



SOME SPECIES OF *AMBLYPYGUS* AGASSIZ, 1840 AND AN INDETERMINATE HOLECTYPOID ECHINOID FROM THE MIDDLE EOCENE ROCKS OF KACHCHH (=KUTCH), INDIA

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ABSTRACT

Three species of genus *Amblypygus* Agassiz, 1840 including one described as new have been recorded and described from the middle Eocene rocks of Kachchh, India along with an indeterminate holectypoid echinoid genus. Further, in view of better preserved specimens, the taxonomic details of the known species of *Amblypygus* have also been updated in the light of recent taxonomic procedures.

Key words : Holectypoid echinoids, *Amblypygus*, middle Eocene and Kachchh.

INTRODUCTION

The rich and diversified echinoid fauna from Tertiary of Kachchh, India is well known globally. The holectypoid echinoids in India are represented by four genera namely, *Amblypygus*, *Conoclypus*, *Conulus* and *Holectypus*. An indeterminate holectypoid echinoid genus has been added to the list of this group of echinoids. Out of these, the genus *Amblypygus* Agassiz, 1840 achieved world-wide distribution throughout most of the Eocene and Oligocene epochs. Duncan and Sladen (1883) were first to record the genus, describing *Amblypygus altus* and *Amblypygus pentagonelis* from the Nummulitic* sequence of Kachchh. Srivastava (1988), while reviewing the Tertiary echinoids from India, noted that the species of *Amblypygus* have limited temporal distribution and thus are of great stratigraphic significance. The macrofaunal association with these echinoids includes *Corbula* sp., *Cardium* sp., *Ostrea* sp., *Turritella* sp. and *Dentalium* sp. besides other echinoid genera namely, *Ecinolampas*, *Schizaster* and *Meoma*.

The exposures of the Tertiary rocks in Kachchh form a crescentic belt lying on the western, south-western and southern borders of the district. These sediments are mainly shallow water, marine shelf deposits. The Tertiary sediments (ranging in age from (?) Thanetian/Ypresian to Burdigalian) rest either on Jurassic rocks or on the Deccan Trap. The biostratigraphic zones of middle Eocene rocks of Kachchh (fig. 1) exposed at Ber Mota as proposed by Tandon (1976) had been followed.

Systematic collection was made by the first author and the late Dr. K.K. Tandon from the middle Eocene sequences exposed around Mori (68° 33' 30": 23° 32' 30"), Ratipar (68° 34' 10": 23° 31' 06") and Ber Mota (68° 36' 10": 23° 28' 05") villages, Kachchh, India (fig.2). The microfauna *Nummulites perforatus*, *Truncorotaloides topilensis*, *T. rohri* and *Orbilinoides beckmanni* present in association with holectypoid echinoids indicate a late Lutetian-Bartonian age for these sediments. In the systematic description of the species, the classification proposed in Treatise by Wagner and Durham (1966) has been followed.

* Grapt (1840) first used the term Nummulitic for the rocks of the Kirthar age in Kachchh. Later, Wynne (1872) also used this term in his Memoir on Kachchh along with a geological map (on a scale of one inch to four miles) which formed the basis for all subsequent geological work in Kachchh.

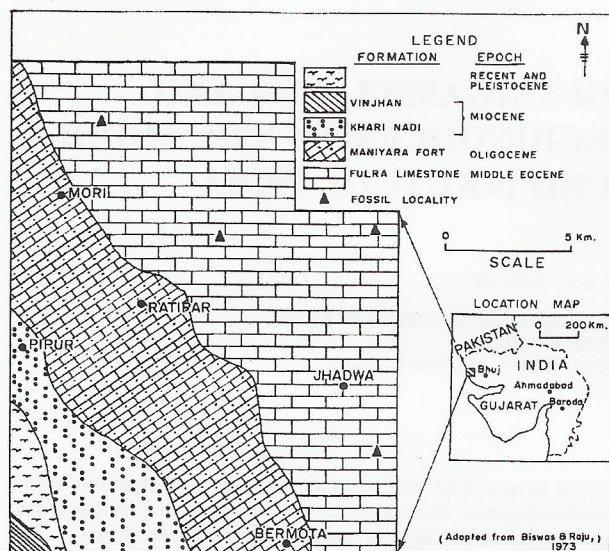


Fig. 1. Geological map of the area showing fossil localities.

The comparative statement of morphological characters of the known species of the genus *Amblypygus* from Kachchh till date is given in table 1.

SYSTEMATIC PALAEONTOLOGY

Order *Holotrypoida* Duncan, 1889

Suborder *Uncertain*

Family *Uncertain*

Genus *Amblypygus* Agassiz, L., 1840

Amblypygus altus Duncan and Sladen

(Pl. I, figs. 1-6)

Amblypygus altus Duncan and Sladen; Duncan and Sladen, 1883. p. 16-18, pl. 4, figs. 1-3.

