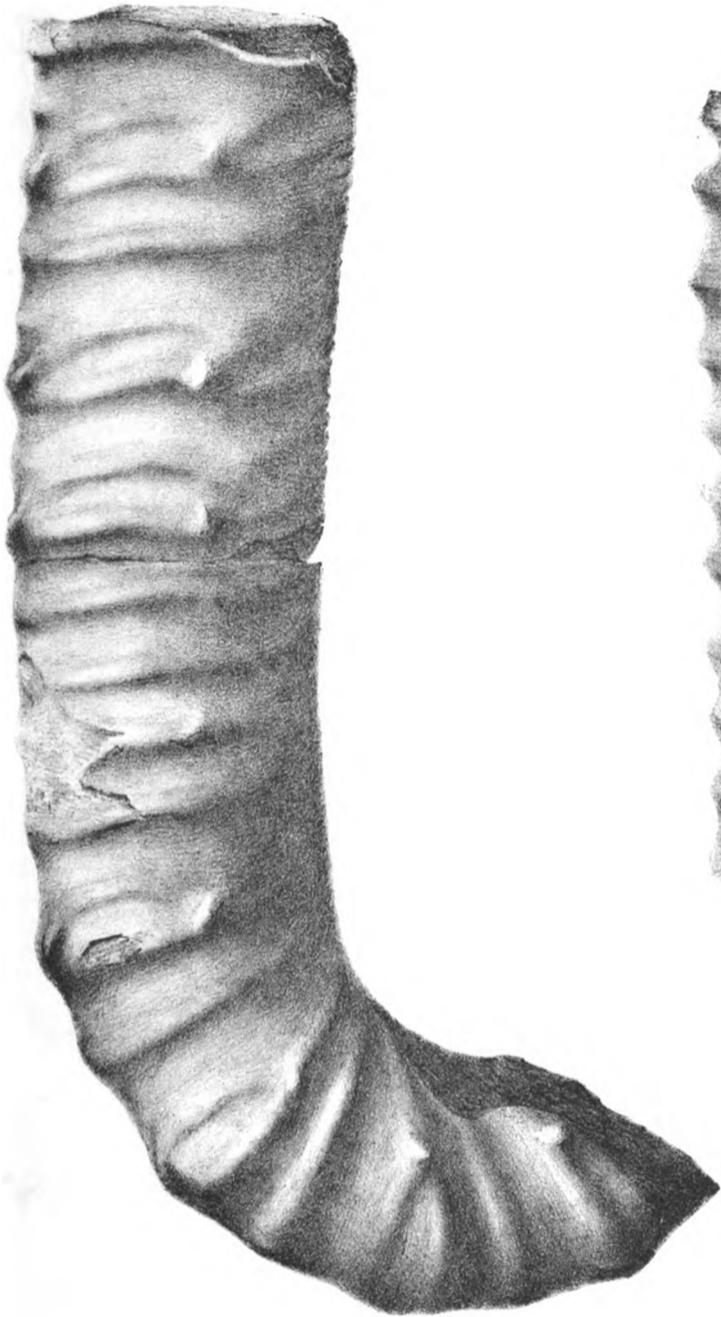


PLATE LXXXII.

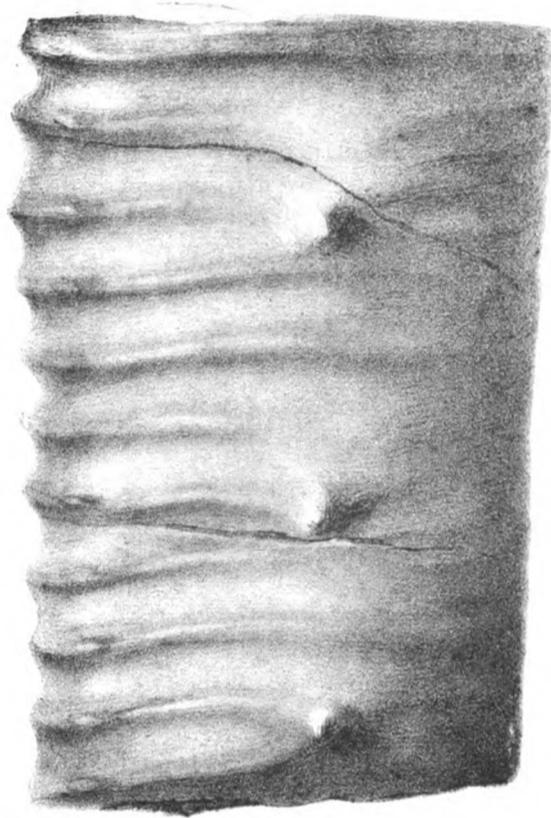
Fig. 1. ANISOCERAS ARMATUM, *Sowerby*, sp. p. 172. Fig. 1 side view of a large fragment of the body-chamber: 1a sectional view of the upper termination: 1b a portion of the ventral, and 1c a portion of the dorsal, view.

Fig. 2. „ „ Fig. 2. Side view of a portion of the body-chamber of a very large specimen, shewing the large size of the inner row of tubercles, and the gradual disappearance of the outer row.

Both specimens are from the neighbourhood of Moraviatoor; *Ootatoor group*: Geological Survey Collection.



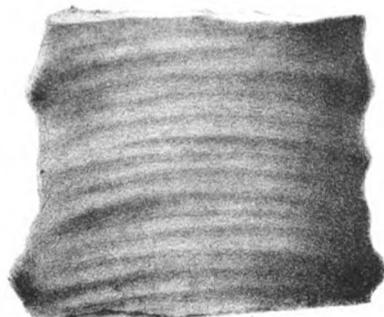
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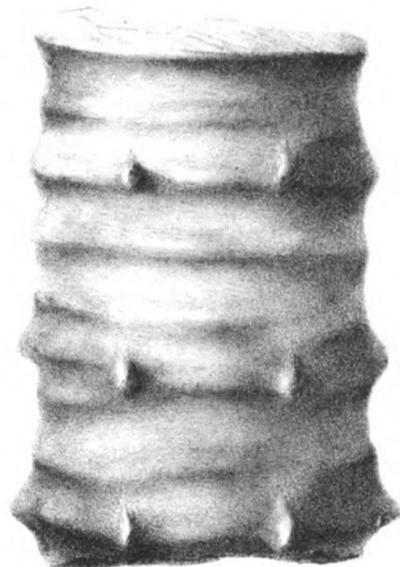
2.



1.a



1.b



1.c

Calcutta.

T Oldham direct

Calcutta.



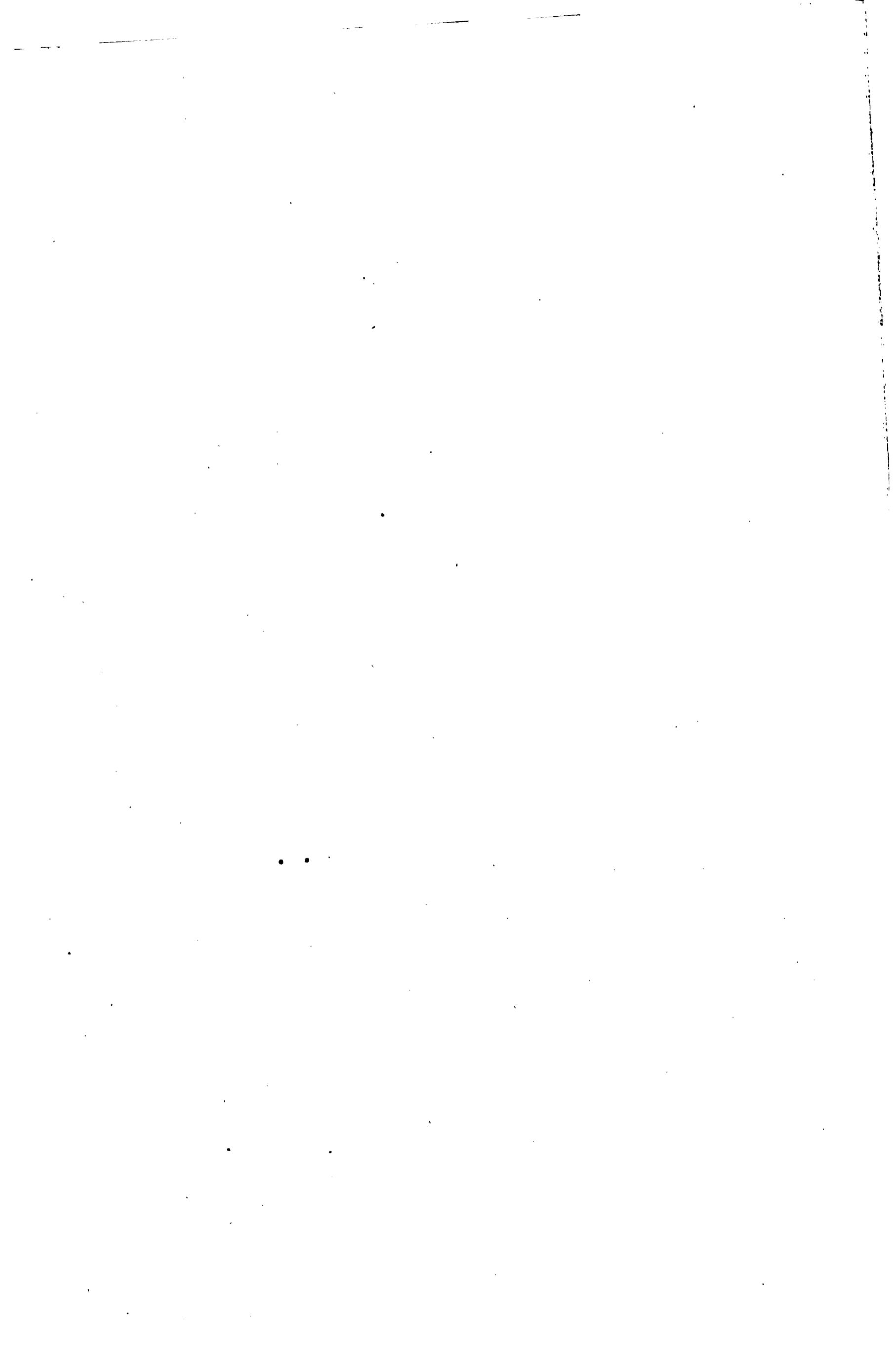
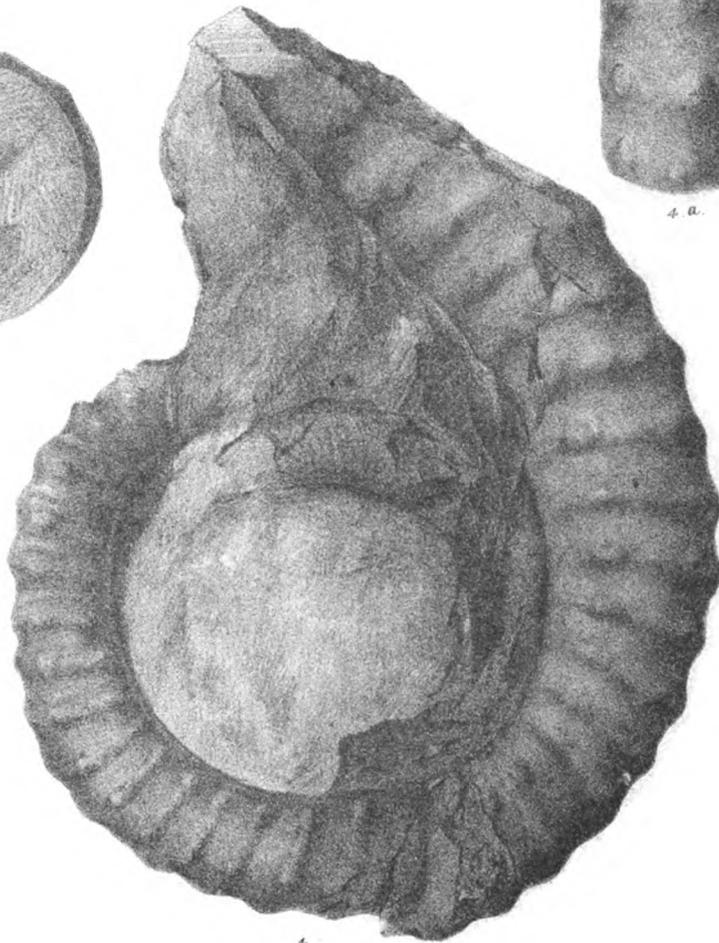
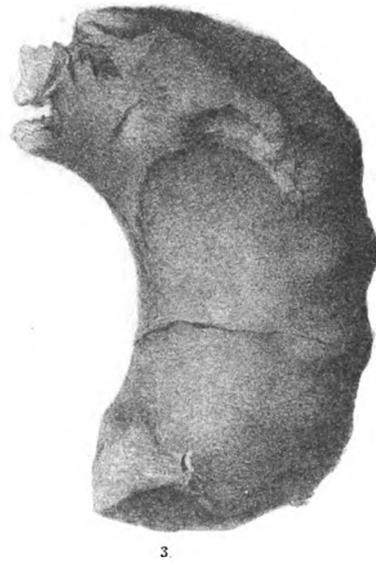
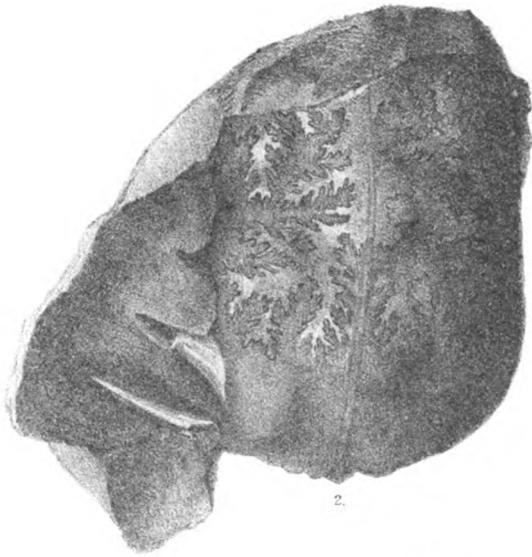
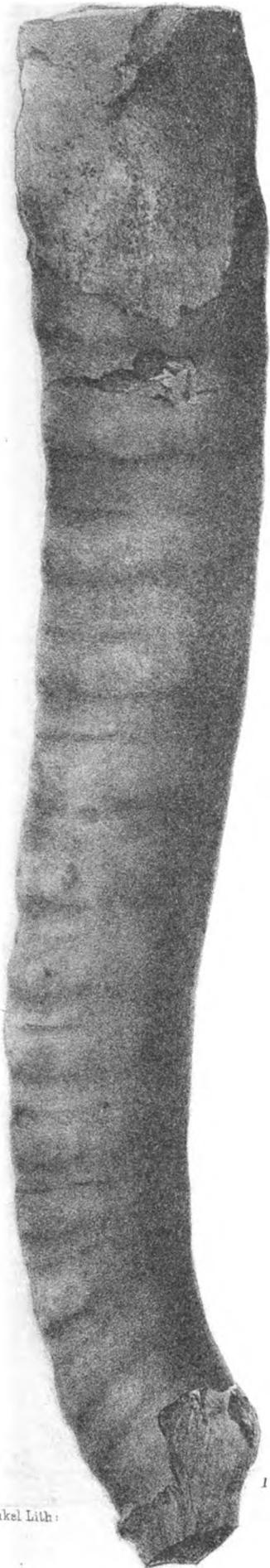
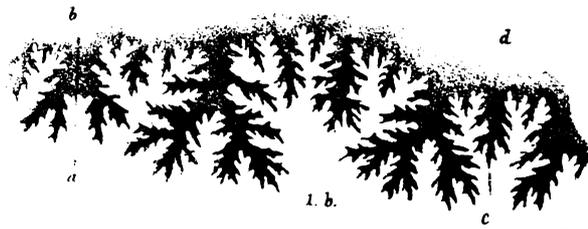


