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MORIDELLA BROCKII BERGH 1888, REDESCRIBED WITH NOTES ON ANATOMY AND EARLY DEVELOPMENT*

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THE opisthobranchiate gastropod *Moridella brockii* Bergh 1888, has been described by its author based on a single specimen collected by Dr. J. Brock in 1884-85 from the Sunda Sea. Ever since that time many later authors (Thiele, 1931 ; Macnae, 1954 ; Marcus, 1958 ; Risso-Dominguez, 1962 ; Edmunds, 1964 ; Risso-Dominguez, 1964) have referred to this species in their taxonomic work, but no material has actually been collected by any. During the course of an intensive collection for the littoral nudibranchs in the Gulf of Mannar and the Palk Bay near Mandapam, the author came across a large number of specimens of this species in a good size range from the Gulf of Mannar. Since this species has now been collected after seventy-six years of its first description and also as it is little known to science, a detailed study of this monotypic genus was felt desirable. In the present communication besides a redescription of the species, some detailed observations made by the author on its anatomy, early development and ecology, which are the first of its kind are presented.

Material—Forty-five specimens (measuring 6 mm. to 34 mm.) were collected during the period January 1964 to April 1964 and January 1965 to February 1965. The largest number of specimens (12) were collected during the month of March 1964.

The material has been deposited in the Reference Collection Museum of the Central Marine Fisheries Research Institute, Mandapam Camp.

Locality—Gulf of Mannar facing the jetty of the Central Marine Fisheries Research Institute.

The genus *Moridella* according to Bergh is characterised as ' Corpus gracilis, elongatum, subcompressum ; rhinophoria quasi moriformia ; tentacula sat elongata. Papillae (Dorsales) vix caducae elongate, seriebus obliquis dispositae, antice areis confortae. Podarium sat angustum, antice angulis tentaculatim productis.

' Processus masticatorius mandibulae nonnihil curvatus, serie denticulorum grossiorum singula. Dentes linguae uniseriate, fere at in Facelinis—Penis inermis.'

The brief description of *Moridella brockii* by Bergh is : ' Colour generalis lacteus, dorsum miniate, varium papillae, dorsales nigrescente brunneae.'

The specimens described here conform to the original description of *M. brockii*, but for some small variations. According to Bergh the general colour of the body

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is white speckled with reddish dots, but in the live condition it varies from light to deep orange. The papillae on the rhinophores are arranged in oblique rows, but in specimens examined here they are arranged irregularly. The position of the anus instead of being posterior to the first row of the right third ceratal group as originally described, appears to vary depending on the number of well defined posterior rows of cerata in the third group. The general pattern of the genital system resembles that of most facelinids, but for the presence of a simple penis in *M. brockii.*

The coiled inner cerata of the last row in each group are noteworthy, because of their uniform occurrence in all the specimens examined. This appears to be a significant character besides the nature of rhinophores, the structure of the radular teeth and the position of the anus.

The description of *Moridella brockii* based on the material examined in the present study is given below.

Aeolidiform body, light to deep orange in colour ; head with a medium notch ; oral tentacles long ; rhinophores club-shaped with smooth stalks and irregularly papillated ; dorsum broad, long and tapering into a short tail ; cerata cylindroconical, non-caducous, slender, arranged in oblique rows, in four to five distinct clusters on either side of the expanded back ; larger inner cerata coiled ; anus in between the posterior well defined rows of cerata of the right third group ; renal opening in front of the right second group ; genital opening on the right lateral side, behind the last row of the first group ; foot broad, anterior corners tentacular and grooved ; cutting edge of the jaw denticulated ; radular teeth with two denticles on either side of the strong median cusp ; renopericardial syrinx simple ; no distinct renal sac ; penis simple, distinct prostate gland absent ; spermetheca club-shaped.