Material : Five specimens; preservation good. Hypotype nos. KTE 388, KTE 391, KTE 393, KTE 398 and KTE 399.

Remarks : This species has already been recorded and described in detail by Duncan and

Sladen (1883) from the Nummulitic rocks exposed at Maniara Fort Hill and Karry, Kachchh. The species is now being recorded from the middle Eocene rocks exposed at the villages Ber Mota and Ratipar, Kachchh. The specimens are identical to those of Duncan and Sladen's (1883) specimens except the length of the peristome, which is slightly less in the present specimens.

Locality : Ber Mota and Ratipar villages, district Kachchh, Gujarat.

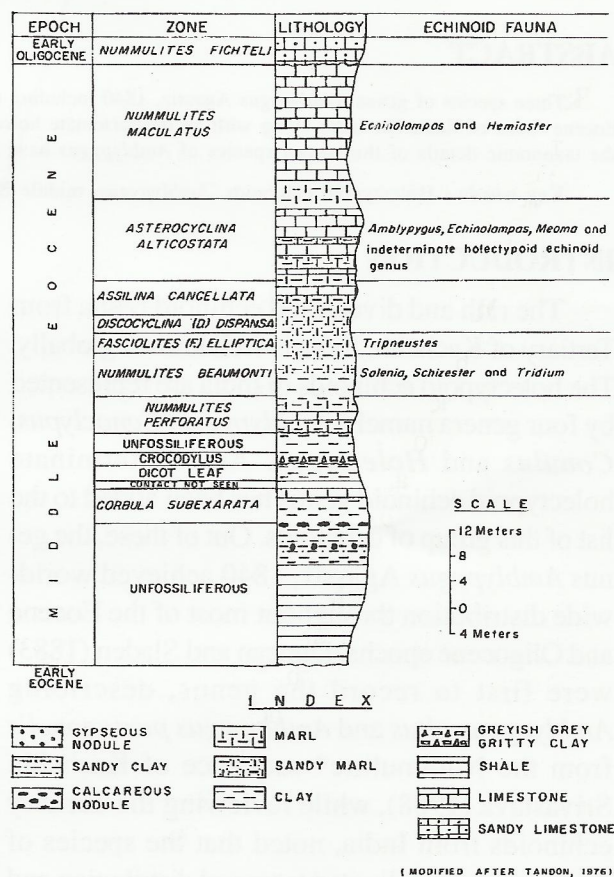


Fig. 2. Litholog of the succession showing distribution of the echinoid fauna with reference to larger foraminiferal zones (modified after Tandon, 1976 (for 1974)).

EXPLANATION OF PLATE I

1. *Amblypygus altus* Duncan and Sladen; aboral view; specimen no. KTE-393.
2. *Amblypygus altus* Duncan and Sladen; lateral view; specimen no. KTE-393.
3. *Amblypygus altus* Duncan and Sladen; oral view; specimen no. KTE-399.
4. *Amblypygus altus* Duncan and Sladen; lateral view; specimen

no. KTE-399.

5. *Amblypygus altus* Duncan and Sladen; oral view showing ambulacral and interambulacral plates; specimen no. KTE-398.
6. *Amblypygus altus* Duncan and Sladen; ambulacra IV showing demiplates, x 9.0; specimen no. KTE-398.



Horizon : *Asterocyclina alticostata* zone, middle Eocene.

Amblypygus moriensis n. sp.

(Pl. II, figs. 4-7; Pl. III, figs. 5-7)

Material : Four specimen complete and well preserved. *Holotype* : no. KTE 259; *Paratype* nos. KTE 260, KTE 263 and KTE 264.

Etymology : The new species is named after the village Mori, district Kachchh, Gujarat.

Diagnosis : Test medium, pentagonal; apical system central, ethmolytic; ambulacra straight; periproct inframarginal, near the posterior margin of the test; peristome eccentric towards anterior side, triangular and oblique.

Description : Test medium, depressed, pentagonal in outline; margin tumid and well rounded; longer than broad and the height is less than half of its length. Apical system central, small, tetrabasal and ethmolytic; genital pores small, rounded and have almost equal diameter; the anterior genital pores are closer than the two posterior ones; ocular plates five in number, small, triangular in shape and each one is perforated by a single and very small circular ocular pore; oculars I and V larger than others. Ambulacra II and IV are shortest and I and V are broadest; poriferous zone well developed, increases in breadth from apex, maximum in the middle and then diminishes gradually and ultimately closes near the ambitus; inner pores small, circular and arranged in a nearly straight, linear series; outer pores elongate transversally; the pore pairs conjugate with a transverse groove, ambulacral plates are pseudocompound consisting of simple and demi plates. Periproct inframarginal

at the posterior margin of the test, longitudinally elliptical and its maximum diameter is larger than that of peristome. Peristome excentric towards the anterior side, obliquely placed in a depression and triangular in shape. Tubercles crenulate and perforate, dense on oral surface and scarce on aboral surface.

