

Cuthona adyarensis, A New Nudibranch (Mollusca : Gastropoda) from Madras*

BY K. Virabhadra Rao

Central Marine Fisheries Research Station, Mandapam Camp, S. India

With 4 Text-figures

Received 31st October, 1951

CONTENTS

	Page
I—Introduction	229
II—External Features of <i>Cuthona adyarensis</i> sp. nov.	229
III—Internal Anatomy	231
IV—Systematic position of <i>Cuthona adyarensis</i>	235
V—Summary	237
VI—Acknowledgment	237
VII—References	237
VIII—Key to the lettering of the figures	238

I—Introduction

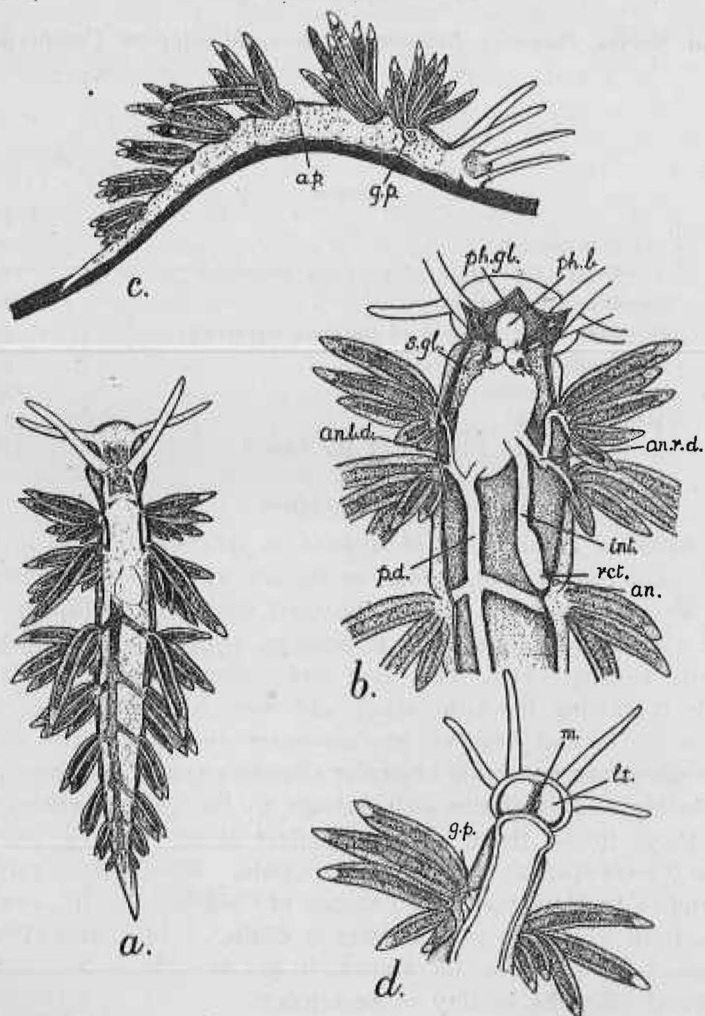
Examination of an algal bed of *Hypnea* on 15th March, 1948 revealed a fair number of small Nudibranch molluscs in shallow waters of the estuary of Adyar River, off its northern bank about a hundred yards of the Elphinstone bridge. The algae were found covered with microscopic hydroids upon which the Nudibranchs were feeding. They were kept under observation in the laboratory in finger-bowls containing brackish water, and were fed on fresh hydroids when available or on minced flesh of brackish-water anemones. The structure was studied by dissections under the binocular microscope, and also from preparations of serial sections. This Nudibranch belongs to the genus *Cuthona* Alder and Hancock (1855), under the family *Tergipididae* (vide Thiele, J. 1931), Section *Aeolidiacea* (Cladohepatica) of the Nudibranchiata. Eliot (1910a, 1916) described from the Indian brackish waters two species of *Cuthona*, viz., *C. annandalei* and *C. henrici*, from which the present form is distinct. As it also differs from all other forms of the genus so far known, it has been here described as a new species, named after the locality of occurrence.