PLATE LXXXIII.

- Fig. 1. ANISOCERAS OLDHAMIANUM, *Stoliczka*, p. 175. Figs. 1 and 1a side view and section of the prolonged portion of the shell: 1b outline of a septum, ab indicating the siphonal saddle, and cd the ventral lobe.
- Fig. 2. „ „ Back view of a portion of the shell on which the lateral spines, and the extreme foliations of the dorsal saddle are visible.
- Fig. 3. „ „ A portion of the shell from the bend of the prolonged part.
- Fig. 4. „ „ Side view of a part of the coiled portion of the shell, having been in one place broken, and re-cemented again; 4a is part of the back view, where the shell begins to leave the spiral direction.

All from the neighbourhood of Odium; *Ootatoor group*:
Geological Survey Collection.



Sankel Lith.

T. Oldham dux*

Calcutta.

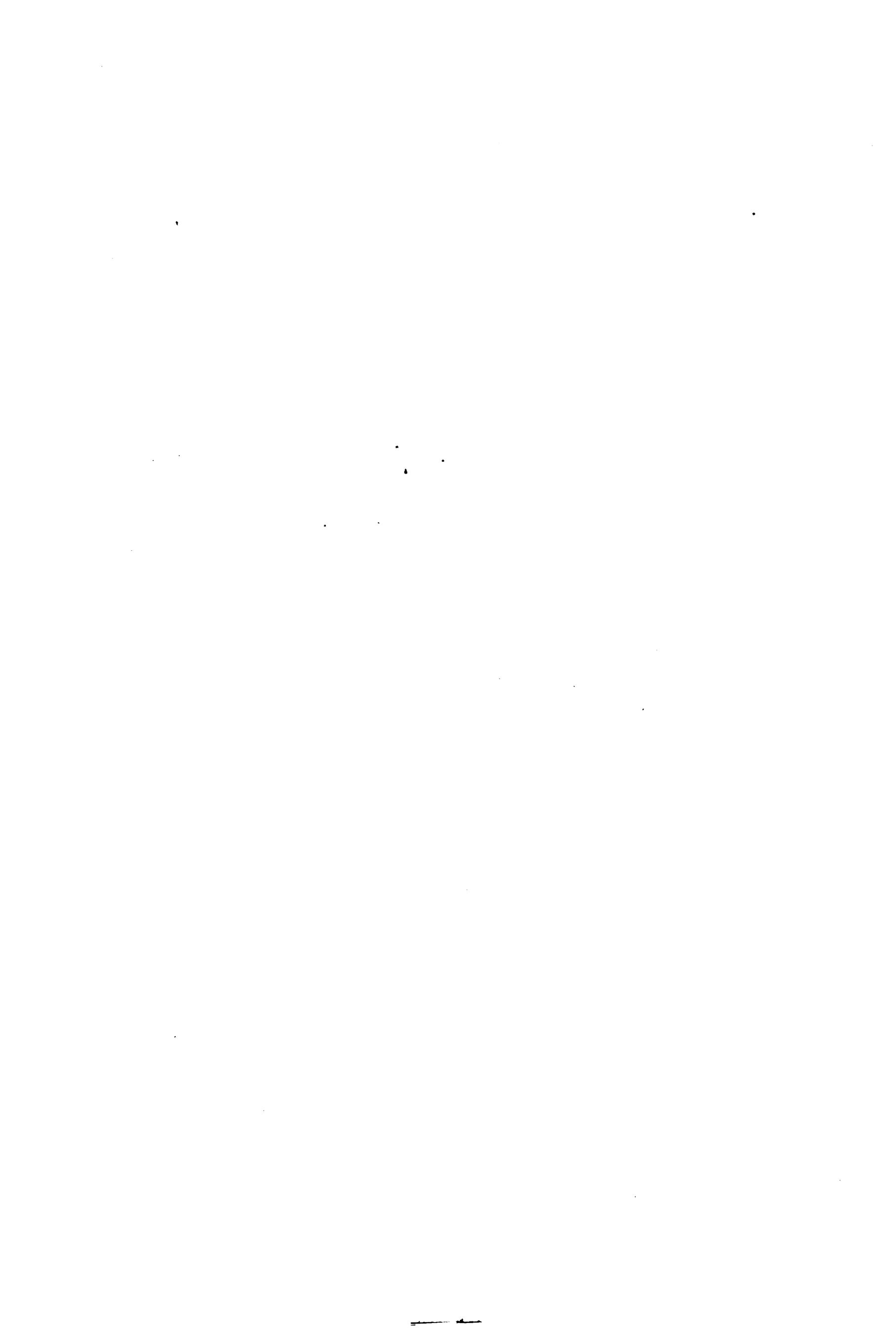


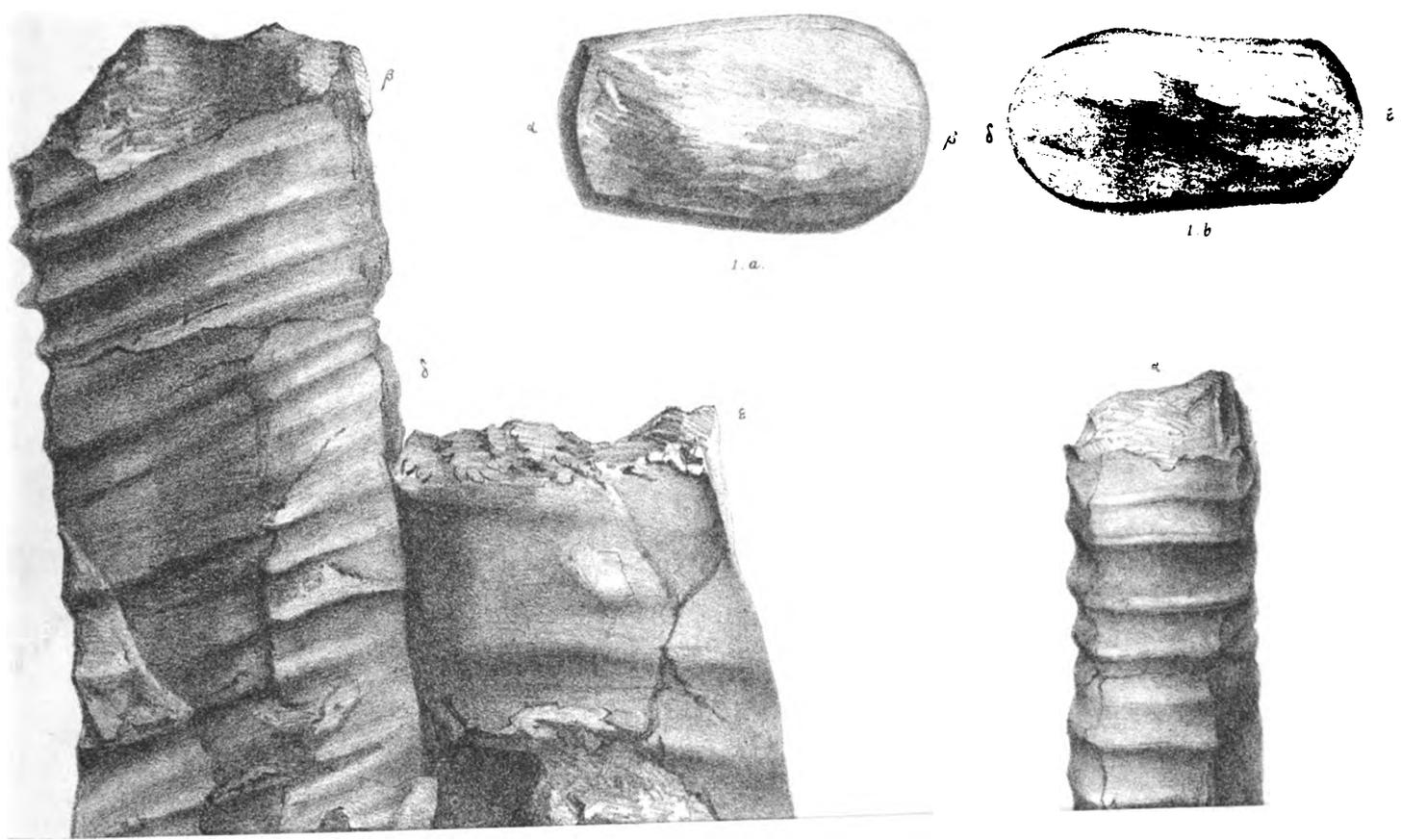


PLATE LXXXIV.

Fig. 1. ANISOCERAS ANGULATUM, *Stoliczka*, p. 176. Fig. 1 side view of a large bent portion of the shell consisting of the body-chamber only; 1a section at the commencement of the air-chambers; 1c dorsal view of a portion, near the mouth; 1d another dorsal view, from a point nearer to the air-chambers.

Fig. 2. „ „ Outline of a septum of another specimen, *ab* indicating the siphonal saddle, and *cd* the ventral or internal lobe; this outline has been partially restored, and must be taken as only generally correct.

Both specimens are from the yellowish sandstone near Odium; *Ootatoor group*; Geological Survey Collection.