Measurements (in mm) : Specimen no. KTE 259 (Holotype)

Length of the test-61.3

Breadth of the test - 55.3

Height of the test- 28.8

Ratio between length, breadth and height - 1.0 : 0.90: 0.47

Petal	Length	Breadth
III	34.0	.5
II & IV	30.5	8.0
I & V	34.0	9.0

Maximum diameter of peristome - 11.5

Maximum diameter of peristome - 6.0

Maximum diameter of periproct - 15.0

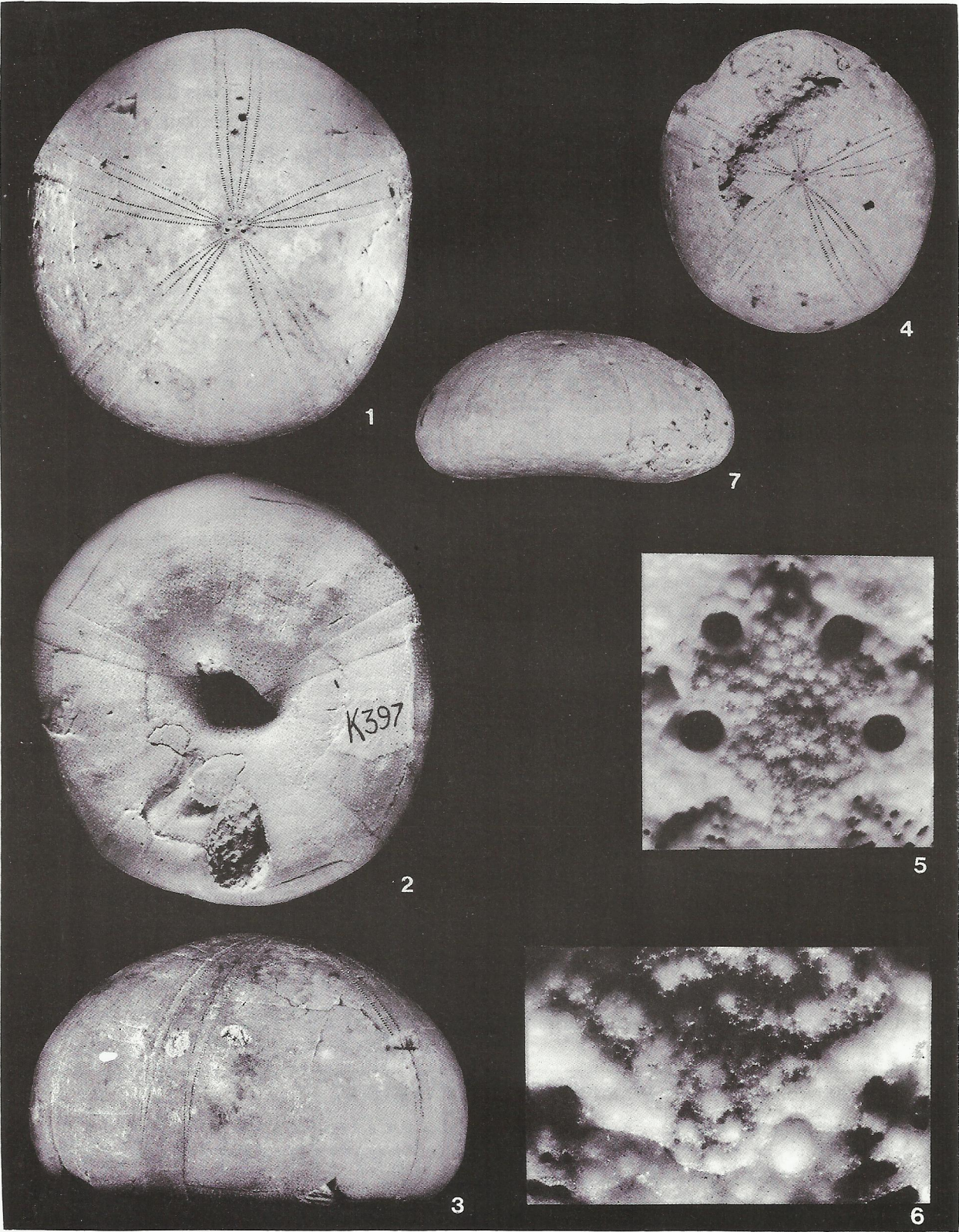
Minimum diameter of periproct - 6.5

Remarks : The new species differs from *A. pentagonelis* Duncan and Sladen (1883) in not having higher test as in the latter species, the ratio between length, breadth and height is 1.0: 0.91: 0.62. Moreover, in *A. moriensis* n. sp. the periproct is longitudinally elliptical, while in *A. pentagonelis* Duncan and Sladen, it is triangular.

