



SOME FOSSIL SPECIES OF CATENICELLID AND SCHIZOPORELLOID BRYOZOANS FROM THE CENOZOIC SEDIMENTS OF WESTERN KACHCHH, GUJARAT, INDIA

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ABSTRACT

Four species of catenellid and schizoporelloid Bryozoa are described from the Cenozoic rocks of western Kachchh, Gujarat, India. *Ditaxipora lakriensis* n. sp. and 'Catenellid gen. et sp.indet.' are new to science and *Tetraplaria tuberculata* Canu & Bassler, 1920 and ?*Malakosaria* sp. are reported for the first time in these rocks. As regards provincial relations, *Ditaxipora lakriensis*, 'Catenellid gen. et sp. indet.' have Indo-Pacific affinities, while *Tetraplaria tuberculata* is an Atlantic element.

Key words: Kachchh, Catenellid, Schizoporelloid, Cenozoic, Bryozoans, Gujarat

INTRODUCTION:

Sonar and Gaikwad (2013a,b and c) have described porcellariid, steginoporellid and cyclostome bryozoans from the Cenozoic rocks exposed along the shelf zone adjoining Mesozoic sequences in western Kachchh, Gujarat (Fig.1). The entire succession from Paleocene to Holocene occurs in this region (Table 1). Fossil bryozoan faunas have been collected from the rocks belonging to the Harudi (Middle Eocene, Lutetian), Fulra (Middle Eocene, Bartonian), Maniyara Fort (Rupelian-Chattian) to Kharinadi (Early Miocene, Aquitanian-Burdigalian) formations.

An enormous quantity and diversity of cheilostome bryozoans has been found in the Cenozoic sequences of western Kachchh. The occurrence of fossil Bryozoa from these rocks was first reported by Tewari *et al.* (1958) and Tewari and Srivastava (1967). Subsequently, Guha and Gopikrishna (2004a, b, 2005 b-f, 2007 a-d and) and Guha (2013) described rich and varied bryozoan faunas from this region. Considering their diversity in these rocks, there is a need to update their systematic through a bed-by-bed study. As an outcome of our research, the present communication describes two catenellid and two schizoporelloid species belonging to the families Catenellidae, Busk, 1852, Tetraplariidae Harmer, 1957 and Calwellidae MacGillivray, 1887.

MATERIAL AND METHODS

Encrusters on bivalve and gastropod shells were collected in the field. About 250 grams of weathered, gently crushed limestone, mudstone and shell were treated with 50% concentrated H₂O₂ for 48-72 hours. Samples were gently washed over a set of standard sieves with mesh size (10f-60f), conventionally used in foraminiferal extraction. Colonies and internodes of bryozoans were picked from different fractions for identification. Before identification, specimens were cleaned by soaking in dilute acetic (5%) acid solution as described by Zágoršek and Vávra (2000). The orifices of autozooids and

avicularium were cleaned with a very thin metallic needle. Colony surfaces were scrubbed in sodium nitrate solution and under tap water with hard 0.2mm brush. The specimens were identified and photographed with the help of JEOL/EO, Version-0.1SEM. Measurements were taken with 15X ocular micrometer in a Nikon, SMZ-800 stereoscopic zoom microscope following standard measuring techniques.

All dimensions cited in this paper are in millimeters, the observed range expressed to the nearest 0.01mm, and the mean and standard deviation calculated following the procedure described by Cheetham (1966). For conciseness, the following scheme of parameters is applied throughout the systematic part of this paper:

Lz= Length of Zooid, Wz= width of zooid, Lop= length of opesia, Wop= width of opesia, N= Number of zooids, Mean, Standard deviation (SD), Coefficient of variation (CV) and observed range.

The systematic part of this paper follows, except otherwise indicated, the bryozoan "Treatise on Invertebrate Palaeontology" Bassler (1953) along with the working list for "Treatise" recommended by Gordon (2014). The described types are housed in the Museum of Geology, P.G. Department of Geology, Government Institute of Science, Aurangabad-431004 under catalogue numbers as indicated in the text.

