

ON A NEW SPECIES OF *DENDRODORIS* EHRENBERG FROM GOA:
MOLLUSCA - NUDIBRANCHIATA

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ABSTRACT

A nudibranchiate mollusc under the genus *Dendrodoris* Ehrenberg, subgenus *Dendrodoris* s. str. obtained from a trawl catch in the Zuari River mouth off Dona Paula in Goa has been described as a new species, *D. (D.) goani*. Its dorsum is covered with large and small papillated tubercles irregularly scattered. The papillary portions are colourless and the tubercular portions dark gray. On the back and along the mantle edge there are grayish brown pigment spots. The general colouration of the dorsum is greenish yellow with a light shade of brownish tinge especially in front of the branchiae. The ventral surface of the mantle and the lateral surfaces of the body are colourless. The rhinophores are retractile with about 24 leaflets. The branchiae are five, tripinnately branched and retractile into a branchial space bounded by raised walls. The foot is oval with a median, frontal cleft and bears anteriorly a narrow groove on either side. The pedal groove is dark gray and the sole of the foot is with a diffused gray in its anterior half. Mouth is pore-like, buccal bulb is suckorial and the pharynx is divisible into a narrow looped anterior portion and an elongated dilated posterior portion. The bilobed ptyaline gland is much larger than the buccal bulb. The presence of small salivary glands, the position of the buccal ganglia and the nature of the short straight intestine without the characteristic dorid loop in front of the digestive gland are as in other members of the subgenus *Dendrodoris*. The generative organs are complex. The hermaphrodite gland envelops the digestive gland completely and the hermaphrodite ampulla is a thick convoluted tube. The prostate is much elongated and lobed and the vas deferens is narrow and much coiled. The penis is with numerous recurved hooks. The male genital vaginal and oviducal openings are separate. An accessory gland is present. The spermatheca is large and roundish and spermatocyst is small and ovoid. The new species *D. (D.) goani* has a combination of characters separately met with in *D. tuberculosa* (Q & G) and a few other species under the genus.

INTRODUCTION

DORIDIFORM molluscs under the order Nudibranchiata are many and varied in their structure presenting considerable difficulties in dealing with their taxonomy. Kay and Young (1969) recognise Doridacea as a superfamily to include ovate dorids like *Discodoris*, *Platydoris* etc., and some limaciform nudibranchs as *Gymnodoris*, all of which despite their varied structural complexities are characterised by the presence of a mid-dorsal anus surrounded by a circlet of branchiae (with the exception of *Okadia elegans* which is without the branchiae). Doridacea bear club-shaped, perfoliate rhinophores which are retractile into elevated rhinophore sheaths. The digestive organs are diversely modified to suit diverse types of feeding, but the majority of Doridacea are rasps, possessing a radula. The mantle may be with or without spicules and the reproductive organs which are always complex differ much in their arrangement even within the same genus.

They are divided into several families and subfamilies. Among them the family Dendrodorididae represented by *Dendrodoris* Ehrenberg 1831 (Synonymous with *Doridopsis* Alder and Hancock 866; *Doriopsis* Bergh 1875, non Pease 1860) is a very specialized group of dorids, wanting in jaws and radula, but with a buccal bulb adapted for sucking. Two subgenera are usually recognised, *Dendrodoris* s. str. and *Doriopsilla* Bergh 1880, the former with soft body-wall and with either

smooth or tubercular surface of the mantle and the latter with tough and rigid body-wall supported by spicules and with mantle surface distinctly granular (Baba, 1949). The generic name *Dendrodoris* of Ehrenberg has priority over *Doridopsis* of Alder and Hancock. It has been shown by Pruvot-Fol (1930) that *Doridopsis* Pease (1860) and *Doridopsis* of Alder and Hancock are not identical but distinctly separate genera although Bergh 1875 mistakenly considered them synonymous (Gohar and Soliman, 1967). *Doriopsis*, represented by *D. nebulosa* Pease 1860 is a radula bearing dorid (Kay and Young, 1969; Edmunds, 1972) unlike *Dendrodoris* in which the radula is wanting.