The new species to some extent resembles *A. subrotundus* Duncan and Sladen (1882- 86) from Kirthar Series of Sind but differs from it in not having anteriorly excentric apical system and circular outline. Further, in the new species, the periproct lies close to the posterior margin of the test while in the species of Sind it is in between peristome and posterior margin of the test.

EXPLANATION OF PLATE II

1. *Amblypygus pentagonelis* Duncan and Sladen; aboral view; specimen no. KTE-397.
2. *Amblypygus pentagonelis* Duncan and Sladen; oral view; specimen no. KTE-397.
3. *Amblypygus pentagonelis* Duncan and Sladen; lateral view; specimen no. KTE-397.
4. *Amblypygus moriensis* n.sp.; aboral view; specimen no. KTE-259.
5. *Amblypygus moriensis* n.sp.; apical disc, x 14.0; specimen no. KTE-259.
6. *Amblypygus moriensis* n.sp.; apical disc (part) showing ethmolytic condition, x 32.0; specimen no. KTE-259.
7. *Amblypygus moriensis* n.sp.; lateral view; specimen no. KTE-259.



Type locality : Mori village, district Kachchh, Gujarat.

Type horizon : *Asterocyclina alticostata* zone, middle Eocene.

Amblypygus pentagonelis Duncan and Sladen

(Pl. II, figs. 1-3; Pl. IV, figs. 1-7)

Amblypygus pentagonelis Duncan and Sladen; Duncan and Sladen, 1883. p. 18, pl. 4, figs. 4-11.

Material : Six specimens; preservation good. Hypotype nos. KTE 277, KTE 389 (half broken), KTE 390 (partly broken), KTE 396, KTE 397 and KTE 401.

Description : Test large, thin, high and pentagonal to subpentagonal in outline; margin tumid and well rounded; longer than broad and broader than high. Apical system central to slightly excentric anteriorly, small and compact, tetrabasal and ethmolytic; genital pores small, rounded and have almost equal diameter, two anterior genital pores are closer than the two posterior ones; ocular plates five in number, small, triangular in shape and each one is perforated by a single and very small circular ocular pore. Ambulacra five, straight, open, unequal in length, do not reach up to ambitus and flush with the test; The poriferous zones well developed, increase in breadth from the apex, maximum at the middle and then diminishes gradually and ultimately closes near the ambitus where the pores are smaller and are more obliquely placed; inner pores small, circular and arranged in a nearly straight linear series, outer pores elongate transversely, the pore pairs are conjugate with a transverse groove. Ambulacral plates are pseudocompound consisting of simple plates and demiplates. A subtriangular demiplate present after two simple plates. Periproct

inframarginal near the posterior margin of the test, large and longitudinally oval. Peristome oblique, triangular and centrally placed in a depression; its maximum diameter is shorter than that of periproct. Tubercles crenulate and perforate, dense on the oral surface while scarce on aboral surface.

Measurement (in mm) : Specimen no. KTE 390.