SYSTEMATIC PALAEONTOLOGY

Order Cheilostomata Busk, 1852
Suborder Neocheilostomina d'Hondt, 1985
Infraorder Ascophora Levinsen, 1909
Superfamily Catenicelloidea Busk, 1852
Family Catenellidae, Busk, 1852
Genus Ditaxipora MacGillivray, 1895

Ditaxipora lakriensis n. sp.
(Pl.I, figs. 1-2.)

Material: Holotype: GIS/B: 0678; Paratypes: GIS/B: 0679-0690.

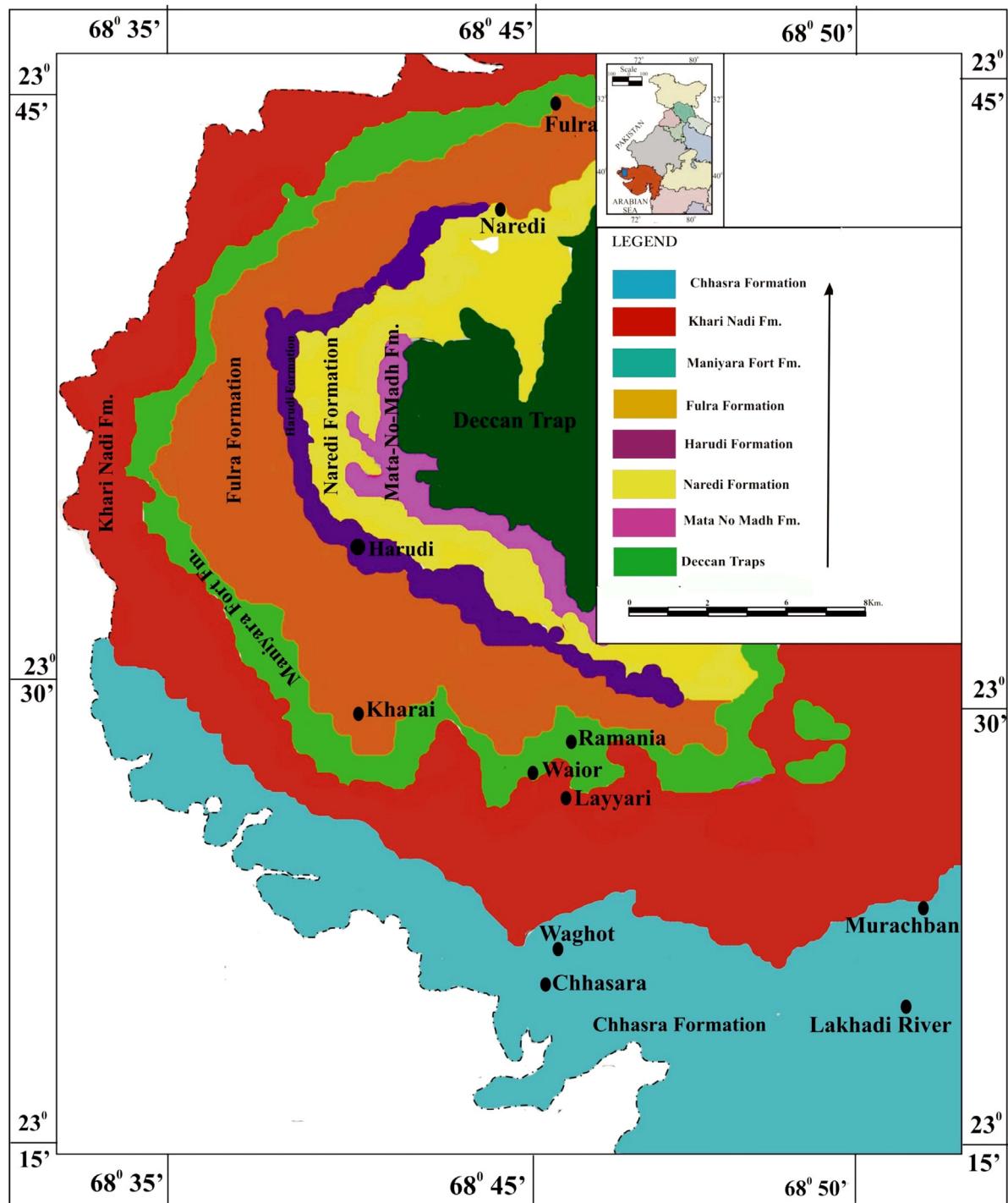


Fig.1 Generalized geological map of Kachchh (modified after Biswas,1992)