The occurrence of *Dendrodoris* (*Dendrodoris*) *rubra* (Kelaart), *Dendrodoris* (*Dendrodoris*) *nigra* (Stimpson) and *Dendrodoris* (*Doriopsilla*) *miniata* (Alder and Hancock), along the Indian coasts is well known (Alder and Hancock, 1866; Satyamurti, 1952; O'Donoghue, 1932; Narayan, 1969). The present form resembles in some respects *Dendrodoris tuberculosa* (Quoy and Gaimard, 1832) which is hitherto known from Mauritius (Bergh, 1889), Gilbert Islands (Eliot, 1906), Hawaiian Islands (Kay and Young, 1969) and Japan (Baba, 1949). It, however, differs markedly from *D. tuberculosa* and all other species under the genus so far known, both in some of the external and internal characters and hence reported here as a new species named after the locality of its occurrence.

The following account is based on a collection of 22 specimens of this dorid obtained from a trawl catch on 12th April 1973 at latitude 15° 26'N by longitude 73° 49' E in the shallow waters of Zuari River north between Dona Paula Point and Sridaon Beach in the vicinity of Panaji, Goa.

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EXTERNAL FEATURES OF *DENDRODORIS* (*DENDRODORIS*) *GOANI* SP. NOV.

The specimens collected were all alive when they were examined. They ranged from 29 mm to 60 mm in length. One of them measuring 54.5 mm in length, 37 mm in width and 23.5 mm in height has been described here in detail (Fig. 1 a-c). The mantle is broadly ovate with its outer surface soft and beset with scattered, papillated tubercles (l.tu & s. tu). At about 8 mm distance from the anterior edge of the mantle, there is a pair of rhinophores (rh), which are retractile into fairly prominent rhinophore sheaths, with smooth walls. The rhinophore stalks are fairly stout and of moderate length, whitish with a tinge of diffused gray. The rhinophore is conical smoothly arched and bears 24 leaflets of light brown colour. Its tip is white and along the outer surface is a whitish ridge. Five tri-pinnately branched branchiae (secondary branchiae) are present mid-dorsally at about three-fourths the length of the animal from its anterior end (br). The branchiae are whitish or pale-brown. In the centre of the branchial circlet is the anus situated on a slightly elevated papilla. When the animal is disturbed the branchiae are partially drawn into the branchial orifice, the margin of which is

raised into a well defined 5-lobed ridge-like wall surrounding the basal region of the branchiae.