Length of the test-94.0

Breadth of the test - 87.7

Height of the test- 60.0

Ratio between length, breadth and height - 1.0 : 0.93: 0.64

Petal	Length	Breadth
III	62.0	12.0
II & IV	60.0	12.0
I & V	65.0	11.5

Maximum diameter of peristome - 18.0

Minimum diameter of peristome - 10.0

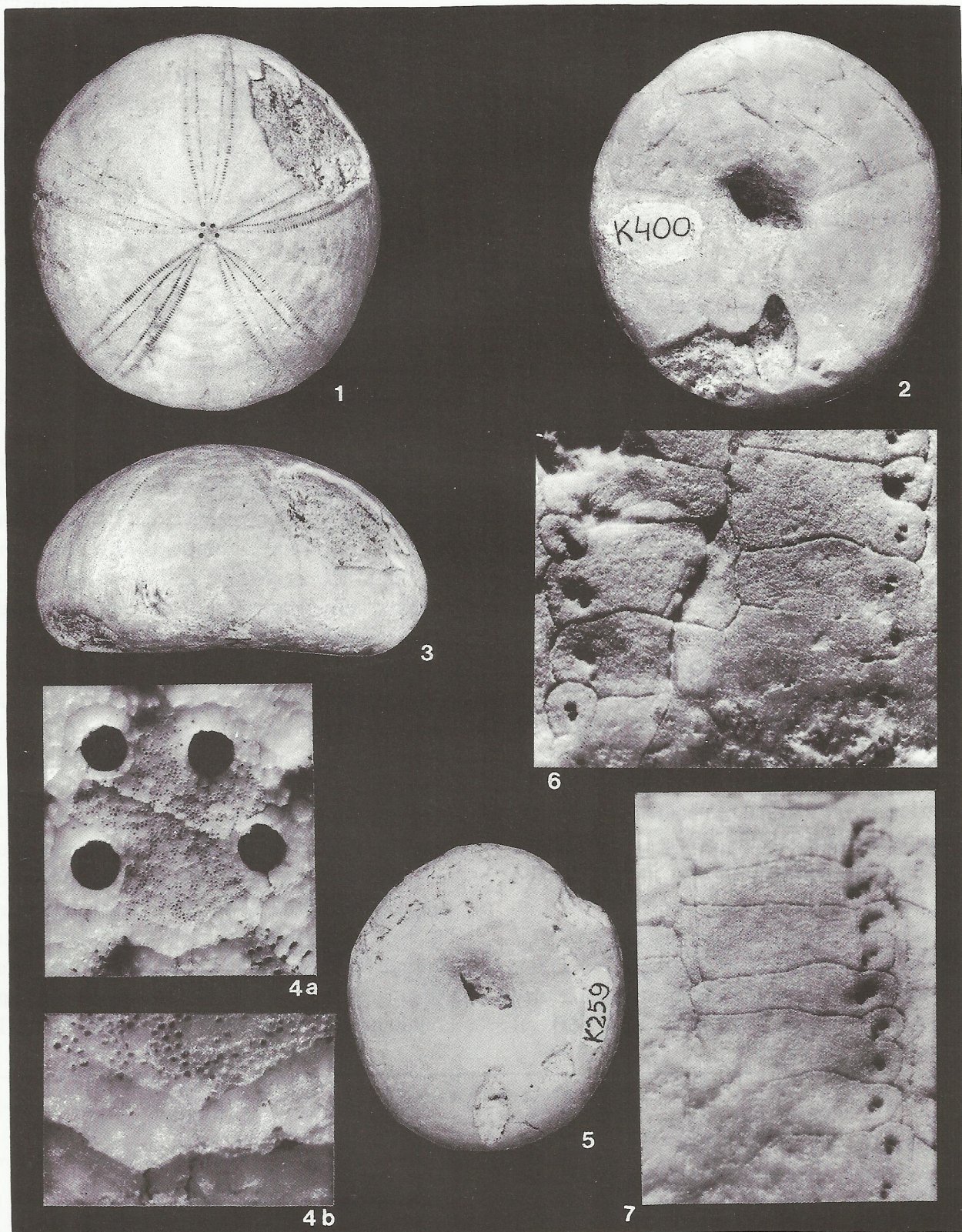
Maximum diameter of periproct - 22.0

Maximum diameter of periproct - 11.0

Variations : Morphological variations (position of apical disc, ambulacral length and breadth, etc.) have been observed among different specimens of this species. The specimen described by Duncan and Sladen (1883) have posteriorly excentric apical disc, longest ambulacrum III, narrowest ambulacra I & V and broadest ambulacra II & IV while in specimen no. KTE 390 (Pl. IV, figs. 1-4), the apical system is central, ambulacra II & IV are shortest, ambulacra I & V are longest and each have almost identical breadth. In another specimen of the same species (KTE 397; Pl. II, figs. 1-3), the apical system is slightly excentric anteriorly and all ambulacral petals have almost identical length and breadth. The anterior and posterior slopes from center to ambitus are gentle. Specimen no. KTE 389 (Pl. IV, fig. 5) is higher and the anterior and posterior slopes from center to ambitus are steeper than other specimens (KTE 397; fig. 3).

EXPLANATION OF PLATE III

1. Genus indeterminate; aboral view; specimen no. KTE-400.
2. Genus indeterminate; oral view; specimen no. KTE-400.
3. Genus indeterminate; lateral view; specimen no. KTE-400.
- 4a. Genus indeterminate; ethmophrat apical disc, x 10.0; specimen no. KTE-400.
- 4b. Genus indeterminate; posterior parts of apical disc showing oculars 1 & 5 (part) and concealed madreporite, x 30.0; specimen no. KTE-400.
5. *Amblypygus moriensis* n.sp.; oral view; specimen no. KTE-259.
6. *Amblypygus moriensis* n.sp.; ambulacrum III on oral side showing demiplates, x 15.0; specimen no. KTE-259.
7. *Amblypygus moriensis* n.sp.; ambulacrum II on oral side shown demiplates, x 13.0; specimen no. KTE-259.