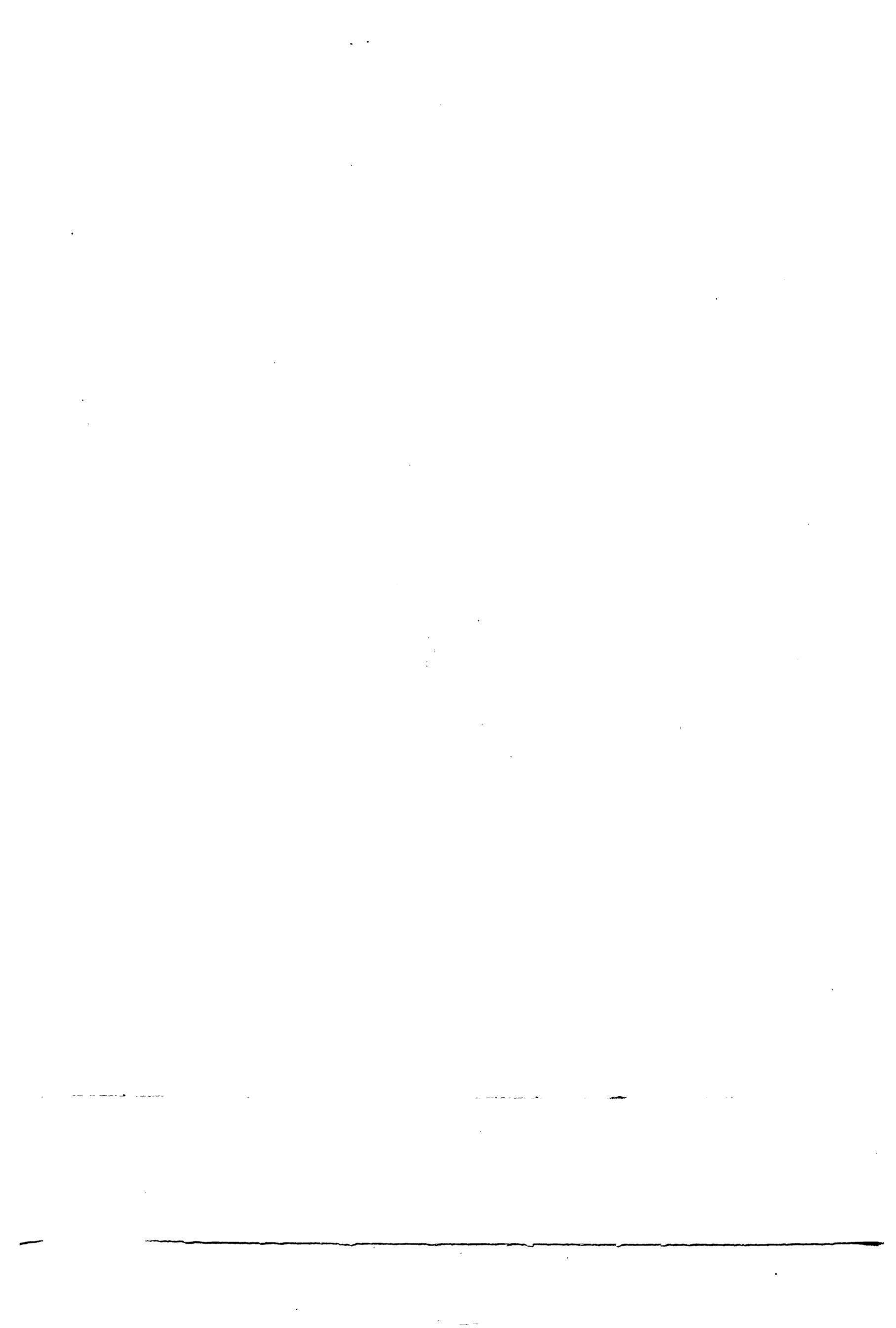




PLATE LXXXV.

- Figs. 1—5. *ANISOCERAS INDICUM*, *Forbes*, sp. p. 181. Side views and sections of different specimens, varying in size, compression, and ribbing. Fig. 3*b* is the outline of a septum, *ab* indicating the siphonal saddle, and *cd* the ventral lobe. The specimens, represented Figs. 1 to 4, are from the neighbourhood of Odium, *Ootatoor group*.
- Fig. 5, is from near Pondicherry. *Valudayur group*. Geological Survey Collection.
- Fig. 6. *ANISOCERAS UNDULATUM*, *Forbes*, sp. p. 177. Fig. 6*a* represents a small enlarged portion of the same fragment represented, Fig. 6. Fig. 6*b* is the section. From Pondicherry; *Valudayur group*.
- Fig. 7. *ANISOCERAS SUBCOMPRESSUM*, *Forbes*, sp. p. 179. Side view and section of a fragment from Pondicherry; *Valudayur group*. Geological Survey Collection.
- Figs. 8—9. *ANISOCERAS LARGE-SULCATUM*, *Forbes*, sp. p. 180. Fig. 8 fragment of the coiled portion; Fig. 8*b* outline of a septum, *ab* being the siphonal saddle, *cd* the ventral lobe. Fig. 9 a fragment of the prolonged portion of the shell. From near Pondicherry; *Valudayur group*: Madras Museum Collection.
- Figs. 10—13. *ANISOCERAS RUGATUM*, *Forbes*, sp. p. 178. The figures represent different fragments of the shell: Fig. 11 is the outline of a septum, of a small specimen, enlarged three times. From Pondicherry: *Valudayur group*: Madras Museum Collection.
- Figs. 14—16. *ANISOCERAS TENUISULCATUM*, *Forbes*, sp. p. 177. Fig. 14 is a side view of the coiled portion of the shell enlarged three times: Figs. 15 and 16 are fragments of the prolonged portion of different thickness. From near Pondicherry: *Valudayur group*. Madras Museum Collection.
- Figs. 17—18. *ANISOCERAS NEREIS*, *Forbes*, sp. p. 182. Side and back views of two fragmentary specimens, from near Odium; *Ootatoor group*. Geological Survey Collection.
- Fig. 19. *ANISOCERAS*, — sp. ? p. 179. From near Pondicherry; *Valudayur group*. Geological Survey Collection.

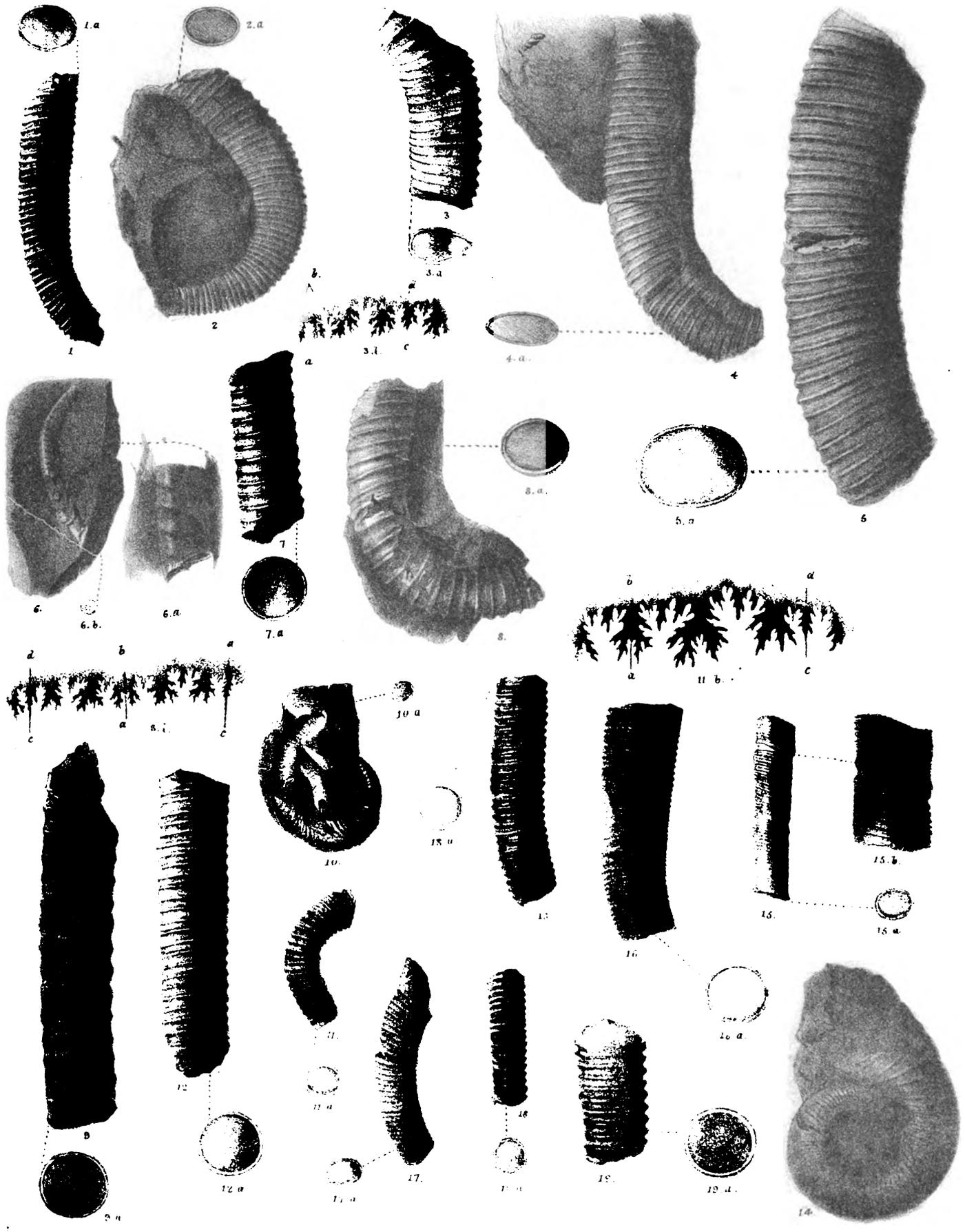


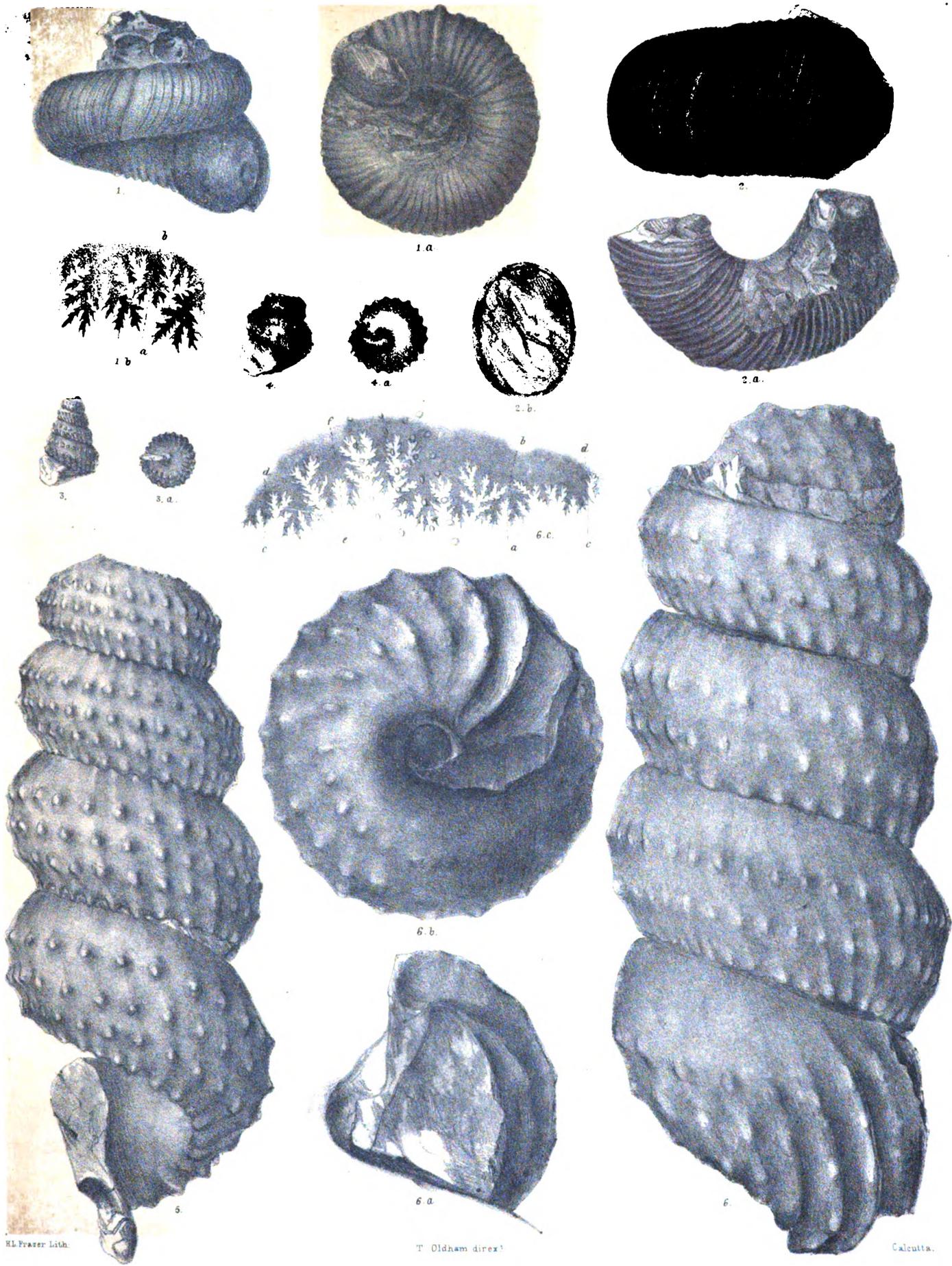
Fig. 1-20.