General Morphology

The specimens are light orange in colour along the dorsal and lateral surfaces. The region between the rhinophores and oral tentacles, the surface of the oral tentacles, the club of the rhinophores, the surface of the cerata and the integument of the pericardial prominence are deep orange in colour. The middle one-third of the oral tentacles and the cnidosacs of the cerata are coated with silvery shining granules. The foot is colourless. The hermaphrodite gland which is visible through the foot is light orange in colour.

The measurements (in mm.) of the largest specimen are given below according to the terminology of Risso-Dominguez (1963) :

Ac : 34 ; Af : 27 ; Bm : 3 ; Bt : 0,5 ; C : 4 ; D : 6 ; E : 15 ; F : 2 ; Hg : 2 ; Hc : 3 ; Hr : 6 ; K : 3 ; M : 2; S : 4 ; P : 2 ; Px : 4.

The antero-median region of the head (Fig. 1b) is notched due to the thick lateral lips. The oral tentacles are long and tapering. The rhinophores (Fig. 1e) are club-shaped and papillated on the back side of the anterior two-thirds of its length. The black pigmented eyes are visible through the integument at the base of the rhinophores. The dorsum is fairly long and tapers into a fine short tail. The cerata rise on either side of the dorsum in four to five groups. In each group the cerata

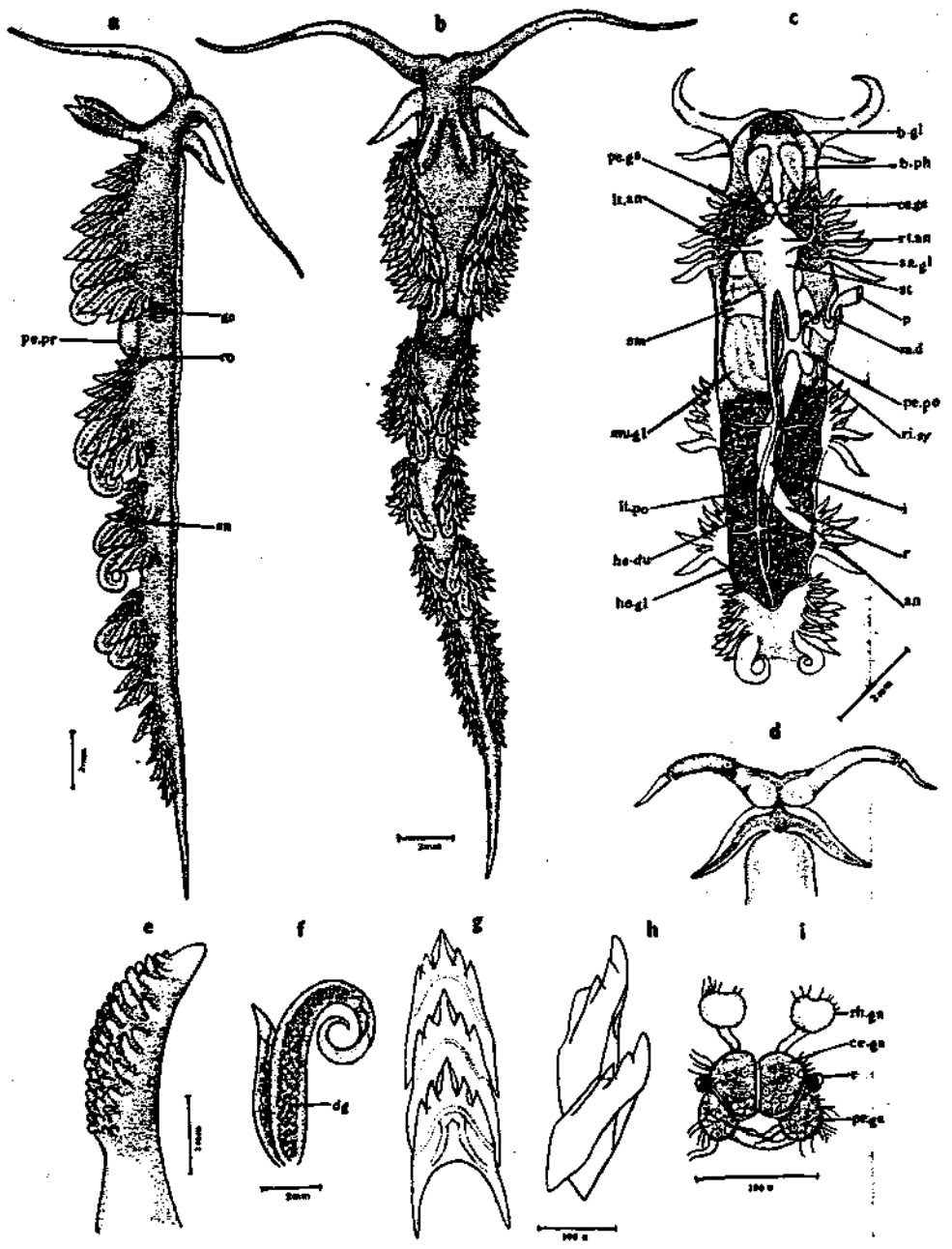

FIG. 1. a. Lateral view of entire animal; b. Dorsal view of entire animal; c. Viscera of anterior region; d. Ventral view of the anterior region; e. Rhinophore; f. Cerata; g, h. Radular teeth; i. Dorsal aspect of the central nervous system.

am. ampulla; *an.* anus; *b.gl.* buccal glands; *ce.ga.* cerebropleural ganglion; *dg.* digestive gland; *e.* eye; *ge.op.* genital openings; *he.dt.* hermaphrodite duct; *he.gl.* hermaphrodite gland; *i.* intestine; *lt.an.* left anterior hepatic diverticulum; *lt.po.* left posterior hepatic diverticulum; *mu.gl.* mucous gland; *oe.* oesophagus; *p.* penis; *pe.ga.* pedal ganglion; *pe.po.* pericardial pouch; *pe.pr.* pericardial prominence; *r.* rectum; *r.op.* renal opening; *rh.ga.* rhinophoral ganglion; *ri.sy.* renopericardial syrinx; *rt.an.* right anterior liver diverticulum; *s.gl.* salivary glands; *st.* stomach.