Remarks : The species has previously been recorded and described by Duncan and Sladen (1883) from the Nummulitic rocks exposed at Maniara Fort Hill and Karry, Kachchh. Now, it is being recorded and described from the rocks of middle Eocene age exposed at Ber Mota and Ratipar. The present specimens have close resemblance with the specimens of Duncan and Sladen (1883). However, in the present specimens the apical system is central to slightly excentric anteriorly whereas in the specimens described by Duncan and Sladen, it is shifted towards posterior side. Moreover, the periproct in the present specimens is much closer to the posterior margin of the test than in the forms described by Duncan and Sladen (1883).

A. pentagonelis Duncan and Sladen (KTE 390) differs *A. altus* Duncan and Sladen (1883) in not having excentric apical system, circular marginal contour and sub-central peristome. The shape of peristome in this specimen is triangular and obliquely placed between the interambulacra 2 and 4 whereas in the *A. altus* Duncan and Sladen, its longest diameter is parallel to the axis of interambulacra 2 and 4. Further, in this specimen, the periproct is longitudinally oval whereas it is triangular in the *A. altus* Duncan and Sladen. Moreover, the ratio between length, breadth and height in *A. pentagonelis* Duncan and Sladen (KTE 390) is 1.0 : 0.93 : 0.64 whereas in *A. altus* Duncan and Sladen, it is 1.0 : 0.90 : 0.58.

A. pentagonelis Duncan and Sladen (KTE 390) also differs from *A. moriensis* n. sp. in not having medium pentagonal test and anteriorly excentric peristome. Further, in KTE 390, all

ambulacra have almost identical width and I & V are longest whereas in *A. moriensis* n. sp. I & V are broadest and II & IV are shortest. Moreover, the ratio between length, breadth and height in KTE 390 is 1.0 : 0.93 : 0.64 while in *A. moriensis* n. sp., it is 1.0 : 0.90 : 0.47.

Locality : Ber Mota and Ratipar villages, district Kachchh, Gujarat.

Horizon : *Asterocyclina alticostata* zone, middle Eocene.

Genus Indeterminate

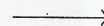
(Pl. III, figs. 1-4)

Material : One complete specimen, preservation excellent; specimen no. KTE 400.

Diagnosis : Test large, subpentagonal in shape, longer than broad and broader than high; maximum width opposite to ambulacra II and IV. Apical system central, small, compact, tetrabasal and ethmophract. Peristome excentric anteriorly. Periproct inframarginal, close to the posterior margin in the test.

Description : Test large, subpentagonal in shape, longer than broad and broader than high; maximum width opposite to ambulacra II and IV. Apical system central, small, compact, tetrabasal and ethmophract; genital pores small, rounded and have almost equal diameter. The anterior genital pores are closer than the two posterior ones; ocular plates five in number, small, quadrangular in shape except I and V which are larger than other and rectangular in shape; each ocular plate is perforated by a very small, circular ocular pore. Ambulacra five open, petaloid to subpetaloid, unequal and raised from the test; ambulacra III is

EXPLANATION OF PLATE IV



1. *Amblypygus pentagonelis* Duncan and Sladen; aboral view; specimen no. KTE-390.
2. *Amblypygus pentagonelis* Duncan and Sladen; oral view; specimen no. KTE-390.
3. *Amblypygus pentagonelis* Duncan and Sladen; lateral view; specimen no. KTE-390.
4. *Amblypygus pentagonelis* Duncan and Sladen; apical disc, x 9.0; specimen no. KTE-390.
5. *Amblypygus pentagonelis* Duncan and Sladen; lateral view; specimen no. KTE-389.
6. *Amblypygus pentagonelis* Duncan and Sladen; ambulacra II near ambitus, x 6.5; specimen no. KTE-389.
7. *Amblypygus pentagonelis* Duncan and Sladen; ambulacra IIb (part of fig. 6) showing demiplates; specimen no. KTE-389.