II—External Features of *Cuthona adyarensis* sp. nov.

Cuthona adyarensis (Text-fig. 1) is a slender aeolidiform Nudibranch attaining a length of about 12 mm., a breadth of 3 mm. and a height of 2 mm. The

* Issued for publication with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

general colouration is pale yellow or orange. The head which is about 1.5 mm. across, bears two pairs of elongated smooth tapering tentacles, viz., a pair of oral tentacles first in the series, and a pair of rhinophores situated a little behind the former. Both the pairs of tentacles are of equal length of about 3 mm., but the second pair is a little stouter than the first. Between the oral tentacles and over the region immediately behind the rhinophores the body wall bears specks of gray. The head is distinctly round in its anterior margin, and bears



TEXT-FIG. 1. *Cuthona adyarensis*, sp. nov.

a. Dorsal aspect of the animal $\times 6$; b. Dissection of the alimentary canal in the anterior region of the animal; c. Lateral aspect of the animal $\times 6$; d. Ventral aspect of the animal in the anterior region $\times 10$.

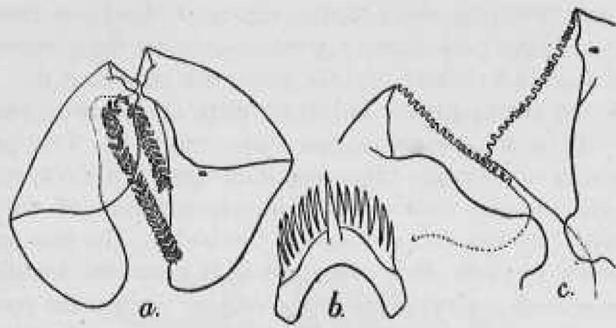
on its median ventral aspect a slit-like mouth (Text-fig. 1 *d.m.*) on either side of which is a small fleshy labial thickening (*l.t.*). A pair of eyes is seen through

the transparent skin covering them in the region of the head close behind the rhinophores. At a distance of about 1.3 mm. from the rhinophores there is the first group of four or five dorsal papillae or cerata on either side of the body. They are slender and elongated, the largest of them being about 3 mm. long and 0.4 mm. thick. Their integument is pale gray except at the tips where it is white. The digestive diverticula extending into them are dark gray, and they terminate in tiny colourless cnidosacs. The arrangement of the cerata is in seven or eight lateral groups on each side of the body. The first and the second groups lie very close to each other, the third is at about the middle region, and the fourth to the seventh, or occasionally the eighth, occupy the posterior half of the body length. In a lateral aspect each group presents a fan-like appearance, as the cerata originate from the body-wall, one behind the other in an oblique line. The anus is distinctly lateral in position on a small papilla (Text-fig. 1c. *a.p.*) just in front of the cerata of the third group of the right side. The genital apertures are situated close together on the right side of the animal on a genital papilla (*g.p.*) beneath the first group of cerata. The foot which extends from one end of the animal to the other is broader than the back, rounded in front and tapers behind into the tail which is about 2 mm. long. There are no prolongations of its anterior corners. The outlines of the digestive and reproductive organs, as well as the heart are faintly visible through the transparent integument.