PLATE LXXXI

Calcutta.







H.L. Fraser Lith.

T. Oldham direx.

Calcutta.





PLATE LXXXVII.

Figs. 1—4. *TURRILITES GRESSLYI*, *Pictet et Campiche*, p. 186. Views of different specimens:

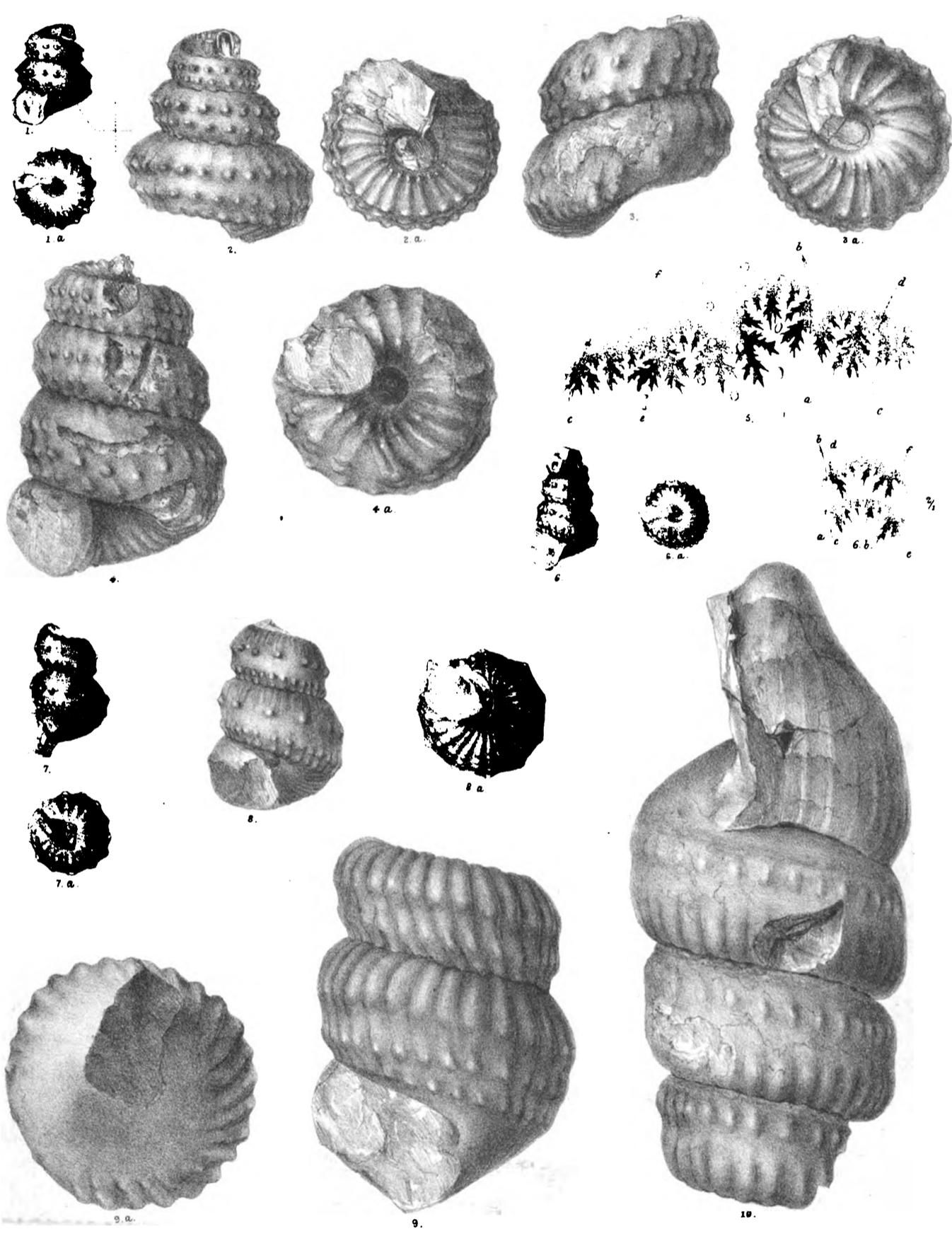
Fig. 1 is enlarged to twice the actual measurements.

Fig. 5. „ „ Outline of a septum of a large specimen, *ab* indicating the siphonal saddle, *cd* the edges of the umbilicus on either side of the whorl, and *ef* the lower edge of the periphery.

Figs. 6—7. *TURRILITES TUBERCULATUS*, *Bosc*, sp. p. 187. Views of different specimens. Fig. 6*b* shews that portion of the outlines of a septum, which lies on the exposed periphery of the whorl; it is enlarged to twice the actual measurement.

Figs. 9—10. *TURRILITES COSTATUS*, *Lamarck*, p. 188. Fig. 9*a* is the view of the base: Fig. 10 shews the thickened part of the last whorl near the mouth; the lowest row of tubercles disappears here.

All the specimens figured on this plate are from the neighbourhood of Odium; *Ootatoor group*: Geological Survey Collection.



H. L. Frazer lith.

T. Oldham direct

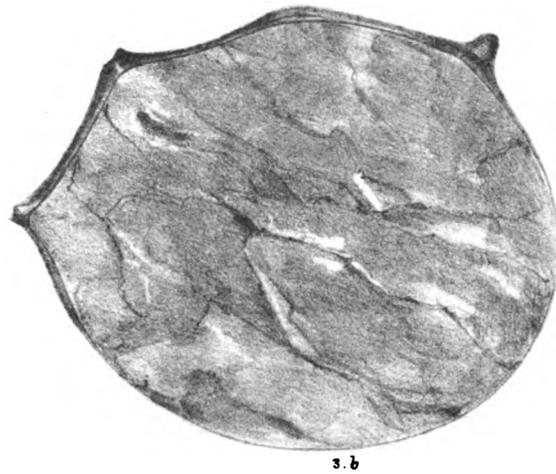
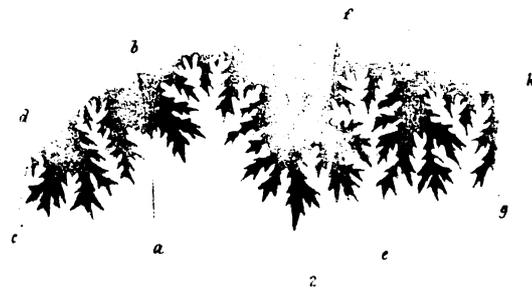
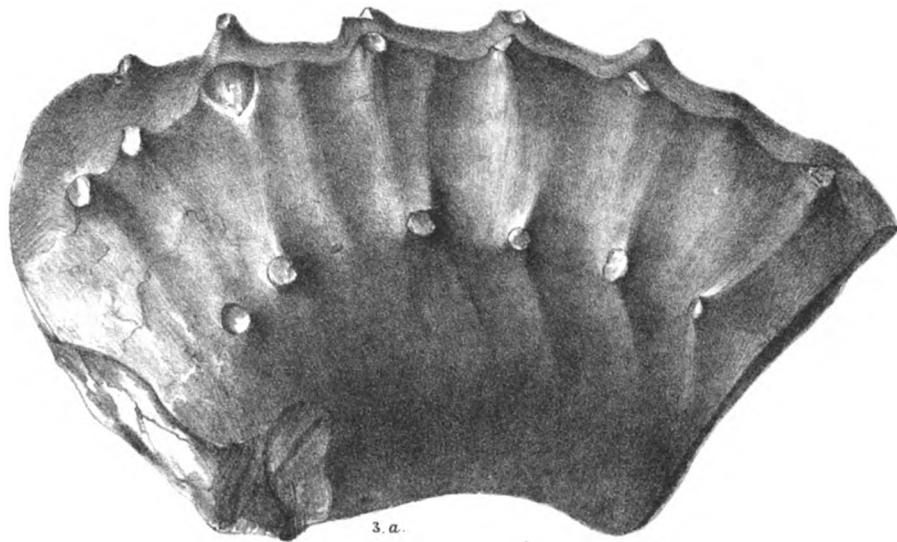
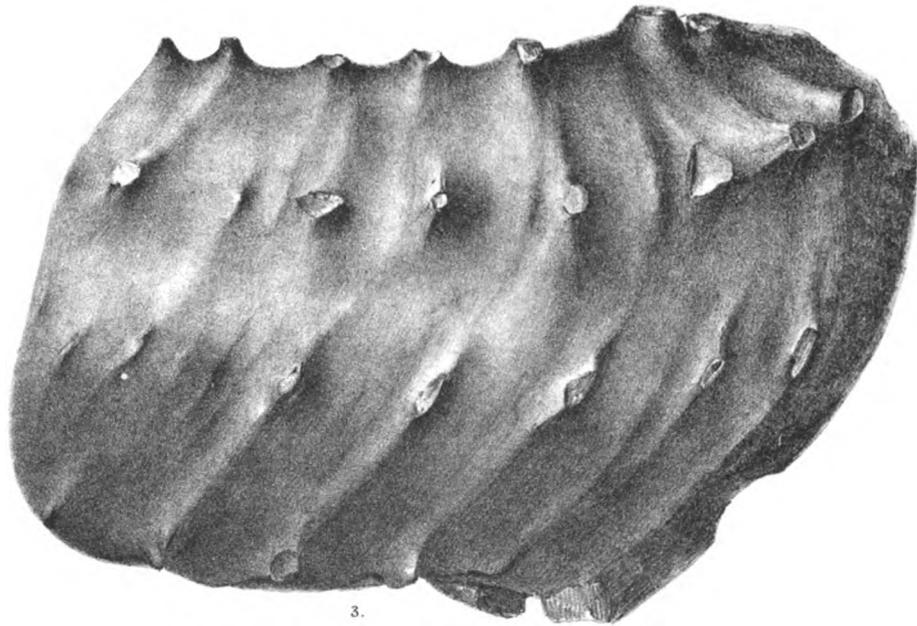
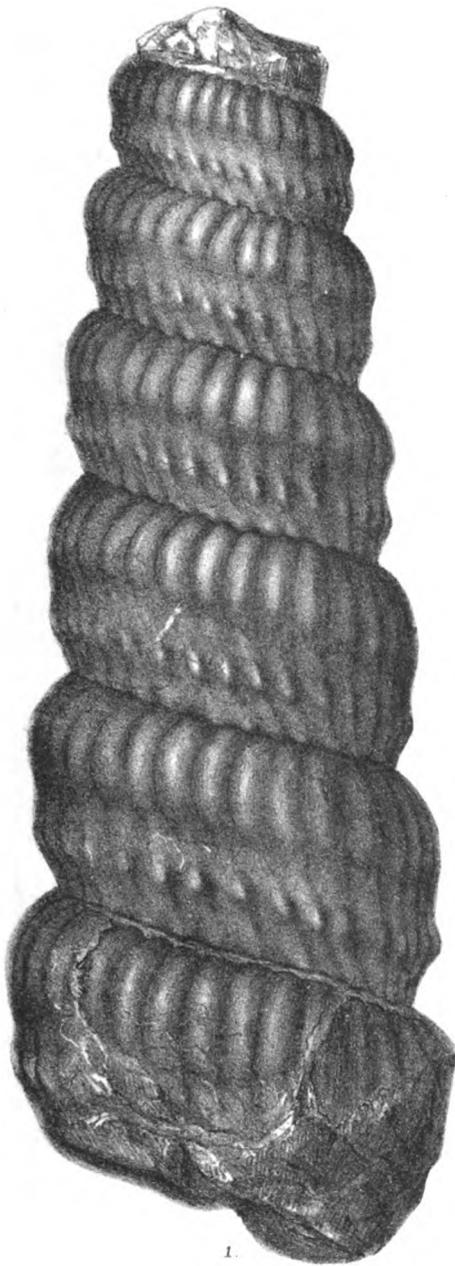
Calcutta



PLATE LXXXVIII.