are arranged in oblique rows. The arrangement of cerata in each group is as follows :

First group : 2, 4, 4, 5, 5, 5, 5, 6 (5+1), 8 (7+1).
Second group : 2, 3, 3, 4, 6 (5+1), 8 (7+1).
Third group : 4, 3, 4 (3+1), 7 (6+1).
Fourth group : 4, 4, 6 (5+1).
Fifth group : 2, 3, 4 (3+1), 3, 4, 4, 3, 1.

The cerata (Fig. 1 f) are non-caducous cylindrical, stout and sharp at their ends. The innermost cerata of the last and the penultimate rows of each group are nearly three times longer than the other cerata of the same rows. The terminal portions of the longer cerata are coiled like watch springs and are capable of extension upto 9 mm. in length when the animal is disturbed. The digestive gland (*dg.*) in each cerata is in the form of a single main stem, gray in colour. The pericardial prominence (Fig. 1 **a**, *pe. pr.*) is a conspicuous, convex bulging situated in between the first and second groups of cerata. The genital openings (Fig. 1, *ge. op.*) are enclosed by a common sphincter muscle, situated on the right lateral side just behind the first outer cerata of the last row of the first group. The renal opening (Fig. 1, *r. op.*) is on the right side, in front of the first row of the second group of cerata. The anal opening (Fig. 1, *an.*) is on an elevated papilla in line with the renal opening, in between the last two well-defined rows of the right third group of cerata. Occasionally a solitary cerata may be present in front of the anal papilla. The variations in the position of the anal opening in the right third group of cerata, in relation to the number of well-defined posterior rows of cerata are shown below :

Total no. of specimens examined	No. of well-defined rows of cerata in the right third group	Position of the anal opening
12	Posterior two rows	Between the posterior two rows
6	Posterior three rows	In line with the penultimate row
8	All four rows	In front of the penultimate row

The mouth is ventral, covered by thick lateral lips. The foot (Fig. 1 **d**) is of uniform width, slightly broader than the dorsum and extends up to the tip of the tail. The anterolateral corners of the foot are produced into tentacular processes, with a deep transverse groove extending the entire length of the processes.

