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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

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: of the Roy. Geol. Soc., Cornwall: Corr. Mem., Zool. Soc., London, &c., &c., SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

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CRETACEOUS FAUNA OF SOUTHERN INDIA

Vol. IV. 1.

The BRACHIOPODA, by Ferd. STOLICZKA, Ph. D., F.G.S., &c. &c.,

Palæontologist, Geological Survey of India.



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JH. HOPIW



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## CRETACEOUS FAUNA OF SOUTHERN INDIA.

Vol. IV.

The Brachiopoda, Ciliopoda, Echinodermata, Anthozoa, Spongiozoa, Foraminifera, Arthrozoa and Spondylozoa by Ferd. STOLICZKA, Ph. D., F. G. S., &c., &c., Palæontologist, Geological Survey of India.

## $C \land L C U T T A$ :

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## CRETACEOUS FAUNA OF SOUTHERN INDIA.

Vol. IV. 4.

Ser. VIII. 4-5. The CORALS or ANTHOZOA, with notes on the Sponges, Foraminifera, Arthrozoa and Spondylozoa, by Ferd. STOLICZKA, Ph. D., F. G. S., &c., &c.,

Palæontologist, Geological Survey of India.

## $C \mathrel{A} \mathbf{L} C \mathrel{U} T \mathrel{T} A$ :

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#### MDCCCLXXIII.

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## INTRODUCTION.

The second division of the Actinozoa, represented in the eretaceous deposits of the Trichinopoly district in Southern India, comprises the corals,—Anthozoa, or Polypi, as they are often called in zoological manuals. They have yielded 57 species, of which the majority occurs in the lowest beds of the series, the Ootatoor group, while the two higher divisions, the Trichinopoly and Arrialoor groups, are comparatively poor in corals,—just the reverse of what I formerly stated respecting the Gastropoda and Peleeypoda. The number of species which had already been described from European cretaceous deposits is small, but the geological results, in point of comparison of our fauna and its age with that of foreign deposits, is rather an interesting one, as I shall have oceasion to notice at the end of the detailed descriptions.

The smaller the animals are, the more steadily and energetically they appear to work, in order that they may replace by numbers what they lose by individual size. Indeed, even setting aside the interest which the study of eorals possesses for the morphologist and the systematic zoologist, few other even of the higher classes of the animal kingdom can compete with the importance, which the eorals possess, and for ages past have maintained, in the economy of nature. The distribution of the eorals in the different depths of the sea has been for years past studied with considerable interest; and the recent researches in deep sea dredgings are adding largely to the information, which is placed at the disposal of the geologist. Need I mention the enormous value which Darwin's and Dana's studies of the formation, extent, and distribution of eoral reefs possess for geological research! It is, I believe, justly asserted that more than one-half of our ancient limestone formations is to be attributed to the existence of eorals and their colonies forming reefs. What greater help can a surveying geologist find, than is afforded to him by the discovery of an ancient coral reef, or of a reef-limestone! If he had been up to that time in doubt about the stratigraphical series of his beds or formations, he finds himself upon that discovery *quite at home*. He knows where he has to seek for the ancient land; he looks after certain animal forms in the lagoons; after others in and on the eoral limestone; and the thickness and character of the cropping out of the limestone indicate to him the relation of the beds beyond the reef.

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## CORALS OR ANTHOZOA

## FROM THE

## CRETACEOUS ROCKS OF SOUTH INDIA.

## Sub-kingdom, ACTINOZOA.

Class,

## ANTHOZOA OR CORALS.

CHARACTER.—Actinozoa consisting of a digestive cavity, provided with a single opening, which is oral, anal, and genital, internally divided at certain regular distances by membranes or laminæ projecting towards a real or imaginary axis, while the upper edge is surrounded by radially disposed, generally hollow, tentaeles; male and female generative and secretionary organs situated in the so-called loculi between the membranes or septa; propagation takes place by ova, or by buds, or partial division; special organs of the senses, of respiration, and circulation, and, as a rule, also of locomotion, are absent. All the Anthozoa are in their natural state inhabitants of the sea, or at least of brackish waters.

The 'Histoire Naturelle des Coralliaires' by Milne-Edwards and Haime, 'Klassen und Ordnungen des Thierreiches' by Bronn, many treatises of Zoology, and recently Fromentel's Zoophytes in the Paléontologie française, Vol. VIII, contain such detailed accounts of the history, organisation, geographical and geological distribution, etc., of this class that it would be quite superfluous to repeat the same in this place. It will fully serve our object towards a proper understanding of the descriptive portion of this monograph, and the terminology used therein, if I attempt to give a brief abstract of the general structure of these creatures, followed by a few words on the distribution and classification of the same.

The Anthozoon in its simple form is a more or less round or cylindrical sae, usually sessile by a broad base, on the opposite end provided with a single oral opening, surrounded by tentacles, of which there are four, six, eight, or a multiple of these numbers present. The oral opening passes through an enlargement, formed by an inverted portion of the outer wall of the body, called the stomach, or directly into the large internal eavity of the body, which is divided into compartments (the so-called *loculi*) by the mesenterial laminæ or septa, these being in an equal or smaller number present than the tentacles. The mode of development followed in these organs is of great systematic importance. There appears to be no strict separation between the animals which possess a so-called stomach, and to which the

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name Anthozoa, Polypi, or Corals, is restricted, and those in which the mouth directly communicates with the general eavity of the body, and which, according to Agassiz, have in late years been transferred to the Hydrozoa,—namely, the so-ealled Podactinaires or *LUCERNARIDÆ*, together with the Madreporaria tabulata and rugosa of Milne-Edwards and Haime.

The general cavity of the body is internally in its entire extent instructed with eilia; the chylus is formed in, or passes from, the so-called stomach into it, and its eirculation, as well as that of the water for purposes of respiration, is chiefly produced through these cilia, while the tentacles act not only as prehensile organs for obtaining food, but also for producing a current of water leading to and from the mouth. This very simple arrangement dispenses with the necessity of all other special organs or vessels for digestion or respiration. Equally so a nervous system, or special organs of sense, are absent, but the soft parts of the body, and particularly the tentaeles, are sensitive both to touch and to the light. Some naturalists believe that the presence of peculiar branched cells in the oral dise indicates the rudiments of a nervous system. In some of the Actiniacea there are peculiar thread-like organs, the so-called craspeda, present between the septa, and these appear to act, at least in some cases, as secretionary organs and assist in digestion. Besides there are in some Anthozoa other organs for the defence of the animals, the so-called nettle threads or acontia, which are emissible and secrete a sharp fluid in the enidæ or nettle cells.\*

The sexes are, as a rule, distinct, either in the same or in different individuums, and in some cases of the compound corals one sex is said to be restricted to a single colony. The progeny leaves the mother either in the form of fertile ova, or as a developed Anthozoon with tentacles. The young, when it leaves the ovum, swims about with a row of cilia, gradually the body curves, forms an internal cavity, the rudiments of tentacles appear, and the young Anthozoon becomes sessile. In other cases propagation takes place by budding, or gemmation, and thus compound colonies are formed.

The body of the Anthozoon is composed of an external and an internal cilia-bearing skin, each consisting of several layers. Between them is the muscular system developed, the several layers being composed of vertical or longitudinal and of concentric fibres. All these soft parts appear to be in certain cases capable of secreting solid particles of various shapes, the so-called selerites or selerodermites, which either remain isolated in the fleshy or dermal mass, or they coalesee to a more or less solid, reticulated or porose skeleton, which was called *sclerenchyma* by Messrs. Milne-Edwards and Haime.

The ealcification, or rather selectification, progresses in somewhat different manner in various forms. In some it takes place only at the basis of the single or compound individuum, and continues to grow and branch as a kind of axis,

<sup>\*</sup> Compare my note on *Sagartia* in Journ. A. S. B. for 1869, vol. xxxviii, pt. ii, pp. 43 and 50. (134)

surrounded by the soft or partially hardened parts of the animal. This kind of progress has been called by Dana foot-secretion, and forms the so-called sclerobasis of the GORGONIDE OF ANTIPATHIDE. In the so-called Madreporaria the selecification takes place in the whole derma, either externally as exotheca or internally as endotheca, or in the central column, forming the so-called columclla; all these secretions begin at the base of the individuums and spread gradually upwards, forming a more or less complete cup or *calyx*. The cudothecal system is strengthened by a sclerification of the mesenterial membranes or lamine, which extend towards the centre of the animal and form the so-called *sepla*, while externally these often correspond to or pass into similar elevations, called the costa. The septa are either connected by vertical cross bars at certain regular distances, as in the FUNGIDE, called synapticula, or they are connected by more horizontally distributed curved laminæ in irregular manner; these are called dissepiments. These, again, are distinguished as endothecal or exothecal dissepiments, according to whether they become developed between the septa or between the costæ. The columella is either a true one, solid, columnar, fibrose, spongiose, or laminar, or it is a pseudo-columella, merely formed by a twisted prolongation of some septa.

Between the inner terminations of the septa and the columella there are in some forms of eorals lamellar or styliform processes developed, which are called *pali*.

Both the septa and pali generally follow certain rules in the course of their development. As already observed, the original number of septa is either six\* or eight; these are called the *primaries*, the subsequent the *secondaries*, and so on. Taking six primaries as the most usual number, each of the six original compartments, including all the septa of subsequent orders, is called a system, and the row of septa itself a *cycle*. The six primaries are followed by six secondaries, each system being divided by one septum, this being the second cycle. This is followed again by a division of each compartment into two by a septum, there being twelve of them in all, forming the third cycle. Up to this the septa of each cycle are in a regularly formed corallum equal in length and strength. The fourth cycle is formed by twenty-four septa, but they are not equal, because after the third cycle each subsequent order consists merely of twelve septa. Thus we have in the fourth evele twelve septa of the fourth and the same number of the fifth order. The rule is, that the twelve younger septa appear first next to the oldest septa, and then to the next older, and so on, and that according to their appearance they increase in length and strength. In the same way we get forty-eight septa in the fifth cycle, belonging to the 6th, 7th, 8th, and 9th orders, and so on; the coral would then possess ninety-six septa, of nine different orders, in five cycles and six systems.

The *pali* always appear after the full development of the septa, and, therefore, they are never present opposite the septa of the last, but always the preceding

\* According to Ludwig, the Rugosa also have originally six primary septa, but two of them become obsolete, the further development becoming, therefore, asymmetrical.

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eyeles. They are either all equal and form a single row, or *coronet*, or unequal, forming two or more eoronets. If only one eoronet of pali is present, it exists opposite the septa of the penultimate cyele; if there are two eoronets, they are placed opposite the penultimate and antepenultimate eycles, and so on.

The septa are on the upper edges either entire, or granular, serrated or dentate; laterally they are granular or spinulose. They are, however, not in all eases regularly developed. Sometimes one or the other of the primaries become obsolete or smaller; in other eases two or four of the secondaries become equal to the primaries; and in such eases we have apparently 3, 4, 5, 8 or 10 systems instead of six.

All these eharacters referring to the seleroderma,—the presence or absence of an exotheca, of dissepiments or synapticulæ, or of pali, the number of systems, eycles and orders of septa, and whether their upper edge is entire or not, etc.,—are of the greatest systematic importance.

In the compound coralla the single individuums are more or less closely connected with each other by the connechyma, which is solid or porose, cellular or lamellar. Its development depends upon the manner of more or less perfect gemmation of the coralla.

I have already observed that all the Anthozoa are inhabitants of sea or brackish water. They are distributed in all latitudes, but, as usually, are more numerous in tropical than in eold seas; the reef-building corals are restricted to the former seas.

Comparatively only a small number of species, mostly the single eoralla, live in great depths of the sea; as a rule, they do not extend beyond about 20 fathoms, and generally they prosper best where the water is elearest and most agitated by atmospherie influence. On the large reefs only the upper layers to the extent of one or two feet are occupied by living individuums. For the study of the character and extent of the various coral reefs and their importance to the geologist, I must refer the reader to the works of Darwin and Dana. It is sufficient to say that the knowledge of the fossil coral fauna is no less important for the determination of the age of geological strata than that of any other group of animals. The simple fact that whole genera and families of corals have become almost entirely extinct indicates the necessity of their fossil remains for the systematic zoologist.

The classification of the Anthozoa is by no means so easy as their simple organisation might indicate, and there is considerable disagreement between various authors even as regards the first principles which ought to be adopted. For our purpose, it will, I think, be sufficient if I give a sketch of the first few divisions according to Bronn, his arrangement being only slightly modified from that of Messrs. Milne-Edwards and Haime.

Bronn, paying more regard to the mode of multiplication than to the number of tentaeles and loculi, divides the Anthozoa into—

I.—POLYCYCLIA, with six primary tentaeles and loculi, both increasing in number with age, forming two or more eyeles.

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## II.—MONOCYCLIA,\* with six or generally eight tentacles or loculi, not increasing with age.

The former order very closely corresponds to the ZOANTIIARIA of authors, and the latter to that of the so-called ALCYONARIA, adding to them the  $\Delta_{NTIPATHID\mathcal{B}}$  with six tentacles, as showing in many respects close relations to the  $GORGONID\mathcal{A}$  with eight tentacles.

The first order, to which the subsequent remarks will solely apply, is divided into-

I.—ScleroderMATA or MADREFORARIA, with the sclerenchyma forming a more or less solid, complete skeleton, and

II.—MALACODERMATA, with or without + single loose sclerites in the derma.

The Madreporaria are generally divided into five sub-orders :

1. *M. APOROSA*, with the septa well developed, and the whole sclerenchyma solid, not perforated.

2. M. PERFORATA, with septa well developed and the selerenchyma perforated.

3. M. TUBULOSA, with the septa rudimentary.

4. *M. TABULATA*, septa well developed or rudimentary, chambers divided by horizontal laminæ.

5. *M. RUGOSA*, with only four primary septa and systems developed in the full grown coral; septa never porose and not granulated laterally.

The *TABULATA* are now generally referred to the Hydrozoa, but I have already observed that the researches in this respect do not appear to me conclusive. The same has been predicted of the  $n_{UGOSA}$ ; by some authors their transfer into the Hydrozoa has actually been carried out, and now it has been shown that there is still less reason for this somewhat hasty alteration of our systematic arrangement.

In the South Indian cretaceous deposits we have fifty-three species belonging to the M. APOROSA, three belonging to the M. PERFORATA, and one to the M. TABULATA. Their distribution in the different families will be readily seen from the table at the concluding pages of this Monograph.

## MADREPORARIA APOROSA.

Family,—CARYOPHYLLIDÆ.

These include a number of genera with simple coralla, attached by a narrow base, or free, with round or ovate calyces divided by septa, with one or more rows

\* His DICYCLIA or the LUCERNARIIDÆ are, I think, rightly excluded from the Anthozoa.

† I am by no means certain that it is correct to speak of the total absence of sclerites or solid inorganic bodies in the Actiniacea, as is generally done even in the most recent works on zoology. In my paper on the anatomy of Sagartia Schilleriana, I have, I believe, satisfactorily shown not only the presence of loose scleroid particles in the internal tissue, but of an almost regular network of the same. (Comp. Journ. A. S. B., 1869, vol. xxxviii, pl. iv, p. 38). I do not consider it at all improbable that the presence of sclerites will be proved also in other similar species. The plan which I would recommend for this purpose is to kill the animal gradually by adding fresh to sea water; then place the specimen in a platina erucible and heat it, until all organic matter is burnt off. In this manner I obtained the rudiment of an almost regular skeleton in the above-mentioned Sagartia.

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of pali round a real or imaginary columella, and with the enambers open in the entire height of the corallum.

The CARTOPHIFLIDE, which were by Milne-Edwards and Haime considered as a sub-family of the *TURBINOLIDE*, differ from the latter by the presence of pali. Fromentel (Pal. Franç. terr. cret., vol. viii, 1863, p. 163,) distinguishes fifteen genera, and indicates two more; but three of these genera occur in South India. *Caryophyllia* with four, *Trochocyathus* and *Platycyathus* each with a single species. The first genus belongs to the group with only a single row of pali; the two others have a double row of unequal but simple pali.

## I. Genus.—CARYOPHYLLIA, Lamarck, 1801.

Comp. Dunean, Paleont. Soe., vol. xxii, Suppl. to Cret. Corals, pt. II, No. 1, p. 2; Fromentel, Paléont. Franç. terr. cret., vol. viii, 1863, p. 164.

The *Caryophyllic* have a simple corallum, which is adherent by its base to foreign masses; the calyx is circular or somewhat ovate, generally rather concave; the columella composed of twisted and more or less confluent lamellæ, forming a crispate, convex upper end; the pali are well developed, all of the same form and size; septa straight, rather broad, sometimes slightly thickened towards the inner end, generally arranged in six, very rarely in only five,\* systems, which are occasion-ally somewhat irregularly developed; eostæ numerous, sub-equal, straight, more or less finely granular, generally most distinct near the calyx, and becoming less distinct towards the base.

Stokes in 1828 was the first to define the present genus in the sense in which it is at present accepted in science. D'Orbigny called a few fossil species Amblocyathus, while others he referred to Cyathina. This last name has also been accepted for the cretaceous species by Messrs. Milne-Edwards and Haime in their monograph of the British cretaceous species, but in their Hist. Nat. d. Corall. the propriety of the name Caryophyllia was re-established. Fromentel (l. cit.) unites to the present genus also Bathycyathus, Milne-Edwards and Haime, which he says only differs from typical Caryophylliæ by thinner pali, more closely united to the septa.

The species of *Caryophyllia* occur both fossil and recent, but the occurrence of the genus in rocks older than cretaceous is not sufficiently certain.

There are four species of the genus represented in the South Indian cretaccous deposits; all belong to the group with the septa arranged in six systems, and all appear to be as yet undescribed forms.

\* C. decemplex, Fromentel, Pal. Franç. terr. cret., vol. viii, p. 168.

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## 1. CARYOPHYLLIA ARCOTENSIS, Stoliczka. Pl. 1, Figs. 1-10.

?? Turbinolia Arcotensis, Forbes, from Pondicherry.

Caryoph. eorallum inverse eonieum, modiee elatum, per-variabile, frequentissime paulo eurvatum et ad intervalla irregulariter eontraetum, basi angustissima affixum; superfieie sublævi, prope calyeem costulata, costulis sub-æqualibus, obsolete rugulatis vel ommino lævigatis; ealyce eireulari seu fere eirculari, medio profunde exeavato; septis in quatuor eyelis sæpissime perfeetis dispositis, lateraliter eonfertim granulatis, ad marginem ealyeis eonvexe elevatis: primariis fortissimis, seeundariis paululum brevioribus atque tenuioribus, terminationibus eonspicuiter inerassatis; palis duodeeim brevibus, modiee inerassatis atque exsertis, ad terminationes septorum ad eyelum tertium pertinentium sitis; columella breviter libera, eonvexa, rugosa, foliose torta, circiter quintam partem ealyeis diametri crassa.

This is an extremely variable species, reversely conical, and always possessing a very narrow basis, sometimes with a slightly dilated disc by which the specimens were sessile. The corals have generally a height of about 17 mm., and the calyx a diameter of 9 or 10 mm. Specimens of 20 mm., or a greater height, are very rarely met with, and equally rare are those with a very wide calyx, such as the specimen represented in fig. 6 on pl. I. The mural theca is well developed, rather thinning out towards the edge of the calyx. The surface shows at distances irregular rugosities and contractions, on which the costæ are sometimes obsoletely traceable; but they scarcely ever reach as far as the base, and the lower part of the polypid is usually quite smooth, while near the upper edge the costæ are always distinct. They are sub-equal in strength, smooth, or very finely and distinctly rugose. The calyx is circular or very nearly so, deeply excavated in the centre; the columella, convex, rugose, and composed of twisted papillæ. There are nearly invariably four complete cycles of septa present, arranged in six systems. The pali arc of moderate length and strength, twelve in number, one being opposite to each tertial septum (see fig. 3a). They are slightly raised, and in the lower section of the corallum become, therefore, confluent with the adjoining septa (see fig. 10a). The columella is very nearly one-fifth of the entire width of the ealyx.

Locality.—East of Andoor, in a pale coloured, moderately coarse sandstone; common.

Formation.—Arrialoor group.

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I have selected for the above species the same specific term under which Prof. Forbes described a South Indian fossil as—

### TURBINOLIA ARCOTENSIS, see Pl. I, Figs. 11-12.

1846. Trans. Geol. Soc., London, vii, p. 163, pl. xix, figs. 9 a and b.

Forbes account is as follows :

<sup>6</sup> T. testa cylindrica, conica, clongatá, disco excavato, lamellis (30) fortibus <sup>6</sup> radiato; lateribus undulatis, striatis, striis tenuibus, confertis, regularibus, æqua-<sup>6</sup> libus.<sup>9</sup>

'Diameter of disc  $0_{\overline{10}}^{6}$  inch. Entire length (or height)  $1_{\overline{10}}^{2}$  inch.'

'A conical species, usually slightly bent, with finely and regularly striated sides, 'and a star of many strong prominent lamellæ. The specimens are rarely well pre-'served. The species is gregarious. It approaches nearly several cretaceous and 'also some tertiary forms.'

' Locality.—Pondicherry.'

It is impossible to identify the species from such an imperfect description, and the two figures, of which copies are given, do not assist in the determination. Still, it is by no means improbable that Prof. Forbes had specimens of the abovenamed *Caryophyllia* before him. A careful comparison of the type is necessary. I was unfortunately not able to lay hands upon it when examining Forbes' originals in 1867.

D'Orbigny referred Forbes' species to *Ellipsosmilia*, (Prod. II, p. 276), and Milne-Edwards and Haime to *Trochosmilia*, (Hist. Nat. des Corall., II, p. 162); but I do not think that either Forbes' description or figure give any positive indication for the latter generic determination. Indeed, Forbes' figure 9*b* appears to me to indicate the presence of a columella as well as of pali.

## 2. CARYOPHYLLIA CUPULIFORMIS, Stoliczka. Pl. I, Figs. 13-15.

Caryoph. corallum cupuliforme, basi augusta affixum; costis inæqualibus, fortioribus fere prope basin, alteris ad medium, ecteris in parte superiore, orientibus, omninis granis rotundatis ornatis; calyce late rotundato, modice concavo, ad marginem subacuto; septis tenuibus, in quinque cyclis dispositis, primis quatuor perfectis, quinto imperfecto; palis decem ad duodecim etongatis, crassiusculis, ad terminationes septorum ad tertium cyclum pertinentium sitis, uno vel duobus palis nonnunquam abortis; columella tamellis crispatis, tortis, supra paulo elevatis, tenuibus composita, circiter sextam partem calycis diametri æquante.

A cup-shaped corallum, generally about 12 mm. high, and with the calyx 10 to 12 mm. in diameter, affixed by a very narrow flat base, which easily wears off, and then the specimens appear to be free grown. The surface is unequally costate, almost in its entire length. The twenty-four costae, corresponding to the three first cycles, originate very near the base and are of about equal strength; those

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of the fourth cycle begin in the middle, and the last nearer to the edge of the calyx; they gradually decrease in strength, but all are ornamented with densely set small, round, granules. The calyx is round, wide, and moderately concave; the calicular margin rather sharp. There are four perfect, and a fifth generally imperfect cycle, the total number of septa being 70 to 82; all are thin. The pali are moderately clongated and thick; there are usually twelve of them, but sometimes two are displaced or not perfectly developed. The columella consists of very thin and much twisted and contorted lamellæ; its upper surface is very slightly raised and spinulose, and its width is about one-sixth of that of the calyx.