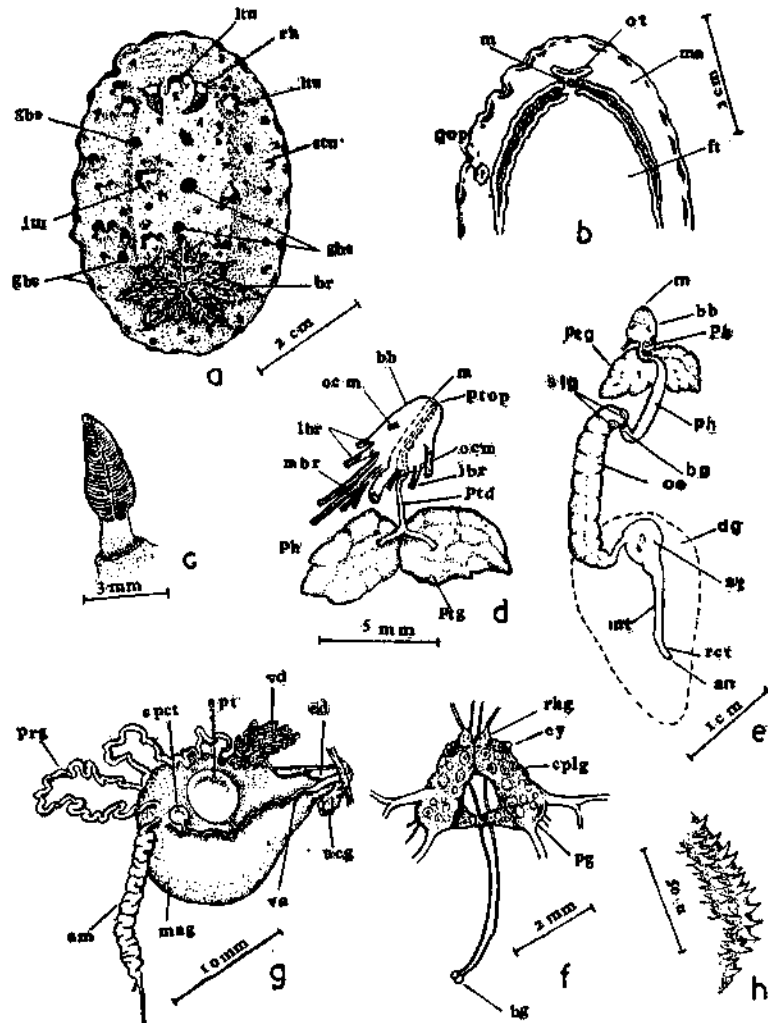


Fig. 1 a-h. *Dendrodoris (Dendrodoris) goani* sp. nov. : a. Dorsal view of entire animal; b. Ventral view of the anterior half of the animal; c. Rhinophore; d. Buccal bulb and ptyaline gland; e. Digestive organ; f. Nerve ring; g. Reproductive organ; h. Penial armature of recurved hooks. (acg.—accessory gland; am.—ampulla; an.—anus; bb.—buccal bulb; bg.—buccal ganglia; br.—branchiae; cplg.—cerebropleural ganglia; dg.—digestive gland; ed.—ejaculatory duct; ey.—eye; ft.—foot; gbs.—gray brown spots; gop.—genital opening; int.—intestine; lbr.—lateral buccal retractors; ltu.—large tubercles; m.—mouth; ma.—mantle; mag.—mucoalbuminous gland; mbr.—median buccal retractors; ocm.—oral branches of columellar muscle; oe.—oesophagus; ot.—oral tentacles; ph.—pharynx narrow portion; ph'.—pharynx dilated portion; pg.—pedal ganglia; prg.—prostate gland; ptd.—ptyaline gland duct; ptg.—ptyaline gland; ptop.—opening of ptyaline gland duct; rct.—rectum; rh.—rhinophore; rhg.—rhinophoral ganglia; slg.—salivary gland; spct.—spermatocyst; spt.—spermatheca; st.—stomach; stu.—small tubercles; va.—vagina; and vd.—vas deferens).

Over the entire dorsal surface of the back are the papillate tubercles, some of which are tiny and microscopic and others fairly large upto about 2 mm in height and about the same in diameter (stu; ltu). Their proximal papillary portions are colourless and the distal tubercular portions dark gray or almost black. In addition to these tubercles, the dorsum bears brownish black pigment spots over the surface. Some of the spots over the middorsal region are comparatively larger in size than those at the sides. All round the mantle edge, submarginally on the dorsal surface there are deep gray almost black elongate pigment spots. Along this mantle edge there are also the minute papillated tubercles. The general colouration of the dorsum is greenish yellow with a splashing of pale brown all over. The pale brown colouration is a little deeper in front of the branchial tufts and along the sides of the body.

The ventral surface of the mantle is smooth. It is colourless or pale white except submarginally where the elongate pigment spots actually situated dorsally are seen through the transparent skin. The sides of the body below the mantle are colourless or pale white. The foot (ft) is flat, broad and oval, a little narrower in front than behind. When the animal is in motion, the foot is visible behind the posterior edge of the mantle. The border of the foot which is thin presents an undulated appearance when viewed ventrally. Anteriorly it bears a groove (Fig. 1b) running along the edge presenting a two-folded appearance. This region is marked by the presence of a dusky blackish gray pigmentation in the pedal integument. The pigmentation also extends in a diffused manner to some distance up to about the middle region of the ventral surface of the foot. The dorsal surface of the foot posteriorly shows a faint diffused brownish colouration. The genital orifice is at a distance of about 10 mm from the anterior end on the right side of the body between the mantle and the foot. The mouth aperture (m) is pore-like, anterior and median in position between the mantle ridge and the foot and is bordered in front by a pair of short oral or cephalic tentacles (or).

INTERNAL ANATOMY

Digestive organs

Correlated with the absence of the radula and the odontophore the buccal bulb in the dendrodorids is comparatively much smaller than in the other dorids. In the present form (Fig. 1 d, e), the minute mouth aperture (m) leads into a small buccal bulb (bb) provided with some intrinsic muscles and extrinsic muscles (ocm; lbr; mbr) which help the animal in its feeding operations. The buccal bulb is run through by a narrow oral tube (ot), opening in front by the mouth and continued behind by a pharynx (ph' and ph). The pharynx is narrow and looped immediately behind the buccal bulb but it is dilated behind into a longitudinally stretching tube. It makes then a sharp bend and is continued by a rather long thin walled saccular oesophagus (oe). A pair of small a ovoid salivary glands and a pair of buccal ganglia (bg) mark the commencement the oesophagus. Posteriorly it narrows down and enters a small dilated stomach (st) or midgut which is embedded in the midgut gland or the digestive gland (dg). The midgut gland ducts open on the floor of the stomach. The intestine (int) arises posteriorly from the stomach and runs medianally and mid-dorsally over the surface of the digestive gland. Terminally it is continued by a short rectum (rct) which runs upwards and opens out by the anus (an) situated in the centre of the branchial cirlet. It may be seen that the intestine arising out from the stomach is short and does not make a loop in front of the digestive gland, which is characteristic of the other dorids.