- Fig. 1. *TURRILITES COSTATUS*, *Lamarck*, p. 188. Side view of a large specimen.
- Fig. 2. „ „ Outline of a septum of another large specimen, *ab* indicating the siphonal saddle, *cd* and *gh* are the edges of the umbilical suture, and *ef* the edge of the lower periphery of the shell.
- Fig. 3. *TURRILITES BRAZOENSIS*, *Roemer*, p. 189. Fig. 3, back view of a fragment, apparently from near the mouth: Fig. 3*a* upper view, and 3*b* sectional view, of the same.

Moraviator : *Ootator* group : Geological Survey Collection.



H. L. Frazer Lith.

H. Bidham sculp.

Calcutta



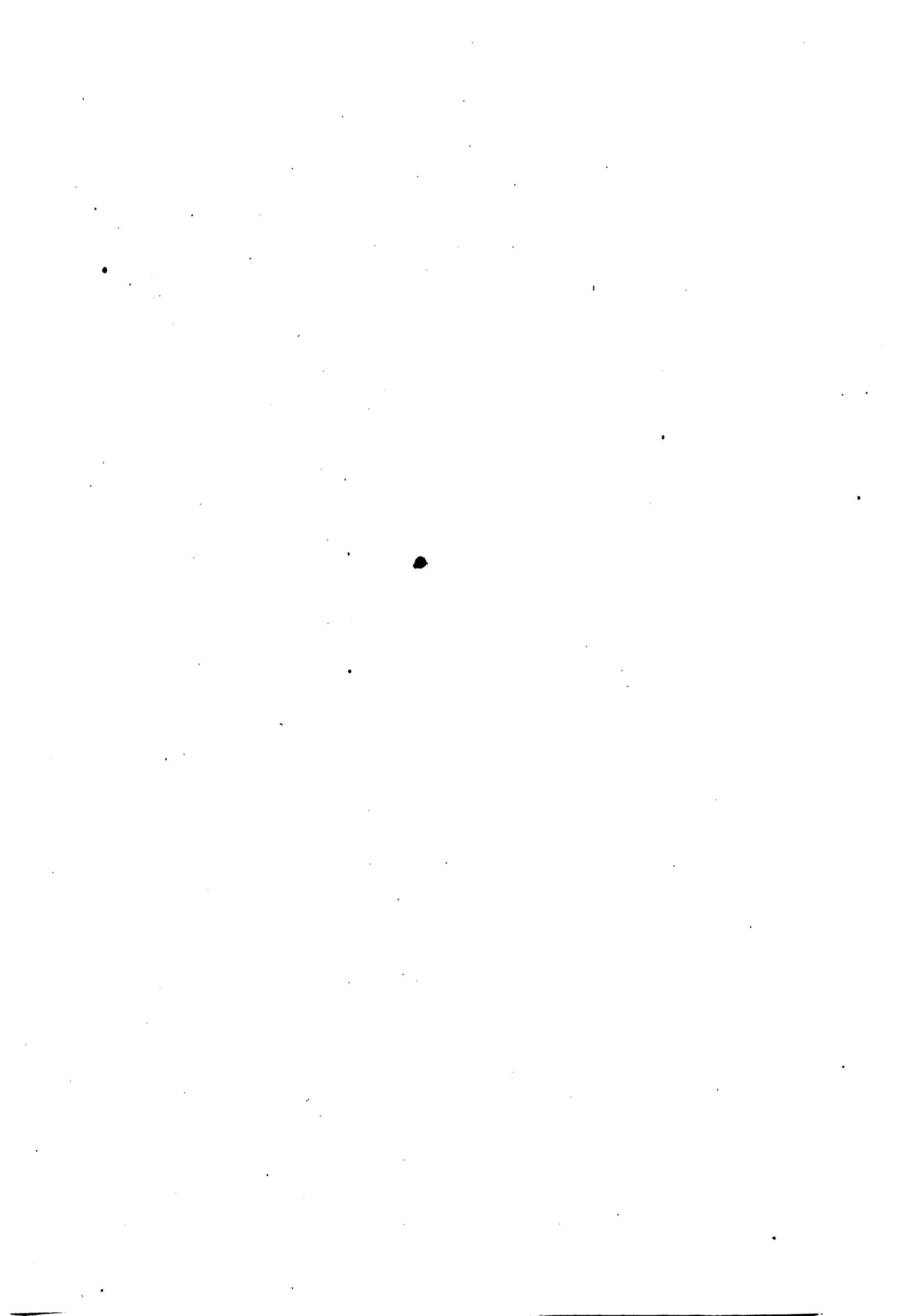
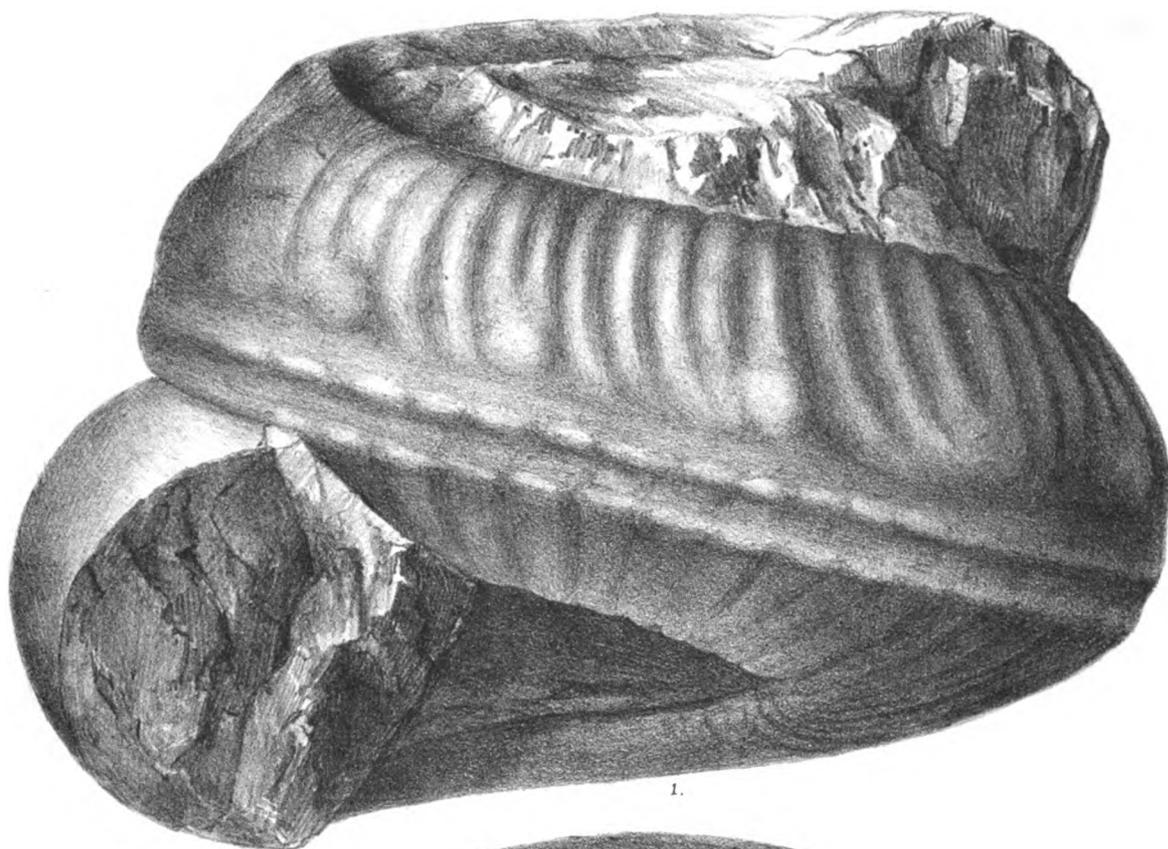
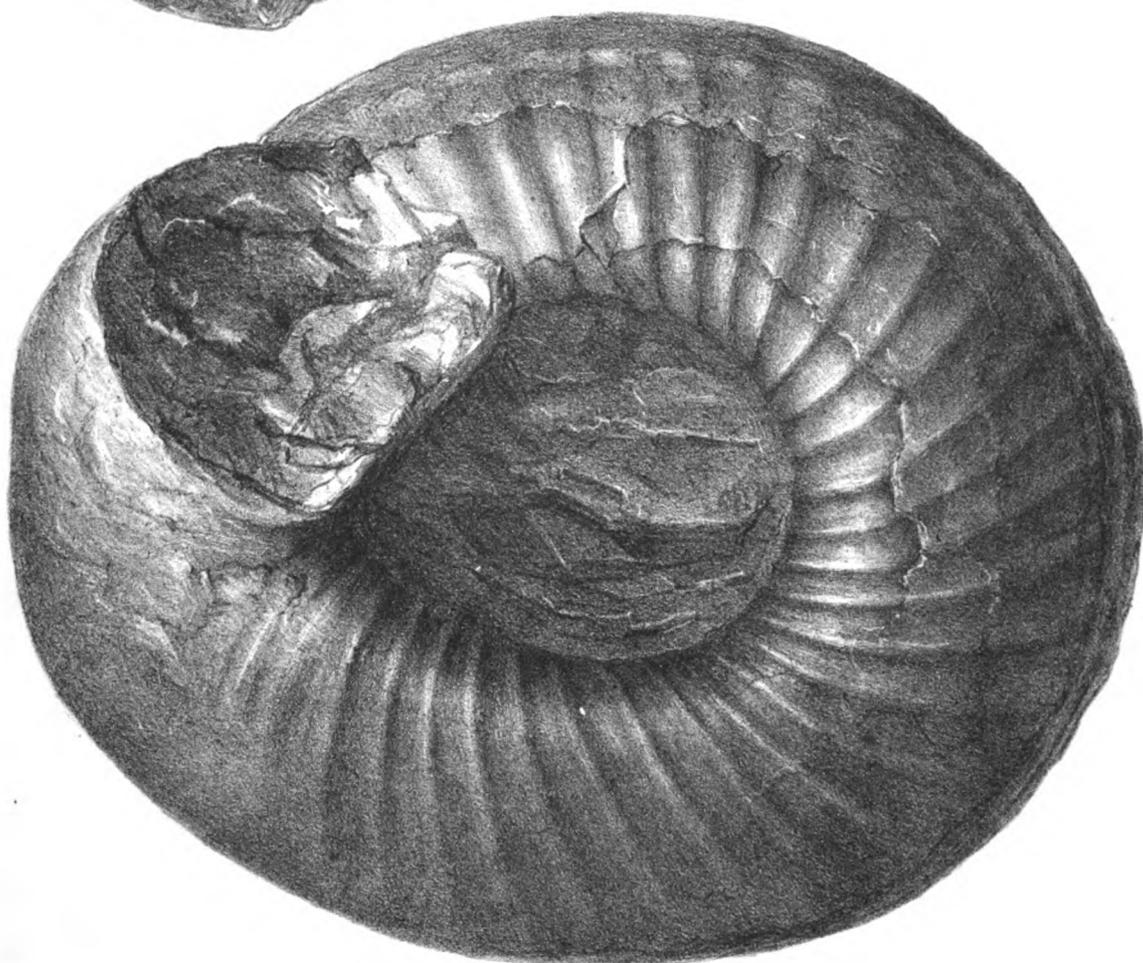


PLATE LXXXIX.

TURRILITES CUNLIFFEANUS, *Stoliczka*, p. 190. Side and base view of the same large specimen, from Odium; *Ootatoor group*: Geological Survey Collection.



1.