This is a very well marked and easily distinguishable species, both by its short cup-shaped form, with rather strongly and unequally costate surface, and by the large number of thin laterally only very finely spinulated septa.

Locality.—Near Moraviatoor, in a yellowish calcareous sandstone; three specimens have been examined.

Formation.—Ootatoor group.

### 3. CARYOPHYLLIA GRANULIFERA, Stoliczka. Pl. I, Figs. 16-17.

Caryoph. corallum sub-cylindraeco obconicum, breve, basi angustata atque contracta, paulum eurvata, affixum, fere omnino costatum, eostis sub-æqualibus, dense granulatis; calyce circulari, parum excavato; septis tenuissimis in quatuor cyclis perfectis dispositis, lateraliter minute granulatis; palis duodecim elongatis, paulo incrassatis, breviter elevatis, ad terminationes septorum ad tertium cyclum pertinenlium sitis, atque cum iis fere confluentibus; columella circa quintam partem calycis diametri occupante, lamellis tenuibus tortis composita, paululum elevata.

Corallum short, sub-eylindrieal, reversely conical, the base being rapidly contracted and slightly curved, the only perfect specimen having been sessile on a small Peleeypod. The mural theca is very thin, and the entire surface covered by densely granulated costae, slightly varying in strength, and nearly quite straight. The ealyx is circular, exceeding the height of the corallum by one or two millimeters, the total height being 9 or 10 mm. In one of the specimens, with a perfect outer surface, the calyx was slightly concave, but it was so obliterated with adherent rock that a section had to be cut, in order to see the distribution of the septa. The only other specimen is a cast. In both the septa are very thin, slightly undulating, arranged in four complete cycles and six regular systems. The pali are clongated, slightly thicker than the primary septa, twelve in number, one palus being opposite each tertial septum. The columella is rather broad and composed of very thin twisted lamellae ; its width equals about one-fifth of the diameter of the ealyx.

This is a very beautiful species, resembling the tertiary Australian *C. viola*, Duncan and Wood, (Quart. Journ., Geol. Soc., London, vol. xxvi, 1870, p. 293, pl. xix, fig. 1). Like this species it is remarkable by the almost entire absence of an c (141)

epitheea; the costae, corresponding to the first three cycles, originate almost immediately above the base, but the granulation becomes gradually stronger towards the upper edge of the corallum. In both specimens the four cycles of septa are perfect and very regular, but the pali are only slightly prominent and almost join the tertial septa. The granules on the costae are all rounded. In a section some distance below the ealyx the two adjoining pali appear almost to unite and meet with the secondary and tertiary septa.

Localities.—North-east of Odium; a single cast specimen in a whitish shelllimestone; east of Kauray, also a single specimen in a sandy limestone.

Formalion.—Ootatoor group.

## 4. CARYOPHYLLIA GRACILIS, Stoliczka. Pl. I, Fig. 18.

Caryoph. corallum sub-cylindricum, curvatum, basin versus compressiusculum atque basi compressa ramose dilatata affixum, lheca murali lenuissima; superficie omnino costata, costis subaqualibus, reelis, latiusculis, modice elevalis, minutissime granulate rugulosis; calyce fere circulari, paululum excavato; septis tenuissimis, paulo undulatis atque lateraliter spinulis aculiusculis numerosis instructis, in quatuor cyclis perfectis dispositis, palis duodecim, clongatis, tenuibus, ad terminationes septorum ad lerlium cyclum perlinentium ac brevium silis; columella lamellis tenuissimis, tortis et spinulosis composita, circ. quartam partem calycis diametri æquante.

This species is readily recognised from the other sub-cylindrical forms, like C. Bredai or C. Debeyana, by the peculiarly compressed and ramose base, by the external surface being entirely costated, by the very thin, spinulose septa, and the rather elongated and slightly thickened pali. This last character shows that the species belong to a group of Caryophyllice, which Milne-Edwards and Haime separated under the name of Balhycyalhus, and which Fromentel, I think, rightly unites with the present genus.

*Locality.*—Ootatoor; a single specimen occurred in a light coloured limestone; the calyx has been so much obliterated by adherent rock that it had to be filed off, in order to permit a clear view of the disposition of the septa.

Formation.—Ootatoor group.

## II. Genus.-TROCHOCYATHUS, Milne-Edwards and Haime, 1848.

The corallum is eupuliform, or more or less cylindrically elongated and conoid, sessile by a dilated or pedunculate base, but generally becoming free in the adult stage; mural theea well developed in the entire length of the corallum, costæ granular or sometimes spinulose; ealyx moderately concave; septa in six systems, and four to six cycles, above sharp, laterally striated, and granulated; pali numerous, unequal in length; columella well developed, broad, composed of twisted strings or columns, or contorted laminæ, granular and generally convex at the upper end.

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Milne-Edwards and Haime united d'Orbigny's *Aplocyathus* with the present genus, and Fromentel (l. e., p. 174,) states that *Paracyathus* is not separable from the same, as it only differs by a somewhat large base and a few minor points in the structure of the pali and the columella.

The *Trochocyathi* are found from the middle jurassie period up to the present time; they appear to have been most numerous, however, in the tertiary period. All the eretaeeous species, seven or eight, as yet known, have their costæ granulated, not spinose.

Only a single species of the genus has been met with in the Ootatoor beds of Southern India.

## TROCHOCYATHUS AFFINIS, Stoliczka. Pl. I, Fig. 19.

Trochocy. coraltum cupuliforme, latius quam altum, basi obtuse conoideum, liberum, superficie costatum, costis inæqualibus, granulatim rugulosis; septis supra acutiusculis, in quinque cyclis—quatuor perfectis, quinto imperfecto—dispositis, lateraliter granulatis; palis circiter 32, valde inæqualibus, nonnunquam subrectis alque inæqualiter incrassatis; columella lata, lamellis sex, contortis atque coufluentibus composita.

A small cupuliform species, very closely allied to *Troch. Harveyanus*, Milne-Edwards and Haime, from the English Gault, but differing from it by a fifth imperfect cycle of septa, and by thinner, more irregular and more numerous pali. The costae corresponding to the first three cycles and half of the fourth cycle differ very little in thickness, but the remaining are very much thinner; all are very finely and somewhat irregularly granulated. The mural thece is somewhat thickneed at the base, but there is no place of attachment traceable on the latter.

*Locality.*—West of Kurribiem, in a yellowish calcareous sandstone; a single specimen was met with.

Formation.—Triehinopoly group.

## III. Genus.-PLATYCYATIIUS, Fromentel, 1861.

Pal. Franç. terr. eret., 1863, tome viii, p. 180.

Corallum discoid or sub-discoid, with the mural theea only horizontally or basally developed and generally smooth; septa numerous, laterally, sharply granulated, arranged in six systems; pali numerous, unequal; columella large, composed of numerous twisted sub-cylindrical columns.

This genus was proposed by Fromentel for Milne-Edwards and Haime's *Trochocyathus Terquemi*, differing from the true *Trochocyathi* by the mere horizontal or basal development of the mural theea, while higher up the septa remain freely exposed. Although this difference appears to be only a slight one, Fromentel believes it to be in conformity with the generally adopted elassification,

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upon which *Leptocyathus*, *Discotrochus*, and other genera are based. There have for the present only two species been described under the genus *Pl. Terquemi* and *Pl. Orbignyi*, both from the cretaceous rocks of France. A third species has occurred in the Ootatoor (Cenomanien) deposits of the Trichinopoly district of Southern India.

## PLATYCYATHUS INDICUS, Stoliczka. Pl. I, Fig. 20.

Platyc. corallum conoidco sub-discoideum, basi angustatum, medio paulo excavatum, theca murali tenuissima sub-lævigata instructum; calyce lato, modice excavato, septis elevatis in quinque cyclis perfectis dispositis, extus omninis fere æqualiter incrassatis, dense sed minute granulatis, lateraliter costulis interruptis, divaricatis et spinutis interpositis instructis, septis primariis et secundariis fere æqualibus, crassissimis, tertiariis paulo tenuioribus, cæteris tenuissimis; palis 21 elongatis, iuæqualibus, tenuibus; columella circiter quartam partem latitudinis calycis æquante, in superficie granulosa.

This species has in general aspect a considerable resemblence to *Pl. Terquemi*, but is readily distinguished from it by the presence of five complete cycles of septa, these being arranged in six systems. The form of the corallum is generally discoid, somewhat roundly angular at the periphery and narrowed at the base, on which alone the mural theca is developed; this last appears to have been nearly smooth. Round the periphery the septa are almost throughout equally thickened and finely granulated, but in the moderately concave ealyx those of the fourth and fifth eyele are very much thinner than those of the three former eyeles; all are densely spinulose and costulate laterally. The pali appear to be only 24 in number, placed opposite the septa of the fourth eyele, and are unequal. In some cases there appear to be also short pali present opposite the tertials, but they are not well traceable in the only specimen examined. The columella is rather coarsely granular and very slightly convex.

*Locality.*—North by east of Odium, in a greenish-grey, slightly ealeareous sandstone, a single specimen occurred.

Formation.—Ootatoor group.

## Family,—TROCHOSMILID\_E.

## (As restricted by Fromentel.)

The coralla are simple, generally sessile by a broad or narrow base, sometimes covered with an epitheca, but generally costate on the surface; ealyx round or ovate, concave; septa lamellar, entire on the upper edge, connected by numerous dissepiments, often forming a well developed coenenchyma.

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The  $T_{ROCHOSMILID,E}$ , as defined by Fromentel, form a natural group of simple coralla, with entire edges to the septa. The simple growth with the great development of the septa separates them from the  $S_{TTLINID,E}$  and allied families, and the presence of dissepiments from the  $T_{URBINOLID,E}$  and  $C_{ARYOPHYLLID,E}$ .

Species of the family are probably more numerous in the cretaceons than in any other formation. Only a comparatively small number is found recent. In Southern India we have four genera represented; *Trochosmilia* with four, *Lophosmilia*, *Epismilia*, and *Psanmosmilia*, each with one species. Of the first-named genus two species are identical with European ones, *T. inflexa*, Reuss, from the Turon beds of the Gosau (Lower Austria) and of France, and *T. tuba*, Fromentel, from the beds of the same age at Sougraigne in France.

## IV. Genus.—TROCHOSMILIA, Milne-Edwards and Haime, 1848.

## Comp. Fromentel, Pal. Franç. terr. cret., tome viii, p. 253.

Corallum simple, obversely conoid, sub-cylindrical or compressed, sub-pedicellate, or sessile with a broad base; calyx sometimes round, more commonly elliptical, very slightly concave; septa numerous in six systems, dissepiments abundant; no columella; wall naked or with a partial rudimentary epitheca; costac simple, generally granulated and distinct in the entire length of the corallum.

This genus includes a large number of fossil species from cretaceous and tertiary deposits. Four species are found in the cretaceous beds of South India.

Dr. Duncan, in his supplement to the British Fossil Corals (Palaeontograph. Soc., vol. xxii, p. 5,) regards *Cælosmilia* as a sub-genus of *Trochosmilia*, the former differing from the latter only by the very small portion of an endotheca and scarce dissepiments. Still it cannot be denied that the *Cælosmiliæ* form a natural group, and the genus is retained as distinct by most authors who have written ou fossil and recent Corals. Indeed in general character the *Cælosmiliæ* much more resemble the *Turbinolidæ* than the *Trochosmilidæ*.

## 1. TROCHOSMILIA BREVICULA, Stoliczka. Pl. I, Fig. 21.

Troch. corallum breviter cylindraccum, basi latissima affixum, theca murali tenui tectum, costis acutis, granulatis, crassioribus cum tenuioribus alternanlibus; sectione rotunda; spatio columellari centrali, minimo; septis in quinque cyclis perfectis dispositis, primariis ad terminaliones internas paulo incrassalis.

A remarkably short, cylindrical species, sessile by a very broad base; the mural theca is thin, and the costæ rather sharp, granulated, stronger and thinner ones alternating with each other; in some places three unequal ones, of which the median is the thickest, appear to be situated between two somewhat stronger ones. The calyx was very shallow, almost flat, with slightly projecting septa near the margin; it had to be filed off, in order to show clearly the distribution of the septa.

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These are arranged in five complete cycles, those of the first cycle being conspieuously stronger than any of the rest, somewhat thickened at their inner ends; in the two next cycles the septa are equal and only a little shorter than the primaries, while the following orders gradually decrease in size and strength.

Locality.—East of Parally, in a sandy limestone, a single specimen was found. Formation.—Ootatoor group.

## 2. TROCHOSMILIA CAMURA, Stoliczka. Pl. I, Fig. 22.

Troch. corallum modice elevatum, sub-cylindraceum, ad intervalla irregulariter contractum, basi lateraliter curvata paulumque angustata affixum; costis sub-distantibus, acutis, granulatis, fortioribus atque tenuioribus alternantibus; sectione rotundate elliptica, spatio columellari sub-angusto, cireiter tertiam partem diametri longioris æquante; septis in quatuor cyclis dispositis, primariis atque seeundariis ad terminationes internas inerassatis.

Although of a similar type to the previous species, in being sessile by a rather broad base, the shape of the corallum is distinctly elliptical in the present form, and the septa are differently arranged, meeting with their ends along a considerably extended columellar space. The septa themselves are also more irregularly undulating, and those of the three first orders are sub-equal in length and strength, conspicuously thickened at their inner ends.

Locality.—East of Parally, in a sandy limestone, only two specimens were found.

Formation.—Ootatoor group.

A third specimen was found a little more south from the above-named locality. north of Moraviatoor. It is a very imperfect one, (Comp. fig. 23, on pl. I); the corallum is very short and rapidly increased in diameter; the base appears to have been very broad, but, like the upper part, it was not perfect, and both have been filed off in order to show the disposition of the septa. The lower section is nearly circular, showing, however, a somewhat irregular increase of eorallum; originally it had only four complete cycles of septa very similar in form and distribution to those of T. eamura. The upper section is roundly ovate, and shows five complete and a sixth incomplete cycle of septa, those of the three first cycles all ending at the edge of the columellar space with a slightly thickened knob. The costa are apparently alternately thicker and thinner, but are on no part of the theea well preserved. Judging from the majority of the characters alluded to, I much rather suspect that the present fragmentary specimen represents a large and somewhat straight growing eorallum of T. eamura than that it belongs to a distinct species. When better specimens have been found, it will have to be ascertained by observation whether the apparently cuneiform shape of the specimen is sufficiently constant to necessitate a separate designation from the one above noticed.

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## 3. TROCHOSMILIA INFLEXA, Reuss. Pl. II, Figs. 1-4.

1851. Trochosmilia inflexa, Reuss, Denk. Akad., Wien, Math. Nat-wiss. Klasse, vii, p. 86, pl. v, figs. 3-5.
1867. " " apud Fromentel, Pal. Franç. terr. cret., viii, p. 270, pl. 39, fig. 1.

Troch. corallum conoideum, basi attenuatum, arcuatum atque affixum, modice compressum; theca murali crassiuseula, eostis acutis, granulatis, tribus inæqualiter (mediano duobus alleris fortiori) tenuioribus inter duos fortiores sitis, omnibus in parte supera distinctioribus, ad basin nonnunquam fere obsoletis; spatio eolumellari angustissimo, longo, septis in quinque eyclis perfectis dispositis, (nonnunquam cyclo sexto imperfecto), iis ad eyelum primum, secundum atque tertium pertinentibus fortissimis, ad terminationes internas incrassalis ae truncatis, oppositis sæpe fere contiguis.

The corallum is generally of a tolerably large size, compressly conoid, with an attenuated and eurved basal portion, and a comparatively small place for attachment. The surface is covered by continuous, rather sharp and granular costae, of which three unequally thinner ones are placed between two stronger ones. The same is the ease with the septa, of which there are, as a rule, five cycles, but often in large specimens there is a sixth incomplete cycle present. The length of the columellar space varies; in rounder specimens it amounts to only about two-fifths of the longer diameter; in more compressed ones, it is sometimes nearly one-half of it. The septa of the three first cycles are almost equal in strength, and their ends at the edge of the columellar space are thickened and truncated, often nearly touching each other.

The largest specimen in our collection measures about 80 mm. in height, though the base is not perfect, (about 12 mm. of the original length having been broken away); the larger diameter at the lower end is about 40, and near the calyx, which is somewhat irregularly compressed, about 70 mm. The variations in the compression of the corallum and the number of septa are indicated by the sections represented in figs. 17, 2 and 3.

Localities.—Near Koloture, in an impure sandy, yellowish limestone; near Andoor and north of Alundanapooram, in a coarse conglomeratic sandstone; not common; at the two last named localities mostly rolled fragments were found.

Formation.—Trichinopoly group.

The species was first described by Prof. Reuss from the Gosau deposits in the Austrian Alps, and has since also been found in the Turonien beds near Trets (Bouches du-Rhône).

Its geological position in India exactly corresponds with that in Europe.

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4. TROCHOSMILIA TUBA, Fromentel. Pl. I, Figs. 24-28.

1863. Trochosmilia tuba, Fromentel, Pal. Franç. terr. cret., viii, p. 280, pl. 30, fig. 3.

Troch. corallum sub-cylindricum, basi attenuatum, pedicellatum atque lateraliter plus minusce fortiter arcualum; costis numerosis, æqualibus, granulatis, suleis angustioribus separatis; calyce rolundato vel rolundate elliptico, modice concavo, septis in quinque cyclis dispositis, lateraliter confertim granulatis; spatio columellari panlum elongato.

This species is rather variable in form ; although always approaching the cylindrieal shape, its section often passes from round in the young to roundly ovate in the more adult, but other specimens remain permanently cylindrical. The base is considerably attenuated, pedicellate, and curved towards one side. The costae are all equal in strength, simple in their entire length and granular, the granules being generally better traceable on one than on the other side of each rib. The calyx is moderately concave ; the septa arranged in five cycles and six systems, the stronger being well marked in the ealyx, and all are densely and rather sharply granular at the sides. The size of the coralla vary from 20—40 mm. in height, and 15 to 25 mm. in the width of the calyx.

Although none of the Indian specimens appear to attain the large size of the type figured by Fromentel, and although the pedicellate base is in none of them very much curved and prolonged, the form of most of the eoralla, the equally thick and granular costæ, and the distribution of the septa, leave scarcely a doubt regarding the identity of the Indian with the European fossil.

Locality.—East of Parally, in a sandy limestone; not uncommon.

Formation,—Ootatoor group.

Fromentel described the species from the Turon beds at Sougraigne (Aude), where it was found by Dumortier.

## V. Genus.-LOPHOSMILIA, Milne-Edwards and Haime, 1848.

Corallum sub-cylindrical or conoid, sessile, somewhat wider near the ealyx; septa exsert, unequal, arched above, laterally granular; columella solid, lamellar, generally short; costa simple, sub-equal, granular, generally most distinct near the ealyx.

This genus was established for a recent species, *L. rotundifolia*, and for one from cretaceous strata, *L. cenomana*, Michelin. The two differ from each other by the former having a tri-lobate columella, while the same is entire in the cretaceous fossil. For this reason *L. cenomana* was separated by d'Orbigny under the name of *Actinosmilia*, a distinction which is believed, and I think rightly, to be unnecessary by the authors of the Histoire Nat. des Coralliaires, (comp. vol. ii, p. 180). Fromentel (Pal. Franç. terr. cret., 1863, vol. viii, pp. 231, &c.,) added (148)

three new species from the cretaceous beds, L. simplex, inflata, and balanophyloides. A sixth one occurs in Southern India.

## LOPHOSMILIA SIMILARIS, Stoliezka. Pl. II, Fig. 6.

Loph. corallum sub-eylindraeeum, modice elevatum, parte inferiori paulo contractum atque basi lala irregulari sessile; sectione eltiptiea; costis æqualibus, tatis, prope calicem distinctissimis, sub-granulosis; ealice paulo contracto, concaviuscuto; septis in quinque cyclis dispositis, eyelo ultimo in specimine unico, ut videtur, imperfecto, modice undulalis, septis primi atque secundi ordinis terminationibus internis paulum incrassatis; columella eirciter quarlam parlem diamelri majoris tonga, undulata, quasi quadrilobata.

The single specimen bears a great resemblance to Fromentel's L. *inflata*; it has a similar sub-cylindrical stem, sessile by a broad base; the costæ are all equal and sub-granular; the calyx was also little contracted, with the edges of the costæ somewhat projecting, but it had to be filed off in order to show clearly the disposition of the septa. Of these there are four complete, and a fifth apparently incomplete cycle; the primary and secondary ones are conspicuously thickened at the inner ends. The columella equals in length about one-fourth of the longer diameter; it is somewhat undulating, as if it were four-lobed, a circumstance which supports M.-Edwards and Haimes' statement regarding the identity of Lophosmilia and Actinosmilia.

Locality.-Near Odium, in a yellowish limestone.

## Formation.—Ootatoor group.

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Lophosmilia is closely allied to *Ptacosmilia*, but while in the former the corallum is usually of small size with the costa most distinct near the calyx, with the septa generally somewhat attenuated at the inner ends, and with a very small number of dissepiments, the same is in the latter generally of moderate size with the costa well developed in the entire length, with the septa internally usually thickened or truncated, and with very numerous dissepiments.

Of *Placosmilia*, adopted in this signification, only a single fragmentary specimen has been found east of Parally in a calcareous rock belonging to the lowest beds of the Ootatoor group.

The specimen, see figs. 7 and 7a on plate ii, has the outer surface covered with sharp, unequal granular costae, of which three subequal ones are interposed between two stronger ones. The section of the corallum is elongately oval, with a columella equalling one-third of the longer diameter. There are five complete cycles, and a sixth incomplete cycle of septa, those of the first and second order being truncate at the inner ends; the dissepiments are very numerous. Until better specimens have been discovered, it will not be possible to give a reliable characteristic of the species, or to identify it with any other previously known.

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## VI. Genus.—EPISMILIA, Fromentel, 1859.

Corallum sub-cylindrical, or more or less compressed and conoid, attenuated at the base or shortly pedicellate, covered with a well developed epitheea, the costæ being indistinct; the calyx is ovate or round, according to the form of the stem, apparently very slightly concave in the centre; the septa are in six systems, smooth or nearly smooth at the sides; dissepiments abundant; no columella is present.

I have slightly altered Fromentel's characteristic, because it appears to have been framed almost only with reference to the two species which that author describes. When the roundness or slight compression, or a more or less pedicellate shape, of the corallum is not considered to possess generic value in the case of *Troehosmilia*, *Plaeosmilia* and others, it is only a natural consequence not to admit it in the closely allied *Epismilia*.

The genus differs from *Trochosmilia* by its well developed epitheca and laterally smooth or nearly smooth septa; the last character also separates it from *Montlivaultia*. It includes a few jurassic and two cretaceous species, to which one is added from South India.