There is a well developed bilobed ptyaline gland (Fig. 1 d, e; ptg) behind the buccal bulb. The ducts arising from the two lobes join together to form a common ptyaline gland duct (ptd) which enters the nerve ring, makes a short loop and runs forward parallel to and beneath the oral tube. The external opening of the ptyaline duct (Fig. 1 d; ptop) is close beneath the mouth opening.

The actual method of feeding has not been observed in *D. goani*. It has, however, been studied by other workers in the allied species (Hancock, 1865; Ghiselin, 1964; Young 1969). *Dendrodoris* and *Doriopsilla* have been known to feed on sponges. The buccal bulb is thrust into the osculum of the sponges by these dorids and the contents are sucked in. Examination of the gut contents as well as the faeces has shown the presence of the sponge spicules.

The protraction of the buccal bulb is brought about by increase in blood pressure in the cephalic haemocoel. The dilations and contractions of the oral tube are caused by the antagonistic action of two sets of its muscles, viz., the circular and radial muscles. Suction is the result of differential contractions and dilations along the oral tube resulting in peristalsis driving the food particles hindwards. After feeding the retraction of the buccal bulb is brought about by the contractions of the oral branches of the columellar muscles and the lateral and the medial buccal retractor muscles (Fig. 1 d; ocm; br; mbr). The function of the ptyaline gland is not adequately understood. Its secretion is without peptic, tryptic and diastatic enzymes, which are abundantly present in the extracts of the digestive gland. The secretion is considered to be acidic helping to dissolve the sponge tissues liberating free the mesenchyme cells and the spicules to be sucked in by the dorids. *Doriopsilla* has no ptyaline gland, although its mode of feeding is the same as in *Dendrodoris*.

In *D. goani* the gut showed uniformly fine, granular pulpy matter without any spicules. Possibly these dorids are capable of sucking the juices of other animals also. In this connection it is worth noting the observations of Gohar and Soliman (1967) in *Dendrodoris fumata*. They had found no identifiable food particles in the alimentary canal and presumed that the dorids might be sucking the juices of the encrusting plants and animals.

Organs of blood circulation and renal excretion

No attempt is made here to describe these structures in detail. They resemble in a general way those of *Kalinga ornata* (Rao, 1936). The heart enclosed in a spacious pericardium is dorsal to the visceral organs immediately beneath the body wall in front of the origin of the branchiae. The auricle is large and triangular measuring 10 mm in the antero-posterior axis and 13 mm across posteriorly. The ventricle is a little smaller and 9 mm across. The auriculo-ventricular opening is provided with flap-like valves. From the ventricle the aorta arises giving off branches to all the visceral organs. Aerated blood from the branchiae is collected into the auricle by a large semicircular efferent branchial sinus. Associated with the circulatory system is a large flattened recemosely branched pale white blood gland measuring about 14 mm long and 8 mm across.

The kidney is a much branched structure spreading amidst the lobules of the midgut gland and the outgoing duct viz., the ureter passes parallel to the rectum and opens to the exterior by the side of the anal aperture. The most conspicuous among the renal organs is the reno-pericardial funnel, 6 mm in its long axis by 3 mm by 3 mm in height and thickness. It is situated within the pericardial chamber, posteriorly behind the auricle towards the right. The renopericardial

funnel opens into the pericardial chamber. Its duct pierces through the pericardial wall and joins the ureter.

Nervous system

The central nervous system is very much concentrated forming a compact ring 3 mm across (Fig 1 f) encircling the narrow pharynx immediately behind the buccal bulb. Paired ganglia *ie.*, the cerebropleurals (cplg) and the pedals (pg) are prominently seen. Anterodorsally there is a pair of rhinophoral ganglia (rhg). A pair of minute eyes (ey) is also present each with a darkly pigmented retinal cup and a round crystalline lens. Connecting the two pedal ganglia there is a very short pedal commissure which is ventral to the pharyngeal tube. Very conspicuous are the cerebrobuccal connectives arising from the cerebropleural ganglia and proceeding towards the buccal ganglia situated at the junction of the pharynx with the oesophagus (Fig. 1e, f; bg). When viewed ventrally, the nerve ring reveals on each side at the junction of the cerebropleural ganglion with the pedal ganglion, a minute statocyst with only a few statoclioths.