III—Internal Anatomy

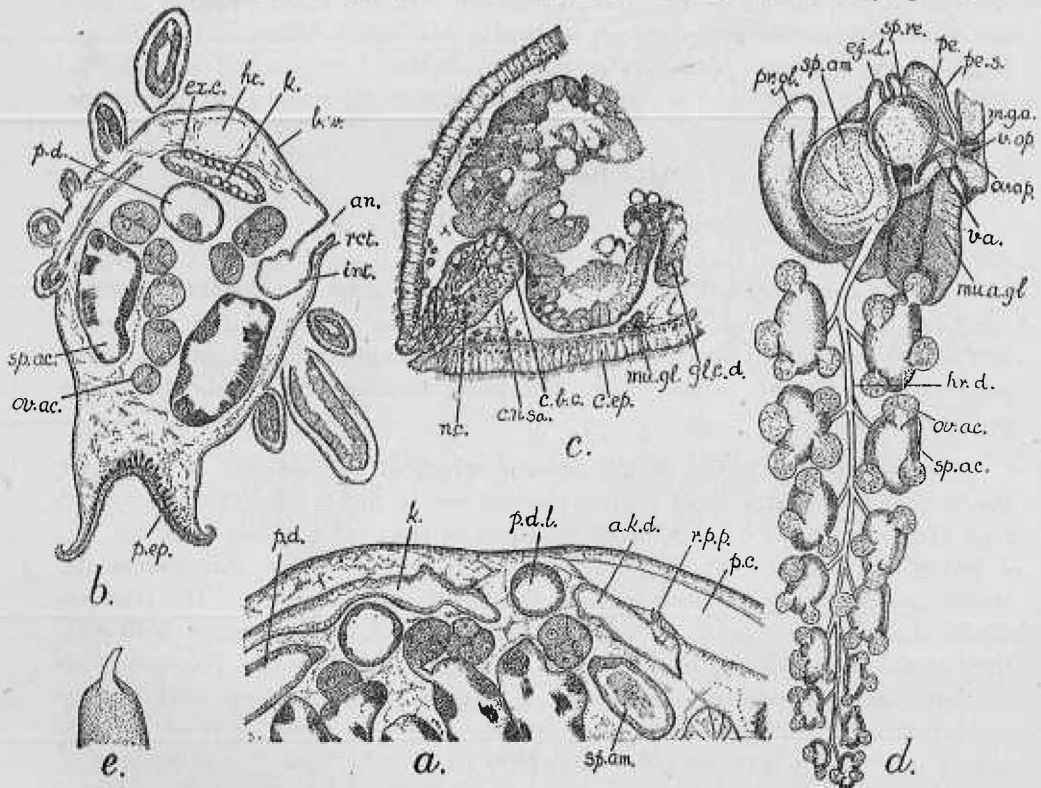
Integuments.—The body-wall (Text-fig. 3b. *b.w.*, and 3c. *c.ep.*) has an outer ectodermal pigmented and glandular epithelium which is ciliated over the tentacles, the labial folds and the cerata. The foot has a columnar ciliated epithelium (Text-fig. 3b. *p.ep.*) with unicellular and multicellular mucous glands, the secretion of which aids in locomotion as in other Nudibranchs. There is loose connective tissue with muscle fibres and blood lacunae beneath the body and pedal epithelia.

Digestive Organs.—The mouth opening which is guarded by a sphincter muscle leads through a short narrow channel into a highly muscular pharyngeal bulb (Text-fig. 1b. *ph.b.*) provided with a pair of jaws and a radula (Text-fig. 2.). A group of unicellular pharyngeal glands (Text-fig. 1b. *ph.gl.*) surrounding the mouth channel pour their secretion into the mouth during feeding. The jaws are chitinous and lie within the dorsal and lateral walls of the pharyngeal bulb with their serrated free ends protruding into the mouth. The radula presents 30 to 35 horse shoe-shaped teeth, each with a median prominent cusp, and slightly smaller lateral denticles, seven on either side. Two racemose tufts of salivary glands (*s.gl.*) open into the pharyngeal bulb on its roof close to the origin of a narrow slender oesophagus which passing through the nerve ring makes a short loop and enters a fairly large dilated stomach (*st.*). The intestine (*int.*) arising from the right dorso-lateral aspect of the stomach is short. It proceeds backwards, bulges slightly on its course, and is continued by a short rectum (*rect.*)

TEXT-FIG. 2. *Cuthona adyarensis*, sp. nov.

a. Jaws and radula $\times 30$; b. a single tooth of radula $\times 150$; c. Anterior edges of jaws $\times 150$.

which turns a little upwards and opens by the anus (*an.*) in front of the third group of cerata on the right side of the animal. The digestive gland is very much branched, and presents three main diverticula. A large posterior