## EPISMILIA CRASSISEPTA, Stoliczka. Pl. II, Figs. 8-9.

Epism. corallum sub-eylindraceum, vel obverse conoideum, erassum, basin versus angustatum, ad intervalla irregulariter constrictum, brevissime atque abrupte pedicellatum, basi arcuata vel torta ac angusta affixum; epitheca rugulose striata; ealyee rotundato, paulum exserto, ad marginem sub-rotundato, medio impressiusculo; septis in quinque eyelis dispositis, eyelo ultimo sæpissime imperfecto, sub-flexuosis, primariis erassissimis, medio fortissimis, ad terminationes internas valde attenuatis, sequentibus gradatim in magnitudine decrescentibus, lateraliter minutissime denticulatis; spalio columellari centrali hand elongato, parvo.

A large sub-cylindrical or obversely conoid species with an abruptly contracted and somewhat twisted, shortly pedicellate base; the epitheca is very strongly, but irregularly developed, the corallum being at intervals more or less contracted, and becoming in places quite irregularly rugose; the calyx is round, slightly exsert, apparently with rounded or obtuse edges and an impressed centre. The septa are very strong, in five cycles, the fifth cycle is, however, mostly incomplete; all the septa are somewhat flexuous, attenuated at their inner ends, the primarics being greatly thickened about the middle; the following septa gradually decrease in strength; their sides appear smooth to the naked eye, but with the lens a very fine crenulation or denticulation is traceable on most of them.

The strength of the septa, between which the dissepiments and the endotheea are very much developed, and the roundness of the stem, readily separate the present species from the two others known from cretaccous deposits.

Locality.—North-west of Moraviatoor, in a brownish limestone.

Formation.—Ootatoor group.

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## VII. Genus.-PSAMMOSMILIA, Fromentel, 1863.

Pal. Franç. terr. cret., vol. viii, p. 288.

Corallum sub-cylindrical, attached by a broad base and with a rounded shallow ealyx; mural theca finely granulated or nearly smooth, formed by super-imposed layers, without any costæ; septa in six systems, laterally granular or striated; no columella.

The genus differs from *Cælosmilia* and other allied forms by the entire absence of costæ. There is as yet only a single species known, *Ps. Orbignyi*, From., from the Cenomanien beds of the island of Aix.

## PSAMMOSMILIA ORIENTALIS, Stoliczka. Pl. II, Figs. 10 & 11.

Psamm. corallum plus minusve clongate sub-cylindraccum, basi lata scssile, modice arcualum, superficie concentrice irregulariter paulo constrictum, sub-tævigatum, calycem versus gradatim ditatatum; calyce sub-rolundato, concavo, margine tenui ac simplici instructo; septis in quatuor cyclis dispositis, lateratiter granulato striatis, primariis crassissimis sed inæqualibus, iis ad cyclum quartum pertinentibus minimis, nonnunquam fere obsoletis.

Although the two, as yet known specimens of this interesting species, are only partially weathered out of a solid limestone rock, both the generic and specific characters are quite sufficient to distinguish the Indian fossil from the European one. There is not a trace of costæ present, and the mural thece appears to have been almost smooth, or only very finely granulated. The edge of the calyx is thin, entire, and the septa not so prominent, as in P. Orbignyi; those of the fourth are sometimes partially imperfectly developed, which appears to be due to a slight irregularity in the growth of the calyx.

Locatily.—South of Cooticaud, in a whitish limestone. Formation.—Ootatoor group, (Cenomanicn).

## Family,-STYLINIDÆ.

Compound massive coralla, in which the multiplication of the corallites is basal or extra-calicinal, and the calyces are entirely free, connected with each other by a costal murail; dissepiments are abundant; the septa entire on the upper edge.

This group corresponds to the *STYLINACE* of M.-Edwards and Haime, by whom it is regarded as a sub-division of the *EUSMILINE*, which again are considered as a sub-family of the *Astreide* in the old sense. The above noticed characters easily separate the *Stylinide* from other allied families, such as the *Astreide* (sensu stricto), which have the edges of the septa granular or dentate.

The South Indian cretaceous deposits have yielded only two genera belonging to the present family, *Stytina* with three, and *Phytlocænia* with a single species; all four are new to science.

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## VIII. Genus.—STYLINA, Lamarek, 1816.

## Hist. Nat. des Corall., tome ii, p. 232.

Massive, generally semiglobose, rounded or flatly expanded coralla, in which the corallites are united by a dense costal or mural theca; the costæ are well developed; the septa entire, in six systems, the calyces usually deeply excavated, of a rounded circumference, with raised edges; the columella styliform.

D'Orbigny divided this genus, as defined by Milnc-Edwards in his early monograph<sup>\*</sup> of the Astrendet Ast

In order to facilitate the determination of the species Milne-Edwards and Haime have divided the genus into several groups, chiefly according to the equal or unequal development of the systems, and then according to the number of cycles. In the South Indian cretaceous deposits three species have been found, one belongs to a group with only very few septa of the fourth cycle, while the two others are referable to a section of chiefly jurassic species with regular six systems and only two complete cycles of septa.

## 1. STYLINA MULTISTELLA, Stoliezka. Pl. III, Figs. 1 & 2.

Styl. corallum subglobosum seu late explanatum, infra subpedieellatum vel concavum; ealyeibus in superfieie supera irregutariter dispositis, 4 ad 5 mm. latis, modice dislantibus atque etevatis, profunde ae infundibiliforme excavatis; septis crassis, intus attenuatis in duobus eyelis dispositis, erassioribus atque tenuioribus alternantibus; columella tenui, profunde sita.

The form of the corallum is very variable, either semiglobose with a concave lower side, or more or less expanded and with a flattened upper side. One of the largest specimens measures 160 mm. in length, 140 in breadth, and about 55 in thickness, the lower side being subpedicellate, the upper only very slightly convex.

\* Ann. des sc. nat., 3me ser., vol. x.

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Older and younger calyees are irregularly distributed over the surface and are moderately distant from each other. Each is about 4 to 5 mm. in diameter, and all are deeply excavated with sloping sides and two complete cycles of strong septa; the secondary septa being somewhat thinner than the primaries; most of the costa are confluent with those belonging to the next calyx, others are not; dissepiments are very abundant; the columella is very deeply situated and thin at its upper end. In weathered specimens (see fig. 2) the ealyces are apparently larger, with perpendicular walls, and the septa become more or less detached from the costae.

Locality.—North-west of Moraviatoor, in a brownish limestone; several specimens have been found together with  $\Delta mm$ . Rolomagenesis and rostratus.

Formation.—Ootatoor group.

## 2. STYLINA GRANDIS, Stoliczka. Pl. III, Fig. 3.

Styl. corallum co specici præcedentis simile, sed erassius, calcibus majoribus,-6 ad 7 mm. latis,- magisque elevatis, atque inter se distantioribus (12 ad 15 mm.), septis in duobus cyclis dispositis, crassis, subæqualibus, subcarinatis, interspatiis polypidum satis exeavatis; calycibus perprofundis; columetta profunde sita, crassiuscula.

A species similar to the preceding, but with much larger and more clevated polypides, the calyees varying from 6 to 7 mm. in diameter; the septa are strong, almost earinate and subequal; the secondaries not differing very much in strength from the primaries; all descend rather rapidly into depth of the calyx.

Locality.—Near Kauray, in a sandy limestone; only a single large but imperfect corallum, 130 mm. long, 110 broad and 60 thick, has been found.

Formation.—Ootatoor group.

## 3. STYLINA PARVULA, Stoliczka. Pl. IV, Fig. 6.

Styl. corallum agariciforme vel subglobosum, breviter pedicellatum, basi latiuseula affixum, aut irregulariter rotundate expansum, deplanatum, epithecă radiatim striatulă teetum; calycibus rotundatis, cire. 2 mm. latis, margine modice elevato circumdatis, 1.5 ad 2, rare 3, mm. distantibus, subæqualibus; septis valde inæqualibus, tenuibus, plerumque 28, rariter 30, in tribus cyclis perfectis dispositis, cyclum quartum in uno systemate solum exhibente; costis confluentibus, attenuatis; columella erassa, solida, medio calycis umbonata, semiglobosa.

The form of the corallum is either convex, subglobose, or more or less depressed, sessile by a broad base, or with a very slightly developed and short peduacle; the lower side has a striated epitheca; the upper is covered with calyces, sometimes overlapping the edges of the corallum and extending on to the lower side. The ealyces are about 2 mm. wide, rounded, with moderately elevated margins, and generally only  $_{\rm F}$  (153)

1.5 to 2 mm., very varely 3 mm., distant from each other. There are in most of the calyces three complete cycles of thin and very unequal septa, and in one system there are four septa of a fourth cycle, rarely are one or two more septa in any of the other systems present. The costa are well developed, confluent; the columella thick, terminating in the centre of the calyx with a large round, prominent knob.

Locality.—Ninnyoor, in a white, earthy limestone; four specimens have been examined; the largest measures 70 mm. in diameter.

*Formation.*—Arrialoor group, of which the present species appears to be a very characteristic fossil.

### IX. Genus.-PHYLLOCENIA, Milne-Edwards and Haime, 1848.

#### Hist. Nat. des Corall., vol. ii, p. 272.

A generally massive corallum with the corallites united by the costa and the exotheca; generation lateral; the calyces have slightly elevated margins; septa well developed in six systems; dissepiments very abundant; columella generally absent, sometimes apparently rudimentary.

Species of this genus occur in cretaceous as well as in tertiary deposits.

## PHYLLOCENIA MULTISEPTA, Stoliczka. Pl. III, Fig. 4.

Phyll. corallum agglomeratum; calycibus rotundate polygonis, marginibus paululum elevatis; costis in interspatiis fere obsoletis; septis in quatuor cyclis dispositis, lateraliter minute granulatis; columella nulla.

This species is based upon a rather imperfect specimen, but it appears to be a true *Phyllocænia*, the columella being entirely absent; there are, however, in some of the corallites lamellæ projecting, which appear quite to close up the columnar space; dissepiments are very abundant. The margins of ealyces are very slightly raised, and the costa between them very imperfectly traceable. The inner ends of the primary and secondary septa are somewhat thickened, and all granulated.

Locality.—North of Alundanapooram, in a coarse conglomeratic sandstone. Formation.—Trichinopoly group.

## Family,—ASTREIDÆ.

This family includes compound massive coralla, with basal or sub-marginal gemmation of the individuums, the ealyces being connected by a costal murail; the septa are always granular or serrated on their upper edges.

Taken in this sense, the *Astrenoæ* correspond to Milne-Edwards and Haime's sub-family *Astrenxæ*, with the exception of the *Lithophyllinæ* and of *MontlivAultiA*, which have been already separated by Fromentel. The same author gives, it is true, (154)

a much more restricted sense to the Astreide; for, according to the above noticed eharacteristic, it will also include his  $L_{ATOM \mathcal{A}.ANDRID.\mathcal{E}}$ , Stmputlide,  $F_{AVID\mathcal{A}}$ , and two or three others. It is possible, and I should say very desirable, that a few separate groups or families should be distinguished; but, for reasons already referred to, I hardly think that this can be done with advantage in the form introduced by Fromentel. It is often, in imperfect specimens, very difficult to decide in what manner the multiplication of the corallites takes place, and until all these and other points in structure have been satisfactorily settled, it will be, I think, for our purpose more advantageous to retain the extent of the  $Astreide \mathcal{E}$  in the older sense. In conformity with this, the family is divided into two groups according to whether the multiplication of the corallites takes place by fissiparity, or by sub-marginal gemmation; the former may be called stimplities, the other  $Astreide \mathcal{E}$ . (excluding the  $T_{HAMNASTREIDE}$ ). Between these two sub-divisions come the FATIDE.

The SYMPHYLLINÆ are represented in South India by the following genera; Thecosmilia with one, Holoeænia with two, Aslroeænia with four, Mycelophyllia with two, and Stelloria with one species; the ASTREINÆ have only four genera, Heliastrea with three, Placaslrea (n. gen.) with one, Isastrea with five, and Latimæandra also with five species. Thus we have in all twenty-four species of ASTREIDÆ, but two or three remain somewhat imperfectly known.

## X. Genus.-THECOSMILIA, Milne-Edwards and Haime, 1848.

## Hist. Nat. des Corall., vol. ii, p. 354.

The corallum is composite, exceptione, sometimes forming large aggregate masses connected together by a well developed epitheea, but the single individuums generally become free near the ealyx, and the epitheea reaches very nearly or fully to its edge; the ealyx is slightly impressed in the centre with somewhat irregular edges; the septa, arranged in six systems, are laterally distinctly granular; in typical specimens no columella is present, but a few aberrant forms have traces of it; the endotheea is abundant.

All the species, as far as known, are, I believe, fossil, and the majority from mesozoie deposits, particularly cretaceous and jurassic.

## THECOSMILIA GEMINATA, Sloliezka. Pl. IV, Figs. 1-3.

Theeosm. eorallum breviter cæspilosum, bi- vel poly-geminatum, ealyeibus subrotundatis, altingentibus, theca erassa comuni eireumdatis, in junioribus fere planis, in adullis modiee convexis, medio paulo concaviusculis, cpitheca usque ad marginem ealyeis extensa; septis crassis in quatuor aut quinque eyelis disposilis.

This is a very remarkable species, in some respects intermediate between Euphyllia and The cosmilia; the presence of a strong epitheca appears, however, to show a decidedly greater relation to the latter genus, though in other respects it also

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closely approaches certain tertiary species of *Latimæandra* and *Heterogyra*, but the fossils are not sufficiently well preserved to ensure a thoroughly satisfactory determination of the genus. The corallum is shortly exspitose and sessile; the single individuums, although entirely free below, cemented by the epithecal mass, are not perfectly separated on the outer surface, the calyces touching each other in a long line by two and two, and thus producing a greater or lesser irregularity in the rounded shape of the calyx. The epitheca reaches up to the margin of the ealyees and surrounds them; the latter are rather flat in young, but more elevated in older specimens; the first have four, the second five cycles of septa, but the last cycle appears to remain incomplete; all the septa, except those of the last cycle, are very strong, thickest about the middle of their length, much attenuated towards and almost meeting in the centre; their sides are very distinctly granular.

The strength of the septa and the projecting epitheca at the edge of the calyx exhibits certain relations to similar characters in *Thecosmilia (Enphyllia?)* sinuosa, Reuss, (Denksch, Akad., Wien, Math. Naturwiss. Klasse, 1854, vol. vii, p. 92, pl. 17, fig. 3), from the Alpine Gosau deposits, but the greater isolation of the calyces in the Indian form readily proves its specific distinctness.

*Locality.*—North-west of Moraviatoor, in a light brownish limestone, apparently not common.

Formation.—Ootatoor group.

### XI. Genus.-HOLOCENIA, Milne-Edwards and Haime, 1851.

## Hist. Nat. des Corall., vol. ii, p. 249.

Corallum solid, globular or branched, with the ealyees irregularly distributed over the surface, connected by short, confluent costæ, which extend from the septa so as somewhat to obliterate the edges of the ealyees; septa serrated, thin, arranged in six systems; columella solid and large.

This genus was proposed by Milne-Edwards and Haime for a lower cretaeeous species of a globular shape, *Astrea micrantha*, Römer, which was subsequently also found in the Dept. de l'Yonne. In the description of that species, the authors of the Hist. Nat. des. Corall. distinctly state that the septa are serrated, and the same is to be observed in at least one of two Indian species. It is, therefore, clear that the genus cannot belong to the *Strlinide*, but has to be referred to the *Strlinide*.

## 1. HOLOCENIA RAMOSA, Stoliczka. Pl. IV, Figs. 4-5.

Holoc. corallum crasse ramosum, ramis cylindraecis aut sub-compressis; calycibus undique sparsis, rotundatis aut rotundate sub-angulatis, 1.5 ad 2 mm. latis atque 1 ad 1.5 mm. inter se distantibus, corum marginibus in superficie perfecta paulo clevalis, costis transcuntibus crenulatis; septis in tribus cyclis perfectis dispositis,

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iis ad primum alque secundum cyclum pertinentibus æqualibus, eæteris multo tenuioribus ac brevioribus, omninis minute serralis lateraliterque dense spinulatis; costis brevibus, granulatis, in depressionibus inter-calicularibus paulo atlenuatis atque plus minusve distincter confluentibus; columella solida, pererassa.

Corallum generally forming diehotome, round or somewhat compressed branches, on which the ealyees are irregularly and rather densely distributed. They are round or roundly polygonal, on a well preserved surface with somewhat raised margins, which are erenulated by the costae passing over the same. When the surface is not well preserved, the calicular margins become obliterate by the costae, and appear more depressed than the interspaces. The width of the ealyees varies from 1.5 to 2 mm., and they are one to one and a half mm. distant from each other. There are three complete cycles of thin septa, all finely serrated on the upper edges, and laterally densely spinulose; those of the first and second cycle are equal in strength and length, extending to the very massive and solid columella; those of the third cycle are much shorter and thinner. On a section the costo- mural theca is rather coarsely and irregularly granular. (See fig. 4b).

Locality.—Moraviatoor, in a brownish limestone; not uncommon. Formation.—Ootatoor group.

## 2. HOLOCŒNIA INDICA, Stoliczka. Pl. V, Fig. 1.

Holoc. corallum irregulariter expansum, depressum, superficie supera undulate planatum; calycibus confertis, approximatis, sub-rolundatis, 1.5 mill. latis, margine paulo elevato circumdatis, depressionibus augustissimis separatis, costis brevissimis in marginibus calycum tuberculiforme elevatis; septis in duobus cyclis dispositis, sex majoribus cum sex multominoribus alque brevioribus alternantibus; columella solida, crassiuscula.

In general character the present species resembles an  $\Delta strocœnia$ , but the calyees are well defined, rounded, their edges crenulated by the very short costæ. There are, as a rule, only two cycles of septa developed; very rarely are a few very short ones of a third cycle noticeable. Scarcely any of the calyees exceed 1.5 mm. in width. I have not been able to see whether the upper edge of the septa is crenulated; laterally there are only few very minute denticles to be observed.

Locality.—Ninnyoor, in whitish limestone; only three specimens, the larger of which is 75 mm. long and 50 mm. broad, have been found.

Formalion.—Arrialoor group.

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## XII. Genus.-ASTROCENIA, Milne-Edwards and Haime, 1848.

## Hist. Nat. des Corall., vol. ii, p. 254.

Compact coralla of a globular, sub-globular, or more or less ramified shape, on which the ealyees are irregularly distributed and close together, polygonal, separated by granules or rudiments of septal costæ; the columella is styliform, solid, somewhat projecting in the middle of the calyx; the septa are granular, arranged in six cycles, but sometimes apparently in eight or ten, some of those of the second cycle being equally strongly developed as those of the first.

The species of this genus only differ from *Stylocænia* by the want of projections at the angles between the calyces, and as these become occasionally or locally in some (particularly tertiary) forms of the latter genus obsolete, several authors consider the distinction of the two genera as doubtful, suggesting that the character alluded to should only be used as facilitating an easier grouping of the species, all referable to one genus. The ramose species have been called *Enallocænia* by d'Orbigny, but the mere mode of growth is justly rejected by Milne-Edwards and Haime as a character of generic value.

Reuss first observed the granulation of the septa. In Ast. Konineki or decaphylla of the Gosau, for instance, the granulation of the upper edge of the septa is very distinct, and the genus must, therefore, be transferred from the STYLINDE to the STYLINDE, treated by Milne-Edwards and Haime as a sub-family of the ASTREIDE.

The typical species of Astroexnia are known from mesozoic and cainozoic deposits. Only recently a few recent species had been referred to it, but they apparently require a verification of the generic determination. Pourtalè's (Illust. Cat. Museum Comp. Zool., No. iv, Deep Sea Corals, 1871, p. 69,) describes a new recent species as Ast. peetinata, incrusting the base of a Madrepora. The author says in the description "costæ spinous, generally not confluent," columella rather stout, conical, hollow, free to a considerable depth; calyces 1.5 mm. wide.

The species occurring in the South Indian cretaceous deposits arrange themselves as follows :---

a. 1. With six primary septa-in three complete cycles,-calyees 2-3 mm., A. retifera, n. sp.

2. " " " —in two cycles—calyces 1.2 to 1.75 mm., A. Reussiana, n. sp.

3. " " " " , , calyees 1 mm., *A. pumila*, n. sp.

b. 4. With ten principal septa-in three complete cycles-A. decaphylla, Mich.

## 1. ASTROCCENIA RETIFERA, Stoliczka. Pl. V, Fig. 2.

Astroc. corallum crassum, semi-globosum, aut tuberosum; calicibus attingentibus, polygonis, (plerumque irregulariter hexagonis) 2 ad 3 mill. latis, marginibus unitis elevatis, tuberculis crassiusculis ornatis; septis in tribus eyclis perfectis (158)

dispositis, nonnunquam duobus vet tribus septis ad cyclum quartum pertinentibus in uno systemate observandis; septis indistincte granuliferis; columella mammitlata.

This species forms large convex or nodular masses, some of them averaging one foot in diameter, and they are nearly quite as high. The ealyces are generally polygonal, mostly hexagonal, and the united raised margins are ornamented with a single row of well marked tubercles. The septa are arranged in three complete cycles and six systems; sometimes there are two or three septa of the fourth cycle developed in one of the systems; all are provided with somewhat flattened granules on their upper edges; the columella is of moderate size, forming a conspicuous hemispherical knob in the centre of each ealyx.

In general character this species resembles *Ast. Konineki*, *(A. magnifica*, apud Reuss), but it differs from it by the number of septa. There is, I think, as yet no cretaceous species known with three complete cycles of septa regularly arranged in six systems.

*Localities.*—Ootatoor, east of Kauray, north-west and north-east of Moraviatoor; common in brownish or whitish limestone.

Formation.—Ootatoor group.

## 2. ASTROCENIA REUSSIANA, Stoliezka. Pl. V, Figs. 3-4.

Astroc. corallum semi-gtobosum, aut late planeque expansum, erassum; calycibus 1·2 ad 1·75 (rare 2) mm. latis, potygonis, modiee distantibus, margine quoque spinutose tubercutifero; septis in duobus cyclis dispositis, primariis usque ad cotumeltam solidam erassiuscutam extensis, secundariis pauto brevioribus, rariter septis nonnullis brevissimis ad cyctum tertium pertinentibus observandis.

This species is somewhat allied to A. Tourtiensis, Bölsche (in Geinitz's 'Elbethalgebirge in Sachsen,' part i, 1871, p. 54), differing from it by more distant calvees, which have very distinctly and spinulously tuberculated margins. There are, as a rule, only two cycles of septa, those of the second cycle being conspicuously shorter than those of the first, while in the European species the two are of equal length. Sometimes there are some very short septa of a third cycle developed in the larger calyces. The coralla are very massive, either semi-globose, or with a flattened upper surface. One of the largest specimens is 110 mm. long, 60 broad, and equally high.

Localities.—Odium, Moraviatoor, and east of Kauray; mostly in a brownish or pinkish limestone.

