

## A NEW SPECIES OF CASSIDULOID ECHINOID *GONGROCHANUS* KIER, 1962 FROM THE LATE CRETACEOUS (MAASTRICHTIAN) ROCKS OF THE ARIYALUR AREA, TAMIL NADU, INDIA

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### ABSTRACT

A new species of the echinoid genus *Gongrochanus* Kier, 1962, i.e. *G. ariyalurensis* has been recorded and described from the Late Cretaceous rocks of Tamil Nadu, India. The new species is characterised by having interpetaloid angle minimum between plates I & V and maximum between petals I & II and IV & V besides anteriorly excentric peristome. This study also confirms that the echinoid genus *Stigmatopygus* d'Orbigny, 1856 does not occur in India.

**Key words:** Cassiduloid echinoids, *Gongrochanus*, Late Cretaceous, Kallankurichchi Formation, Ottakovil Formation, Ariyalur district and Tamil Nadu.

### INTRODUCTION

The Kallankurichchi Formation of the Ariyalur Group in the Ariyalur-Pondicherry depression of the Cauvery Basin (fig. 1) is richly fossiliferous and has yielded diverse assemblages represented by bivalves, bryozoans, echinoids, gastropods and larger foraminifers. Some of these fossils (e.g. bivalves and echinoids) also extend into the overlying Ottakovil Formation. These fossil groups have received the attention of a number of specialists who have contributed a valuable palaeontological database on the varied aspects of the faunas (Stoliczka, 1866,

1868, 1871, 1872, 1873b; Kossmat, 1895, 1897, 1998 and Sastry, Rao and Mamgain, 1968, 1972).

The major part of the Kallankurichchi Formation of the Ariyalur Group (Sastry, Rao and Mamgain, 1972; Madhavaraju and Ramasamy, 1999) is exposed in the quarries of the Tancem Cement Factory. The formation is largely made up of marine carbonates with beach conglomerates at the base and increasing sand content towards the top. The overlying Ottakovil Formation is completely sandy and characterised by the presence of bivalves and echinoids. It seems that the sandy carbonates of the uppermost part of the Kallankurichchi Formation mark the transition to the sandstone of the Ottakovil Formation (Kohring, Bandel, Kortum and Parthasarathy, 1996). Guha and Mukhopadhyay (1996) consider that the carbonates of the Kallankurichchi Formation are mainly bioclastic grainstone with some packstone, having rich assemblages of macroinvertebrates and representing shell back deposits on a platform margin.

M'Clelland (1840) erected and established an echinoid genus *Cyrtoma* collected from the Cretaceous rocks of the Khasi Hills near Cherrapunji, India. He described six species of this genus. However, Das Gupta (1920) combined all these species under *Cyrtoma herschelliana* M'Clelland, 1840. Later, a new echinoid genus *Gongrochanus* was proposed by Kier (1962) with *Cyrtoma*

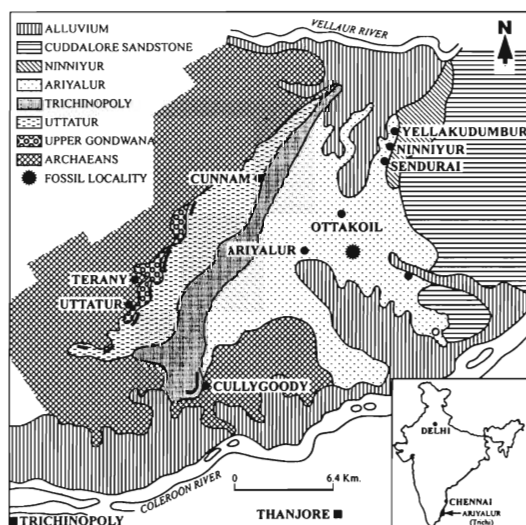


Fig. 1. Geological map of the area\*showing fossil locality (after Blanford, 1862; Rama Rao, 1956; Garg and Jain, 1979)

*herschelliana* M'Clelland, 1840 as the type species. Bhattacharya and Bhattacharya (1978) reported specimens of *Gongrochanus herschelianus* (M'Clelland), 1840 as *Stigmatopygus elatus* (Forbes) from the Mahadek Formation (Late Cretaceous) of Assam. Das, Bora and Ghosh (1981) studied variations in this species and suggested that the population of this taxa included larger forms occurring towards the open oceanic regions than in the nearshore regions because of the fact that ontogeny is more complete in relatively calm, deeper water regions than on the agitated bottoms near the shore.