EXPLANATION OF PLATE I

- 1, 2. *Ditaxipora lakriensis* n.sp.; 1. Close-up view of a segment showing alternating pairs of autozooids, avicularia, orifices and frontal shield. 2. Close-up view of a single autozooids showing Triangular median gymnocystal ridge on the frontal shield, orifice and an avicularium; 3, 4. *Catenicellid* gen. et sp. indet; 3. Close-up view of a complete segment showing zigzag ridge in the middle of the branch and details of autozooids; 4. Close-up view of single autozooid showing gymnocystal ribs pores and pair avicularia adjacent to orifice; 5, 6 & 9. *Malakosaria gordoni* n.sp.; 5. Close-up view of a complete segment showing back to back arrangement of autozooids. 6. Close-up view of pair of autozooids showing T-shaped gymnocystal rib on the frontal and lateral surface, hook like avicularian process in the scapular regions. 9. Close-up view of T-shaped gymnocystal rib on the frontal and lateral surface. 7,8, 10 & 11. *Tetraplaria tuberculata* Canu & Bassler, 1920. 7. Close-up view of a complete segment alternate arrangement of autozooids and one ovicelled autozooid. 8. Close-up view of part of segment showing two lateral small tubercles on the autozooid. 10. Close-up view of ovicell showing frontal shield of the ovicell. 11. Close-up view of pair of basal autozooids tapering at the base and showing basis-rami.



Table 1: Tertiary Stratigraphy of Kachchh (after Biswas, 1992)

TIME IN M.Y.	SERIES	STAGES	LITHOSTRATIGRAPHY FORMATIONS	LITHOLOGY
10	MOICENE	MESSINIAN TORTONIAN SERRAVALLIAN LANGHIAN	SANDHAN —Unconformity—	Sandstones, minor limestones and shales.
20		BURDIGALIAN	CHASRA	Silty shales and impure limestones
		AQUITANIAN	KHARI NADI	Variegated siltsstones and sandstones.
30	OLIGOCENE	CHATTIAN RUPELIAN	MANIYARA FORT	Foraminiferal limestone, shales and coral biostromes, lumpy claystones.
40	EOCENE	PRIABONIAN		
50		BARTONIAN LUTETIAN YPRESIAN	FULRA HARUDI —Unconformity—	Dense foraminiferal limestones. Claystones/ limestones, coquina, etc.
60	PALAEOCENE	THANETIAN	NAREDI —Unconformity—	Claystones/ limestones,
70		DANIAN	MATANOMADH —Unconformity— DECCAN TRAP	Volcanoclastics, shales and sand- Basalt

Measurements:

	Range (mm)	Mean(mm)	N
Lz	0.41-0.49	0.421	10
Wz	0.19-0.25	0.209	10
Lop	0.08-0.10	0.087	10
Wop	0.08-0.09	0.085	10

Diagnosis: Segments delicate. Autozooids arranged in alternating pattern. Orifices transversely oval, T-shaped, triangular gymnocystal ridge and two lateral ridges branching from it proximally on the frontal shield. Avicularium somewhat rounded located distolateral corner of autozooid. Ovicells not observed.

Description: Segments delicate, erect. Autozooids arranged in alternate fashion; vase shaped with sides tapering towards proximal end. Orifices wider than long, arched distally, proximal edge concave. Frontal shield with two long ridges tapering proximally, separated by T-shaped, triangular median gymnocystal ridge. A single avicularium per zooid, always on the outer (marginal) side of the orifice, with a rounded operculum, without cross bar and acute rostrum. Ovicells not observed.