Formation.—Ootatoor group.

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## 3. ASTROCŒNIA PUMILA, Stoliczka. Pl. IV, Fig. 7.

Astroc. corallum parvum, sub-globosum, calycibus minutis, approximatis, polygonis 0.7 ad 1 mill. latis, profundiusculis, marginibus tuberculis crassis spinulosis, paululum alternantibus ornatis; septis in duobus cyclis perfectis dispositis; columella sub-mammillata.

A remarkably small form of a sub-globular shape, and with the ealyces from 0.7 to 1 mm, wide; they are polygonal, moderately exeavated, and the united margins are crowned with a row of rather strong, sharp, and somewhat alternately placed tubereles, so as to form a slightly undulating row. There are only two complete cycles of unequal septa, regularly arranged in six systems. The columella is styliform, with a sub-mammillate upper end. The small size of the ealyees readily distinguishes the present species from all other known Astrocania. As regards general character one of the nearest allied species is Bölsche's Ast. Tourtiensis\* from the lower Planer near Planer; but this has not only larger ealyees, but also a larger number of septa.

Locality.—Ninnyoor, in a whitish earthy limestone; only the figured specimen has been examined.

Formation.—Arrialoor group.

#### 4. ASTROCENIA DECAPHYLLA, Michelin. Pl. V, Figs. 5 & 6.

1847. Astrea decaphylla, Michelin, Icon. Zoophytol., p. 302, pl. 72, fig. 1.

1854. Astrocania cad., apud Reuss, Denksch. Akad., Wien, Math. Nat. Klasse, vol. vii, p. 94, pl. 8, figs. 4-6. " Mil.-Edwards and Haime, Hist. nat. des Corall., ii, p. 258. 1857. • 7

Astroc. corallum globosum aut scmi-globosum, nonnunquam incrustans; calycibus polygonis plerumque duo, rariter tres, mill. latis, polygonis, interspaciis subcristatis, aut depresse latiusculis, et granulatis separatis, viginti septis majoribus atque minoribus alternantibus, granuliferis instructis; columella solida, ad terminationem superam sub-mammillata.

Corallum more or less globular or sometimes inerusting other substances with smaller and larger ealyces irregularly disposed. The latter are polygonal and generally have a diameter of two, rarely three millimeters; they are separated by simple tuberculated ridges, the tubercles being placed somewhat alternately, and when the surface is somewhat worn off, they give the appearance of two separate rows; on a polished surface these two rows become still better traceable. The septa are twenty in all, alternately shorter and longer, four of the second cycle being quite as strong as those of the first eyele; of the third eyele only eight are present, all are granular on the upper edge and laterally finely denticulate. The columella is sub-mammillate at the upper end, thicker in some ealyees than in others.

\* Geinitz's Elbethalgebirge in Saehsen, pt. i, 1871, p. 54, pl. xi, figs. 7 and 8. )

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M.-Edwards and Haime give the diameter of the ealyces at 3 mm.; this, however, is rarely the ease. In several specimens from the Gosau by far the greater number of the ealyces are only two min. in average; the same is to be observed in Michelin's original figure, and in a South Indian example.

Locality.—North of Alundanapooram, in a coarse sandstone; and near Ninnyoor, in white sandy limestone; only the two figured specimens have been found; the upper surface is a good deal worn off; but the characters of the species are unmistakable.

Formation.-Triehinopoly and Arrialoor groups.

The species also occurs in the Turon beds at Bains-de-Rennes (Corbières), in the Gosau deposits of the Gosau valley and near Piesting in Lower Austria.

Besides the small specimen from Ninnyoor there is a second large ramose specimen in the collection from the same locality. The general growth of this specimen is somewhat different from that of decaphylla; the calvees are polygonal with raised margins; larger and smaller ones are irregularly distributed, measuring from two or three to four mm. in diameter, a few even five mm. The smaller ealyees have ten long and ten short septa, exactly as in typical decaphylla; the larger ones have twelve larger and as many shorter; thus regularly three eyeles in six systems. The columella is thick and solid. As the only specimen is not perfectly well preserved, it is difficult to say whether we have in this branched form only a variety of Act. decaphylla before us, or a really distinct species.

#### XIII. Genus.-MYCETOPHYLLIA, Milne-Edwards and Haime, 1848.

The corallum is massive and sessile by a more or less expanded base, covered with a thin epitheea; the corallites are united by their costo-mural theca, forming shorter or longer variously twisted series; the costa are very short, and, like the septa, sharply and nearly equally serrated, the latter being in a small or moderate number present; the ealyees are very shallow and the dissepiments very abundant, filling up the inter- septal space to very near the top of the ealyx; columella absent or rudimentary.

There are only a few recent and tertiary and one erctaceous (M. antiqua, Reuss, from the Gosau) species known. They are easily distinguished by the moderate number of septa and the shallow ealyces filled up with endotheeal dissepiments.

### 1. MYCETOPHYLLIA NOBILIS, Stoliczka. Pl. VI, Fig. 1.

Myc. corallum solidum, supra leviter concexum, infra basi angustata affixum, epitheca tenni, vix striatuta tectum; calycibus in scriebus varie tortis, plus minusve clongatis confluentibus, 10 ad 15 mm. tatis, interdumque latioribus; coslis attenuatis brevissimis, continuis, nonnunquam thecd intercostali junctis; scplis in quatuor cyclis dispositis, cyclo quarto sæpissime imperfecto, iis ad primum atque secundum cyclum (161)

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## pertinentibus fortissimis, fere æqualibus, omnibus subcristatis atque granuliferis; columella obsoleta.

A large and apparently typical species of the genus, having a massive corallum, above convex, below somewhat attenuated, and covered with a thin epitheea. The ealyces generally vary from 10—15 mm.; some are occasionally even larger, all very shallow, filled up by very numerous disseptments to near the top. The large ealyees have four nearly complete cycles of septa, those of the two first cycles being almost equal in strength; smaller ealyees have the fourth cycle incomplete, or not at all developed; all the septa are considerably attenuated, equally and rather finely serrated on their upper edges. There is no apparent trace of a columella.

*Locatity.*—North of Alundanapooram, in a grey, eoarse, calcareous sandstone; only the figured specimen has been examined.

Formation.—Trichinopoly group.

## 2. ? MYCETOPHYLLIA STELLATA, Stoliczka. Pl. V, Fig. 7.

A small round corallum, about 25 mm. in diameter and 10 in height, with the upper surface moderately convex, the lower covered with a thin concentrically rugose epitheca, and about the centre with a somewhat irregular rather broad place of attachment. The gemmation is extra calicular, as in *Mycetophyllia*. The calyees are irregularly distributed over the surface, more or less confluent, smaller and larger ones interposed between each other, and of a small depth. The larger and perfect calyees have two cycles of septa; those of the first very thick, crested, laterally strongly ribbed or dentate; those of the second much shorter. In the smaller, or in the more or less confluent calyees, the development of the septa is by no means so regular. The costa are indistinct and short, and the calyees separated by confluent variously twisted ridges.

I notice this species only provisionally under the above generic name for want of a more appropriate one, but it most probably belongs to a new genus. The single specimen is, however, not in a sufficient state of preservation to characterize a new generic division. The fossil exhibits, as regards the form of the septa, some relation to that described from the Gosau by Prof. Rcuss under the name of  $Arcacis \ lobata$ , (Denksch. Akad., Wien, Math. Nat. Klasse, vol. vii, p. 83, pl. xiii, figs. 13 and 14).

Locality.—East of Parally, in a coarse sandstone. Formation.—Ootatoor group.

## XIV. Genus.—STELLORIA, d'Orbigny, 1849.

Corallum massive, with the polypierites directly connected by their mural theca, radiating from a central point and extending to the periphery, with new intercalated series; centre of the calyees quite indistinct, the columella is rudimentary or absent.

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The type of this genus is an upper cretaceous fossil, described by Michelin as *Anthophyllum sulcatum*; it has at the first glance the appearance of a Turbinolid coral, but its proper position is no doubt in the *Astreider*. M.-Edwards and Haime doubtfully refer two other species to the genus, one *St. rustica*, d'Orb., known from a very brief characteristic, and the other *St. agariciles*, (Goldf.), described by Reuss as *Latimicandra* from the Gosau. From any of these species the single fragment of a true *Stelloria* from South India is different, and I shall refer to it under the name of

## STELLORIA ARCOTICA, Sloliczka. Pl. V, Fig. S.

It is a segment of a broadly conoid coralhum, about 40 mm. in diameter and 18 in height. The lower surface is costulate, but evidently much worn off. On the upper surface the calicular series radiate from the centre,\* slightly undulating, and in their course alternating with shorter ones; there is no cohumella, and the septa are coarse, about half a mm. distant; the ridges are divided by a solid undulating lamina, from which the septa, so to say, issue on either side almost vertically. Long dissepiments are to be observed at distances.

The septa are granular on the upper edges, and laterally unequally and sparingly denticulated. Until better preserved specimens have been found, a more detailed characteristic must be deferred.

Locality.—East of Parally, in brown limestone. Formalion.—Ootatoor group.

#### Sub-family,—ASTREINÆ.

## XV. Genus.-HELIASTREA, Milne-Edwards and Haime, 1857.

#### Hist. Nat. des Corall., tome ii, p. 456.

This genus was proposed for a number of recent and fossil species, formerly mostly referred to *Astrea*, but differing from the typical species of this genus *(Madrepora astroiles* of Pallas) by the gemmation of the corallites taking place at different heights of the single individuums, but not at the calyx itself. The coralla are massive, generally rounded, covered below by a thin epitheca. The calyces have raised margins, with the costa well developed and connected by a cellular exotheca. The septa are granular, the primary ones at their inner ends generally thickened; dissepiments numerous; columella spongiose.

## 1. HELIASTREA ORTIVA, Stoliczka. Pl. VI, Fig. 2.

Heliasl. corallum crassum, valde expansum, supra planiusculum; calycibus rolundalis vel sub-rolundalis, circa 5 ad 6 mill. latis, marginibus crenulatis modice elevalis circumdalis, irregulariter in superficie dispositis, sub-dislantibus; costis \* Where about twenty of them must have taken their origin.

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granulatis inter calyees distinctis; scptis in tribus eyclis regularibus dispositis; exotheea late cellulosa.

Judging from a fragmentary specimen, the corallum appears to be largely expanded, with a rather flattened upper surface, and from 30 to 40 mm. thick. The calyces are rounded or roundly ovate, moderately distant and irregularly distributed, with raised margins and granular well marked eostie, which, however, very easily wear off, and then the interspaces between the calyces remain irregularly granular or even smooth. There are three complete cycles of septa, those of the first order conspicuously thickened and not distinctly separable from the large spongiose columella. All the septa are above granular and laterally densely and finely denticulate. The exothece is formed in almost parallel horizontal layers, and is largely cellular.

Locality.—North of Odium, in a coarse calcarcous sandstone; apparently rare. Formation.—Ootatoor group.

## 2. ? IIELIASTREA, sp. indet. Pl. III, Fig. 5.

A fragment of a *Heliastrea*, differing from the previous species by a greater distance of the calyces from each other, has the whole surface so much worn off that no definite characteristic can be given of the species. There are three cycles of septa, but those of the third cycle are very small and sometimes obsolete. The primary septa are attenuated towards the centre. The exotheca is very largely cellular, and in horizontal, parallel layers.

Locality.—South-west of Penangoor; the single specimen is partly silicified. Formation.—Ootatoor group.

## 3. HELIASTREA ROTUNDA, Stoliezka. Pl. VI, Fig. 3.

Heliast. corallum crassum, orbieulare, supra et infra lente convexum; calyeibus 3 ad 4 mill. latis, sub-rotundatis, vet rotundate polygonis, margine paulo elevatis, interspatiis angustis paulisper profundis separatis, septis in tribus aut quatuor cyclis dispositis, cyclo quarto imperfeeto, tenuibus, dense atque minute granulatis, lateraliterque minulissime spinulatis; columella lata, spongiosa.

An orbicular eorallum, almost equally convex above and below, the upper surface of which is partially cavernose, the cause of which, however, appears to be merely accidental. The calyees are irregularly and rather densely distributed over the entire upper side; they have slightly elevated margins, and are separated by rather shallow and narrow depressions; the diameter of each calyx varies from 3 to 4 mm., and the shape in younger specimens is generally quite eircular, approaching to roundly polygonal in the more adult. The septa are thin, granular above, finely denticulate at the sides; there are three complete cycles of them, and the larger ealyees have besides a fourth incomplete cycle, the total number of septa thus varying from 24 to 40.

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This species is closely allied to *H. Simonyi*, Reuss, from the Gosau deposits, but the latter has somewhat larger and more regularly rounded and elevated ealyees.

Locality.—Near Moraviatoor, in a brownish earthy limestone; apparently very rare.

Formation.—Ootatoor group.

#### XVI. Genus.—PLACASTREA, gen. nov., 1873.

Corallum massive; calyees irregularly disposed on the upper surface, closely connected with each other by a septo-costal murail; septa on their upper edge granular, laterally in their entire length equally and rather finely denticulate; columella in its entire length consisting of a solid compressed lamina, with a finely granular upper edge, similar to that of the septa.

This genus differs from true *Astrea* by its entirely solid compressedly columnar columella; the septa are in both equally granular and equally denticulate, but the denticles are in *Placastrea* not enlarged at the inner ends of the septa. Externally in general appearance the genus has very much the character of an *Isastrea*.

A single species occurs in the Ootatoor beds of South India, and I am not acquainted with any other which can be referred to the same genus. It appears to represent *Cyphastrea* in the group of true Astreidat, which have the ealyees confluent, not isolated and provided with elevated margins.

#### PLACASTREA ELEGANS, Stoliezka. Pl. VII, Fig. 1.

Plaeast. eorallum irregulaviter expansum, modice crassum, sub-pedicellatum, versus marginem tenue, suprå uudulate irregulariter convexiuseulum; ealyeibus plerumque sub-hexagonis, minoribus atque majoribus interpositis, 4 ad 7 mm. latis, modice eoneavis, eostis brevissimis sub-angulate elevatis junetis; septis confertim granulatis, in quatuor cyclis dispositis, cyclo quarto sæpe imperfecto, iis ad primum atque secundum eyclum pertinentibus usque ad columetlam fere extensis, eæteris conspicuiter crassioribus; columetta compresse styliformi, 1 ad 1.5 mm. longa, modice exserta, margine superiore minute granulata.

The only specimen examined is a fragment of a large, apparently planorboid, and sub-pedicellate corallum; its lower surface is much weathered off, so that the probable existence of an epitheca cannot be ascertained; the upper surface is irregularly but slightly convex. The calyces are of rather large size and are moderately excavated, separated by elevated sub-angular ridges, which are crossed by the costæ. There is no regularity to be observed in the arrangement of the calyces, and smaller and larger ones are intermixed. The larger calyces generally have four complete cycles of septa, but in the majority of them the fourth cycle is incomplete; all are finely and rather densely granular on the upper edges, and finely denticulated on the sides.

Locality.—Odium, in brown limestone. Formation.—Ootatoor group.

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## XVII. Genus .--- ISASTREA, Milne-Edwards and Haime, 1851.

#### Hist. Nat. des Corall., vol. ii, p. 526.

The solid corallum is very variable in shape, forming more or less convex or depressed masses, sessile by a pedunele or by a large flattened base, sometimes also short branches are produced; the lower side is covered by a striated or costulate epitheca; on the upper the calyces are irregularly distributed, of small or moderate size, close together, generally polygonal, being merely separated by ridges of a comparatively thin costo-mural mass; the gemmation of the calyces takes place near their margins; the septa are numerous, thin, granular above, laterally provided with spinulose equal or very nearly equal granules; they are attenuated at their inner ends; discepiments are usually abundant; the columella is generally slightly developed, spongiose, or almost obsolete, being replaced by a twist of the inner ends of the septa.

The species of *Isastrea* were believed only to occur in mesozoic strata, extending through all the formations from the Trias to the uppermost cretaceous, but more recently some typical forms were also described from tertiary deposits by Prof. A. E. Ritter v. Reuss. The species appear to have been, however, most numerous and most varied during the jurassic period, particularly the middle division of it; five occur in the South Indian cretaceous beds.

#### 1. ISASTREA EXPANSA, Stoliczka. Pl. VII, Fig. 2.

Isast. corallum plane expansum, modiee incrassatum, infra epitheea tenuiter striata teetum, supra planiusculum; ealycibus poly- (plerumque six-aut septem-) gonis, marginibus elevatis, crasse crenulatis separatis, majoribus 6 ad 8 mm. latis, satis coneavis, septis 48 ad 60 tenuibus, inæqualibus, dense granulatis, lateraliter spinulatis instructis, septo-costis ad primum, seeundum atque tertium eyclum pertinentibus in margine unito ealyeum tuberculiforme elevatis; columella tenuiter spongiosa.

The peculiarity of this species consists in the costæ corresponding to the three first cycles of septa, becoming sharply subtubercular on the elevated and rather sharply angular margins, which separates the calyces. This character alone separates it from all known *Isastreæ*, as far as I have been able to compare them. The size of the calyces and the great number of septa closely correspond to *I. morehella*, (Reuss), from the Alpine Gosau deposits, but in this species the corallum is always convex, often pedicellate, and the columella in the calyces is much less developed. All the septa are unusually finely and densely granular above and also laterally.

Locality.—Odium, in brown earthy limestone; not common. I have examined three fragments which unmistakably belong to the same species; the largest is figured.

Formation.—Ootatoor group.

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#### 2. ISASTREA SIVA, Stoliezka. Pl. VII, Figs. 3-4.

Isast. corallum ovatum, modice crassum, glomeralum aut irregulariter expansum infra epithecâ granulato-striata teclum, supra convexiusculum; calycibus polygonis, angustis 3 ad 5 mm. latis, satis profundis, majoribus septa 36 ad 48, granulifera, dense sita et inæqualia exhibentibus; costis brevissimis, nonnullis in interspatiis clevatis aut subcarinatis cateris crassioribus; columella tenuiter spongiosa.

The corallum appears to be rather variable in growth, ovate or irregularly expanded, subpedunculate, and covered below by a striated thin epitheca. The upper surface is undulating, flattened or very slightly convex, with the calyces quite irregularly disposed, polygonal, from 3 to 5 mm. in diameter, and rather concave. They are separated by more or less elevated, angular ridges, over which the septal costae pass almost without any interruption. Some of the smaller ealyces are not even distinctly separated from the adjoining ones, which gives the species rather an aspect of some *Latimæandræ*, or when the inter-calicular ridges are less elevated, that of a *Thamnastrea*. A few of the costæ are on the elevated interspaces generally slightly thicker and more elevated than the majority of the other ribs. The larger calyces have 36-48 granular and closely set unequal septa, shorter and longer ones generally alternating; the number of septa is, however, searcely in any two calyces the same. The columella is rather small, spongiose, sometimes apparently only formed by the twisted ends of the septa.

The species is closely allied to *I. profunda*, Rcuss, (Denksch. Akad., Wien, Math. Nat. Klasse, vii, 1854, p. 116, pl. ix, fig. 6), which has, however, the mural theca, separating the ealyces, tolerably well developed, while in the Indian fossil this is almost entirely wanting.

Locality.-North-east of Moraviatoor, in brownish earthy limestone.

Formation.—Ootatoor group.

Two casts of large specimens, weathered out in a brown limestone, are from northcast of Kauray. They generally agree with the typical form from Moraviatoor, but the size of the ealyees varies mostly from 5 to 7 mm. Whether this larger size of the ealyees merely indicates an individual variation, or really a different species, must be determined from better preserved specimens.

#### 3. ISASTREA CYATHINA, Stoliczka. Pl. VII, Figs. 5-6.

Isast. corallum obverse conoideum, parvum, subpedicellatum, basi angustissima affixum seu fere liberum, epitheea lævigata indutum, infra epitheeam costis subgranulosis tenuioribus atque erassioribus alternantibus, indistincter fascieulatis, instructum; calycibus sub-quadrangulariter polygonis, paulum profundis, majoribus atque minoribus interpositis, marginibus paulo elevatis unitis, theea costo-murali tenui; calycibus majoribus 8 ad 9 mm. latis, septis 48-60 granuliferis, lateraliter

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dense spiaulose granulosis, iis ad primum atque secundum cyclum pertinentibus cæteris conspicuiter erassioribus; columella tenuiter spongiosa, distincta.

A small cyathiform species, with an attenuated stem, terminating pointedly, and eovered by a smooth epitheea. The upper surface is moderately convex, with few larger and smaller shallow ealyees, separated by elevated margins, on which the septa meet, but without perceptibly increasing in thickness. The larger calyees are in general sub-quadrangular, 8 to 9 mm. wide, while the smaller ones only measure 3 to 4 mm. The former have 48 to 60 granular and laterally densely dentieulated septa, of which those of the first and second cycle are conspicuously stronger than the others. The columella is well developed, thinly spongiose.

As compared with the size of the corallum, that of the shallow ealyces is remarkably great, and this character seems to be peculiar to the present species, distinguishing it from allied forms.

Localities.—Kullay, in a variegated limestone, and east of Parally, in a coarse calearcous sandstone.

Formation.—Ootatoor group.

- 4. ISASTREA MORCHELLA, Reuss. Pl. VII, Figs. 7-8.
- 1854. Latomæandra morchella, Reuss, Denksch. Akad. der Wissensch. Wien, Math. Nat. Klasse, vii, p. 107, pl. xxi, figs. 9-10.

Isastrea morchella, apud Mil.-Edw. and Haime, Hist. Nat. des Corall., ii, p. 534.

Isast. eorallum sub-globosum, supra eouvexiuseulum, breviter aut sub-pedieellatum, aut irregulariter expansum, basi lata affixum, infrå epitheea eostulata indutum, costulis supra granulatis, inæqualibus, ad basin pedieelli elongati sub-obsoletis; ealyeibus polygonis, 4 ad 10 mm. latis, plus minusve profunde exeavatis, plerumque jugis angulatis separatis, nonnunquam duobus adjaeentibus eonfluentibus aut indistincter divisis, theea murali aut septo-eostali erassiuseula; septis supra deuse granulatis, lateraliter spinulatis, numerosis, 48 ad 65 in ealyeibus majoribus, sub-æqualibus; columella tenuiter spongiosa.

I have compared the Indian specimens with typical ones from the Gosau, and they do not exhibit any essential difference. The form of the corallum varies equally in both places; in the Gosan the majority of specimens found are, however, globose, strongly convex above; in South India the greater number of specimens are sub-pedicellate with slightly convex or even flattened upper surface. The depth of the calyces also changes according to the state of preservation, but they are always concave, separated by well marked ridges, angular when well preserved, obtuse or even flattened when worn off.

The size of the ealyces varies from 4—10 mm., the majority are 6 or 7 mm.; in those of larger size generally the beginning of a division may be traced; they are all polygonal, mostly irregularly hexagonal. The septa are finely granular

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above and laterally; there are from 48 to 65 of them in adult individuums; those of the first and second cycle are equal and extend to the spongiose columella; those of the third cycle are slightly shorter, while the subsequent generally decrease in length, and sometimes connected with each other or with the preceding septa.