Stoliczka (1873a) described *Stigmatopygus elatus* (Forbes) from the Senonian rocks of the Ariyalur Group of South India. Kier (1962) considered this species to be a junior synonym of *Gongrochanus herschelianus*. Badve and Aziz (1983) revised *Gongrochanus* Kier, 1962 on the basis of material previously recorded by Stoliczka (1873a) from Cretaceous rocks of South India, establishing six new species based on some morphological differences. Recently, Smith and Jeffery (2000) reviewed this genus and synonymized all species of Badve and Aziz (1983) under *G. herschelianus* Kier, 1962. During the present investigation, it has been observed that the characteristic echinoid genus *Gongrochanus* Kier, 1962 occurs abundantly in the Kallankurichchi and Ottakovil formations, which was documented earlier by Stoliczka (1873a) as *Stigmatopygus* d'Orbigny, 1856 (*S. elatus* (Forbes)).

#### SYSTEMATIC PALAEONTOLOGY

In the systematic description of the species, the classification proposed by Kier (1966) has been followed. The material for this research work was collected by Prof. A.K. Jauhri from the Late

Cretaceous (Maastrichtian) rocks of the Kallankurichchi and Ottakovil formations (Ariyalur Group) of Tamil Nadu, India.

Order **Cassiduloidea** Claus, 1880

Family **Faujasiidae** Lambert, 1905

Genus ***Gongrochanus*** Kier, 1962

*Gongrochanus ariyalurensis* n. sp.

(Pl. I, figs. 1 -8)

**Material:** Ten specimens; preservation good. Holotype No. TCE 151\* Paratype Nos. TCE 155, TCE 158, TCE 160\* TCE 161 (incomplete and broken), TCE 163\*, TCE 164\*, TCE 165, TCE 166 and TCE 167 (Specimens marked with an asterisk\* have been photographed)