Anatomy

The anatomical details are shown in Figure 1 **c**. The slit-like mouth is surrounded by voluminous buccal glands (*b. gl.*), leading through the smooth chitinous inner lips into the fairly big buccopharynx (*b. ph.*). The jaws (Fig. 2 **a**) are light orange red in colour in the live condition but turn brownish yellow after preservation. The cutting edge (Fig. 2 **b**) of each jaw has a row of strong blunt denticles. The radular ribbon is light orange in colour with 16 to 18 teeth arranged in a

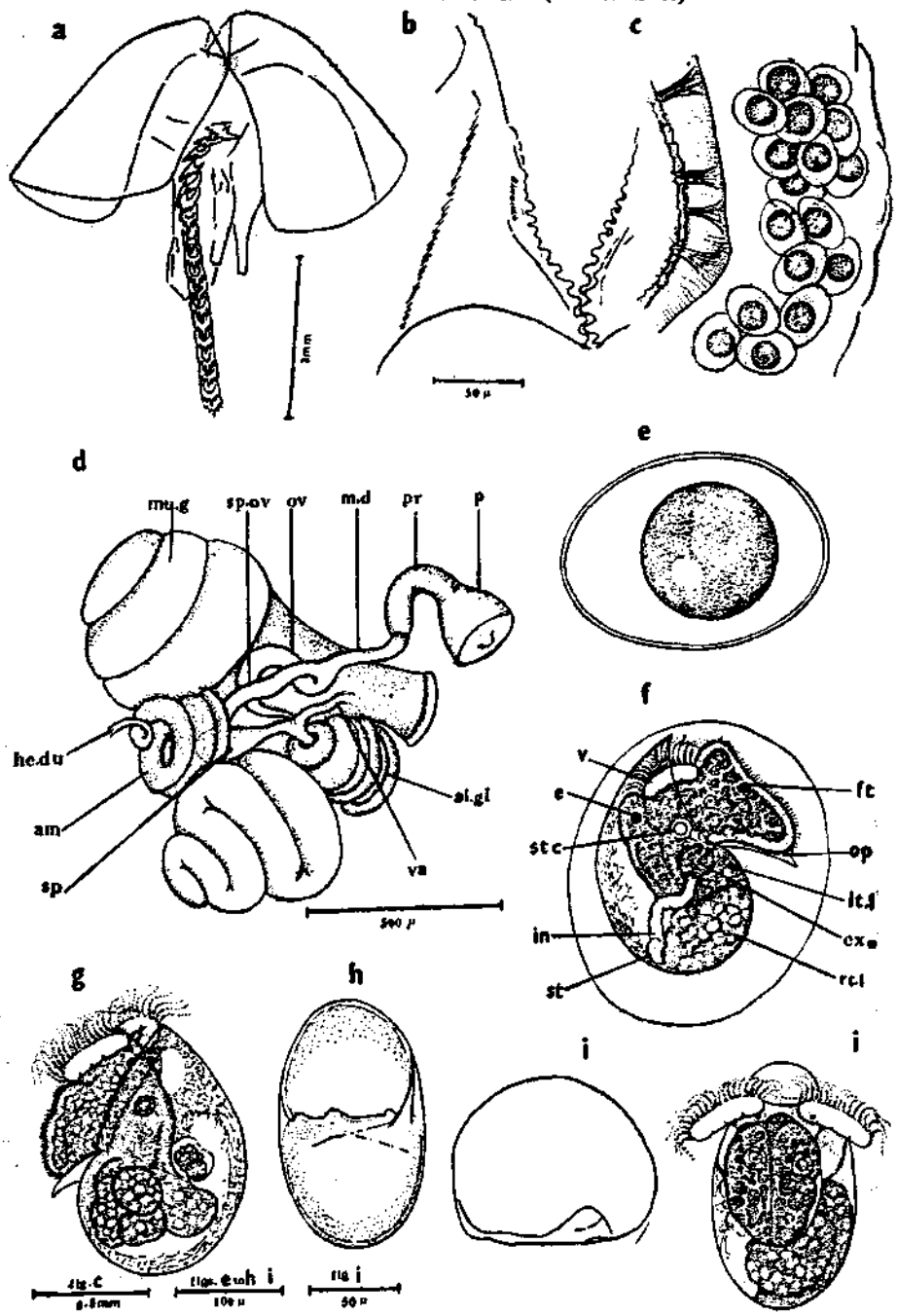

FIG. 2. a. Jaws with radula ; b. Cutting edge of the jaws ; c. Diagram of reproductive organs ; d. Bit of spawn ; e. Egg before cleavage ; f. g. j. Veligers ; h. Empty shell ; i. Operculum.

al.gl. albumen gland ; *am.* ampulla ; *e.* eye ; *ex.o.* larval excretory organ ; *ft.* foot ; *he.dt.* hermaphrodite duct ; *in.* intestine ; *lt.l.* left liver lobe ; *m.d.* male duct ; *mu.gl.* mucous gland ; *op.* operculum ; *ov.* oviduct ; *p.* penis ; *pr.* prostatic part of the male duct ; *rt.l.* right liver lobe ; *sp.* spermatheca ; *sp.o.* sperm oviduct ; *st.* stomach ; *st.c.* statocyst ; *v.* velum ; *va.* vagina.

single row, the formula being 0.1.0. The teeth are more or less uniform in size, measuring 320 μ-329 μ in length and 165 μ in width. No older teeth are present in any of the radulae examined. Each radular tooth (Fig. 1 g, h) has two lateral denticles on either side of the stout, sharp pointed median spine. A pair of large salivary gland (*s. gl.*) open into the buccopharynx by narrow ducts. The stomach (*st.