Locality.—North of Alundanapooram, in a coarse conglomeratic sandstone; common.

Formation.—Trichinopoly group.

In Europe the species has been found in the coral deposits of the Nefgraben in the Gosau, which deposits, according to the majority of the fossils they contain, appear best to correspond with D'Orbigny's Turonien, a geological position exactly corresponding with that in which the fossil abundantly occurs in South India.

#### 5. ISASTREA conf. HÖRNESI, Reuss. Pl. VII, Fig. 9.

A remarkable species with large (6–7 mm. wide) angular calvees and with from 48—60 very thin, granular, laterally thickly spinulated septa of unequal length, and a large spongiose columella.

There is a fragment and an entire corallum, which had been sessile by a somewhat narrowed base, in our collection. The stem is covered with an epitheca, which is near a few concentric swellings, and also near the upper edge costulated, the ribs being in these places granular. The species exhibits, as regards the form of calyces and the number of septa, the greatest relation to *Isast. Hörnesi*, (Reuss), (*Prionastrea eadem*, Denksch. Akad., Wien, Math. Nat. Klasse, vii, 1854, p. 115, pl. xiii, figs. 7–8), but the two Indian specimens are not sufficiently perfect to insure the identity of the species.

Locality.—Moraviatoor, in coarse ealeareous sandstone. Formation.—Ootatoor group.

#### XVIII. Genus.-LATIMÆANDRA, d'Orbigny, 1849.

#### Milne-Edwards and Haime, Hist. Nat. des Corall. ii, p. 543.

Corallum variable in shape, forming globular, subpedunculate, irregularly expanded, or even subdendroid masses, the consistency or solidity of which depends upon the greater or lesser development of the mural theca, connecting the single individuums; the enlargement of the stem takes place by gemmation at or near the edge of the ealyces, which are more or less distinctly separated from, or confluent with, each other, and are very variable in form; the columella is rudimentary; septa granular above and spinulosely serrated laterally.

Latimæandra differs from Isastrea principally by the tendency of the ealyces to become confluent, forming united series. There can be two sections distinguished. The one-called *Chorisastrea* by Fromentel-in which the ealyces are separated from each other by more or less distinct depressions, and the second, or true K (169)

Latimæandra, in which the series of ealyees are separated by united ridges, over which the costæ pass without interruption. These two sections are so intimately connected with each other that authorities on the subject, like Milne-Edwards or Reuss, do not consider a separation into two genera practicable.

I have to notice five species of the genus from South India, only one of which is identical with a European form. This and a new species belong to the second section which I mentioned, while three others are referable to the first.

The Latimæandræ occur in all formations, but chiefly in the mesozoic.

#### a. Sub-genus Chorisastrea.

#### 1. LATIMEANDRA OBCONICA, Stoliczka. Pl. VIII, Fig. 1.

Latim. corallum brevc lateque conoideum, basi angustissimum, infrâ theca radiatim costellata tectum, costellis granuliferis, supra deplanatum aut minimme eonvexum; calycibus magnis, irregulariter polygonis, majoribus simplicibus 8 ad 10 mm. in diametro, interdumque duobus aut tribus eonfluentibus, parum profundis, sulcis angustis separatis; septis crassiuseulis, in calycibus perfectis eireiter 35 ad 40, longioribus atque brevioribus plerumque alternantibus, granulatis, lateraliter distanter atque obtuse spinulatis; columella sub-obsoleta.

The corallum of this species far more resembles that of an *Isastrea* than of a *Latimæandra*, being shortly, broadly conical, and covered by a thin, radiately costulated theea; the upper surface is flattened or slightly convex. The calyces are, however, separated by distinct, though narrow furrows, and among a number of isolated ones there are sometimes two or three united; they are rather shallow or polygonal. The septa are thick at their outer ends, thin interiorly, granular, and laterally provided with moderately numerous spinose subequal tubercles.' The columella is in some calyces apparently quite absent, in others there are traces of it.

Localities.—East of Parally, in a coarse calcarcous sandstone; north-east of Moraviatoor, in an earthy, brown limestone; rare.

Formation.—Ootatoor group.

#### 2. LATIM.EANDRA GYRINA, Stoliezka. Pl. VIII, Figs. 2-3.

Latim. corallum rotundate convexum, sub-pedicellatum, aut irregulariter expansum, infra radiatim striato—costulatum, eostulis aeutis, subgranutiferis; ealycibus irregularibus, satis profundis, paucis simplieibus, plurimis in seriebus elongatis aut varie tortis unitis, sulcis angustis separatis; septis subgranulosis, lateraliter tenuiter spinulosis, subæqualibus; eotumella sub-obsoleta.

A moderately convex species, with the corallum subpedicellate or irregularly expanded, striately costulated below, the ribs being very sharp and indistinctly ( 170 )

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granular. The ealyces are rather deep, from 5 to 7 mm. in width, separated by narrow furrows; few of them are single, the majority united by two or more, generally in series of five and six, these series being variously twisted. The edges of the ealyces are always rounded, or roundly obtuse, but never sharply angular, as is usually the ease in the preceding species.

Locality.—East of Parally, in a brownish sandy limestone. Formation.—Ootatoor group.

#### 3. LATIM.EANDRA CRASSA, Stoliezka. Pl. VIII, Fig. 4.

Latim. eorallum crassum, irregulariter expansum, supra undulato deplanatum; calycibus eirciter decem mm. latis, profundis, in seriebus elongatis, varie tortis, atque sulcis latiuseulis separatis, confluentibus, septis crassis, granulatis, circiter 1 mm. distantibus, subæqualibus, tenuissimis, nonnunquam fere obsoletis, cum crassioribus alternantibus.

This species is readily distinguished from all others by the great width of the calicular depressions, and the length and strength of the septa, of which the stronger ones are all about equal and distinctly granular, while the intermediate and very thin ones are sometimes searcely traceable; the former are generally a little more than one mm. distant from each other, two cycles of them generally meet in one ealyx, the less numerous thin septa belonging to the third cycle. The depressions separating the calicular ranges are moderately wide, but rather shallow, and the septal costa when crossing them considerably decrease in strength. The distance of the centre of one calyx from the next in the same series varies from 10 to 15 mm., while that of one calyx from another in the next adjoining row varies from about 15 to 25 mm.

Locality.—Odium, in a brown calcareous sandstone. Formation.—Ootatoor group.

#### b. Latimæandra, sensu stricto.

#### 4. LATIMÆANDRA INTERRUPTA, Stoliczka. Pl. VIII, Fig. 6.

Latim. eorallum irregulariter expansum, tenue, supra undulate convexiuseulum; calycibus 4 ad 5 mm. latis, in seriebus varie tortis, sæpe interruptis, irregularibus, dispositis, satis profundis, jugis communis convexiusculis, 2 ad 3 mm. latis, separatis, septis in tribus cyclis dispositis, cyclo tertio imperfecto, dense granulosis, lateraliter spinulatis, octo ad decem cæteris multo fortioribus; columella obsoleta.

The corallum is rather thin, irregularly expanded, with the calyees very irregularly distributed, only from 4 to 5 mm. wide, three or four of them being confluent in variously shaped twisted or curved depressions, separated by clevated ridges, over which the costæ pass without interruption. There are from 20 to 40 septa in

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one ealyx, of which 8 or 10 are much stronger than the rest; but all are very densely granular on their upper edges. In the lengthened ealieular valleys about 15 to 20 septa are counted in a length of 10 mm., but those of the third cycle become almost obsolete.

Locality.—East of Parally, in a brownish ealcareous sandstone. Formation.—Ootatoor group.

#### 5. LATIM.EANDRA (? M.EANDRASTREA) CONCENTRICA, Reuss. Pl. IX, Fig. 1.

1854. L. concentrica, Reuss, Denksch. Akad., Wien, Math. Nat. Klasse, VII, p. 107, pl. xvii, fig. 1. 1857. cadem, M.-Edwards and Haime, Hist. Nat. des Corall., II, p. 549.

Latim. corallum depressum, tenue, irregulariter expansum, infrá radiatim striato-costellatum, supra undulatum; ealyeibus parvis, profundis, eire. tres mm. latis, plurimis in seriebus varie tortis sæpcque interruptis,—plerumque concentriee dispositis ac eonfluentibus, jugis acutiuscule angulatis communis, calycum latitudine, separatis; septis numerosis, fore æqualibus, confertim granulatis, circiter tribus unius millimetri longitudinem occupantibus; columella parva, spongiosa.

An irregularly,- mostly in thin layers,- expanded species, with an undulating upper surface. The ealyees are small and mostly united in variously twisted, often interrupted, and more or less concentrically arranged depressions of three or four mm. in width. The ridges which separate them are about equally broad and rather sharply angular. The septa are very numerons, three to one mm. distant, and finely granular. At irregular distances some of the ridges become occasionally much stronger.

M.-Edwards and Haime (loc. cit.) draw attention to the very close resemblance of the present species to L. *ataciana*; the former only appears to differ from the latter by the more or less pronounced concentric arrangement of the calicular valleys, and especially by thinner septa.

Both species have probably to be referred to *Mæandrastrea*, which belongs to the  $F_{AVID\mathcal{A}}$ , a family placed by M.-Edwards intermediate between the *LYTHOPHYLLINÆ* and the *ASTREINÆ*.

Locality.-North-cast of Odium, in a brownish limestone; rare.

Formation.—Ootatoor group, (upper beds).

Reuss described the species from the Gosau beds near Piesting in Lower Austria, and I have collected specimens of the same in the Edelbach-graben of the Gosau valley itself. One of the latter proved on comparison perfectly identical with the Indian fossil,

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#### Family,—THAMNASTREIDÆ.

Prof. Renss suggested<sup>\*</sup> the separation of this family from the true  $\Delta strends$ , particularly referring to it the two genera *Thamnastrea* and *Dimorphastrea*. Both have a compound corallum with extra calicular gemmation, but the calyces are confluent with their septo-costa, and internally the septa are at regular distances connected by transverse lamellae, which have a far greater resemblance to the synapticulae of the *Fungine*, than to the dissepiments of the *Astrends*, and thus the present family may be regarded as a connecting link between the two last named ones.

Reuss adds (l. cit., p. 24,) a new genus *Pseudastrea*, with the type species *Ps. columnaris* from tertiary beds in Styria; and, I think, the genus *Comoseris*, which has very distinct synapticulae, might be added. Fromentel appears to refer to the present family under the name '*Comosériniens*' on p. 159 of Pal. Franç. terr. eret., vol. viii, 1863.

I have to report from South India upon four species of *Thamnastrea*, one of *Dimorphastrea*, and one of *Comoseris*.

# XIX. Genus.—TILAMNASTREA, Lesaurage, 1823.

Hist. Nat. des Corall., vol. ii, p. 555.

Corallum very variable in form and size, globular, conoid, or with the upper surface flattened, or forming branched stems, on which the gemmation is submarginal. The ealyees are superficial, connected in all directions with each other by their septal costæ; their centres are, however, distinct, with a more or less well developed columella; they are irregularly distributed over the entire surface. The septa and costæ are granulated laterally, and very variable in number.

The species are all fossil, extending from the mesozoic into the kainozoic epoch, though very much decreasing in number in the latter. There exists a remarkably great similarity between the different species, and as the size and form of the ealyces often vary on different portions of one and the same corallum, the precise definition of the species is accompanied with no small amount of difficulty, or rather uncertainty. This may be gathered from the fact that the authors of the Hist. Nat. des Coralliaires relate about 30 doubtful species, which had in former vears been established by themselves.

I have to notice from South India five species. Unfortunately the materials are such, that although the specific distinction cannot be questioned, I am unable to pronounce any of them as identical with formerly described species.

#### 1. THAMNASTREA HIEROGLYPHICA, Stoliczka. Pl. VIII, Fig. 5.

Thamnast. eorallum plus minusre regulariter orbieulare, supra fere planum, infra convexiuseulum, calycibus numerosis irregulariter dispositis, impressis, versus peripheriam concentrice approximatis, 3 ad 5 mm. latis, alque 7 ad 10 mm. \* Denksch. Akad., Wien, Math. Nat. Klasse, vol. xxiii, 1864, p. 23.

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inter se distantibus; septis 24 ad 30 erassiusenlis, in tribus eyetis dispositis, nonnunquam eyeto quarto imperfeeto; columella spongiosa; costis tateratiter dense granulatis, rectinsentis seu modice undutatis.

The corallum is largely orbicular, with an almost flat, upper, and a moderately convex lower surface. The calyees are quite irregularly distributed, only towards the periphery they become somewhat concentrically confluent. Each has a breadth of about 3 to 5 mm., and the centres of the adjoining ones are between 7-10 mm. distant, except when an interpolation of younger calyees takes place, in which case they are closer to each other. There are slight depressions to be observed between the ealyees. One of the peculiarities of the present species is, that the septal costae continue rather straight, or slightly undulating, from one ealyx to the other. There are, as a rule, three complete cycles of septa, but sometimes their number rises to 30, so that a few septa of the fourth cycle begin to appear; generally only 12-15 of them extend to the columella, which is distinctly spongiose, somewhat elevated in the centre.

The species is closely allied to *Th. decipiens*, Mich., (*Th. confusa*, Reuss), but differs from it by the absence of the peculiar regularity in the costae extending in a concentric direction from one calyx to the other, a character which always appears to be well marked in the European fossil.

*Localities.*—North-cast of Kauray, in a brown limestone, and east of Parally, in a pinkish, conglomeratic and sandy limestone; not common.

Formation.- Ootatoor group.

# 2. THAMNASTREA BREVIPES, Stoliezka. Pl. IX, Figs. 2-3.

Thamnast. corallnm agariciforme, supra convexiusentum, breviter pedicellalum, basi tata et irregutari sessile, epitheeâ tenni indutum, infra epitheeam tenuiter costettatum, costutis granutiferis; catycibus irregulariter dispositis, majoribus atque minoribus intermixtis, concaviusentis, sæpe subrotundatis, circiter 5 mm. tatis; septis in tribus cyclis dispositis, cyclo tertio sæpe imperfecto, duodecim ad columettam spongiosam extensis, cæteris brevioribus; interspatiis catycum modice elevatis, costis noununquam sub-obsoletis instructis; columetta medio soliduta, clevata.

A small, shortly pedunculated species, sessile by a broad irregular base. The epitheca is very thin, and the surface below it marked with granular rather thin, more or less confluent or branching ribs. The upper surface is convex; the calyces irregularly arranged, about 5 mm. in diameter, and from 3 to 8 mm. distant, measured from the centre of one ealyx to the other. There are three cycles of septa present, but the third cycle is often incomplete, and generally only the older twelve septa extend to the columella; they appear to have their inner

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end somewhat thickened and confluent with the columella, which is central, solid, and moderately elevated. The costa are thinner when crossing the elevated interspaces between the calyces, the mural mass being rather strongly developed.

Locality.—Ninnyoor, in a whitish limestone.

Formation.—Arrialoor group.

#### 3. THAMNASTREA CRASSA, Stoliezka. Pl. IX, Fig. 4.

Thamnasl. eorallum crassum, irregulariter expansum, supra undulate planalum; calyeibus irregulariter dispositis, 2 ad 3 mm. latis, atque 5 ad 7 mm. distautibus; septis tenuibus, granulatis, lateraliter dense spinulatis, in tribus cyclis perfectis dispositis, iis ad primum atque seeundum eyclum pertinenlibus usque ad columellam spongiosam et parvam extensis, eæteris multo brevioribus.

Only a fragment of the corallum of this species has been examined, and judging from this, the specimen appears to have been unusually large, undulately flattened above, convex below, and assuming a thickness of about 100 mm. The ealyces are irregularly disposed, of small size, and connected by easily curved, thin, granular, costæ. The septa are usually disposed in three complete cycles; only rarely there are a few of a fourth cycle present; those of the first and second cycle extend to the columella, the others are shorter, and all are laterally densely spinulated. The septo-costæ are generally arranged in six radiating bundles.

Locality.—Odium, in brown earthy limestone. Formalion.—Ootatoor group.

#### 4. THAMNASTREA PULLATA, Sloliezka. Pl. IX, Fig. 5.

Thamnast. eorallum depressum, tenue irregulariter diseoidale, supra plane convexiuseulum, infra coneaviuseulum; calycibus irregulariter dispositis, 2<sup>5</sup> ad 3 mm. latis, approximatis, septis distanter granulatis, in tribus eyelis dispositis, cyelo tertio sæpe imperfeelo, eostis brevibus, regione eostali paulo elevata, theca murali satis dislineta; columella spongiosa, medio sensim elevata.

A small species, closely resembling *Th. tenuissima*,\* Milne-Edwards and Haime, but the corallum is depressed, instead of globular, and the inter-ealieular spaces are, like the columella, conspicuously elevated, while the calyces themselves are somewhat concave and comparatively rather wide, roundly polygonal. There are in both species three cycles of septa, but the third cycle is usually incomplete; all septa are rather coarsely granular, and only those of the two first cycles extend to the spongiose columella.

Locality.—East of Parally, in a coarse conglomeratic sandstone. Formation.—Ootatoor group.

\* Comp. Bölsche in Geinitz's 'Elbethalgebirge in Sachsen,' 1871, p. 51, pl. 12, figs. 1-2.

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#### 5. THAMNASTREA INDUTA, Stoliezka. Pl. IX, Fig. 6, and Pl. X, Fig. 1.

Thamnast. corallum obverse eonoideum, basi angustata aut latiuscula affixum, epithecă crassa, coneentrice distanter rugosa, in rugis atque prope marginem superiorem costis granuliferis notata, indutum, supra leviter convexiusculum; ealyeibus duobus, vel pluribus, paulo majoribus serie uniea minorum plus minusve eonfluentium prope peripheriam sita circumdatis, theca eosto-murali satis distineta separatis, paulisper eoneaviusculis, majoribus rotundate polygonis, 6 ad 7 mm. latis, cum septis in quatuor eyclis dispositis, cyclo quarto imperfecto, alteris minoribus septis in duobus aut tribus cyclis dispositis, cyclo tertio imperfecto; septis omninis lateraliter crasse granulatis.

This species is in some respects intermediate between *Dimorphastrea* and *Thamnastrea*, as there are some calyces enlarged in the centre, regularly surrounded by a series of smaller ones; the central ones have also a larger number of septa than the row of smaller ones, but on account of the greater number of central ealyces, the species is, I think, more correctly referable to *Thamnastrea* than to *Dimorphastrea*. Whether this distribution is a merely accidental occurrence, eannot be for the present ascertained, because only two specimens exist in the eollection, and these are not very perfectly preserved, except on the sections. The corallum was evidently sessile, with a tolerably broad base, and is covered with a well developed, thick epitheea, marked at some distances with concentric rugosities, on which, as well as near the upper edge, rather coarsely granular, equal ribs are to be observed. The septo-costal murail is well developed. The columella is distinctly papillose or spongiose in all ealyces.

Locality.—Odium, in a brown earthy limestone; very rare. Formation.—Ootatoor group.

#### XX. Genus.-DIMORPHASTREA, d'Orbigny, 1850.

Corallum of moderate size, compound, externally covered with an epitheca; ealyees confluent, connected by a rudimentary costo-mural theca; the median one is the largest, the others arranged in more or less regular concentric series; costæ generally clongated and, like the septa, serrated, and laterally granular; columella spongiose or papillose.

The genus differs from the previous one simply by the arrangement of the ealyees, of which a single central one is the largest.

Species of *Dimorphastrea* are at present only known from cretaceous and tertiary deposits; they are, however, much less numerous than the *Thamnastreæ*.

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#### DIMORPHASTREA PATELLARIS, Stoliczka. Pl. X, Fig. 2.

Dimorphast. eorallum late breviterque conoideum, epithecá crassula, sub-lævigata indutum, basi angustissima pedicellata affixum; superfieie supera planiuscula; calyee magno centrali septis in quatuor cyelis perfectis dispositis instructo, septis ad primum atque secundum cyclum pertinentibus usque ad columellam extensis; calyeibus minoribus in seriebus duobus concentricis sub-marginalibus dispositis, plus minusve distineter confluentibus, septis in tribus cyclis dispositis instructis; septis omninis tennibus, granulatis, lateraliter crassiuscule spinulatis, theca costo-murali fere obsoleta; columella granulose minuteque papillosa,

The figured specimen is the only one examined. It is obversely shortly and broadly conoid, with a very narrow sub-pedicellate base for a place of attachment; the epitheca on the lower side is moderately thin, with few concentric swellings and some short ribs near the upper edge. The upper side is flattened, with a large calyx in the centre and two concentric rows of smaller ones along the periphery. The central calyx has four complete cycles of septa, and has a diameter of about 7 mm.; the other much smaller calyces generally possess only three cycles, sometimes there are a few septa of the fourth noticeable. The costæ are well developed, and, like their continuations, rather coarsely laterally spinulose, but the mural thece is almost entirely wanting. The columella consists of numerous thin, somewhat twisted columns.

Locality.—East of Poodoor, in a brownish, sandy limestone; apparently very rare.

Formation.—Ootatoor group.

#### XXI. Genus.—COMOSERIS, Orbigny, 1849.

#### Milne-Edwards & Haime, Hist. Nat. des Corall., iii, p. 62.

The coralla are composite, generally shortly sub-pedunculate and mostly irregularly expanded, below covered with an epitheca, above exhibiting numerous confluent calyces, with granulated and laterally strongly denticulated septa, and a rudimentary columella; they are separated by angularly elevated confused ridges.

Until a short time ago *Comoseris* was merely known from a few jurassic species. Recently two tertiary species, (*C. alternans* and *conferta*), were described by Prof. A. v. Reuss from Northern Italy. The discovery of a member of the genus in the cretaceous deposits of South India is, therefore, particularly interesting, because it proves its existence in the time intermediate between the two formations alluded to.

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#### COMOSERIS OLDHAMIANA, Stoliczka. Pl. X, Fig. 3.

Comos. corallum breve, irregulariter sub-rotundate explanatum, supra convexiusculum, calycibus numerosis, parvis, plerumque uniserialibus, sed irregulariter dispositis, jugis modice elevatis, angulatis et irregulariter confluentibus separatis instructum; septis erassis, sub-æqualibus, granulatis, lateraliterque spinnlatis, in tribus cyclis dispositis, cyclo tertio sæpissime imperfecto, omninis ad medium sensim attenuatis atque inter se plus minusve distincter confluentibus; columella parva sed distincter spongiosa.

This species has a remarkably close resemblance to the jurassic *C. irradians*, the corallum being irregularly ovately expanded, slightly convex above, and very shortly pedunenlate below. The single specimen as yet known has searcely any traces of the epitheca preserved; it is only indicated by irregularly concentric swellings, and the entire surface shows instead a radiating striation. The ridges on the upper side are rather sharply angular, moderately clevated, and quite irregularly but rather closely confluent. The calyees situated in the depressions are uniserial, small, with a small and distinctly spongiose columella. There are three cycles of septa, those of the last being very often incomplete, their total number varying from 18 to 24; they differ only slightly in strength and are rather coarsely granular. Both the calyees and ridges are almost equally numerously distributed over the entire upper surface.