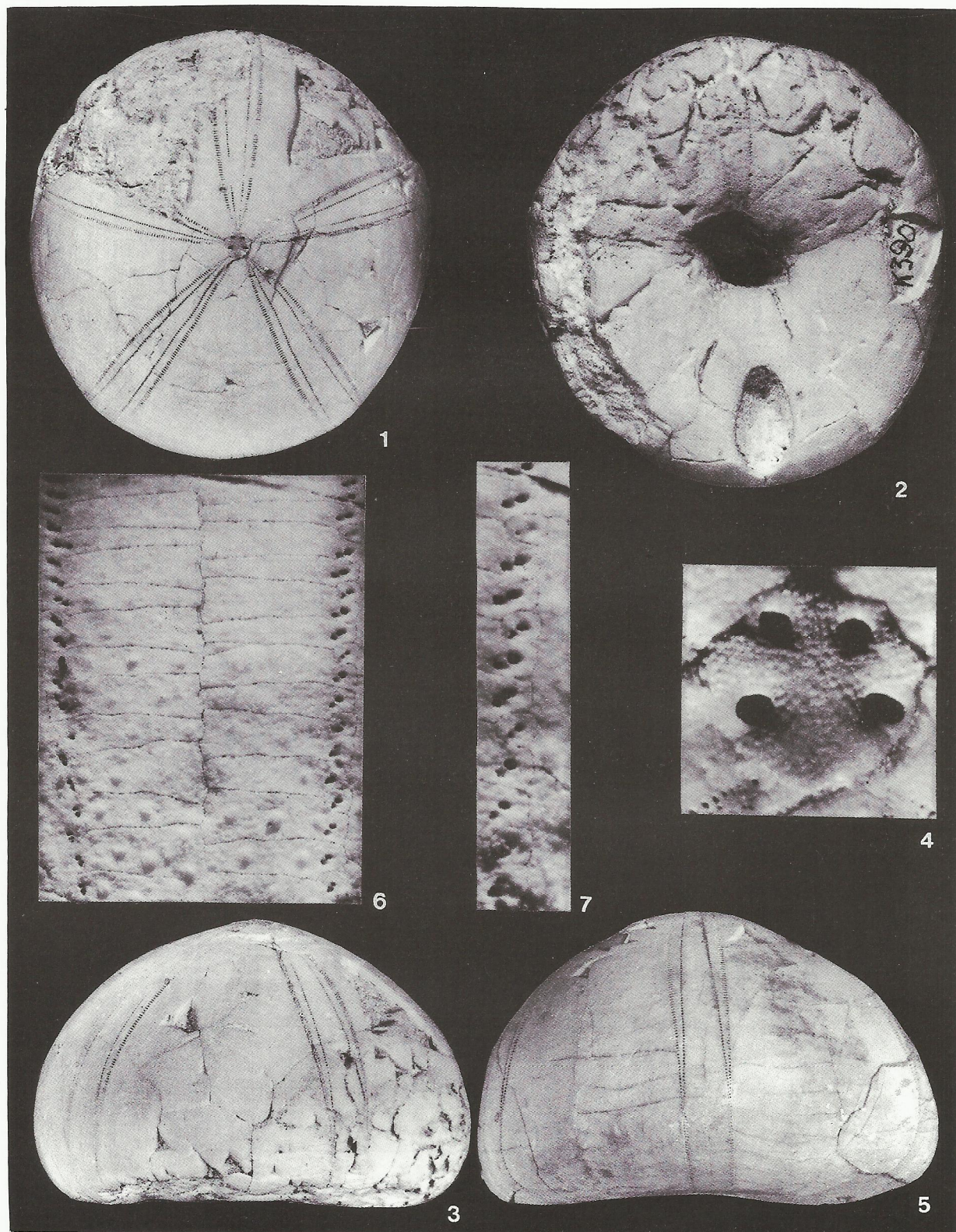


TABLE 1. COMPARATIVE CHART OF CHARACTERS OF AMBLYPYGUS SPECIES OF KACHCHH, INDIA

Sl. No.	Characters → Taxa ↓	Test				Apical System	Ambulacra	Petals (dimensions in mm)						Peristome	Periproct	Test dimension (mm)			Ratio L : B : H
		Size	Shape	Marginal contour	Slope			II & IV		III	I & V								
								L	B		L	B	L			B			
1.	<i>Amblypygus altus</i> Duncan & Sladen (recorded and described by Duncan & Sladen)	Large	Sub hemispherical	Circular	Nearly equal on all sides	Pentagonal or irregularly circular, slightly excentric anteriorly or central, ethymolitic	Open, flush with the test. III – Narrowest & shortest I & V – Longest	40	13	38	12	50	13	Sub central, oblique L B Specimen 18 11 – Larger 14 06 – Smaller	Large, pear shaped, longitudinal, close to posterior margin. (L – 21 ; B – 14)	94	86	55	1.0 : 0.91 : 0.58
2.	<i>A. altus</i> Duncan & Sladen (KTE - 399)	Large	Sub hemispherical	Circular	Nearly equal on all sides	Slightly excentric anteriorly or central.	Open, flush with the test.	–	–	–	–	–	–	Central, oblique and triangular (L – 13 ; B – 7)	Large, longitudinally Elliptical (L – 17 ; B – 9)	82	75	42	1.0 : 0.91 : 0.51
3.	<i>A. mortensis</i> n. sp.	Medium	Depressed	Pentagonal	–	Central, ethymolitic	Flush with the test, open. (II & IV – shortest ; I & V – broadest)	30.5	8	34	7.5	34	9	Oblique, excentric and triangular (L – 11.5 ; B – 6)	Longitudinally elliptical (L – 15 ; B – 6.5)	61.3	55.3	28.8	1.0 : 0.90 : 0.47
4.	<i>A. pentagonelis</i> Duncan & Sladen (recorded and described by Duncan & Sladen)	Large	Hemispherical	Pentagonal	–	Excentric posteriorly	Widely open, slightly raised III – Longest I&V – Narrowest II&IV – Broadest	42	12	45	10	36	10	Oblique large (L – 18 ; B – 8)	Large, longitudinally elliptical	85	77	53	1.0 : 0.9 : 0.62
5.	<i>A. pentagonelis</i> Duncan & Sladen (KTE - 397)	Large	–	Pentagonal	–	Slightly excentric anteriorly or central.	Straight, flush with the test. All petals have equal width	–	10	–	10	–	10	Oblique, large, central (L – 20 ; B – 9)	Large, pyriform, close to posterior margin. (L – 21 ; B – 12)	87	82	48	1.0 : 0.94 : 0.56
6.	<i>A. pentagonelis</i> Duncan & Sladen (KTE - 390)	Large	–	Sub - pentagonal	–	Central, ethymolitic	Flush with the test, open, straight and do not reach upto the ambitus (II & IV – shortest ; I & V longest)	60	12	62	12	65	11.5	Oblique, triangular, central	Large, longitudinally oval near posterior ambitus. (L – 22 ; B – 11)	94	87.7	60	1.0 : 0.93 : 0.64
7.	Genus indeterminate	Large	–	Sub - pentagonal	–	Central, ethmophract	Sub petaloid to petaloid and raised from the surface of the test	44	10	42	9.5	45	11	Oblique, excentric and triangular (L – 14.5 ; B – 7.5)	Large, longitudinally oval near posterior ambitus. (L – 18.5 ; B – 9)	75.1	70	40	1.0 : 0.93 : 0.53