**Etymology:** The new species is named after the district Ariyalur in Tamil Nadu, India.

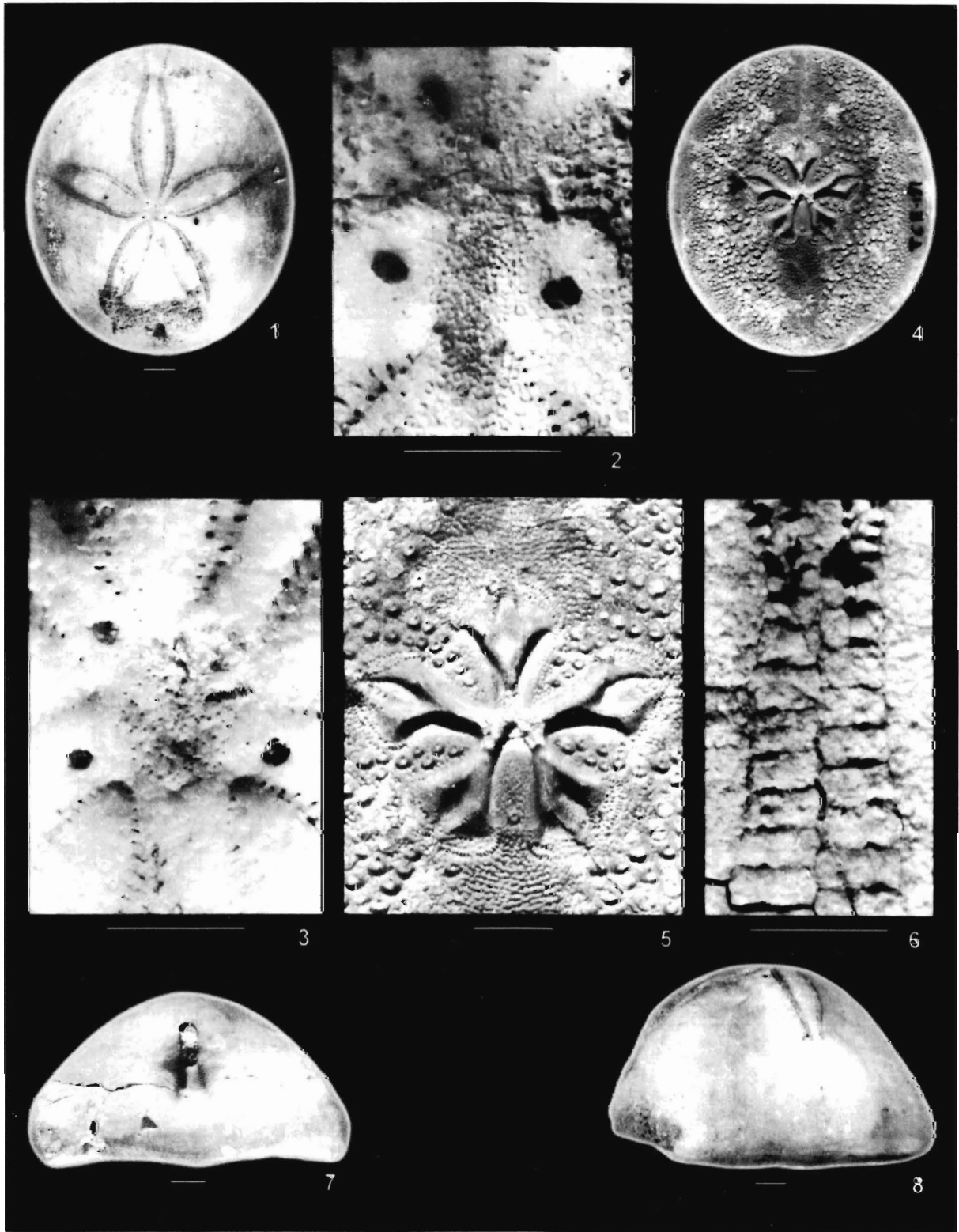
**Diagnosis:** Test medium, oval to subpentagonal. Apical system central at highest point of test, ethmolytic, tetrabasal with three genital pores (G2 missing); Ambulacra subpetaloid, III is longest, I & V are narrowest and shortest. The interpetaloid angle between the petals I & V is minimum and it is maximum between petals I & II and IV & V. Priroct supramarginal. Peristome excentric anteriorly. Bourrelets tooth-like and strongly developed. Phyllodes very broad with many single pores arranged regularly in two series in each half of ambulacrum with no pores between these series.

**Description:** Test medium, thin, oval to subpentagonal in outline; margin tumid and well rounded; longer than broad and broader than high. It is broadly rounded anteriorly, slightly protruded posteriorly and its maximum width is posterior of centre (opposite to posterior extremity of I & V). Anterior slope of test is steeper than posterior. Apical

#### EXPLANATION OF PLATE I

Bar represents 5.0 mm for figs. 1,4,5,7 and 8; 2.5 mm for figs. 2,3 and 6

1. *Gongrochanus ariyalurensis* n. sp.; aboral view; specimen no. TCE-164.
2. *Gongrochanus ariyalurensis* n. sp.; apical system; specimen no. TCE-163.
3. *Gongrochanus ariyalurensis* n. sp.; apical system; specimen no. TCE-164.
4. *Gongrochanus ariyalurensis* n. sp.; oral view; specimen no. TCE-151.
5. *Gongrochanus ariyalurensis* n. sp.; peristome; specimen no. TCE-151.
6. *Gongrochanus ariyalurensis* n. sp.; petal III near ambitus; specimen no. TCE-160.
7. *Gongrochanus ariyalurensis* n. sp.; posterior view; specimen no. TCE-151.
8. *Gongrochanus ariyalurensis* n. sp.; lateral view; specimen no. TCE-164.