Locality.—North-west of Moraviatoor, in a brown limestone; only the figured specimen has as yet been found.

Formation,—Ootatoor group.

#### Family,—CYCLOSERIDÆ.

#### Fromentel, Pal. Franç. terr. cret., viii, 1867, p. 323.

The CYCLOSERIDÆ include simple coralla, covered with an epitheca, the costæ on it being granular, branching and often anastomosing; the septa are numerous, thin, sub-equal, granular or dentate, and connected by synapticulæ.

Fromentel (l. eit., p. 325,) distinguished fourteen genera, out of which only two occur in South India, *Thecoscris* being represented by one and *Cyclolites* by four species.

#### XXII. Genus.—THECOSERIS, Fromentel, 1869.

Comp. Pal. Franç. terr. eret., 1870, tom. viii, p. 367.

Corallum more or less regularly turbinate, pedicellate, sessile, provided with a well developed epitheea; ealyx flat or moderately eonvex, impressed in the centre; septa very numerous, equal or sub-equal, thin, servated or dentated at their upper edges, sometimes anastomosing, meeting in the centre of the calyx without forming a columella.

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This genus was recently established for certain liassic species, which, in external appearance, closely resemble *Leptophyllia*, but differ from it by the presence of a well marked epitheca, and by their synapticulæ. One species from South India appears to be referable to it. It is probable that some of the species without columella, described as aberrant forms of *Trochoseris*, will have to be referred to the present genus.

#### THECOSERIS AGARICINA, Stoliczka. Pl. XI, Fig. 1.

Thecos. corallum irregulariter agariciforme, breviter pedicellatum, calyce suprá ovate elongatum, epilhecâ concentrice rugoso-striata; calyce plane convexiusculo, medio paulo impresso, septis tenuissimis, numerosissimis, æqualibus, acute denticulatis.

The short stem of the single specimen is only partially preserved, but on the lower side of the expanded portion the concentrically rugose epitheca is well developed. The calyx is of a somewhat irregular, elongately ovate shape, slightly convex above and impressed in the centre. There is no trace of a columella. The septa are very numerous, apparently almost equally thin throughout and finely denticulate at their upper edges; they all somewhat curve towards the periphery, and anastomose, a circumstance which is probably chiefly due to a slightly irregular growth of the eorallum, and a somewhat unequal development of the epitheca.

*Locality.*—Near Odium, in a nodular earthy limestone; only the figured specimen has as yet been found.

Formation.—Ootatoor group.

#### XXIII. Genus.—CYCLOLITES, Lamarck, 1801.

#### Comp. Fromentel, Pal. Franç. terr. cret., tom. viii, p. 330.

Corallum circular, ovate or sub-ovate, upper surface hemispherical, or more or less flattened, septa very numerous, equal or unequal, radiating from a central groove or fossula, in which they meet somewhat irregularly, but do not form a separate columella; base flat or concave, with generally a thin, rarely thickened, mural selerenchyma, covered by a concentrically folded epitheea.

This genus is as yet only known in a fossil state, and by far the largest number of species occurs in cretaceous deposits. From entel distinguishes a few groups of the genus, in order to facilitate the determination of the different forms; with the few species, which occur in South India before us, it is, however, not desirable to enlarge on this subject of detailed study.

Before noticing the four species presently to be described, I have to draw attention to a specimen of a *Cyclolites*, so thoroughly imbedded in a brownish limestone from near Ootatoor that it is impossible to extricate it from the rock. Judging from external shape and the distribution of the septa, the specimen appears to be very closely allied to *C. elliptica*, Lam., but better specimens are necessary to insure a good characteristic of the species, or its identification with one already known.

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# 1. CYCLOLITES CONOIDEA, Stoliczka. Pl. X, Figs. 4-5.

Cyc. corallum ovatum, conoideo elevatum, erassum, apice obtuse arcuato; fossula latiuscula, modice profunda, dimidium diametri majoris paulo superante; lateribus convexiuscule declivibus; septis numerosissimis, sub-granulatis, sub-æqualibus, septimo quoque septo plerumque fortiore; basi in juniore modice concava, in adulto fere plana, lævigata, concentrice distanter plicosa, medio paulo tumidula, peripheriam versus declivi atque radiatim striata, peripheria ipsa acute angulata.

Although merely known from the two specimens figured, these are suffieiently well preserved to characterize the species. It is somewhat allied to *Cyclolites conica* and *C. undulata*, but differs from both by the great length of the central groove or fossula, which is rather broad and comparatively shallow, deseending on either side of the longitudinal axis. The sides are moderately convex. The septa close together, not very fine, and nearly equal; in most places each seventh or occasionally eighth septum appears to be somewhat thicker than the intermediate ones. The original edge of the septa has only partially been observed, but they all appear to be rather sharply, though not densely, granular. The base is coneave in the smaller, nearly flat in the larger specimen, with a central thickened boss; the epithece is thick, concentrically folded, and towards the periphery marked with radiating striæ. The peripherical edge itself is sharp.

Locality.—Near Valudayur; two specimens in a whitish sandstone. Formation.—Arrialoor group.

#### 2. CYCLOLITES FÆCATA, Stoliczka. Pl. X, Figs. 6-9.

Cycl. corallum ovatum vel rotundate ovatum, modice elevatum, lateribus convexinsculis; fossula centrali, satis profunda, in longitudine dimidium diametri majoris æquante; septis moderate crassis, numerosissimis, sat distanter grannlatis, quoque quarto septo aut quinto alteris interpositis tennioribus fortiori; basi concaviuscula, sub-lævigata, theca murali tenui, distanter concentrice sulcata, atque peripheriam versus radiatim striolata.

Diam. maj. speciminis maximi 24, diam. min. 21.5, alt. 8 mm.

The corallum is ovate or roundly ovate, with a nearly flat, but more generally somewhat coneave base. The upper part is moderately elevated, with convex sides, and a centrally situated fossula, equaling in length half the longer diameter of the corallum. The septa are very numerous, and each fourth or fifth is stronger than the intermediate ones, which again differ in strength; they are all somewhat distantly and not strongly granular. The base is radiately striated towards the periphery.

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This species bears a close resemblance to C. spinosa, Fromentel, (Pal. Franç. terr. eret., viii, p. 342, pl. 60, fig. 3), which differs from the Indian fossil by more densely spinnlated septa and a much shorter fossula.

Localities.—Near Veraghoor\* and Valudayur, in pale coloured sandstone; near Suderampet, in bluish sandstone; not uncommon.

Formation.—Arrialoor group.

# 3. Cyclolites filamentosa, (Forbes). Pl. X, Figs. 10-12.

1846. Fungia filamentosa, Forbes, Trans. Geol. Soc., Lond., vii, p. 163, pl. xix, fig. 11.

1851. Cycloseris ,, , Mil.-Edwards and Haime, Polyp. foss. terr. palæoz., p. 127, and Hist. Nat. des Coral., iii, p. 54.

1870. Cyclolites filamentosa, apud Fromentel, Pal. Franç. terr. eret., viii, p. 341, pl. 69, fig. 3.

Cycl. corallum circulare vel sub-rotundum, hemisphericum, lateribus valde eonvexis; fossula dimidio diametri breviore, modice profunda, eentrali; septis numerosissimis atque exilissimis, septo quoque quinto vel sexto paulum fortiore, omninis acute granulatis lateraliterque spinulosis; basi sæpissime eoneava, rare fere plana, concentrice crasse plicata, theca murati solida et crassa, radiatim obsolete striolata.

Diam. speciminis maximi 23; alt.11 mm.

This is a species with extremely thin septa, which on a well preserved surface searcely vary in strength. This character combined with the shorter fossula, and a more regularly hemispherical shape, readily separates it from the previous species, in which also the mural theea at the base of the corallum is much thinner than it is in *filamentosa*, although this last is generally the smaller species.

Locality.--Near Valudayur, in a grey, fine-grained sandstone; apparently eommon.

Formation.—Arrialoor group.

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# 4. CYCLOLITES ORBICULUS, Stoliczka. Pl. XI, Fig. 2.

Cyel. eorallum orbicularc, parvum, supra convexiusculum, infra eoneaviusculum; fossula brevissima, sub-ovata, satis profunda; septis pererassis, cireiter 56, fortioribus cum brevioribus atque tenuioribus atternantibus, distanter grosse sub-tubereulatis; basi concava, sub-lævigata.

The single specimen differs so essentially from other species of *Cyclolites*, that, although in a rather deficient state of preservation, it can hardly be confounded with any other known form. The solidity of the corallum and the unusual strength of the septa do not make it probable that the specimen is very young. The fossula is moderately concave, central, and somewhat ovate in shape. There are about 26

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<sup>\*</sup> Comp. Mem. Geol. Surv. of India, vol. iv, p. 136, where, in his report upon the geology of the Trichinopoly district, Mr. H. F. Blanford refers to this species under the name of *Fungia filamentosa*, Forbes.

or 27 longer septa which originate in the fossula, and about as many shorter ones. In some places a third series of still thinner ones begins to appear, but its septa are, as a rule, not very distinctly traceable. The base is concave and appears to have been smooth.

An allied species was described by Fromentel (Pal. Franç. terr. eret., tom. viii, p. 359, pl. 63, fig. 3,) from the Gault or Upper Greensand deposits of Sainte Croix under the name of *C. Sanctæ-crucis*; it differs from the Indian form by having somewhat fewer and more equally strong septa, and a much smaller fossula, almost only represented by a central pit.

Locality.-Near Veraghoor, in a greyish sandstone.

Formation.—Arrialoor group.

#### MADREPORARIA PERFORATA.

#### Family,-MADREPORIDÆ.

Milne-Edwards and Haime, in their Hist. Nat. des Coralliaires, vol. iii, p. 99, divide the whole of the *Anthozoa* PERFORATA into two families, the *MADREPORID\_E* and the *PORITIDE*. The former is sub-divided in three sub-families, the *EUPSAMMINE*, without independent ecenenehyma, the *MADREPORINE* and the *TURBINARINE*, with ecenenehyma, but the former has the septa unequally, the latter equally developed.

#### Sub-family.-EUPSAMMINÆ.

This sub-family includes, according to Milne-Edwards and Haime, simple and complex forms, the single coralla being without an epitheca; the septa are well developed and distributed in six systems, the septa of the third and subsequent orders are generally united by pairs, or in a greater number among themselves; the columella is spongiose or granular, and the walls are subcostulated, granulated, and perforated.

The *EUPSAMMINÆ* are represented in the South Indian cretaceous deposits by two species, apparently belonging to the typical genus *Eupsammia*, which has, I think, as yet only been known from tertiary deposits.

# XXIV. Genus.-EUPSAMMIA, Milne-Edwards and Haime, 1848.

Corallum simple, sub-cylindrical or obeonic, free, without any lateral mural expansion; ealyx ovate or rounded, and of moderate depth; septa rather thin, laterally granular, generally irregular, in four or five cycles, sometimes with indications of a sixth one; columella well developed; costæ numerous, simple, extending the entire length of the corallum from the base, composed of fine but somewhat irregular granules.

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M.-Edwards and Haime refer five species to *Eupsammia*, all from tertiary strata. The genus is very closely allied to *Balanophyllia*, differing from it by its free, often slightly umbilicated base, and also generally by the septa of the last few cycles being irregularly united to each other.

#### 1. EUPSAMMIA VARIANS, Stoliczka. Pl. XI, Figs. 3-7.

1846. Cladocora sp. apud Forbes, Trans. Geol. Soc., Lond., vii, p. 163, pl. xix, fig. 10.

Eups. eorallum obverse eonoideum, eylindraeeo elongatum, basi angustatum, modiee areuatum, in ætate adulta ad intervalla plus minusve fortiter atque irregulariter eontraetum; theea murali tenui, eostis modice latiuseulis, suleis multo angustioribus separatis, simplicibus, vix undulatis, granulis irregularibus minutisque compositis; ealyee satis profundo, rotundate ovato, ejusdem sectione ovata; septis tenuissimis, in quinque eyelis dispositis, iis ad primum atque secundum eyelum pertinentibus eæteris fortioribus et simplicibus, iis ad tertium, quartum ae quintum ordinem pertinentibus, in altitudine variabili prope columellam unitis, septis ad ordines sequentes pertinentibus multo tenuioribus atque subæqualibus, nonnunquam paulo irregularibus; columella lata, tenuiter spongiosa.

This is a very variable species as regards the shape of its corallum. A very young specimen (fig. 3) is regularly obversely conical, with a pointed free base, the calyx was moderately excavated and roundly ovate. Other specimens are more or less cylindrically clongated and at distances irregularly contracted, but all are curved, and none of them show any place of basal attachment. The mural theca is always thin. The costa are nearly all equal, composed of fine granules and separated by much narrower furrows; they are almost straight. Of the larger specimens none showed the calyx exposed, and the septa are only traceable in a section of the stem. There are five cycles of septa; those of the first and second cycle are simple and somewhat thicker than the others, but, on the whole, all may be said to be thin, and they are laterally finely granulated. All the other septa are rather irregular and somewhat undulating. Those of the fourth and fifth order meet the third near the columella, but generally at different distances from it. The subsequent septa are sub-equal, and mostly unite with those of the fourth and fifth eycles, as well as with themselves, about half way between the columella and the peripherical edge. The width of the columella very nearly equals one-fourth of that of the entire corallum; it is very thinly spongiose.

Locality.—North of Odium, in a whitish calcarcous sandstone; not common. Formation.—Ootatoor group.

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#### 2. EUPSAMMIA DENOTATA, Stoliczka. Pl. XI, Figs. S-9.

Enps. corallum inverse conoideum, basi attenuatum, lente curvatum, theca murali incrassata indutum, costatum, costis æqualibus, suleis multo angustioribus separatis, simplicibus, sulco quoque civeiter tribus seriebus granorum composito; septis tenuissimis, in sex eyclis dispositis, modice confluentibus, cyclo ultimo imperfecto; sectione eoralli rotundate elliptica; columella tenuiter spongiosa, circiter quartam partem totius diametri lata.

I have only two rather imperfect specimens for examination, but they appear to belong to a well marked and distinct species. The form is reversely conoid with a roundly ovate section of the corallum, the perfect ealyx has not been observed. The mural theca is of great thickness, and the costic, each apparently composed of about three series of granules, which are comparatively broader than in *Eups*. *varians*. There are six cycles of septa present, but the last is incomplete; all are very thin, undulating, but not very irregular.

Locality.—North of Odium, in a yellowish limestone. Formation.—Ootatoor group.

#### Family,—PORITIDÆ.

The members of this family are characterised by their compound coralla being entirely composed of a reticulated selerenchyma; the single individuums are directly connected by a spongiose mural theea or a porose cœnenchyma, and are propagated by an extra-calicular gemmation; septa small, but otherwise well developed; visceral eavity with dissepiments, but never sub-divided by tabulæ.

Species of this family are found both fossil and recent. They are represented in South India by a single species, belonging to M.-Edwards and Haime's\* subdivision *PORITINÆ*, in which the ecenenchyma is very slightly or not at all developed.

#### XXV. Genus.-COSCINAR ÆA, Mitne-Edwards and Haime, 1848.

Massive coralla of a dense tissue and without an epitheea; ealyees concave, with well developed septa and without pali, directly connected with each other by the septal costa.

The type of this genus is *C. mæandrina*, Ehr., *(C. Bottæ*, M.-Edwards and Haime), a recent species from the Red Sea. The authors of the Hist. Nat. des Corall. (loe. eit.) also refer to the same genus Reuss' *Porites mammiltata*<sup>†</sup> from the Gosau deposits, and a very closely allied, if not the same, species also occurs in South India.

† Denksch, Akad., Wien, Math. Nat. Klasse, vii, 1854, p. 129, pl. x, figs. 9-10.

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<sup>\*</sup> Hist. Nat. des Corall., iii, p. 173.

#### COSCINARÆA conf. MAMMILLATA, Reuss. Pl. XI, Fig. 10.

The only figured specimen which appears to be referable to the European species is a east; the eorallum is globose and sessile by a contracted base; the upper surface has some irregular impressions, and there is no trace of an epitheea. The ealyees are somewhat eoneave, mostly one mm. wide, and directly eonnected by the serrated septal eostæ; there are about 20 to 24 septa, of which, however, generally only eight reach to the centre, occupied by a thin eolumella. The figure represents a portion of the surface enlarged seven diameters.

I do not see any essential difference between the Indian and the Gosau fossil, but as the former is merely a east, the determination is somewhat doubtful.

Locality.—Odium, in a brown limestone.

Formation.—Ootatoor group.

#### MADREPORARIA TABULATA.

#### (See p. 5).

Of the four (or perhaps three) families, distinguished in this sub-order by the authors of the Hist. Nat. des Corall. (vol. iii, p. 224), only that of the

#### Family,—MILLEPORIDÆ

is represented by a single species. The family is characterised by a large development of a cellular or tubular ecenenchyma.

#### XXVI. Genus.-HELIOPORA, Blainville, 1834.

Massive eoralla of a shortly cæspitose, tuberose, or lobate shape, with largely developed, thinly tubular eœnenehyma, forming terminally fine pores on the surface, separated by somewhat raised papillose granules; calyces round; septa very short, but distinct; no eolumella.

The genus merely differs by its very short septa from *Polytremacis*, in which they reach to near the centre; it oeeurs both recent and fossil, but appears to be one of the rarest eorals. M.-Edwards and Haime referred to it two species,  $\Pi$ . *Partschi* and *macrostoma*, described as *Polytremacis* by Prof. Reuss from the Gosau deposits. Since then only very few species have been noticed from the kainozoie epoch. A single species occurs in the Cenomanien beds of South India.

#### HELIOPORA EDWARDSANA, Stoliczka. Pl. XI, Fig. 11.

Helip. corallum globosum, incrustans, in superficie irregulariter atque sparse tuberosum aut submammillatum; calycibus rotundis, unam mm. latis, in partibus elevatis approximatis, in interspaciis planiusculis aut concavis 4 ad 5 mm. distantibus;

0

(185)

septis octodecim subæqualibus, brevissimis; eænenchymate confertim minuteque poroso, poris irregulariter dispositis, granulis papillosis separatis, circiter quintam partem unius mm. distantibus.

In its internal structure of the ecenenchyma and the eighteen very short septa, this cretaceous form is almost quite identical with the recent species, the type of the genus H. coerulea,\* Grimm, but the calvees are considerably larger. The corallum has a few obtuse protuberances, on which the ealyces are often very close together, while in the flattened or concave interspaces the distance between them increases to 4 and 5 mm.

*Locality.*—East of Kauray, in a brown limestone with coarse quartz-grains; only the figured specimen has been found.

Formation.—Ootatoor group.

#### GENERAL REMARKS DERIVED FROM THE EXAMINATION OF THE SOUTH INDIAN CRETACEOUS CORALS.

As I have already had occasion to observe in my introductory note, the examination of the corals from the cretaceous deposits in the Triehinopoly and South Areot districts proved no less interesting than that of the other classes of animals, both in a zoological as well as geological point of view.

The conditions of the deposits were not so quiet that we could expect to find any of the Alcyonaria or of the Malacodermata preserved, but the Sclerodermata, or Madreporaria, are represented by fifty-seven species, namely, fifty-three belonging to the *Arorosa*, three to the *PERFORATA*, and one to the *TABULATA*. With the exception of a single new generic type, for which I proposed the name *Placastrea*, all the others belong to previously known genera, but the majority of the species are new.

Among the genera there are a few, like *Comoseris* or *Eupsammia*, which had not formerly been known to occur in cretaceous rocks; a few others, like *Platycyathus*, *Psammosmilia*, or *Stelloria*, belong to the rarest fossils, and some were previously only imperfectly known.

Looking at the whole fauna we see the reef-building Astrender, Streamer, Streamer, and THAMNASTREIDER much exceeding the other families in numbers of species, as well as in frequency of occurrence of specimens. Coral reefs appear to have been of considerable extent, particularly along the old shores within the Ootatoor group; in the two other groups they were much more local. But still there are strong indications that these local faunæ have been much richer than I have been able to show from the comparatively scanty materials in our collection.