Organs of reproduction

Very well developed and elaborate are the organs constituting the reproductive system. The mid-gut gland is completely enveloped by a layer of hermaphrodite gland, with closely packed microscopic hermaphrodite follicles richly supplied with blood from a close net work of blood vessels. The hermaphrodite duct which is narrow to begin with enlarges into a lobulated hermaphroditic ampulla (Fig. 1 g; am) of about 17 mm in length. It narrows down abruptly and enters the anterior genital complex. The male part of the reproductive system reveals a long fairly thick, much lobed tubular prostate gland (prg) which is about 60 mm in length and 0.8 mm in thickness. This is continued by an extremely narrow much coiled vas deferens (vd) leading into a slightly enlarged ejaculatory duct (ed) lodging the penis which is provided with innumerable minute recurved hooks (Fig. 1 h). The male opening is close to the vaginal opening, but the two are distinctly separate. The vaginal tube is narrow and coiled leading to a large round spermatheca (spt). The incoming and the outgoing ducts to the spermatheca are joined together. The outgoing duct from the spermatheca is in communication with the spermatocyst which is a much smaller vesicle than the spermatheca. There is also a duct leading out from the spermatocyst into the muco-albuminous gland of the anterior genital complex. The much convoluted oviducal passage in the muco-albuminous gland leads to the exterior by the oviducal opening close to the vaginal opening. At the junction of the male genital, vaginal and the oviducal passages there is a minute accessory gland (acg).

DISCUSSION

The new species *Dendrodoris goani* has a combination of structural characters which are separately met with in *D. tuberculosa* (Quoy and Gaimard) and a few other species under the genus. The diagnostic characters of the form are as follows: Dorsum covered with large and small papillated tubercles irregularly scattered, papillary portions colourless, tubercular portions dark gray; dorsum and mantle edge with small greyish brown pigment spots; general colouration of the dorsum greenish yellow with a splashing of pale brown in front of the branchiae; ventral surface of mantle and the lateral surfaces of the body colourless; rhinophores with

about 24 leaflets, retractile into sheaths with entire margins; branchiae five, tripinnate and retractile into branchial space bordered by raised flaps; foot with a cleft anteriorly below the pore-like mouth and with a narrow groove running on either side to some distance antero-laterally; colourations of foot dark grey in the pedal groove and light diffused gray in the anterior half of the pedal sole; ptyaline gland larger than the buccal bulb; pharynx divisible into narrow short looped anterior portion and elongated dilated posterior portion, but the rest of the alimentary canal as in other dendrodorids; reproductive organs complex and characterised by the presence of a convoluted tubular hermaphrodite ampulla, long much lobulated prostate gland, a narrow much coiled vas deferens, an ejaculatory duct lodging a penis with recurved hooks, separate male genital, vaginal and oviducal openings, a spermatheca much larger than the spermatocyst and an accessory gland close to the opening of the oviduct.

Among the several species under the genus *Dendrodoris*, *D. tuberculosa*, (Q and G), *D. gemmacea* (Alder and Hancock) and *D. coronata* Kay and Young have prominent warty tubercles on the dorsum. *D. rugosa* Pease is considered (Kay and Young, 1969) synonymous with *D. tuberculosa*. In all the three species the branchiae are five as contrasted with *D. nigra* (Stimpson) and *D. rubra* (Kelaart) which usually possess six to eight branchiae.

D. tuberculosa is characterised by densely distributed large and small warty prominences, the larger ones being surrounded by the smaller ones along the mid-dorsal region of the mantle and the smaller, rugose ones along its margin. The colouration of the mantle is gray brown with a darker brown shade ramifying on the mid-dorsum between the tubercles. The ventral surface of the mantle and that of the foot are grayish and there is a purplish streak running along the inner margin of the mantle. The foot bears three large white spots with a black margin (Kay and Young, 1969). Baba (1949) states that there is also a variety *D. tuberculosa* without such white spots well distributed in the Indian and the Pacific Oceans.