system at highest point of test, central, small, compact, ethmolytic, tetrabasal with three genital pores (G2 missing); genital pores small and rounded.; five ocular plates small, triangular and each is perforated by a single and very small circular ocular pore. Ambulacra subpetaloid, unequal in length, do not reach up to ambitus and flush with the test; III is longest, I & IV are narrowest and shortest; interpetaloid angle between I & V is minimum ( $51^{\circ}$ - $54^{\circ}$ ) whereas it is maximum between petals I & II and IV & V ( $87^{\circ}$ - $90^{\circ}$ ). However, interpetaloid angle between petals II & III and III & V ranges from  $60^{\circ}$  to  $68^{\circ}$ . Poriferous zones well developed; inner pores small and circular, outer pores elongate transversally; pore pairs conjugate with a transverse groove. Ambulacral plates simple. Periproct supramarginal, longitudinally elliptical with a broad transverse depression ventral to it lying on posterior truncation near posterior extremity of I & V. Oral surface flat Peristome excentric anteriorly, broader than long, subpentagonal in shape and lies in a depression. Bourrelets strongly developed, tooth-like and jutting into peristome. Phyllodes very broad with many single pores arranged regularly in two series in each half of ambulacrum with no pores between these series (about 20 pores in each outer series and about 9 in each inner series). These pores are widely separated from edge of peristome. Two buccal pores are present on vertical wall of peristome. A prominent bulge occurs longitudinally in median area of each phyllode. Tubercles noncrenulate and nonperforate, dense on oral surface and scarce on aboral surface. Tubercles missing in median areas of interambulacrum 5 and ambulacrum III orally.

*Measurement of tests (in mm):*

Sl. No.	Specimen No.	Length (L)	Breadth (B)	Height (H0)	Ratio between L: B: H
1.	TCE 151*	46.6	41.0	21.5	1.0 : 0.88 : 0.46
2.	TCE 155	69.9	-	29.4	1.0 : - : 0.42
3.	TCE 158	45.5	38.7	21.0	1.0 : 0.85 : 0.46
4.	TCE 160*	-	39.8	22.3	- : 1.0 : 0.56
5.	TCE 163*	48.7	41.0	28.5	1.0 : 0.84 : 0.58
6.	TCE 164*	47.8	41.6	29.2	1.0 : 0.87 : 0.61
7.	TCE 165	47.5	41.2	25.3	1.0 : 0.86 : 0.53
8.	TCE 166	43.6	37.0	22.5	1.0 : 0.84 : 0.51
9.	TCE 167	49.9	42.8	21.6	1.0 : 0.85 : 0.43

*Measurement of the holotype (in mm):*

Specimen No. TCE 151

Length of the test – 46.6

Breadth of the test – 41.0

Height of the test – 21.5

Ratio between length, breadth and height – 1.0 : 0.88 : 0.46

Petal	Length	Breadth
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III	19.3	5.0
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II & IV	15.5	5.0
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I & V	12.9	4.9
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Maximum diameter of periproct – 5.9

Minimum diameter of periproct – 2.8

Length of peristome – 3.2

Breadth of peristome – 4.1

Distance between peristome and anterior ambitus – 20.4

Distance between peristome and posterior ambitus – 23.0

*Remarks:* The new species has close resemblance to *G. herscheliana* Kier, 1962 recorded by M'Clelland (1840) from the Cretaceous rocks of the Khasi Hills near Cherrapunji and by Stoliczka (1873a) as *Stigmatopygus elatus* (Forbes) from the Senonian rocks (Ariyalur Group) exposed near Yermanoor and at southeast of Kaudoor in gross morphology. However, the described new species differs from *G. herscheliana* in having a narrower test and anteriorly excentric peristome whereas in *G. herscheliana* the test is broader and it has central peristome. Further, in *G. ariyalurensis* n sp., the bourrelets are longer and narrower than those of *G. herscheliana*. Moreover, in the new species, the interpetaloid angle between the petals I & V is minimum ( $51^{\circ}$ - $54^{\circ}$ ) and it is maximum between petals I & II and IV & V ( $87^{\circ}$  - $90^{\circ}$ ), whereas in *G. herscheliana* the interpetaloid angle (Table 3,p. 243; Badve and Aziz, 1983) is maximum between petals II & III and IV & IV ( $89^{\circ}$ - $91^{\circ}$ ) and minimum between the petals I & II and IV & V ( $48^{\circ}$  - $59^{\circ}$ ).