*) is spacious, the internal epithelium of which has deep circular folds. The long intestine (*in.*) is in continuation of the posterior part of the stomach and extends posteriorly under the genital mass. At its posteriormost portion the intestine takes a turn to the right, rises upwards as rectum and opens to the exterior by the anus in the third group of cerata. A typhlosole is present on the dorsal side of the intestine. A number of other smaller folds on the lateral and ventral sides extend up to the anal opening. The right and left hepatic diverticulae (*rt. an.*, *lt. an.*) arise from the antero-dorsal region of the stomach, supplying branches to the first group of cerata. The posterior left hepatic diverticulum (*lt. po.*) arising from the posterior part of the stomach is median in position and extends posteriorly giving of branches to the right and left posterior groups of cerata.

The central nervous system is composed of the six ganglia (Fig. 1 i). The eyes are situated on short optic nerves. The rhinophoral ganglia (*rh. ga.*) are fairly big connected to the cerebropleural ganglia (*ce. ga.*) by short thick commissures.

The kidney is diffused all over the gonad, connected with the pericardial cavity by reno-pericardial syrinx (Fig. 1 c, *ri. sy.*). The syrinx is a simple organ without any internal folds, its inner layer being lined with long cilia. A short ureter arises from the kidney below the reno-pericardial syrinx. No distinct renal sac is present unlike in *Phidiana brevicauda* (Engel, 1925) and *Phidiana selenkai* (Marcus, 1961).