Remarks: Presence of T-shaped, triangular gymnocystal ridge and lateral ridges is a characteristic feature to differentiate this species from the other species described elsewhere from the world. The present species exhibits a close resemblance to

Ditaxipora pannensis Braga in Antolini et al., 1980 (p.60, figs. 63-64) from the Priabonian (Upper Eocene) of northern Italy (see Gordon & Braga, 1994, p.68, fig.6a-c) in the shape of colony and autozooids, but, differs in having a transversely oval orifice, T-shaped gymnocystal ridge. The present species differs from *Ditaxipora internodia* (Waters (see Gordon & Braga, 1994, p.66, fig.5a-c) from the Miocene of Victoria in the alternating pattern of the autozooids, shape of autozooids and gymnocystal ridge.

Occurrence: 13 zoarial fragments from Chhasra Formation (yellow limestone of Lakdi River).

Type Horizon and locality: Fossiliferous yellowish limestone of the Chhasra Formation exposed on the left bank of Lakdi River, 6 km from Tera.

Age: Lower Miocene (Burdigalian).

Derivation of name: The species is named after type locality Lakdi Nadi.

Catenicellid gen. et sp. indet.

(Pl.I, figs. 3-4, 12.)

Material: GIS/B: 0691-0695.

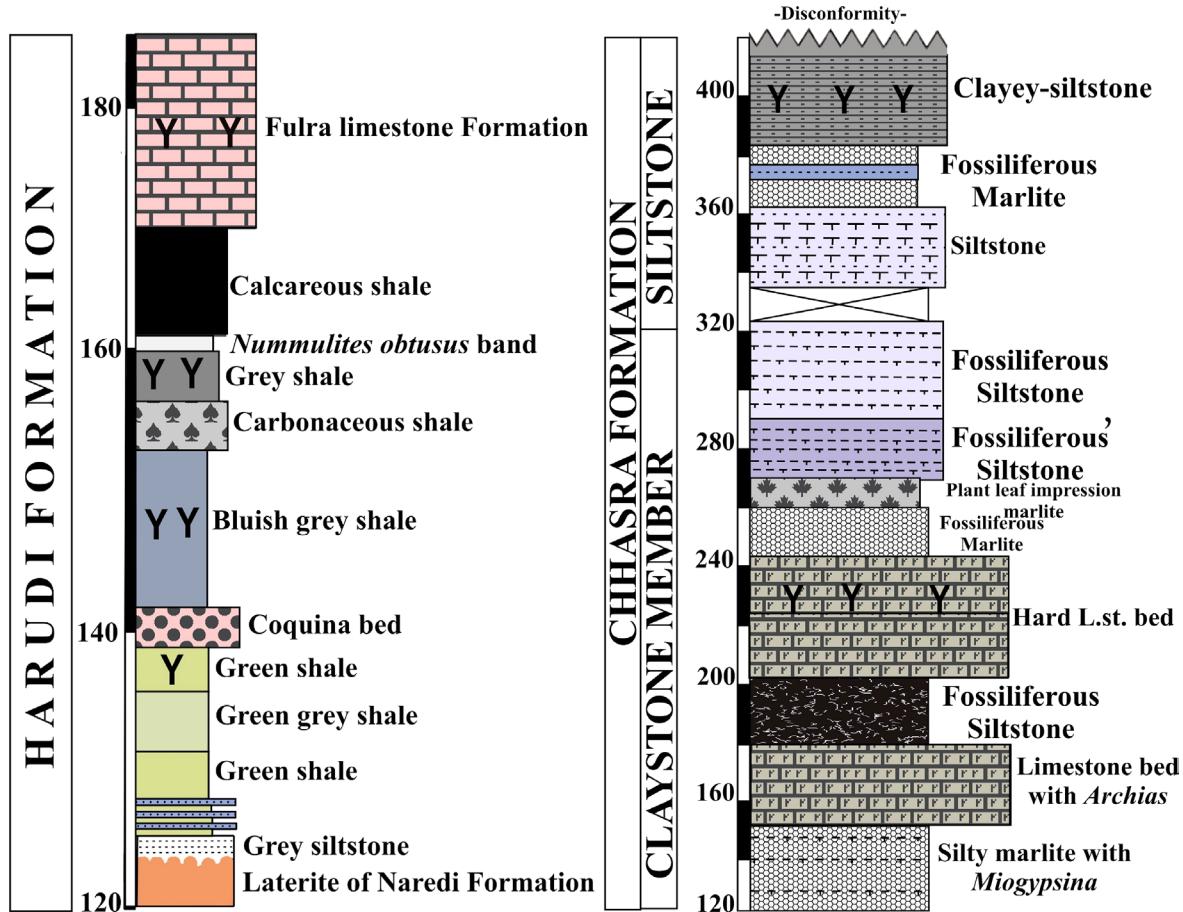
Measurements:

	Range (mm)	Mean (mm)	N
Lz	0.40-0.51	0.782	6
Wz	0.20-0.27	0.373	6
Lop	0.18-0.21	0.32	6
Wop	0.10-0.11	0.172	6

Description: Segments 3.85 mm long and 0.47-0.54 mm wide, with up to 6 or 7 autozooids per segment. Autozooids arranged in alternating fashion, rather slender and small, the most proximal autozooid roughly club-shaped, tapering proximally. Gymnocyst or frontal shield evenly perforated by numerous pores and a significant costal field in the distal half of the frontal shield giving impression of coastal ribs. Orifice wider than long with shallow broad sinus along proximal edge, the primal border slightly raised. Adjacent to the orifice is a pair of avicularia, the axial one occasionally absent, if not facing frontally, the marginal one facing laterally, each slightly projecting. Each with a hemispherical operculum, without cross-bar, with small triangular rostrum. A small pore chamber frequently observed below avicularia. Ovicells not observed.

Remarks: Kachchh specimens closely resemble genus *Ditaxipora* in having alternate arrangement of autozooids. This material differs from *Vasignyella* in which only fertile internodes are biserial like *Vasignyella ovicellata* Vieira et al., 2007 (p.52, figs.2-14). The autozooids in present specimens appear to have a significant costal field in the distal half of the frontal shield. These give the impression of both gymnocystal pores and ribbing. That combination, in addition to multizoidal segments, indicates that the present form is a new genus and species.

According to D.P. Gordon (pers. commun. 2013), the photographs of the specimens resemble *Ditaxipora* - gymnocystal pores are well developed. However, the autozooids in the present specimens appear to have a significant costal field in the distal half of the frontal shield. The upper left autozooid in the photo and the lower right autozooid also seem to have ribs (more evident on the left-hand side). If this is indeed a costal field, then it seems to be a new genus. *Ditaxipora* conceptually



Y-Bryozoan Colony

Fig. 2. Generalized Lithosections of the Harudi and Chhasra formations (modified after Biswas, 1992).

could be derived from such a form by reduction of the costal field to a vestigial suboral pair of costae. The gymnocystal pores are indicative of this relationship. However, only a few poorly preserved specimens at hand hence, it is not possible now to erect new genus and species. Instead, it is better to leave them in open nomenclature, until better preserved material will be obtained.

Occurrence: 6 zoarial fragments from the Chhasra Formation (yellow limestone of Lakdi Nadi)

Grade Lepraliomorpha Gordon, 1989

Superfamily Schizoporelloidea Jullien, 1883

Family Tetraplariidae Harmer, 1957

Genus *Tetraplaria* Tenison-Woods, 1878

Tetraplaria tuberculata Canu and Bassler, 1920
(Pl.I, figs. 7-8, 11)

Tetraplaria tuberculata Canu & Bassler, 1920 p. 368, pl.48, figs.7-10; Tewari & Srivastava, 1967, p.26, fig.2, nos.4 and 4a.