*Variation:* In one of the specimens of the present collection (TCE – 163), a depression runs near the posterior part of the apical disc (Pl. 1 fig. 2). Probably, it is the madreporite which has extended posteriorly separating more widely the oculars I & V (ethmolytic condition).

*Type locality:* The specimens have been collected from 3.2 km east of Ariyalur in Tamil Nadu, India.

*Type Horizon:* Kallankurichchi Formation, Ariyalur Group; Late Cretaceous (Maastrichtian). Few specimens have also been recovered from the overlying Ottakovil Formation of Late Cretaceous (Maastrichtian) age.

#### REPOSITORY

All the described and photographed specimens have been deposited in the Museum, Department of Geology, University of Lucknow, Lucknow – 226007.

#### CONCLUSION

The present study supports the observations of Badve and Aziz (1983) that the echinoids from the Kallankurichchi and Ottakovil formations (Ariyalur Group) of the Ariyalur area earlier referred to *Stigmatopygus elatus* (Forbes) by Stoliczka (1873a) no longer conform to the echinoid genus *Stigmatopygus* d'Orbigny, 1856. It may now be split into two distinct populations, which belong to another echinoid genus *Gongrochanus* Kier, 1962. One of the populations is referable to *Gongrochanus herschelanus* previously described as *Stigmatopygus elatus* (Forbes) by Stoliczka (1873a) from the Ariyalur area, Tamil Nadu, while the other one, is represented by the *Gongrochanus ariyalurensis* n. sp. The new species is easily distinguishable from *Gongrochanus herschelanus* in having minimum interpetaloid angle between petals I & V and maximum between petals I & II and IV & V besides the anteriorly excentric peristome and narrower test. Further, the study also confirms that the echinoid genus *Stigmatopygus* d'Orbigny, 1856 does not occur in India.

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#### REFERENCES

- Badve, R.M. and Aziz, S.A. 1983. Revision of cassiduloid genus *Gongrochanus* Kier (Echinodermata Echinoidea) from south Indian Cretaceous deposits. *Proc. Ind. Acad. Sci. (Anim. Sci.)* 92(3): 231 – 246.
- Bhattacharya, A. and Bhattacharya, U. 1978. Biostratigraphy of the marine Cretaceous shelf sediments of Meghalaya, India with special reference to its Indo – Pacific affinity. *Third Regional Conference on Geology and Mineral Resources of South East Asia, Bangkok, Thailand*: 9-24.
- Blanford, H.F., 1862. On the Cretaceous and other rocks of the south Arcot and Trichinopoly districts, Madras. *Mem. Geol. Surv. India*, 4(1): 1 – 217.
- Das Gupta, H.C. 1920. A short note on the Cretaceous echinoid *Cyrtoma* M'Clelland. *Jour. Asiatic Soc. Bengal. N.C.*, XVI: 296-300.
- Das, N.K., Bora, A.K. and Ghosh, D.N. 1981. Studies on the variation in *Stigmatopygus elatus* from the Mahadek Formation (Cretaceous) of Meghalaya. *Bull. Ind. Geol. Assoc.* 14(2): 121 – 132.
- Garg, R. and Jain, K.P. 1979. Polyscythin radiolarian from phosphatic nodule of the Uttatur Formation, south India. Part-I, Nasselleria. *Bio.Mem.*, 3(2): 133-175.
- Guha, A.K. and Mukhopadhyay, T.J. 1996. Cretaceous – Palaeocene Carbonate Microfacies of Tamil Nadu and Pondicherry. *Jour. Geol. Soc. India*. 47(1):115-127.
- Kier, P.M. 1962. Revision of the cassiduloid echinoids. *Smithsonian Miscellaneous Collections*, 144(3):125-134.
- Kier, P.M., 1966. Cassiduloids in Moore. R.C. (Ed.) *Treatise on Invertebrate Palaeontology*. Geol. Surv. Amer & Univ. Kansas Press, U3(2): 492-523.
- Kohring, R., Bandel, K., Kortum, D. and Parthasarthy, S. 1996. Shell structure of a dinosaur egg from the Maastrichtian of Ariyalur (southern India). *N.Jb. Geol. Palaont. Mh.*, 1: 48-64.
- Kossmat, F., 1895. Untersuchungen Über die Sud-Indesche Kreide Formation *Beitz. Pal. Geol. Oster.* 9:97 – 203.
- Kossmat, F. 1897. The Cretaceous deposits of Pondicherry. *Rec. Geol. Surv. India*, 30: 51 – 110.
- Kossmat, F. 1898. Untersuchungen Über die Sud-Indesche Kreide Formations. *Beitz. Pal. Geol. Oster.* 11: 1 – 46, 89 – 152.