The structural arrangement of the reproductive organs (Fig. 2 d) is typical of the family Facelinidae (Odhner, 1939). The hermaphrodite gland (*he. gl.*) is a compact mass, extending from the posterior region of the heart up to the root of the tail occupying the whole body cavity. Each male follicle is surrounded by a number of female follicles. The hermaphrodite duct (*he. du.*) is a thin tube formed by the union of ductules extending the whole length of the gland below the posterior extension of the left liver. The ampulla (*am.*) is a long stout tube of uniform length, coiled in structure. The sperm oviduct (*sp. ov.*), which is a long coiled tube, is in continuation of the ampulla and gives origin to a short oviduct (*ov.*) and a long male duct (*m.d.*). The terminal part of the male duct slightly bulges to form the glandular prostate (*pr.*). The penis (*p.*) is cylindrical, with a blunt end. Its external opening is situated on a low central papilla. The vagina (*va.*) is a short muscular tube opening into the female atrium. The spermatheca (*sp.*) is club-shaped, embedded beneath the ampulla and the right and left mucous gland masses (*mu. gl.*). The oviduct is wide at its origin, becoming narrower as it passes through the spermathecal duct and the coiled albumen gland (*al. gl.*). The female atrium is broad and muscular with longitudinal folds over the inner surface. Internally, the atrium consists of two branches and each branch enters into the voluminous mucous glands.

Early Development

The egg strings were found during the months of January to March in the field. In the laboratory the specimens were kept in sea water having a salinity of 29.75‰ and temperature of 25.5°C to 27°C. The egg strings were deposited at the bottom of the glass bowls, in which they were kept. The egg string (Fig. 2 e) is 1 mm. in

diameter, always perfectly concentric, deposited in an anticlockwise direction and light orange in colour. It is transparent gelatinous in nature fixed to the substratum by means of a transparent thin covering. The ova (Fig. 2 e) are spherical light orange in colour enclosed in double walled capsules and measure 122 μ across. The egg capsules measure each 257 μ across the long axis and 175 μ across the short axis.

The details of the development are given below :

Date	*Time*	*Development stages*	*Duration of development*
17-3-64	9.00 a.m.	Egg string.	30 minutes after spawning.
25-3-64	9.00 a.m.	Veligers fully formed but not liberated.	7 days old.
28-3-64	9.30 a.m.	Veligers started liberation.	10 days old.

The fully formed veliger has a large shell measuring about 286 μ along its long axis. The shell (Fig. 2 h) is transparent, colourless and heavily pitted on the dorsal and lateral surfaces of the whorl. Convex peg-like projections are present on the collumellar region of the shell. The newly hatched veliger (Fig. 2 f, g, i) measured 286 μ along its long axis and 183 μ along its short axis. Its bilobed velum (*v.*) is bordered with long cilia. The foot (*ft.*) is fairly big, tongue-shaped and fringed with delicate cilia. A longitudinal median furrow runs along its whole length. The eyes (*e.*) are dark pigmented, situated close to the origin of the velar lobes. Paired statocysts (*st. o.*) are visible through the foot. The stomach (*st.*) is continued through a short intestine (*in.*) opening into the mantle cavity by the anus through a short rectum. The liver mass is bi-lobed (*rt. l, lt. l.*) fairly big in size and light orange in colour. The larval excretory organ (*ex. o.*) is a spherical body close to the anal opening, deep orange red in colour. Soon after the liberation, the veligers settle on the bottom of the bowl and creep actively with their tongue-shaped foot.

Ecology

The specimens have always been found under the loose stones and in the algal turf, below the lower part of the sublittoral zone. However, a large number of specimens were collected only under the stones. The under surface of the stones has been found to be covered with sponges, colonial ascidians and anemones. The presence of a single kind of nematocysts in the cnidosacs indicate that these nudibranchs prefer feeding on some definite species of anemone which has not been identified. The specimens measuring 6 to 8 mm. are immature and are often found under algal turf. Other ecological observations on this species agree with those given by Risso-Dominguez (1963) for the members of the family Facelinidae.

Summary

The facelinid nudibranch *Moridella brockii* Bergh 1888 has been rediscovered and redescribed with notes on anatomy, early development and ecology after seventy-six years of its first description.

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