Among the reproductive organs in *D. tuberculosa* the hermaphrodite ampulla is a stout coiled tube, the prostate gland is thick and shortlobed, the vas deferens and the ejaculatory duct are short coiled, the latter having cirral hooks and the vaginal passage and the ejaculatory duct have separate openings. The present form differs from *D. tuberculosa* in having sparsely distributed papillate tubercles being dark gray, almost black; there is no purplish streak along the inner margin of the mantle and no white spots are present on the foot. The structure of the prostate and the vas deferens is also different. In *D. goani* there is a distinct accessory gland which is wanting in *D. tuberculosa*. However, a similarity exists between the two species in having separate openings for the vaginal passage and the ejaculatory duct.

In *D. coronata* the tubercles are pustule-like over the entire dorsum, but those in front of the branchial region form a crownlike ridge. There is only a single external opening for the ejaculatory duct and the vaginal duct. No hooks are present in the ejaculatory duct and no accessory gland. These characters are distinctive in separating it from the present form.

Another species with compound tubercular warts is *D. gemmacea* which is elegantly coloured. The pattern of colouration and arrangement of the tubercles is very distinctive. The larger warts are 3 on either side of the median line, each

surrounded by a circle of smaller ones. The smaller tubercles are irregularly set on the sides of the mantle. Behind the rhinophores, three longitudinal rows of rhomboidal patches are present on the back, each with a bluish spot in the centre and similar patches in front of the rhinophores also. The tubercles are yellowish with a dark spot in the centre. The branchiae are ash white and the rhinophores are purplish. The internal structure is little known. *D. atromaculata* is characterised by pale buff general colouration of the notum with scattered, branched or serrated pailae bearing pointed white tips, only three tripinnately branched branchial plumes and foot with a dark blotch situated in front (Alder and Hancock, 1896).

There are yet other species of *Dendrodoris*, namely *D. nigra* (Stimpson), *D. rubra* (Kelaart), *D. fumata* (Ruppell and Leuckart), *D. guttata* (Odhner), *D. elongata* Baba, *D. atropos* (Bergh) and *D. krebsii* (Mörch). While some of them are considered valid at specific levels, others are more synonyms of the more common and very variable species. All these are characterised by soft dorsum without tubercles, thus differing from *D. goani*. They generally possess more than 5 branchiae. *D. nigra* which is very variable in colour ranging from orange to brown in the juvenile stages but invariably deep black in the adult occasionally possesses minute pustules on its back. *D. nigra* and *D. goani* are distinctly separate because of the wide differences between the two, not only in regard to their external characters but also in their internal structure. The differences are marked especially in the nature of the reproductive organs, *D. nigra* showing the union of the ejaculatory duct and the vaginal passage with a single external opening as contrasted with the condition already described in *D. goani*.

In *Dendrodoris rubra* (Kelaart) which is red, carmine, vermilion or reddish brown, with or without gray irregular dorsal markings, the ejaculatory duct and the vaginal passages are united, opening by a single external opening as in *D. nigra*. In both the hermaphrodite ampulla is bulbous unlike the thick, lobulated or coiled ampulla present in *D. goani*. Gohar and Soliman (1967) consider that the Red Sea form *D. fumata* (Ruppell and Leuckart) and the widely distributed species *D. rubra* (Kelaart) and *D. nigra* (Stimpson) in the Indian and the Pacific Oceans are conspecific. They prefer to use the name *D. fumata* to them on the basis of priority. While *D. nigra* has an accessory gland in its reproductive organs, *D. rubra* and *D. fumata* have none. Since there are other structural differences also as pointed out by Edmunds (1971), it is safer to consider the forms as constituting three distinctly separate species. *D. atropos* (Bergh) of the Atlantic and the Pacific coasts of North America, having a reddish band along the edge of the mantle differs from *D. nigra* in which the reddish border when present is more inside and parallel to the edge. *D. atropos* and *D. krebsii* (Mörch) are considered synonymous (Edmunds, 1971).

D. guttata (Odhner) has an orange yellow mantle with thickly set well defined black markings surrounded by white rings and the branchiae are 6 tripinnate. The rhinophores have each a black ring down the tip. *D. elongata* (Baba) is a long holothurian-like animal with dirty yellow general colouration of the mantle which is covered with dark brown mottles (Baba, 1949). These very characters of the two species are distinctive in separating them from *D. goani*.