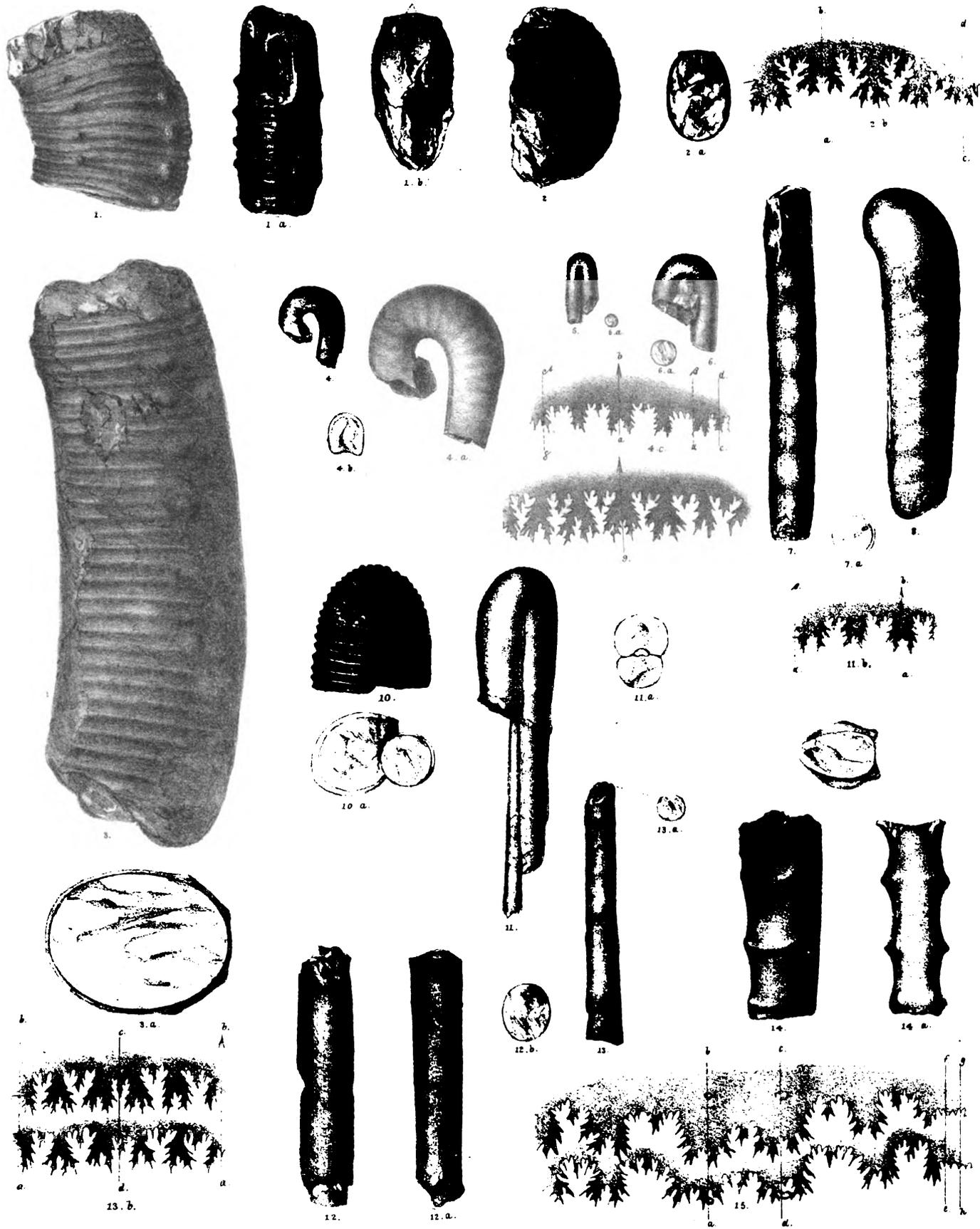
1 a.





PLATE XC.

2. HAMITES PROBLEMATICUS, *Stoliczka*, p. 191; Fig. 1, seems to have the regular ornamentation of the shell: Fig. 2, represents a specimen in which the inner row of tubercles is wanting, and the thickness of which is somewhat greater. Fig. 2*b*, is the outline of a septum, *ab* being the siphonal saddle, and *cd* the middle of the ventral lobe.
Odium; *Ootatoor group*: Geol. Survey Collection.
3. HAMITES, *conf.* MEYRATI, *Ooster*, p. 191. Side view and section of large fragment from the calcareous sandstones near Odium: *Ootatoor group*: Geol. Surv. Collection.
4. HAMULINA SUBLEVIS, *Stoliczka*, p. 193; Fig. 4, side view of the natural size; Figs. 4*a*, and 4*b*, increased to twice the actual measurements: Fig. 4*c*, outline of a septum, enlarged three times, *ab* indicating the siphonal saddle, *cd* the ventral lobe: *aβ* and *γδ* are the internal edges of the shell.
Odium: *Ootatoor group*: Geol. Surv. Collection.
- Figs. 5—9. PTYCHOCERAS SIPHO, *Forbes*, p. 194; specimens represented in various stages of growth, all from Pondicherry; *Valudayur group*: Madras Museum Collection.
- Fig. 10. PTYCHOCERAS GAULTINUM, *Pictet*, p. 195; a fragmentary specimen devoid of the shell surface. Odium: *Ootatoor group*: Geol. Surv. Collection.
- Fig. 11. PTYCHOCERAS FORBESIANUM, *Stoliczka*, p. 195. Figure of a tolerably complete cast, enlarged to twice the measurements.
Moraviatoor: *Ootatoor group*: Geol. Surv. Collection.
- Fig. 12. BACULITES TERES, *Forbes*, p. 197: A fragment of the upper portion, with the impression of the mouth.
Pondicherry: *Valudayur group*: Geol. Surv. Collection.
- Fig. 13. " " Another fragment, with some transverse sulci indicating stages of growth. Fig. 13*b* outline of a septum, enlarged three times; *ab* indicating the siphonal saddle, and *cd* the ventral lobe.
Odium: *Ootatoor group*: Geol. Surv. Collection.
- Fig. 14. BACULITES VAGINA, *Forbes*, var. *Ootacodensis*, *Stoliczka*, p. 198. A fragment with very sharp ribbings and tubercles on the dorsal edges.
Ootacod: *Arrialoor group*: Geol. Surv. Collection.
- Fig. 15. " " " Outline of a septum of a large specimen from Pondicherry; the incisions are only slight: *ef* and *gh* indicate the ventral edges.



H. L. Frazer Lith.

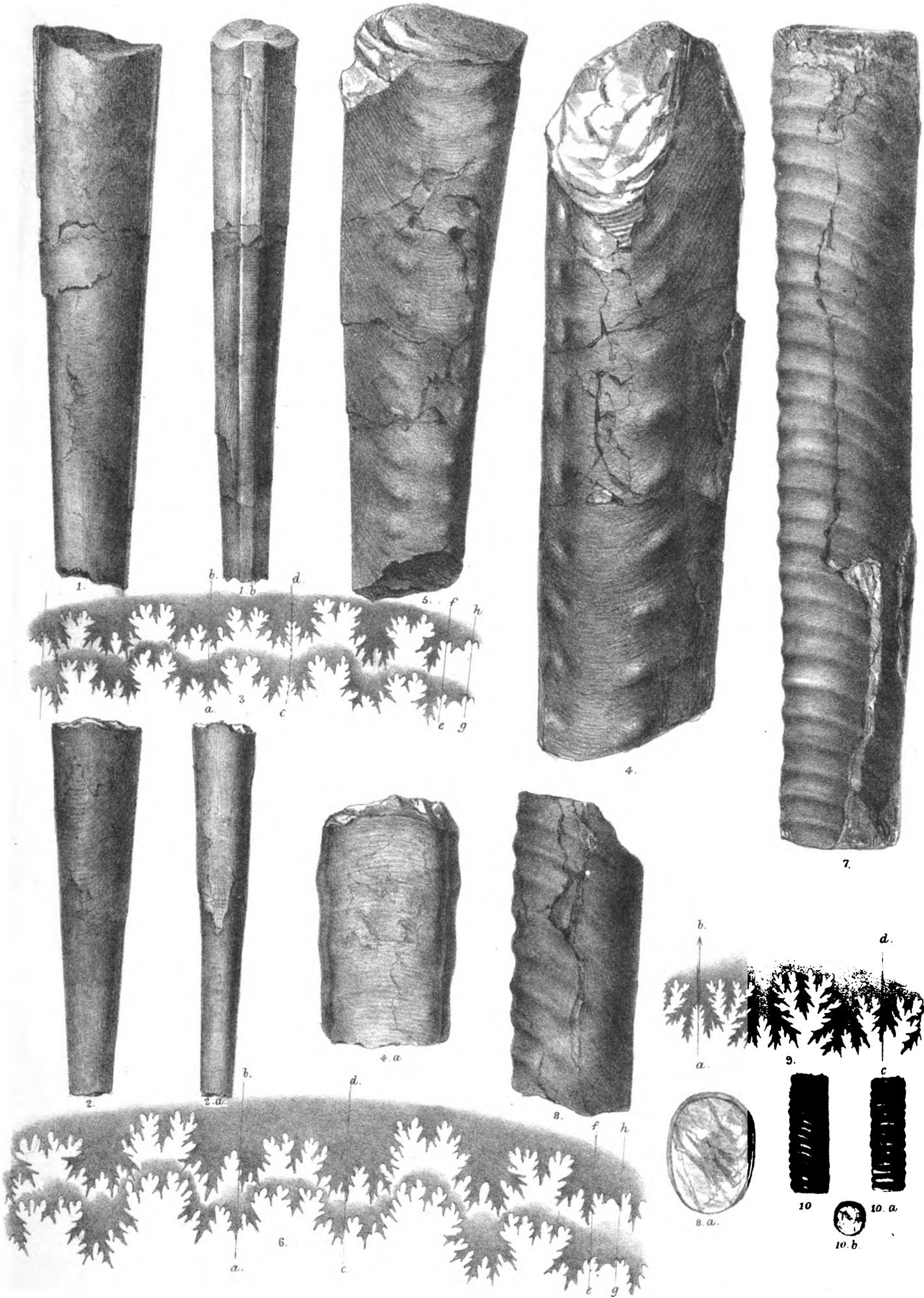
T. Oldham direct

Calcutta.



PLATE XCI.

- Fig. 1. BACULITES VAGINA, *Forbes*, p. 198; Figs. 1 and 1*b*, side and ventral views of a nearly smooth specimen.
- Fig. 2. " " " Side and back views of another fragment still nearer to the point of the shell.
- Fig. 3. " " " Outline of septa of a large specimen.
- Fig. 4. " " " Side view of a large specimen with portions of the mouth at the upper end. Fig. 4*a* represents a portion of the back view, on which the striæ of growth are seen bent forward.
- Fig. 5. " " " Side view of a large specimen with two rows of lateral tubercles.
- Fig. 6. " " " Outline of one septum, remarkable for the narrowness of the chambers.
- All the specimens from Pondicherry; *Valudayur group*:
Geol. Surv. Collection.
- Fig. 7. BACULITES GAUDINI, *Pictet*, p. 199. Side view of a large fragment.
- Fig. 8. " " " Figs. 8, and 8*a*, side view, and section, of a smaller fragment, rather compressed laterally.
- Fig. 9. " " " Outline of a septum: *ab* indicating the siphonal saddle, and *cd* the ventral lobe. Both specimens are from the sandstones near Odium: *Ootatoor group*: Geol. Surv. Collection.
- Fig. 10. " " " Figs. 10, 10*a*, and 10*b*; Side and back view, and section of a small and closely ribbed specimen.
- Pondicherry: *Valudayur group*: Geol. Surv. Collection.



H. J. Frazer Lith.

T. Oldham direx.

Calcutta

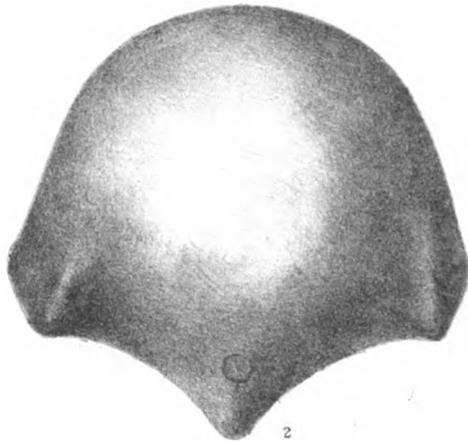


PLATE XCII.

- Fig. 1. ANISOCERAS OLDHAMIANUM, *Stoliczka*, p. 175; Upper view of the coiled and turreted portion of the shell, from the yellowish sandstones, near Odium : *Ootatoor group* : Geol. Surv. Collection.
- Fig. 2. NAUTILUS SERPENTINUS, *Blanford*, p. 208; view of the convex side of a chamber to shew the position of the siphuncle.
- Fig. 3. NAUTILUS SPHÆRICUS, *Forbes*, p. 203; Figs. 3, and 3a, side and front views of a small specimen, with the fine striæ of growth on the shell-surface preserved : Odium : *Ootatoor group* : Geol. Surv. Collection.
- Fig. 4. NAUTILUS BOUCHARDIANUS, *D'Orbigny*, p. 203, Figs. 4, and 4a, side and front views of a large specimen from Arrialoor : *Arrialoor group* : Geol. Surv. Collection.



1.