<sup>\*</sup> Comp. fig. 11 on pl. xxiv of vol. VII of Denksch. Akad., Wien, Math. Nat. Wissensch. Klasse, 1854. (186)

The distribution of the species in the three divisions of the South Indian cretaceous deposits will be apparent by a glance at the accompanying table :---

No.	NAME.		Page.	Plate.	Figure.	Locality and groups in India.		Geological position elsewhere.
	Sub-Order,-M. APOROSA.							
т	CARYOPHYLLIDÆ.		5					
~	CARYOPHYLLIA-		6					
	Arcotensis Stol.		7	T	1-10	E. of Andoor	Arrialoor.	
0	cupuliformis Stol			· T	13-15	Moraviatoor	Oofstoor	
2	33 Capaciformio, Con	• • • •	0	т	10-10	F Odium F Kourov	Ditto	
3	" granagera, stor.	•••	10	r	10-17	Ostataon	Ditto	
f.	B gracus, Stol.	•••	10	2	18	Ootatoor	Ditto.	
11	IROCHOCYATHUS		10				The second se	
5	" affinis, Stol.		11	1	19	W. Kurribiem .	Trichinopoly.	
111	PLATYCYATHUS		11					
6	" indicus, Stol.		12	I	20	Odium	Ootatoor.	
11	TROCHOSMILIDE.	•••	12					
1 V	TROCHOSMILIA	• • •	13	т	- 21	E Parally	Ditto	
,	annung Stol		1.1	T		Ditto	Ditto	
	in Camera, stor.			1	22	Talatana thundan	Trichinonoly	Turon had, of the
9	,, injiexa, neuss		1.2	11	1-1	pooram.	a- Trienmopoly	Gosan, and France.
10	,, tuba, Fromentel	•••	16	I	24-28	Parally	Ootatoor	Inron beds of rrance.
V	LOPHOSMILIA	•••	16					
11	" similaris, Stol.	•••	17	11	6	Odium	Ditto.	
VI	Epismilia		18					
12	" crassisepta, Stol.	•••	18	ΙI	8-9	Moraviatoor	Ditto.	
VII	PSAMMOSMILIA		19					
13	" orientalis, Stol.	•••	19	II	10-11	Cooticaud	Ditto.	
III	STYLINIDÆ.		19					
VIII	STTLINA		20	TTĬ	1.0	Manapiataan	Ditto	
1.*	manasteria, 8101.	•••	20	111	1-2	MORAVIALOOF	Ditto.	
10	" granuts, Stol.	•••	21	111	-3	Kauray	j Dirto.	
16 IX	", parvula, Stol.	•••	21	1 V	6	Ninnyoor	Arrialoor.	
17	multisepta, Stol.		22	III	.4	Alundanapooram	Trichinopoly.	
IV	ASTREIDÆ.		22					
Χ	THECOSMILIA	•••	23					
18	,, geminata, Stol.	•••	23	ΙV	1-3	Moraviatoor	Ootatoor.	
19	ramosa, Stol.	••••	21	IV	4-5	Moraviatoor	Ditto.	
20	indica, Stol.		25	v	1	Niunxoor	Arrialoor.	
XH	ASTROCENIA		26			In any out in		
21	" relifera, Stol.		26	V	2	Oot., E. Kauray, Mor	ra- Octatoor.	
22	", Reussiana, Stol.		27	V	3- 1	Odium, E. Kauray, M	lo- Ditto,	
23	" pumila, Stol.		28	ΙV	7	Niunyoor	Arrialoor.	
24	,, decaphylla, Mich		29	v	5-6	Alundanapooram, N	in- Trichinopoly,	Arrialoor Turon beds in the Coo
XIII	MYCETOPHYLLIA		29			nyoor.		the Gosau, and near
25	" nobilis, Stol.		29	V1	1	Alundanapooram	Trichinopoly.	Piesting in Austria.
26	? stellata, Stol.		30	v	7	Parally	Ootatoor.	
XIV	STELLORIA		30					
27	" Arcotica, Stol.		31	V	8	E. Parally	Ditto.	
							2	( 187 )

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No.	o. Name.			Page.	Plate.	Figure.	Loc	ality and g	Geological position elsewhere.	
X V	Ileliastrea-			31						1
25	17	ortiva, Stol.		31	VI	2	Odium		Ootatoor.	
29		sp. indet.		32	111	5	S. W. Penango	or	Ditto.	
30		rotunda, Stol.		32	VI	3	Moraviatoor		Ditto	Near H. Simonui, from
XVI	PLACASTREA-			33						the Gosau.
31	.,	elegans, Stol.		33	VII	1	Odium		Ditto.	
XVII	ISASTREA-			34						
32		expansa. Stol.		34	VII	2	Odium		Ditto.	
33		Siza, Stol.		35	7.11	3-4	Moraviatoor		Difto	Close to I profunda
34		cyathina, Stol.		35	VII	5-6	Kullay, Parall	v	Ditto	from the Gosau.
35	,,	morchella, Reuss		36	VII	7-8	Alundauanoor	am	Trichingpoly	Turon heds of the Gosau
36	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	couf. Härnesi Rev	198	37	VII	9	Moraviatoor		Ootatoor	and near Piesting.
XYIII	LITINZINDE		.0.5	97	• • • •	U		•••	outation	from the Gosau deposits.
	ANA KIDIJEA N DA.	observies Stol		90	VIII	Ţ	Parally Moras	,	Ditto	1
20	33	aveiua Stol	}	20	7111	9_3	Parally	• •••	Ditto	
20	**	gyrana, Stol	••••	20	VIII	-0 A	Odium	•••	Ditto	
40	53	intermenta Stal	•••	20	VIII	3	E Parally	•••	Ditto.	
41	12	enterruptu, stol	*** }	39	111	1	Odium	•••	Ditto	Gosan valley and near
31	0 10 IT 4 N	NACEDELD E	••••	40	14	1	ourum	•••	Ditto	Piesting.
V	Trans	NASINELDZE.	•••	•*1						
AIA	IHAMNASTRE:		•••	41	27111	~	Kouror Davel		Octation	
42	33	nierogiyphica, Stol	•	41	¥111	9	Ninnuoon	ly	Arrioloon	
13	. >3	brevipes, Stol.	•••	42	IX	2-3	Allium		Arrialoor,	
41	33	erassa, Stol.	•••	43	12	4	Dana Da	•••	Ditto	
45	33	pullata, Stol.	•••	43	IX VV 0 V	5	Odium		Ditto,	
46 X X	" DIMORPHASTR	induta, Stol.		41	17 % 7	6 & 1	ousum		Ditto	
17		patellaris, Stol.		45	Х	2	E. Poodoor		Ditto.	
XXI	Comoseris-			45			Monaulataan		Ditto	
18	"	Oldhamiana, Stol.	•••	46	Х	3	MORAVIALOOU	•••	1/1100.	
VI XXII	CY(	-	•••	-46 -46						
19	33	agaricina, Stol.		47	XI	1	Odium		Ootatoor.	
XXIII	CYCLOLITES-	••••		47					4	
50	33	conoidea, Stol.	•••	48	X	4-5	valudayur	•••	Arrialoor.	
51	33	fæcata, Stol.	••• ;	48	X	6-9	Veraghoor, Va	ludayur	Ditto.	
52	33	filamentosa, Forb.	•••	49	Х	10-12	Valudayur		Ditto.	
53	11	orbiculus, Stol.		49	XI	2	Veraghoor	•••	Ditto.	
WIT	Sub-order,-	-M. PERFORAT.	Α.	50						
XXIV	EUPSAMMIA-	TREPORTDZE,	••••	50						
51	33	varians, Stol.		51	XI	3-7	N. Odium		Ootatoor.	
55	33	denolata, Stol.		52	XI	8-9	N. Odium		Ditto.	
VIII	P	CRITIDÆ.		52	1					
XXV	COSCINAR#A-			52						
00	33	Reuss.		53	XI	10	0 lium		Ootatoor	C. mammillata is from the Gosau deposits.
	Sub-order	,-M. TABULAT.	A.	53						
IX	MIL	LEPORIDÆ,	•••	53						
1111	A REAL PROPERTY AND A REAL		and the second s	12.2						

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It will be seen that out of the fifty-seven species forty-two are only known from the Ootatoor or lowest division, five from the Triehinopoly or middle, and nine from the Arrialoor or upper division, while a single species is common to the two last. The faunas are, therefore, as well defined as could be expected, and they indicate the soundness of the principles upon which the distinctions of these divisions have been based.

From our former researches we know that the Ootatoor beds are characterised as Cenomanien by Nautilus sub-lævigalus, Ammoniles rostratus (vel inflatus), Am. Rotomagensis, navicularis and Mantelli, Avellana elongala, Inoeeranus labiatus, Evogyra sub-aurieulala (vel columba), Gryphæa vesieulosa, Terebratula depressa, and capillata, Cidaris vesieulosa, and many other fossils.

The Trichinopoly beds have a good number of characteristic Turonien fossils, such as Amm. peramplus, and A. Guadeloupæ, Turritella Neptuni, Pholadomya caudala, Eriphyla lenticularis, Modiola typica, Gryphæa diluviana and carinata, Rhynchonella compressa, etc.

The Arrialoor group, which represents the Senonien and Danien of d'Orbigny, is distinguished by Nautilus danieus, Amm. Ootacoodensis, Seala sub-turbinata, and striato-coslata, Rissoina aeuminata, Gryphæa vesieularis, pectinata and ungulata, Exogyra laciniata, Amusium membranaeeum, Radula tecla, Inoceramus Crispii, Crania Ignabergensis, Cidaris sceptrifera, and many others of upper cretaeeous type, as are, for instance, all the Ciliopoda (or Bryozoa), recorded in a former number of this volume.

When we look upon the eoral fauna of the Ootatoor group, we meet with only one or two species identical with European forms, like Trochosmilia tuba, From., and others not satisfactorily determined, which have certain affinities common with some species from the Gosau. The reason of this seantity in identification lies in the fact, that there are comparatively only few corals known from Cenomanien beds in Europe, and this fact makes, therefore, our Ootatoor coral fauna not only locally interesting, but geologically important for the study of this formation. The more striking is it when we find that out of the five species from the Trichinopoly beds no less than three, Trochosmilia inflexa, Astroecenia decaphylla, and Isastrea morchella, occur in the Gosau and partly also in France, and in both localities the beds are referred to the Turonien. One of the species, Ast. decaphylla, which has in Europe a great geographical distribution in space, indicates this by its being common to the Triehinopoly and Arrialoor groups. From the last named group there are no other identical species with European forms, but we have actually not much to go upon in the identification of the species of this group, because the older publications on this subject are hopelessly insufficient.

# INDEX

# TO THE CORALS.

[ N. B.-The species described from South Iudia are marked with an (\*) asterisk. ]

ACTINOSMILIA AMBLOCYATHUS ASTHOPHYLLUM suleatum APLOCYATHUS ARMACIS lobata ASTREA , decaphylla ,, micrantha ASTREIDÆ ASTREIDÆ ASTREIDÆ ASTROCE NIA	···· ··· ··· ··· ··· ··· ··· ··· ··· ·	$     \begin{array}{r}       16 \\       6 \\       31 \\       11 \\       30 \\       33 \\       28 \\       24 \\       19 \\       31 \\       31     \end{array} $	DISC ELL ENA EPIS *	OTRO IPSOS LLOC SIMHI ,,	CHUS MILIA ENIA IA crassi	···· ··· ···		12 8 26	*MYCI * ?	TOPN YLI "	LIA nobilis stellata	***	29 30
AMBLOCYATHUS ANTHOPHYLLUM suleatum APLOCYATHUS ARMACIS lobata ASTREA , decaphylla , micrantha ASTREIDÆ ASTREIDÆ ASTREIDÆ	···· •··· ··· 22, ··· 26	$\begin{array}{c} 6\\ 31\\ 11\\ 30\\ 33\\ 28\\ 24\\ 19\\ 31 \end{array}$	ELL ENA EPIS * EUP	IPSOS LLOC SIMHI "	MILIA ENIA IA crassi	•••• •••	••••	8 26	* ? Papa	"	stellata	***	30
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APLOCYATHUS AREACIS lobata ASTREA , decaphylla ,, micrantha ASTREIDÆ ASTREIDÆ ASTREINÆ	···· ···· 22, ···· 26	$     \begin{array}{r}       11 \\       30 \\       33 \\       28 \\       24 \\       19 \\       31     \end{array} $	Ena Epis * Eup	LLOC SIMII "	ENIA IA crassi	•••• •••		26	PARA				
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ASTREA ,, decaphylla ,, micrantha ASTREIDÆ ASTREINÆ ASTROCENTA	 22,  26	$33 \\ 28 \\ 24 \\ 19 \\ 31$	* Eur	., ,,	crassi	conta		18	Рпут	LOCCENIA			22
" decaphylla " micrantha ASTREIDÆ ASTREINÆ ASTROCENIA	 22,  26	28 24 19 31	Eur	HLTI	та	Supur		18	*		multisepta	•••	22
"micrantha Astreidæ Astreinæ	22,  26	24 19 31			114			23	PLAC	ASTREA	marticeptit	•••	33
ASTREIDÆ ASTREINÆ	22,  26	19 31			sinuosa	1		2.1	*		 60'3118	•••	33
ASTREINÆ	26	31	EUP	SAMA	IIΛ			50	PLACE	SALITA	- 5	•••	17
ASTROCENTA	26	01	*		deno	otata		52	PLAT	VOVATITES		• • •	11
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			1	,,,	cœrn	lea	•••	54	~				
CŒLOSMILIA		13	*	29	Edwa	irdsana	•••	53	SAGAI	RTIA Schi	lleriana		5
CARYOPHYLLIA		6		39	maer	ostoma		53	STELI	ORIA			30
* Areotensis		7		3.9	Parts	schi	• • •	53		າ ສຽກ	rieites		31
Bredai		10	Hoi	OCŒ.	NIA	•••	•••	24	*	" Arc	otica		31
* cupuliformis		8	*	"	iudie	a	•••	25		,, rust	iea		31
Debeyana		10	*	33	ramo	sa	•••	21	STYLI	NA	• • •		20
decemplex		6	HET	EROC	XR7	***		<b>24</b>	* 33	grand	is		21
* gracilis		10							* 23	multis	tella		20
* grannlifera		9	ISAS	TREA		•••	31,	33	* 33	parvul	a		21
viola		9	*	,,	eyathiu	a		35	STYLI	NIDE	***	13,	19
CARTOPHYLLIDE		5	*		expanse	ι		34	STYLC	CENIA	•••		26
CHORISASTREA		37	*		conf. II	örnesi		37	SYMPI	IYLLIDÆ			23
CLADOCORA		51	崇		morehel	lla	34,	36					
COMOSFRIS	41.	45			profund	a		35	Тпам	NASTREA		35,	41
alternaus	,	45	*		Siva	: •		35	*	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	brevipes		42
conferta		45		~						33	eonfusa		42
irradians	***	46	Tim		37.33.79.1		01	-01	*	>>	erassa	•••	43
* Oldhamiana	•••	46	LIAT	1.31.452	NDRA		∠.≞,	40		<b>3</b> 9 (	decipiens	• • •	42
COSCINAREA		52	*	33	at	aciania	•••	40	*	,,	hieroglyphica		41
Botte	•••	52	*	,,,	60	neentrica	•••	40	*	22	induta	•••	44
" "Dottes	***	52	*	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	er	ussa	•••	09   20	*		pullata		43
CVATILINA	•••	6	~	**	g)	ring	•••	20		,,	tennissima		43
Статнорнова		20	-74-	53	111	orchollo	•••	20	Тпам	NASTREII	E	•••	41
CYCLOLITES		4.7	*	22	nn	orenena	•••	90	THECO	DSERIS			46
comica	•••	48	Tim	<u>,,,</u>	00	сощен	•••	00	*	,, ag	aricina		47
» conciden	•••	48	LAT	OMAS.	ANDRIDA	Ľ		20 10	THECO	SMILIA		• < •	23
ollipticu	• • •	17	Liep.	FOCY.	THUS .	***	•••	12	*	. g	eminata		23
* fmontn	•••	19	LOP.	nosn	ILIA hali		•••	10		., 8	innosa		24
* flamontosa	•••	10		33	bala	anophynoide	cs	17	TROCE	JHTLYOO	JS		10
* orbioulus	•••	40		,,,	cen	omana	•••	10	*	33	affiais		11
" ,, Orbicitius	•••	50		> 2	infla		• • •	17		39	Harveyanus		11
,, salietto-erucis	•••	40	24	33	roti	unditolia	•••	16		22	Terquemi		11
n spinosit	••••	40	- Tr	33	sim	ntaris	•••	17	TROCE	OSMILLA		8,	13
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			*MÆ	ANDR	ASTREA	eoneentrica		40	TROCI	IOSMILID.	E		12
DIMORPHASTREA		44	Mrc	ETOP	HYLLIA			29	TURBI	NOLIDE			13
patellaris		45			a	ntiqua		29	*TURBI	NOLIA A	rcotensis		7
( 190 )													

#### CRETACEOUS SPONGIOZOA OF SOUTHERN INDIA.

### Description of a species of Sponges and one of Foraminifera from the cretaceous deposits of South India.

#### Sub-kingdom, AMORPHOZOA or PROTOZOA.

This fifth large division of the animal kingdom is represented in the eretaeeous deposits of the Trichinopoly district of Southern India merely by two determinable species, one Sponge and one Foraminifer. Both are fortunately referable to well known European fossils, *Siphonia piriformis*, Goldf., a very characteristic Cenomanien species, and *Orbitoides Faujasi*, Duj., an equally characteristic Senonien species. The former is found in our Ootatoor or lowest, the latter in the Arrialoor, or uppermost, division, thus admirably supporting the view which we have taken of the age of the eretaeeous deposits of the Trichinopoly and South Areot districts.

#### Class, SPONGIOZOA.

The study of this elass\* has, within the last few years, been greatly extended through the elaborate researches of Dr. J. E. Gray, Bowerbank, Kent, Eimer, Hæckel, O. Schmidt, and many others. The fossil species have been worked out by Goldfuss, Bronn, Geinitz, W. Dunker, Baron Rosen, etc. One of the most complete and most recent systems proposed is that of O. Schmidt, who divides the class into—

1.—*HEXACTINELLIDÆ*, in which the silicious spiculæ are formed after the triaxial type.

2.—*HALISARCINÆ*, with the silieious spieulæ of uni-axial type.

3.—*LITHISIDÆ*, with a compound skeleton of apparently irregularly arranged spieulæ, in part probably calcareous, in part silicious.

4.—*CALCISPONGLÆ*, with a calcareous skeleton.

The only species observed in South India belongs to the

#### Group, LITHISIDE,

being a form of the

#### Genus-SIPHONIA, Park., 1811.

It is characterised by a simple or geminal, globular, pyriform or even cylindrical body, with a central or sub-central cylindrical eavity at the upper end; from this cavity radiate in different directions thin canals, which terminate between small pores on the outer surface, the same having no epitheea; the specimens are generally sessile by a peduncle.

The Siphoniæ are chiefly known from eretaeeous deposits.

\* Recently their relation to the Anthozoa and the Coelenterata, generally, have been repeatedly pointed out.

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#### SIPHONIA PIRIFORMIS, Goldf. Pl. XII, Figs. 1-2.

1826. Goldfuss, Petræf. Germ., I, p. 16, pl. vi, fig. 7.

1871. Geinitz, Elbthalgebirge in Sachsen, part I, Unterer Quader., p. 38, pl. 0, figs. 1-14.

One of the three specimens found in India is almost regularly pear-shaped, broadest near the upper end, which is depressedly convex; a few protuberances on the pedunele indicate that it had been ramified towards the base, somewhat as in Michelin's\* figure of a specimen from Rouen. The circumference of the upper side is roundly ovate, and the width of the cavity is nearly one-fourth of the longer diameter. The canals on the upper side are, as usually, thin and anastomosing, disappearing towards the periphery. The openings at the outer surface are ovate, about one mm. long and from one-half to three quarter mm. broad; the finely porose interspaces generally being from one to one and a quarter mm., sometimes more, but transversely rarely exceeding two mm., while, when the surface is somewhat worn off, the openings of the canals become longitudinally confluent, forming more or less deep furrows.

The internal structure, as seen on a polished section, is quite irregularly interwoven, rather largely cellular and traversed by the larger canals, issuing from the axis.

Two other Indian specimens are shortly pedunculate, with a wide, irregularly rounded circumference near the upper convex surface. In one the width of the central cavity is about one-sixth, in the other only about one-eighth of the total diameter, which considerably exceeds the height of the specimen.

European specimens vary equally in form, as do those three found in India. Geinitz says, that they change from piriform to globular, pedunculated, or even to cylindrical shape, and that the base of the peduncle is either single or ramified.

I have compared European specimens with our fossil, and their structure agrees perfectly. If we had to go merely by Goldfuss' figures, his *Siphonia ficus*, from near Goslar, ought to be united with the present species, but in comparing actual specimens from that locality, the inter-canalicular texture appears to be finer and denser than in *piriformis*. It is, however, just possible that this difference merely consists in a somewhat different preservation of the specimens.

Locality.--North-cast and north-west of Moraviatoor, in a brownish sandy limestone.

Formation.—Octatoor group.

The species is, as already noticed, a characteristic fossil of the Cenomanien or *Rotomagensis* beds in Saxony (lower Quadermarl and lower Plæner), Bohemia, and almost throughout France. The closely allied (if not identical) English species, *S. Konigii*, from the chalk is considered as distinct on account of its very long peduncle, but this is not shown in Mantell's† original figure.

† Geol. Sussex, p. 179, pl. xvi, figs. 19, 20, 21.

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<sup>\*</sup> Iconograph, zoophyt., 1840-47, p. 137, pl. xxxiii, fig. 1.

#### Class, RIHZOPODA OR FORAMINIFERA.

Like the Sponges the Rhyzopods are a mere organic fluid or viscose mass, without any special or permanent organs, but their little shells, simple or chambered, compete in regularity, exactness of proportion, beauty of form and of ornamentation with almost anything else we know in the animal kingdom. The names of Ehrenberg, Schultze, Dujardin, Carpenter, and many others will for ever remain connected with the study of this class. For the fossil forms no one has greater merit than A. d'Orbigny and Prof. A. E. von Reuss; the latter author having in 1861 published\* an elaborate Prodromus towards a natural system of the Foraminifera, particularly with reference to the fossil forms, of which no other naturalist has examined a larger number.

Prof. v. Reuss divides the entire class into two large divisions, according to the shell being porous or not. Of the next importance is considered the calcareous or silicious structure, etc.

Our species belongs to the group with a porous shell, which is traversed by a complicated system of canals.

Besides this single determinable species, I have only observed a few very imperfect specimens of a *Rotalia* from the marly limestone of Chokanadapooram and one small, smooth *Lagena* from the sandy beds at Yermanoor, both belonging to the Arrialoor group.

# Family,—NUMMULITIDÆ.

# Reuss, l. cit., p. 389.

#### Genus.—ORBITOIDES, d'Orbigny, 1847.

Shell discoid or lenticular, with sharpened margins, composed of a central simple layer of spirally or concentrically arranged cells, connected by eanals with each other, and superposed on both sides by several other layers of cells; outer surface more or less rough, granular, or tubercular and porous.

The species of the genus are found from the cretaceous epoch up to the present time.

#### ORBITOIDES FAUJASI, (Defrance). Pl. XII, Figs. 3-5.

Rcuss in Sitzungsb. Akad., Wien, Math. Nat. Klasse, 1861, vol. xliv, pt. i, p. 309, (cum syn.).

Shell discoid, varying from four to eight mm. in diameter, and one to three in thickness, sharpened at the periphery, sometimes irregularly bent; on both sides equally convex, or nearly flat on one of them, sometimes with a prominent central

\* Sitz. Ak., Wien, Math. Nat. Klasse, xliv, pt. i, p. 355. Scarcely a volume of either Sitzungsberichte or Denkschriften of the Academy is published without some valuable contribution to the fossils of this class.

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# CRETACEOUS FORAMINIFERA & ARTHROZOA

boss. Surface more or less distinctly granular and sub-tubercular, finely porose. The ehambers in the middle layer are concentrically arranged round a large nuclear cell; they are anastomosting with neighbouring chambers in the same series as well as with those belonging to the previous and subsequent circles; these chambers are squarish on the section, and their thickness varies from one-fifth to one-tenth of the total thickness. The cells in the superimposed layers are considerably smaller, depressed; on a vertical section their ranges are perpendicular, or very nearly so, to the horizontal central layer, and their number varies from four to twelve; generally they are not equally numerous on the two sides.

Prof. Reuss, who has described the internal structure of this species in great detail, has not been able to observe the communication of the cells belonging to the same concentric series. This connection is very clearly seen on two sections made of Indian specimens, and I have also observed it on two other sections of Maastricht specimens; it is exactly the same as observed by Carpenter in tertiary species of the genus. (Comp. Quart. Jour. Geol. Soc., Lond., 1850, vol. vi, p. 32, etc.).

Localities.—Ninnyoor, in white limestone; Chokanadapooram, in a pinkish earthy limestone.

Formation.—Arrialoor group.

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Orb. Faujasi is one of the most common Foraminifers in the Senonien beds at Maastricht; it has also been found on the island Rügen, at Aachen, and various other places of Germany and France (Royan, Lanquais, etc.).

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# Note on the Arthrozoa and Spondylozoa, represented in the South Indian cretaceous deposits.

These two sub-kingdoms are so very scantily represented in our collection that it is scarcely worth while to enter into any particular details on the subject. However, in order to complete the account of the fossils which have as yet been found in these deposits, I shall briefly notice those species which have been described from Messrs. Kaye and Cunliffe's collection, adding to these a few others of which specimens have been procured during the course of the survey.

#### VERMES.

If we exclude a few doubtful tubes which are to all appearance referable to the *PHOLADACEA*, and others which belong to the *VERMETIDE*, there are four species of *Serpula* and one of *Ditrupa* represented. The specific determination of these tubes is often very unsatisfactory, and though our materials are comparatively not very large, they admit of a tolerably good definition of at least three different forms.