Material: Plesiotypes: GIS/B: 0696-0717.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	0.60-0.68	0.634	8
Wz	0.34-0.36	0.346	8
Lop	0.19	0.19	8
Wop	0.13-0.14	0.135	8

Description: Internodes erect, articulated, 4-serial. Autozooids arranged in pairs, facing alternately at right angles to one another; convex, with distinct sutures between autozooids; pyriform, tapering proximally; frontal shield with elongated pits, each with a pore. Orifices semicircular, proximal edge somewhat concave or straight, with two small tubercles on either side of the orifice. Ovicells large, globular, hyperstomial, resting on the distal autozooid, frontal surface with numerous small pores.

Remarks: The present species agrees in all essential characters with *Tetraplaria tuberculata* Canu & Bassler, 1920 (p.368, pl.48, figs.7-10) described from the Upper Eocene of Florida. *Tetraplaria turgida* described by Tewari & Srivastava from the Lutetian of Sche also agrees in all essential characters with the present species except they have not mentioned about tubercles on proximolateral sides of the orifice. *T. orospinea* Gordon & d'Hondt, 1997 (p.27, figs. 49-52) widely differs from the Kachchh species in having inconspicuous flattened condyles and six oral spines. *T. ventricosa* (Haswell) (see Gordon and d'Hondt, 1997, p.27-28, figs. 53-54) also differs from the present species in having a comparatively deep, U-shaped sinus at proximal edge of the orifice and stout condyles. The *Tetraplaria* sp. Gordon & d'Hondt, 1997 (p. 28, figs. 55-56) differs greatly from the present species in having a v-shaped rounded sinus with 2-4, tiny ephemeral spines. *T. immersa* (Haswell) (see Harmer, 1957, p.1055, Pl. 69, figs.5-7) also differs from the

present species in having a broad rounded orificial sinus.

Occurrence: Out of a total of 22 zoarial fragments in the present collection, 8 from the Fulra Formation (buff colour limestone of Fulra type section) and 14 from the Harudi Formation (claystone member of Harudi type section).

Distribution: Upper Eocene (Priabonian): Florida USA.

Family Calwellidae MacGillivray, 1887
Genus Malakosaria Goldstein, 1882

?*Malakosaria* sp.
(Pl. I, fig. 5, 6, 9-10)

Material: Holotype: GIS/B: 0718; Paratypes: GIS/B: 0719-0732.

Measurements:

	Range (mm)	Mean (mm)	N
Lz	0.50-0.60	0.56	4
Wz	0.24-0.38	0.32	4

Description: Colony erect, dichotomously branching. Autozooids biserial arranged in back-back, alternating series; distally broad, tapering proximally, frontal shield smooth, with single, long, narrow T-shaped rib. Scapular region of autozooids exhibits hook-like avicularian process, curved proximally. Orifices oval, higher than wide. No oral spines, avicularia. Ovicells not present in the available material.

Remarks: The illustrated specimens are tentatively included into the ?*Malakosaria* genus, due to worn condition most of the characters are obscured and they lack ascopore. However, they resemble to this genus in a few morphological characters. The present species differs from *Malakosaria sinclairii* (Busk, 1857), (p.172, XV, figs.1, 2, and 3) in these characters. *Malakosaria atlantica* Vieira et al., 2010 (p.27-28, figs.64-66) widely differs from the present species in having elongate autozooids, a crescentic ascopore and six oval excavations around the orifice.

Occurrence: 15 zoarial fragments from the Harudi Formation (gypseous shale member of Harudi type section).

Discussion: *Ditaxiporina lakriensis* and Catenicellid gen. et sp. indet. are confined to lower Miocene rocks of the Chhasara Formation of Western Kachchh, Gujarat. However, ?*Malakosaria* sp. is common in middle Eocene rocks of the Harudi Formation of the Western Kachchh, Gujarat. *Tetraplaria tuberculata* is distributed in tropical to warm temperate waters. It is known to occur from the middle Eocene to the upper Eocene, being distributed in Florida, USA and Kachchh, Gujarat.

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