TEXT-FIG. 3. *Cuthona adyarensis*, sp. nov.

a. Longitudinal section through the body in the region of the paricardium and the kidney $\times 150$; b. Transverse section of the body passing through the anal region $\times 30$; c. Longitudinal section through tip of cerata $\times 150$; d. General arrangement of the reproductive organs of the animal; e. Penial armature $\times 150$.

diverticulum (*p.d.*) meets a second short one (*an.l.d.*) from the left anterior region of the body, and together they open into the hind part of the stomach. The third diverticulum (*an.r.d.*) is from the anterior right region of the animal, and it communicates with the stomach close to the origin of the intestine. From the right and left anterior diverticula extensions of the digestive gland enter the first two groups of the cerata of the respective sides. The median posterior diverticulum bears lateral branches in the region of the third to the last groups of cerata of either side into which the ramifications of the digestive gland enter as in the anterior groups. The posterior diverticulum terminates blindly in the tail. The three main diverticula, as well as the glandular extensions into the cerata, being dark gray are visible through the outer integument (Text-fig. 1a.).

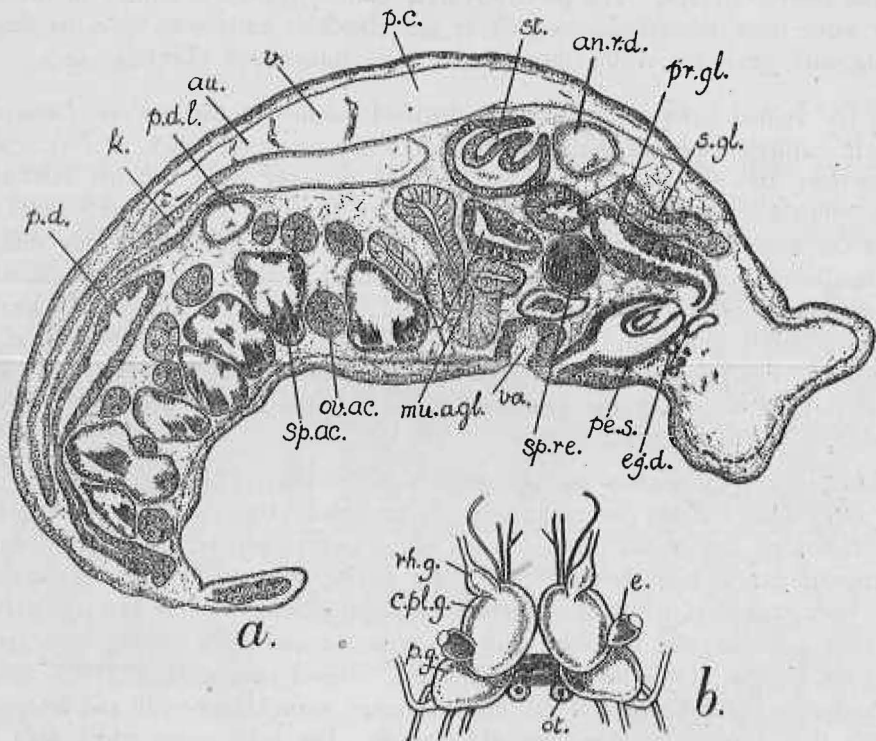
The animal feeds normally on the hydroid colonies of *Bimeria* and *Laomedea*, but in captivity minced flesh of brackish water anemones such as *Phylocoetes gangeticus* and *Boloceractis gopalai* is found to serve as a suitable substitute. The animals cover the pieces of flesh with slime from the pharyngeal glands, and then cut them into bits with the help of the jaws. The cut portions are reduced to smaller scrapings by the radular teeth. Serial sections revealed the presence of nematocysts (*n.c.*) of the Colenterate food throughout the alimentary canal in an unexploded condition. The cnidosacs (Text-fig. 3c. *cn.sa.*) at the tips of the cerata contained particularly large numbers of them in cells known as the cnidoblast cells (*c.b.c.*). At the junction of the digestive gland with the cnidosac there is a strong sphincter muscle.