1. SERPULA FILIFORMIS, Sow. Pl. XII, Fig. 6.

Sowerby, Trans. Geol. Soc., Lond., iv, p. 340, pl. 16, fig. 2. Reuss, Böhm. Kreide., pt. i, p. 20. S. socialis, in part, Goldfuss, Petraf. Germ., pl. 69, fig. 12.

The tubes are round, smooth, generally half a millimeter thick, rarely increasing to one mm., growing socially in large masses, composed of variously twisted bundles of about 15 to 30 tubes in each.

The Indian form exactly agrees with the European one in the form and thickness of tubes and manner of growth; it can, I think, be fairly considered as identical with it. It was first well figured by Goldfuss as *S. socialis*, under which name he included forms from devonien, jurassic, and cretaceous beds. Sowerby proposed to restrict Goldfuss' name to the jurassie form, and named the upper Greensand one from Blackdown *S. filiformis*. It occurs almost throughout the upper cretaceous beds (Upper Greensand and Chalk, Cenomanien, Turonien, and Senonien, Quadersanstein and Plæner) of England, France, Germany and Austria (Bohemia, Galizia, and the Banat).

Locality.—Arrialoor, in light grey sandstone. Formation.—Arrialoor group.

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#### CRETACEOUS ARTHROZOA

2. SERPULA conf. GORDIALIS, Schlotheim. Pl. XII, Figs. 7-8.

Comp. Goldf. Petræf. Germ., p. 241, pl. 71, fig. 4.

Tubes round, smooth, varying in thickness from one to one and a half millimeter, growing in short bundles, or in more compact masses variously entangled between each other, or more solitary, creeping on shells and other substances.

The Indian species does not appear to exhibit any perceptible difference from the European one above referred to, but I have no specimens for comparison, and do not wish, therefore, to pronounce their absolute identity, because the mode of growth somewhat differs from the form figured by Goldfuss, although Schlotheim refers to compact masses.

It is probable that Sowerby's *S. plexus* from the Chalk also belongs to this species (Comp. Min. Conch., vi, p. 201, pl. 598, fig. 1); it certainly is not identical with *filiformis*, as suggested by Reuss (Böhm. Kreide, pt. i, p. 20).

Localitics.—Arrialoor, in grey sandstone; south of Mulloor, in whitish or yellowish sandstone.

Formation.—Arrialoor group.

S. gordialis is an extremely common species in the Upper Plæner and Maastricht beds, all through Germany, Northern Austria, and France.

#### 3. SERPULA OOTATOORENSIS, Stoliczka. Pl. XII, Figs. 9-10.

Tubes simple, moderately bent, six to seven mm. thick, round, somewhat transversely rugosely striated; the thickness of the solid test is one to one and a third mm. The one end is oceasionally thickened by a circular swelling. The tubes resemble those which in the Planer of Bohemia and Saxony are often quoted as *Serpula amphisbana*, Goldf., and some of which no doubt belong to the *Serpulipæ*, while others are referable to *Gastrochæna* and *Teredo*. They are of almost equal thickness throughout.

Locality.—Ootatoor and west of Odium, in earthy limestone; the species does not appear to be rare; several specimens are in the collection.

Formation.—Ootatoor group.

#### 4 SERPULA ? HAMATA, Forbes. Pl. XII, Fig. 11.

Dentalium? hamatum, Forbes, Trans. Geol. Soc., Lond., vii, p. 138, pl. xv, fig. 8.

Of this species, of which no specimen exists in our collection, I have already observed (in Vol. II of the Pal. Indica, p. 444,) that the description and figure of the species are based upon a longitudinally ribbed *Serpula*. Forbes' original is taken from a fragment imbedded in a calcarcous sandstone, which is wholly perforated with these annelide tubes; their shells are thick; externally they appear to have four

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longitudinal somewhat distant ribs on one-half of the circuit, five somewhat closer on the other. The external layer of the shell is more compact than the inner, which breaks off in thin lamellæ. On the section the longitudinal ribs are perfectly clearly traceable, but the shell is so thoroughly attached to the rock that it always leaves only the east visible as soon as an attempt is made to remove it.

I can only add an approximate figure of the outer side and of the section.

#### 5. DITRUPA? LONGISSIMA, Forbes. Pl. XII, Fig. 12.

Trans. Geol. Soe., Lond., vii, p. 157, pl. xix, fig. 13.

<sup>6</sup> D. testa cylindrica, longissima, concentrice regulariter striata, striis minutissimis, <sup>6</sup> (nucleo lævi).<sup>2</sup>

' Length of specimen  $4\frac{1}{2}$  inches, diameter  $0_{T_{\overline{0}}}$  inch.

<sup>c</sup> A very long, regularly curved, eylindrical shell. The surface is marked with <sup>c</sup> very minute concentric striæ. The east is smooth. The habit is so truly that <sup>c</sup> of a testaceous tubicular *Annelide*, and the regularity of form so similar to the <sup>c</sup> aspect of a *Ditrupa*, that, although the mouth is not preserved, I have little hesi-<sup>c</sup> tation in referring it to that well-marked genus.

'It is contained in a mass of rock from Pondicherry, and is associated with '*Baculites*, and various univalve and bivalve shells.'

Such is Forbes' account of this species. From the last reference to *Baculites*, it appears most probable that the beds referred to belong to the Arrialoor group. There is no specimen of it in our collection.

#### CRUSTACEA.

Prof. Forbes gave a figure of the earapace of a crab from Pondicherry out of Mr. Kaye's collection. A second specimen was presented by Mr. Cunliffe to our Museum, but it is, like the former, incomplete. Very probably it belongs to some species of a *Neocarcinus*. I give figures of both on pl. xii, figs. 13 and 14. Our specimen is either from the Arrialoor beds at Pondicherry, or, judging from the occurrence of *Turritella affinis*, Stol., with our specimen, it may also be from the Veraghoor sandstone of the Trichinopoly group.

A second specimen of a Crustacean is from the Ootatoor shales at Ootatoor; it is the left hand of an *Haploparia*, or some other closely allied genus. A figure of this fragment is also given on pl. xii, fig. 15.

The only other Crustacean which I saw was a small *Cytherina* from the yellow Arrialoor sandstones at Yermanoor, occurring together with *Stygmatopygus etatus*, (Forbes).

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#### PISCES.

Sir Philip J. Egerton described in vol. I of the Quart. Journ. Geol. Soc., London, (reproduced in Trans. Geol. Soc., vol. vii, p. 89 et seq.), the following species:—

Enchodus serratus, Eg.; Sphærodus rugulosus, Eg.; Corax pristodontus, Agassiz; C. incisus, Eg.; Otodus? marginatus, Eg.; O. basalis, Eg.; O. nanus, Eg.; O. divergens, Eg.; O. minutus, Eg.; Oxyrhina triangularis, Eg.; Lamna complanata, Eg.; L. sigmoides, Eg.; Odontapsis constrictus, Eg.; O. oxyprion, Eg.

I shall very briefly notice these in a somewhat similar order, adding a few more species. I do not need to repeat the great uncertainty in the determination of these stray relies, and will, therefore, not attempt to characterize the genera.

1. PTYCHODUS LATISSIMUS, Ag. Pl. XII, Fig. 16.

Agassiz, Poiss. foss., vol. iii, pl. 25a and 25b, figs. 24-26; idem, Geinitz, Reuss, Mantell, et auctorum.

A single tooth in the collection exactly agrees in the general squarish form, moderate convexity, and in the thickness of the enamel bands with the European species; the sharp edges of these enamel bands are very minutely crenulated, as is usually the case in this and most other species of the genus. The exact locality of the specimen is not recorded, but it was together with a small fish bone of quite similar preservation, and this leaves but very little doubt that both are from east of Olapaudy in the Arrialoor group.

In Europe *Pt. latissimus* is one of the most common species of the middle and upper cretaceous beds, Upper Greensand and Chalk.

#### 2. Spilærodus Rugulosus, Eg. Pl. XII, Fig. 17.

Sir Philip Egerton figures (Quart. Journ. Geol. Soc., Lond., 167,) a few *Sphærodus* teeth, which, he says, are distinguished from other allied 'forms by the wrinkled or shrivelled appearance of the superficies.' The specimens are from Pondicherry.

#### 3. PYCNODUS? sp. Pl. XII, Fig. 18.

A single fragment of a jaw from the *Ootatoor beds* east of *Ootatoor* is in our collection. It has a single series of four teeth, the last being very small; the penultimate is largest, longer than broad, sloping posteriorly; the two following are shorter than broad and squarish, depressedly convex above. The specimen evidently belongs to some *Pyenodonte* fish.

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#### 4. Corax pristodontus, Ag. Pl. XII, Fig. 19.

Egerton (l. cit., p. 167,) says that a fragment exactly corresponds with specimens from the Maastricht beds.

#### 5. CORAX INCISUS, Eg. Pl. XII, Fig. 20.

Compare Egerton, I. cit., p. 168.

Neither of the two last species is represented in our collection.

#### 6. OTODUS MARGINATUS, Eg. Pl. XII, Fig. 21.

#### Egerton, l. cit., p. 168.

Egerton says that the tooth which he refers to the above species has a narrower cone than most specimens of *O. appendiculatus*, and that the inner surface is more arched than in any other known species. The cutting edge is sharp, and so distinct as to have the appearance of a border, separated from the remainder of the shaft by a shallow groove.

#### 7. OTODUS BASALIS, Eg. Pl. XII, Figs. 22 & 23.

Egerton, l. cit., p. 168.

Differs from the former and from *O. appendiculatus* by the great size of the lateral cusps and the comparatively small size of the middle cone. We have a specimen of this species from east of *Ootatoor* in the *Ootatoor group*.

#### 8. OTODUS conf. SEMIPLICATUS, Münst. Pl. XII, Fig. 24.

Agassiz, Poiss. foss., vol. iii, p. 272, pl. xxxvi, figs. 32,?33; Reuss, Böhm. Kreidef., pt. 1, p. 5.

A single specimen of a tooth from the sandstone beds north of *Kunnanore*, in the *Arrialoor group*, is very closely allied to the above-named species, except in having a more slender cone, but as the form of this varies in different places of the same jaw, that point does not invalidate the probable identity of our fossil with the European one. The width of the base considerably exceeds the height of the middle cone, and is on both sides along the margin longitudinally plicated. The edges are undulately serrated as soon as they descend from the cone, and the lateral cusps are of moderate size and rather distant. All these characters perfectly agree with the European fossil, which occurs in the Planer of Saxony and of Bohemia.

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#### CRETACEOUS SPONDYLOZOA

9. OTODUS NANUS, Eg. Pl. XII, Figs. 25-28.

Egerton, l. eit., p. 169.

In addition to Egerton's figure, I give representations of two specimens from *Ootatoor* and of one from *Odium*. All these three differ from the typical form by a larger size, but all agree in general form, proportion of width and thickness, etc. The specimen from Odium is nearly straight, and on one side shows the origin of a small lateral cusp.

## 10. Otodus minutus, Eg. Pl. XII, Figs. 29-30.

Egerton, l. eit., p. 169.

This is very closely allied to the last, but somewhat more slender and with proportionately larger cusps. It occurs both at *Pondicherry* and in the sandstones cast of *Ootatoor* in the *Ootatoor beds*. The larger teeth are very like those of *Lamma complanata*, but are convex on both sides.

#### 11. OTODUS DIVERGENS, Eg. Pl. XII, Fig. 31.

Egerton, l. cit., p. 169.

The peculiarity of this species is said to rest in the great development of the lateral ensps and in their position close to the cone. The specimen from Mr. Kaye's collection is as yet unique.

# 12. OXVRHINA TRIANGULARIS, Eg. Pl. XII, Figs. 32-33.

Egerton, l. cit., p. 169.

The cones do not appear to differ in the least from those of *Otodus nanus*, but are said to have no lateral cusps, and are, therefore, referred to *Oxyrhina*.

#### 13. OXYRHINA (MERISTODON), sp. Pl. XII, Fig. 34.

Our collection contains a single tooth from *Olapaudy* in the *Arrialoor group*; it does not appear to have any trace of lateral cusps. The inner surface is somewhat more convex than the outer one, and both are longitudinally plicated, the ribs being very much thinner than the interspaces separating them, and they disappear towards the end of the cone. The edges are rather sharp and slightly crenulated. The whole tooth is very much of the type of the English *Oxyrhina paradoxa*, Ag.

14. ODONTAPSIS CONSTRICTUS, Eg. Pl. XII, Figs. 35-37.

Egerton, l. cit., p. 171.

This species is common both at *Pondicherry* and *cast of Ootatoor* in the *Ootatoor group*. In one specimen from the latter locality, I have been able to trace on one side a very small lateral cusp; it is situated very much posteriorly and low down.

As regards the shape of the cone itself, the Indian specimens are perfectly identical with some of those described by Reuss as *Oxyrhina angustidens* from Bohemia (Comp. Reuss, Bohm. Kreidef., pt. i, p. 6, pl. iii, figs. 7-9). Both of them show the small depression at the centre of the outer basal margin of the cone.

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#### OF SOUTHERN INDIA.

#### 15. LAMNA COMPLANATA, Eg. Pl. XII, Fig. 38.

16. LAMNA SIGMOIDES, Eg. Pl. XII, Fig. 39.

The peculiarities of these species may be seen from the accompanying figures. As no specimens exist in our collection, I have nothing to add to Egerton's notice.

17. ODONTAPSIS OXYPRION, Eg. Pl. XII, Fig. 40.

This is distinguished from *O. rhaphiodon* by the large lateral cusps being more elongated and sharper at the points.

18. ENCHODUS SERRATUS, Eg. Pl. XII, Fig. 41.

Egerton, l. cit., p. 166.

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Egerton, when examining three specimens of an *Enchodus* from Mr. Kaye's collection, says that they differ from those of *E. haloeyon*, Ag., by the surface of the enamel being more smooth and even, in consequence of the fineness of the longitudinal strike, which in *haloeyon* are coarser and strongly marked. The transverse bands are said to be broader and the form of the teeth less attenuated. The chief difference rests in the finely serrated eutting edge, which in *haloeyon* is said to be smooth and entire. No figure is given of any of the specimens, all three being said to be imperfect.

Our collection possesses a single tooth from the neighbourhood of *Karapaudy* in the *Arrialoor group*. It undoubtedly very closely resembles that of *E. haloeyon*, particularly the figures given by Geinitz in Charact. etc., pt. iii, p. 63, pl. xvii, figs. 13-14, but the longitudinal striation is finer, disappearing towards the pointed end and also towards the lateral margins. The enamel is, however, in our specimen unfortunately so much weathered off that no serration can be traced at the edges. The tooth is nearly an inch long.

#### SAURIA.

In his report on the geology of the Trichinopoly District (Mem. Geol. Surv., India, vol. iv, p. 139), Mr. II. F. Blanford mentions the occurrence of a *Megalo*saurus tooth together with some bones in the *Arrialoor beds* at *Cullmoad*. I have seen some fragments of these bones; they are, as Mr. Blanford remarks, so very fragile and imperfect that no reliable determination can be made, and unfortunately the solitary fragment of the tooth is not at present accessible, so that I am unable to add anything to the information given by Mr. Blanford.

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Fig.	22.	TROCHOSMILIA CAMURA, Stol., p. 14; same views as of the last species; Parally, Ootatoor group.
Fig.	23.	TROCHOSMILIA? CAMURA, p. 14; side, upper, lower and sectional views; the septa are marked with black lines; <i>Moraviatoor</i> , <i>Ootatoor group</i> .
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## PLATE II.

Figs.	1-4.	TROCHOSMILIA INFLEXA, <i>Reuss</i> , p. 15; 1, 1 <i>a</i> , 1 <i>b</i> , two side views and a section of a large corallum, Koloture; 2 and 3, polished sections; 4, a worn specimen, side view; <i>Alundanapooram</i> , <i>Trichinopoly group</i> .
Fig.	5.	Trochosmilia? side and sectional views near the ealyx; Moraviatoor, Ootatoor group.
Fig.	6.	Lophosmilia similaris, Stol., p. 17; same views as of the last species; Odium, Ootatoor group.
Fig.	7.	Placosmilia? p. 7; section in natural size, and a portion of the outer surface en- larged; Parally, Ootatoor group.
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Figs.	10-11.	PSAMMOSMILIA ORIENTALIS, Stol., p. 19; 10 <i>a</i> , very short eorallum, only round the ealyx weathered out of a limestone rock; 11, side view of a more elongated specimen; Cooticaud, Ootatoor group.





## PLATE III.

Figs.	1—2.	STYLINA MULTISTELLA, Stol., p. 20; 1, upper view of a large convex eorallum; 1a, a few calyces in twice the natural size; 2, portion of a flat corallum, with the surface much weathered off; $2a$ , a polished section; Morariatoor, Ootatoor group.
Fig.	3.	STYLINA GRANDIS, Stol., p. 21; 3, a portion of a corallum, and 3a a few ealyces of the original surface; 3b, a polished section; all figures in natural size; Kauray, Ootatoor group.
Fig.	4.	PHYLLOCCENIA MULTISEPTA, Stol., p. 22; 4, a portion of a corallum, natural size; 4a, a few calyces enlarged, the uniform shaded portion is a polished surface; Alundanapooram, Trichinopoly group.
Fig.	5.	HELIASTREA? p. 32; npper and side views of a portion of a corallum, mostly silicified; <i>Perganager</i> , <i>Optation</i> , group





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## PLATE IV.

Figs.	1-3.	<b>THECOSMILIA</b> GEMINATA, Stol., p. 23; 1, 1 <i>a</i> , upper and side views of a large specimen, with only a small portion of a second individuum preserved; 2, a young bi-geminate corallum; 2 <i>a</i> , side view of the same; 3, upper view of another corallum composed of three individuums; Moraviatoor, Ootatoor group.
Figs.	4—5,	HOLOCENIA RAMOSA, Stol., p. 24; 4, side view of a corallum, natural size; 4a, small portion of the original surface enlarged; 4b, the same of a polished surface; 5, sectional view of a broken branch of a large eorallum; Moraviatoor, Oolaloor group.
Fig.	, 6.	STYLINA PARVULA, Stol., p. 21; 6, 6a, 6b, top-, side- and lower views of an agarieiform corallum; 6c, a portion of original surface, and 6d, that of a polished surface enlarged; Ninnyoor, Arrialoor group.
Fig.	7.	ASTROCCENIA PUMILA, Stol., p. 28; 7, 7 <i>a</i> , side- and top- views of a small eorallum, natural size; 7 <i>b</i> , a portion of the original surface enlarged; Nin- nyoor, Arrialoor group.



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Fig.	1.	HOLOCENIA INDICA, Stol., p. 25; I, upper view of the eorallum; 1a, a portion of the original surface; 1b, a similar one of the polished surface, enlarged; Ninnyoor, Arrialoor group.
Fig.	2.	ASTROCENIA RETIFERA, Stol., p. 26; 2, 2a, 2b, similar views as of the last species; Moraviatoor, Ootatoor group.
Figs.	3—4.	ASTROCŒNIA REUSSIANA, Stol., p. 27; 3, upper view of a corallum with rather small calyces; 4, another specimen with slightly larger calyces; 3b is a polished surface; 4a, an original surface, enlarged; Kauray, Ootatoor group.
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Fig.	7.	? MYCETOPHYLLIA STELLATA, Stol., p. 30; 7, 7a, top- and side- views of the corallum, and 7b, a small portion of the original surface enlarged; E. of Parally, Ootatoor group.
Fig.	8.	STELLORIA ARCOTICA, Stol., p. 31; 8, upper, and 8a, lower views of a fragmen- tary corallum; Sb, small portion of the upper surface enlarged; Parally, Ootatoor group.

# PLATE V.



Fig.	 1.	MYCETOPHYLLIA NOBILIS, Stol., p. 29; 1 and 1 <i>a</i> , upper view, and portion of the side view of a large corallum; N. of Alundanapooram, Trichinopoly group.
Fig.	 2.	HELIASTREA ORTIVA, Stol., p. 31; 2, upper view of a corallum; near the right end the original surface is preserved, about the middle the surface is wea- thered off, and at the left end it is polished; 2b, enlarged original surface; 2c, weathered surface; 2d, polished surface; 2e, side view of a portion of the corallum; Odium, Ootatoor group.
Fig.	 3.	HELIASTREA ROTUNDA, Stol., p. 32; 3, upper view of the corallum, natural size; 3a, original, 3b, polished surface; Moraviatoor, Ootatoor group.

# PLATE VI.



## PLATE VII.

Fig.	. 1.	PLACASTREA ELEGANS, Stol., p. 33; a portion of the original corallum in natural size, and a few calyees enlarged; Odium, Oototoor group.
Fig.	. 2.	ISASTREA EXPANSA, Stol., p. 34; similar figures as of the last species; Odium, Ootatoor group.
Figs.	3—4.	ISASTREA SIVA, Stol., p. 35; 3 and 4, upper views of two different specimens in natural size; 3a, a small portion of the surface enlarged; N. E. of Moravia-toor, Ootatoor group.
Figs.	<b>5</b> —6.	<ul> <li>ISASTREA CYATHINA, Stol., p. 35; 5, 5a, side and upper views in natural size;</li> <li>5 b, upper view, enlarged twice the natural size; Parally; 6 and 6a, side and upper views in natural size of a specimen from Kullay; Ootatoor group.</li> </ul>
Figs.	7— <u>8</u> .	ISASTREA MORCHELLA, Reuss, p. 36; 7, 7a, side and upper views of a large, pedi- cellate specimen; 8, 8a and 8b, upper, side and lower views of a very much depressed, almost discoid specimen; N. of Alundanapooram, Trichinopoly group.
Fig.	9.	ISASTREA (con/.) HÖRNESI, Reuss, p. 37; side and upper views of a specimen with polished upper surface; Moraciatoor, Ootatoor group.



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Fig.	1.	LATIMÆANDRA OBCONICA, Stol., p. 38; upper, side and lower views in natural size; le, a small portion of the upper surface enlarged; E. of Parally, Ootatoor group.
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Fig.	6.	LATIMÆANDRA INTERRUPTA, Stol., p. 39; 6, a portion of the eorallum in natuarl size;



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## PLATE IX.

Fig.	* * *	1.	LATIMÆANDRA [? MÆANDRASTREA] CONCENTRICA, <i>Reuss</i> , p. 40; 1, upper view of a corallum; 1 <i>a</i> , a small portion of the original surface; 1 <i>b</i> , a similar one of the polished surface, enlarged; <i>Odium</i> , <i>Ootatoor group</i> .
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Fig.	• • •	6,	THAMNASTREA INDUTA, Stol., p. 44; polished view of the upper surface of a shortly pedieellated corallum; Odium, Ootatoor group.



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## PLATE X.

Fig.	l.	THAMNASTREA INDUTA, Stol., p. 44; 1 and 1 a, upper and side views of a eorallum in natural size; 1b, a small portion of the polished surface enlarged; Odium, Ootatoor group.
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		PLATE XI.
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Figs.	3—5.	Orbitoldes Faulasi. Defr., p. 61: 3, 3g, 3b, 3c, two views of a complete speci-
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