- Madhavaraju, J. and Ramasamy, S. 1999.** Microtextures on quartz grains of Campanian –Maastrichtian sediments of Ariyalur Group of Tiruchirapalli Cretaceous, Tamil Nadu- Implication on depositional environments. *Jour. Geol. Soc. India*, **54**(6): 647 – 658.
- M’Clelland, J.M. 1840.** On Cyrtoma, a new genus of fossil echinida. *The Calcutta Journal of Natural History*, **1**(11): 155 – 187.
- Rama Rao, L.R. 1956.** Recent contributions to our knowledge of the Cretaceous rocks of south India. *Proc. Ind. Acad. Sci. B*, **45**:85 – 245.
- Sastry, M.V.A., Rao, B.R.J. and Mamgain, V.D. 1968.** Biostratigraphic zonation of the Upper Cretaceous formations of Trichinopoly district, South India. *Geol. Soc. India, Mem.* **2**: 10-17.
- Sastry, M.V.A., Rao, B.R.J. and Mamgain, V.D. 1972.** Ostracod fauna of the Ariyalur Group (Upper Cretaceous), Tiruchirapalli District, Tamil Nadu, Part I. Lithostratigraphy of Ariyalur Group. *Mem. Geol. Surv. India. Pal. Ind. N.S.* **40**:1-48.
- Smith, A.B. and Jeffery, C.H. 2000.** Maastrichtian and Palaeocene echinoids : a key to world fauna *Special papers in Palaeontology*, **63**: 1 -406.
- Stoliczka, F. 1866.** Cretaceous fauna of South India. The Cephalopods *Mem. Geol. Surv. India. Pal. Ind. Ser.1&3*, **1**: 1 – 216.
- Stoliczka, F. 1868.** Cretaceous fauna of South India. The Gastropoda *Mem. Geol. Surv. India. Pal. Ind. Ser. 5*, **2**: 1-500.
- Stoliczka, F. 1871.** Cretaceous fauna of southern India. The Pelecypoda, with a review of all known genera of this class, fossil and recent. *Mem. Geol. Surv. Pal. Ind. Ser. 6*, **3**: 1 -537.
- Stoliczka, F. 1872.** Cretaceous fauna of South India. The Brachiopoda *Mem. Geol. Surv. India. Pal. Ser. 8*, **4**(1): 1-31.
- Stoliczka, F. 1873(a).** Cretaceous fauna of South India. The Echinodermata. *Mem. Geol. Surv. India. Pal. Ind. Ser. 8*, **4**(3), 98-99, pl. V. figs. 1 -8.
- Stoliczka, F. 1887(b).** Cretaceous fauna of South India. The Corals. Sponges. etc. *Mem. Geol. Surv. India, Pal, Ind. Ser. 8*, **4**(4):1-69, 130 – 202.

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