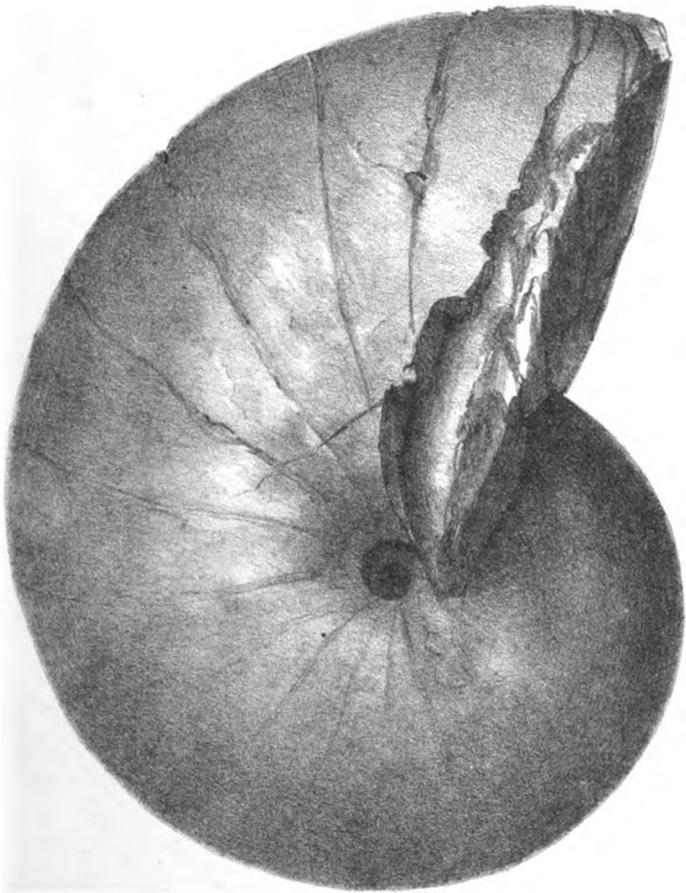
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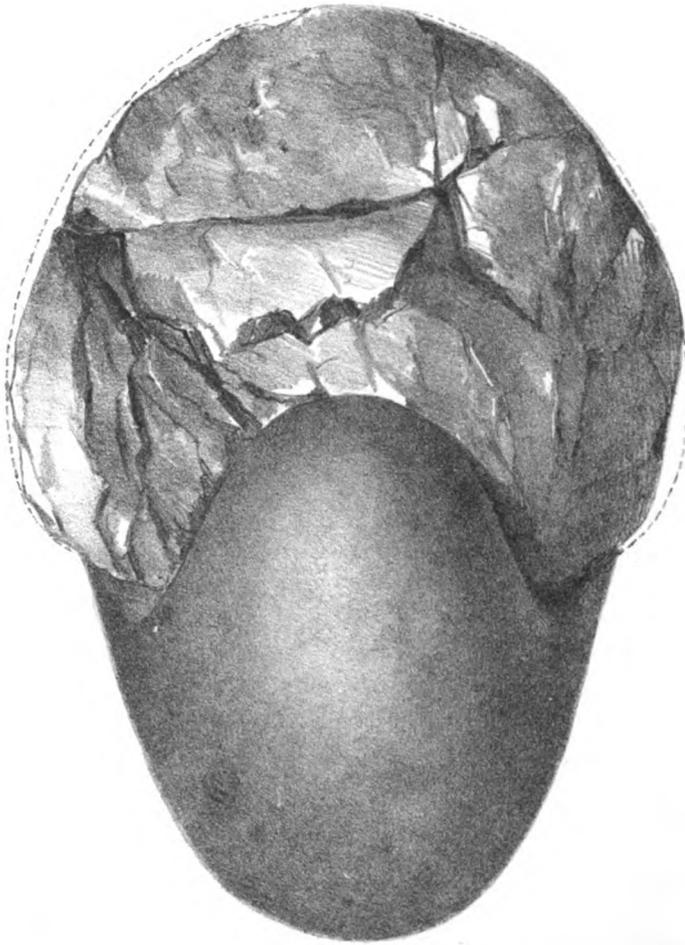
3.



3. a.



4.



4. a.

H. L. Fraser lith.

T. Oldham del.

Calcutta



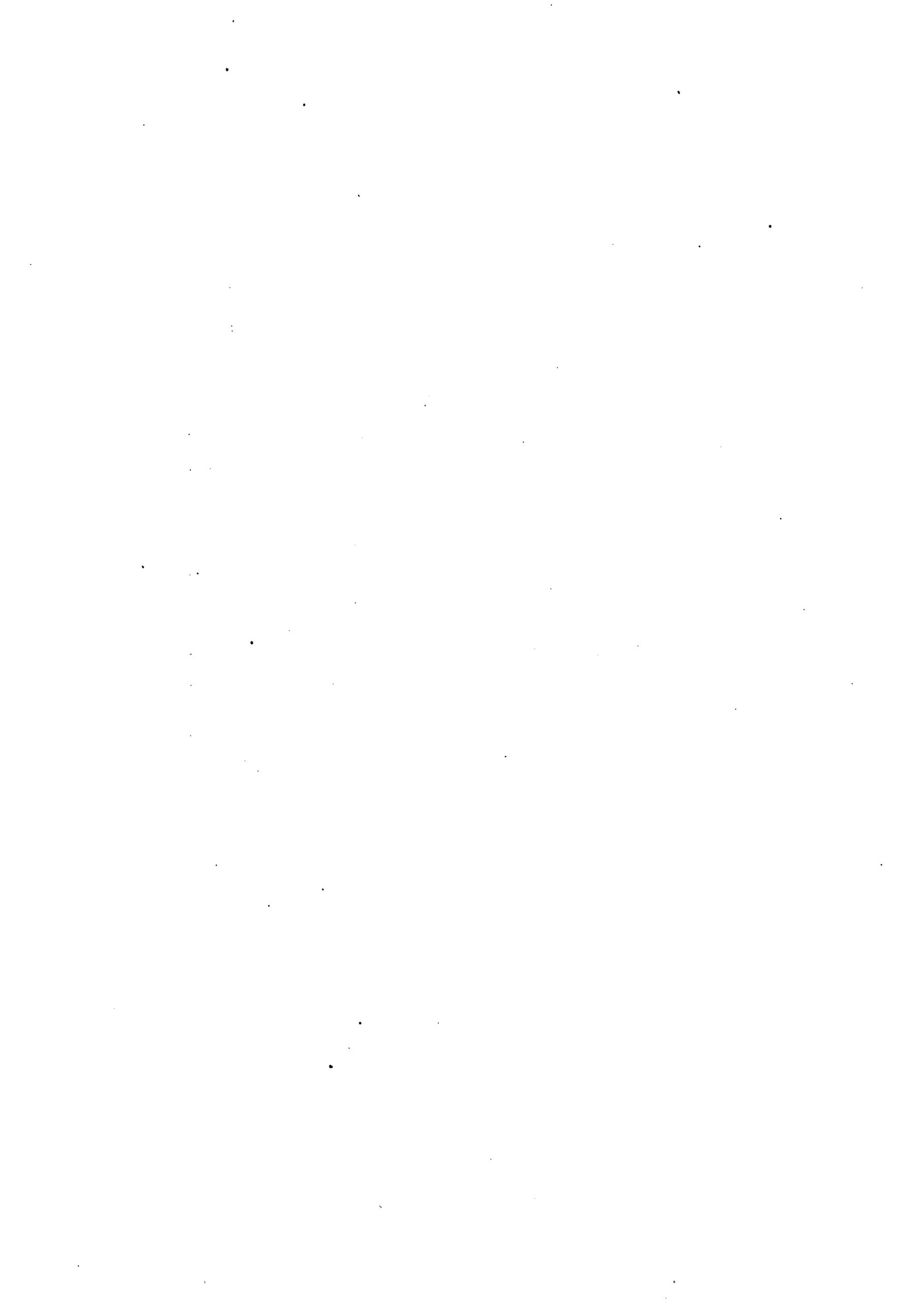
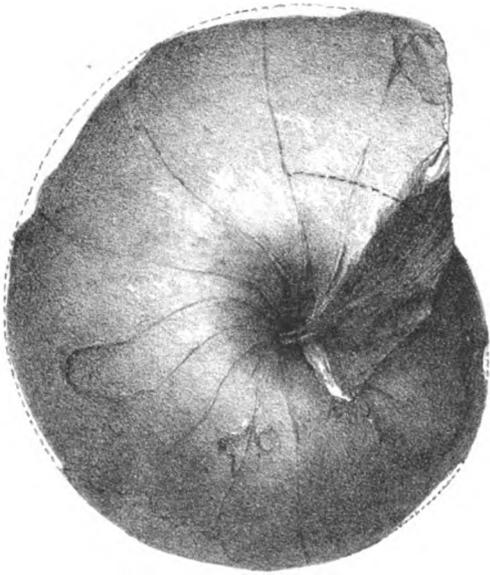


PLATE XCIII.

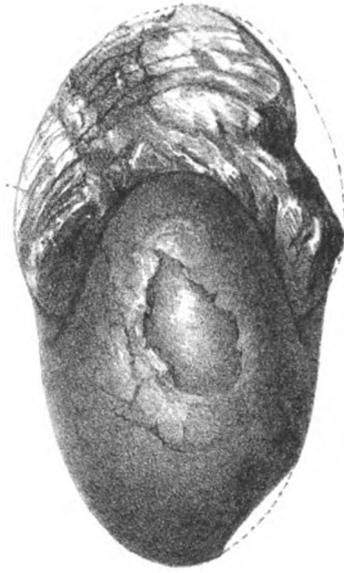
- Fig. 1. NAUTILUS LENTIFORMIS, *Stoliczka*, p. 207; Figs. 1, and 1*a*, side and front view, and Fig. 1*b*, view of chamber to shew the position of the siphuncle.
Anapandy, *Trichinopoly group*: Geol. Surv. Collection.
- Fig. 2. NAUTILUS JUSTUS, *Blanford*, p. 206; Figs. 2, and 2*a*, side and front views of a small but nearly perfect specimen: Fig. 2*b*, shews the position of the siphuncle; and Fig. 2*c*, is an enlarged view of the reticulate striation of the surface of the shell.
Odium: *Ootatoor group*: Geol. Surv. Collection.
- Fig. 3. NAUTILUS PSEUDO-ELEGANS, *D'Orbigny*, p. 210; sectional view of the inner whorls to shew the position of the siphuncle. Odium: *Ootatoor group*: Geol. Surv. Collection.
- Fig. 4. NAUTILUS ANGUSTUS, *Blanford*, var. p. 209, Figs. 4, and 4*a*, side and front views of an inflated variety; from near Coothoor; *Arrialoor group*: Geol. Surv. Collection.



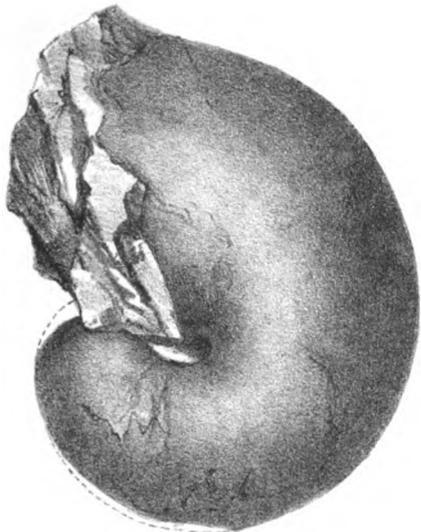
1.



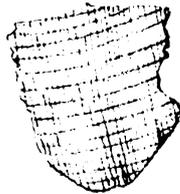
1. b.



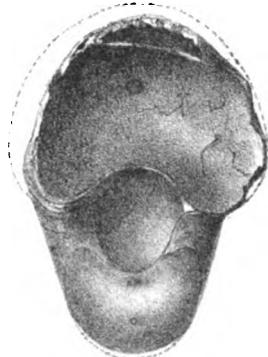
1. a.



2.



2. c.



2. b.



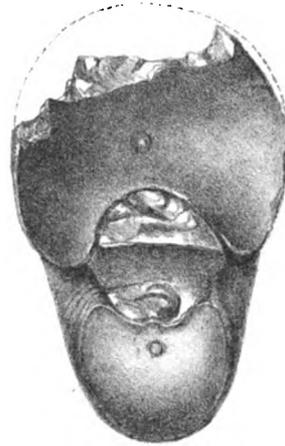
2. a.



4.



4. a.



3.