narrowest and smallest while ambulacra I and V are longest and broadest. The poriferous zones are well developed, increase in breadth from apex, maximum at the middle and then diminish gradually and ultimately close near the ambitus; inner pores are small, circular and arranged in a straight linear series, outer pores elongate transversally, the pore pairs are conjugate with transverse grooves; ambulacral plates are pseudocompound consisting of simple and demiplates. Periproct inframarginal, close to the posterior margin of the test, longitudinally oval, its maximum diameter is more than that of peristome. Peristome excentric anteriorly, sunken, triangular and obliquely placed in a depression. Tubercles crenulate and perforate, dense on the oral surface while scarce on aboral surface.

Measurements (in mm) : Specimen no. KTE 400

Length of the test-75.1

Breadth of the test - 70.0

Height of the test- 40.0

Ratio between length, breadth and height - 1.0 : 0.93: 0.53

Petal	Length	Breadth
III	42.0	9.5
II & IV	44.0	10.0
I & V	45.0	11.0

Maximum diameter of peristome - 14.5

Minimum diameter of peristome - 7.5

Maximum diameter of periproct - 18.5

Minimum diameter of periproct - 9.0

Remarks : The presence of subpetaloid to petaloid ambulacra in the present specimen restricts to place this specimen under suborders Holoctypina and Echinoneina as they have non-petaloid ambulacra. Further, the gill slits present in the Holoctypina are also missing in the specimen under study. Moreover, the present specimen can also not be kept under Suborder Conocypina as it has conjugated pore pairs whereas in Suborder Concolypina, these are non conjugate. Therefore, the specimen under study has been placed under Suborder Uncertain.

The specimen resembles *Amblypygus* Agassiz, L., 1840 in gross morphology but differs from it in not having ethmolytic apical system. The present

specimen differs from *Echinogalerus* Konig, 1825 of Late Cretaceous Period in having large pentagonal test, conjugate pore pairs, monobasal apical system and longitudinally oval periproct whereas *Echinogalerus*, has small test (rounded or oval), non conjugate pore pairs, tetrabasal apical system and subtriangular or transversally oval periproct. It differs from *Rhopostoma* Cooke, 1959 of Palaeocene Period in having inframarginal periproct whereas in *Rhopostoma*, which is like *Echinogalerus* Konig, 1825, the periproct is supramarginal.

The differences in the apical disc, in author's opinion, are one of the generic characters on which a specimen can be placed in a different genus. This single specimen though resembles the genus *Amblypygus* in more or less in all aspects, its apical disc has ethmophrat condition (Pl. III, figs. 4a-b). Further, it is also confirmed in the present specimen that the ocular 1 and 5 are not a part of interambulacral plates. The presence of an ethmophrat apical system in the specimen under study tends to suggested that it should be given a new name. Since, the new form is based on a single specimen, the authors have placed this specimen under indeterminate genus and they refrained themselves from proposing a new name to this specimen for want of more specimens. It is also possible that the form may be representing a new trend in the evolutionary process of the genus *Amblypygus* or is a mutant.

Locality : Ber Mota village, district Kachchh, Gujarat.

Horizon : *Asterocyclina alticostata* zone, middle Eocene.

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REPOSITORY

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

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