Organs of Circulation and Respiration.—The heart (Text-figs. 3a & b. and 4a. *ht.*) enclosed in the pericardium (*p.c.*) lies beneath the dorsal body-wall behind the region of the stomach and consists of an oval ventricle (*v.*) in front and a triangular auricle (*au.*) behind. The aorta arising from the ventricle divides into two main trunks of which the anterior one supplies blood to the cephalic organs, anterior genitalia and the foot, and the posterior one sends numerous branches into the follicles of the hermaphrodite gland. Blood passing through the arteries is next collected in lacunae of the internal organs, cerata, body-wall and foot, from which it is carried by veins into the auricle. The main veins which lead into the auricle from behind are three. The entire surface of the body-wall inclusive of that lining the cerata helps in the exchange of gases in respiration.

Organs of Renal Excretion.—The kidney (Text-figs. 3a. & b. and 4a.) is broadly divisible into two parts, viz., (i) a large elongated kidney sac (*k.*) lying beneath the dorsal body-wall immediately behind the heart and extending up to the posterior extremity of the body-space, and (ii) a narrow diverticulum (*a. k. d.*) leading out from the anterior extremity of the first part and proceeding forwards beneath the pericardium to the right of the animal. The diverticulum communicates in front both with the pericardium and the rectum. The kidney is lined by specialised excretory cells which are cubical with highly vacuolated cytoplasm and round nuclei (*ex.c.*). The reno-pericardial passage (*r.p.p.*) is short and lined by cells bearing tufts of large cilia protruding into its lumen. As the diverticulum

communicates with the rectum, the waste materials from the pericardium and the kidney sac finally find their way out through the anus.

Nervous System and Sense Organs.—In the central nervous system (Text-fig. 1b. *c.n.s.* and Text-fig. 4b.) paired cerebro-pleural (*c.pl.g.*) and pedal ganglia (*p.g.*) are situated behind the pharyngeal bulb dorsal to the oesophagus. The cerebro-pleural ganglia of the opposite sides lie so close to each other that the commissure connecting them dorsal to the oesophagus is very short and is visible only in sections. The pedal and the cerebro-pleural ganglia of the same side are con-



TEXT-FIG. 4. *Cuthona adyarensis*, sp. nov.

- a. Longitudinal section of the animal to the right of the median line $\times 30$;
 b. Central nervous system.

nected by short cerebro-pedal and cerebro-pleural connectives. The pleural portions of the cerebro-pleural ganglia of the opposite sides, as well as the two pedal ganglia are connected by pleural and pedal commissures running ventral to the oesophagus. The cerebro-pleural ganglia are also connected by means of buccal connectives with a pair of small buccal ganglia. The nerves supplying the rhinophores arise from small rhinophoral ganglia (*rh.g.*) united with the cerebro-pleurals in front. The eyes (*e.*) which lie beneath the skin have their nerve supply from the cerebro-pleurals and consist of a pigmented cup-like retina and clear crystalline lens. The otocysts (*ot.*) are two in number arising in connection

with the pedals, but having their nerve supply from the cerebral portion of the cerebro-pleural ganglia. Each otocyst has a single otolith.