REFERENCES

- ALDER, J. AND A. HANCOCK 1886. Notice of a collection of nudibranchiate Mollusca made by Walter Elliot, Esq., with descriptions of several new genera and species. *Trans. Zool. Soc., London*, 5:113-147.

- BABA, K. 1949. *Opisthobranchia of Sagami Bay*: 1-194. Tokyo, Iwanami Shoten.
- BERGH, R. 1870-1892. *Malacologische Untersuchungen*. In *Semper's Reisen im Archipel der Philippinen*, Bd. 2 Leipzig: 1-1168.
- EDMONDS, M. 1971. Opisthobranchiate Mollusca from Tanzania (Suborder : Doridacea). *Zool. J. Linn. Soc.*, 50: 339-396.
- EHRENBERG, C. G. 1831. *Symbolae physicae animalia evertibrate exclusive insectis*. Mollusca, Berlin.
- ELIOT, C. N. E. 1906. On the nudibranchs of Southern India and Ceylon with special reference to the drawings by Kelaart and the collections belonging to Alder and Hancock preserved in the Hancock Museum at New Castle-on-Tyne. *Proc. Zool. Soc. Lond.*, 1906 : 636-690; 998-1008.
- GHISELIN, M. T. 1964. Feeding of *Dendrodoris (Doriopsis) albopunctata*, an opisthobranch gastropod. *Ann. Rep. Amer. malacol. Union.*, 31 : 45-46.
- GOHAR, A.H.F., AND G. N. SOLIMAN 1967. The biology and development of *Dendrodoris (=Doriopsis) fumata* (Rupp. and Leuck.) (Gastropoda, Nudibranchia). *Publs. mar. biol. Stn. Al Ghardaqa*, 14 : 31-54.
- HANCOCK, A. 1865. On the Anatomy of *Doridopsis*, a genus of the nudibranchiate Mollusca. *Trans. Linn. Soc.*, 25 : 189-207.
- KAY, E. A., AND D. K. YOUNG 1969. The Doridacea (Opisthobranchia; Mollusca) of the Hawaiian Islands. *Pacific Science*, 23 (2) : 172-231.
- KELAART, E. F. 1859. Descriptions of new and little known species of Ceylonese nudibranchiate molluscs. *Ann. Mag. nat. Hist.*, 3 : 291-304; 488-496.
- NARAYANAN, K. R. 1969. On the Opisthobranchiate fauna of the Gulf of Kutch. *Proc. Symposium on Mollusca, Mar. biol. Assn. India*, 1 : 188-213.
- O'DONOGHUE, C. H. 1932. Notes on Nudibranchiata from Southern India. *Proc. malac. soc. Lond.*, 20 : 141-166.
- PEASE, W. H. 1860. Descriptions of new species of Mollusca from the Sandwich Islands in the collection of Hugh Cuming. *Proc. Zool. Soc. Lond.*, 1860 : 18-36.
- PRUVOT-FOL, A. 1930. Du Genere *Dendrodoris* Ehrenberg et ses rapports avec le genre *Doriopsis* Pease et avec quelques autres. *Bull. Mus. Hist. Nat. Paris*. 11 (2, 3): 291-297.
- QUOY, J. R. AND J. P. GAIMARD 1832. *Voyages dedecouvertes de l' Astrolabe... les Annes 1826-29, Zool.*, 2 (1) , 320 pp and Atlas. Paris; Tastu.
- RAO, K. VIRABHADRA 1936. The morphology of *Kalinga ornata* Ald and Han. *Rec. Ind. Mus.* 38 (1) : 41-79.
- RUPPELL, E. AND F. S. LEUCKART 1828. *Neue wirbellose Theire des Rothen Meeres*. In. E. Ruppell, *Atlas zuder, Reise im Nordlichen Afrika*, 47 pp Frankfurt-am-Main: Bronner.
- SATYAMURTHI, S. T. 1952. The mollusca of Krusadi Island. 1. Amphineura and Gastropoda: Sub-class Opisthobranchia. *Bull. Madras. Govt. Mus. (N. S. Nat. Hist.)* 1 (2, pt 6): 216-251.
- STIMPSON, W. 1856. Descriptions of some new marine invertebrates from the Chinese and Japanese Seas. *Proc. Acad. nat. Sci. Philad.*, 7 : 375-384.
- YOUNG, D. K. 1969. The functional morphology of the feeding apparatus of some Indo-West-Pacific dorid nudibranchs. *Malacologia*, 9 (2): 421-446.