H. L. Frazer Lith.

T. Oldham direct.

Calcutta

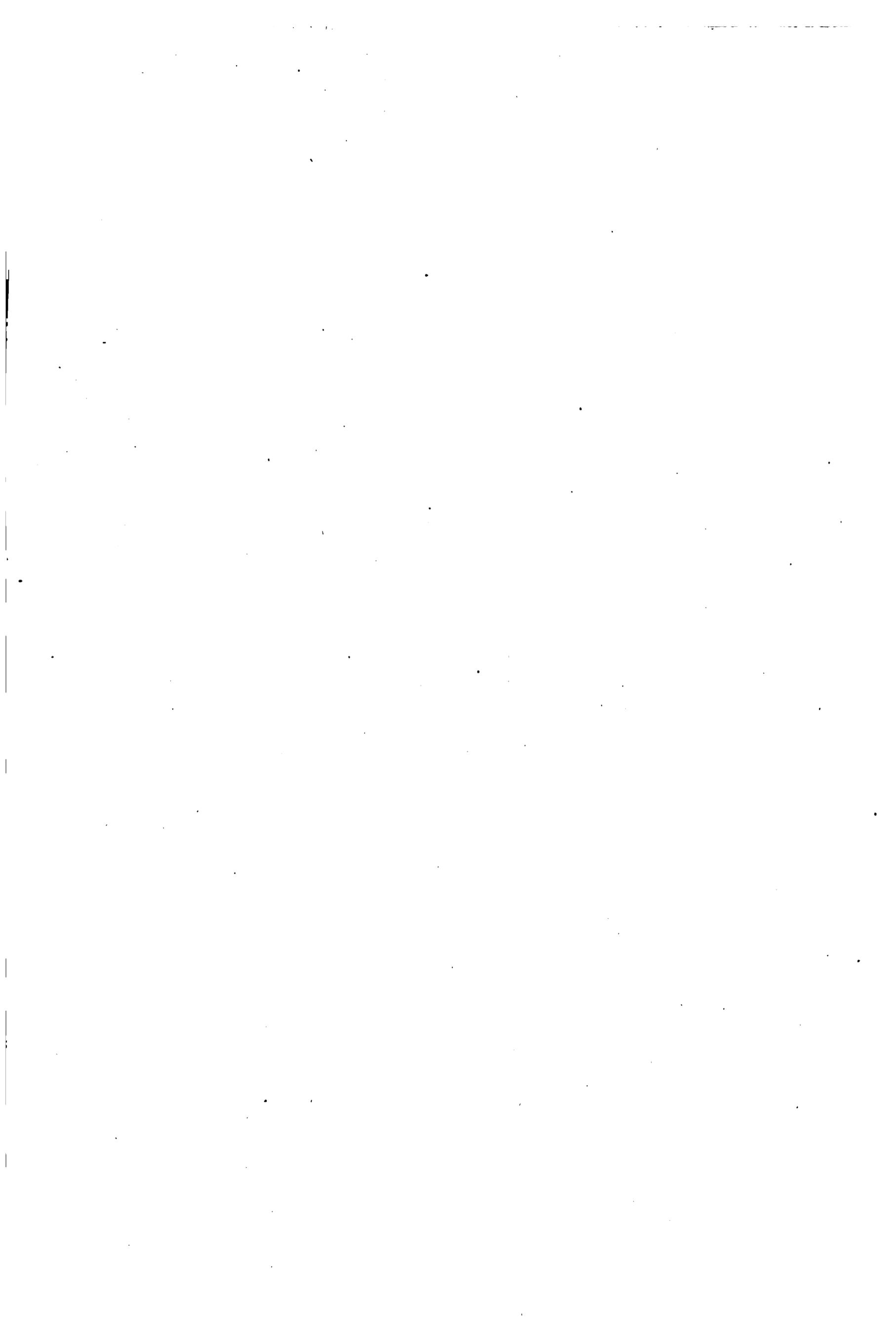
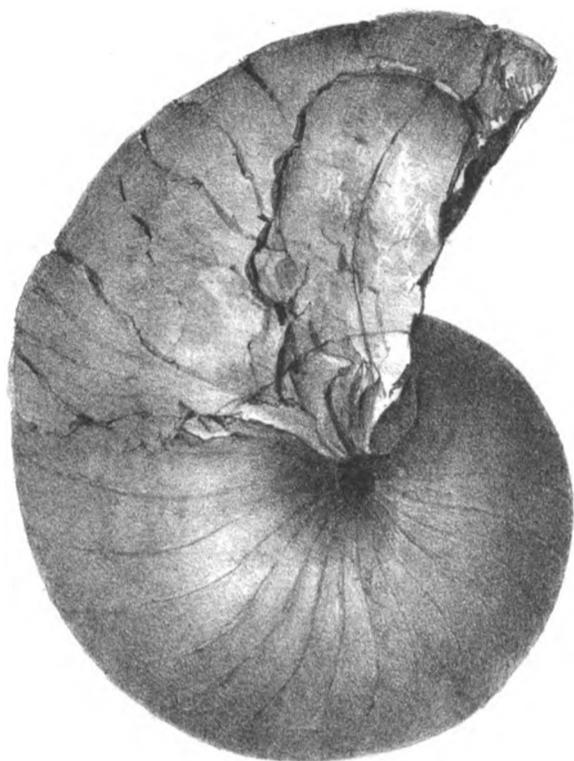


PLATE XCIV.

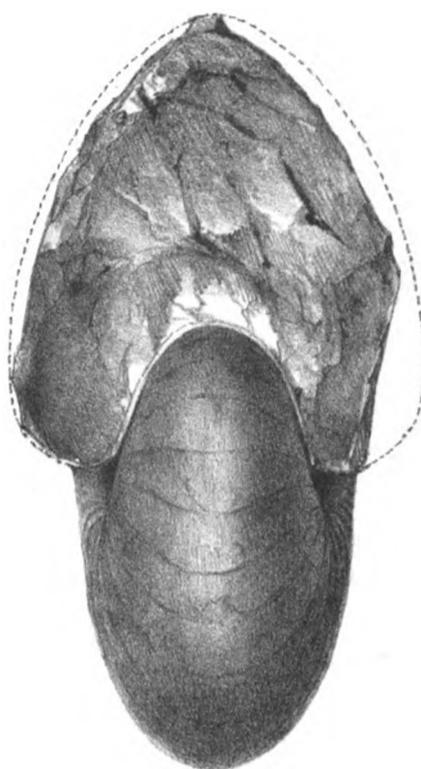
Fig. 1. NAUTILUS FLEURIAUSIANUS, *D'Orbigny*, p. 206; Figs. 1, and 1a, side and front views of a specimen from Odium: *Ootatoor group*: Geol. Surv. Collection.

Fig. 2. NAUTILUS NEGAMA, *Blanford*, p. 211; Fig. 2, side view of a small specimen with an unusually small number of chambers: Fig. 2a, a portion of the inner whorls exposed to shew the siphuncle in a sectional view: Fig. 2b, small portion enlarged to shew the striation of the shell.

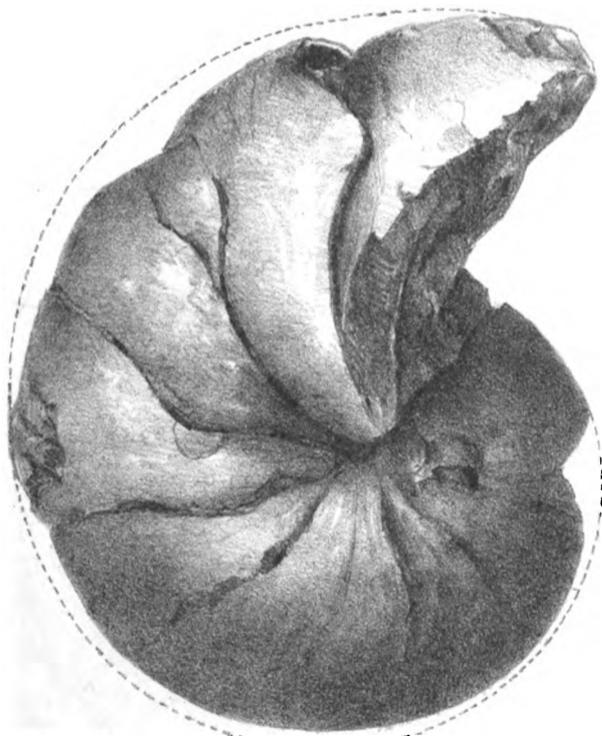
Odium: *Ootatoor group*: Geol. Surv. Collection.



1.



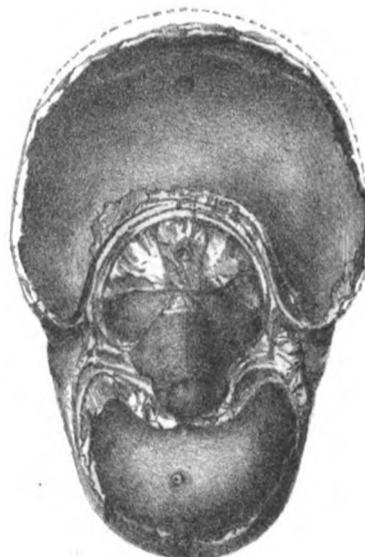
1.a.



2.



2.b.



2.a.

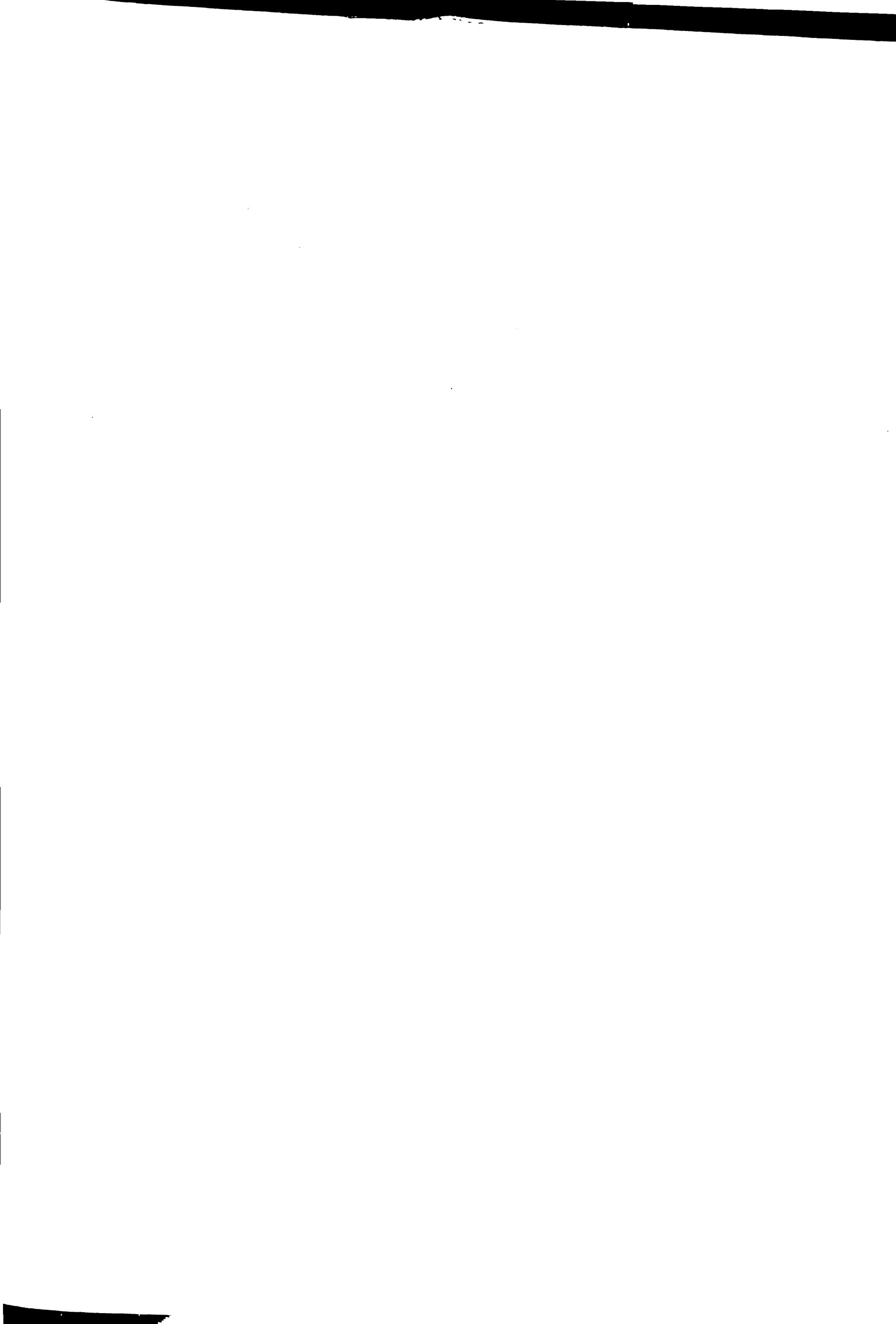
H. I. Frazer Lith.

T. Oldham direx.

Calcutta.







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