Organs of Reproduction.—The follicles of the hermaphrodite gland, the hermaphrodite duct and the anterior genital complex which together occupy the major portion of the body-space of the animal comprise the reproductive system (Text-figs. 3*d*. and 4*a*.). Seven to eight hermaphrodite follicles, gradually descending in size from the anterior to the posterior ones, lie on either side of the posterior digestive diverticulum. Each follicle has several small roundish peripheral ovular acini (*ov.ac.*) communicating with a large single spermatic acinus (*sp.ac.*). The outgoing ducts from the different spermatic acini of the follicles lead into a median hermaphrodite duct which almost runs parallel to the posterior digestive diverticulum. It bulges anteriorly into a large seminal ampulla (*sp.am.*) and bifurcates into the male and female passages in the anterior genital complex. The male genital organs of this complex consist of a well developed stout prostate gland (*pr.gl.*), a narrow ejaculatory duct (*ej.d.*) and an eversible penis in the penis sheath (*pe.s.*). The penis is terminally armed with a weak, but distinct stylet (Text-fig. 3*e.*). In the female organs of the complex the chief part is the oviduct which takes a complicated course through the muco-albuminous gland (*mu.a.gl.*) and opens by the oviducal aperture (*ov.ap.*). The vaginal passage (*va.*) from its external opening (*v.op.*) situated close to the oviducal opening, runs inwards to open into the proximal part of the oviduct which is modified as the fertilization chamber. A small sperminal receptacle (*sp.re.*) is associated with the vaginal passage. Spermatazoa from the male acini pass into the sperminal ampulla of the hermaphrodite duct, and during copulation between two individuals, when the penis of one is inserted into the vaginal passage of the other, the contraction of the sperminal ampulla of one permits their passage into the sperminal receptacle of the other. Later on they enter the fertilization chamber and fertilise the ova during deposition of the spawn. The fertilised eggs are surrounded by nutritive albumen and enclosed in membranous capsules. They are then extruded out wrapped in mucus in the form of strings, which are usually found twisted round the weeds.

IV—Systematic position of *Cuthona adyarensis*

Alder and Hancock in 1855 in the appendix to their monograph on the British Nudibranchiata erected the genus *Cuthona* for an Aeolid which they described earlier in the same work as *Eolis nana*, characterised by the presence of a head produced at the sides, two pairs of simple linear tentacles, clavate branchiae in close set rows, a broad foot having rounded anterior angles, and a uniseriate radula with teeth having a single large median and several smaller lateral denticles. There are two allied genera, *Cratena* Bergh and *Amphorina* Quatrefages, the validity of which was questioned by Eliot (1910*b*), and O'Donoghue (1926). Eliot (1910*b*) provisionally retained *Amphorina* and merged *Cratena* with *Cuthona*. O'Donoghue (1926) in his revision of the nomenclature of certain

Nudibranch genera has pointed out that the genus *Amphorina* has no standing, the monotype *A. alberti* Quatrefages being synonymous with *Eubranchius farrani* Forbes; that the genus *Cratena* established by Bergh in 1864 as a new name for the preoccupied *Montagua* of Fleming and *Doris coeruleus* of Gray (1846) is a sound and valid genus; and that the subsequent restoration of the genus *Amphorina* by Bergh in 1882 to include *Doris coeruleus* of Gray (synonymous with *Amphorina coeruleus* of Trinchese 1879) and the retention of *Cratena* to include now a number of forms with undoubted characters of *Cuthona* Alder and Hancock are erroneous and confusing.* In the light of O'Donoghue's findings it is clear that Eliot's (1910b) provisionally retained genus *Amphorina* is indeed *Cratena* as established by Bergh in 1864. The genus *Cratena* after the restoration of *Amphorina* has no standing and Eliot (1910) is correct in merging it with *Cuthona*.

The following are the specific characters of *Cuthona adyarensis*: general colouration pale yellow or light orange with specks of gray over head and bases of rhinophores; head rounded in front; oral tentacles and rhinophores smooth without perfoliations, long and pointed at tips; cerata slender, elongated, dark gray with whitish tips, and arranged in 7 or 8 lateral groups on either side of the body; anus lateral in front of the third group of cerata of the right side; radula with about 35 horse-shoe-shaped teeth each with a prominent median denticle and seven smaller lateral denticles on either side; otocyst each with a single otolith; and penis with weak armature of the nature of a minute stylet.

Locality.—Estuary of Adyar River near Madras. Type material will be deposited with the Zoological Survey of India (Indian Museum), Calcutta.

Cuthona adyarensis is markedly different from the other two species recorded from the Indian brackish waters, viz., *C. annandalei* Eliot (1910 a) from Maltah River at Port Canning, and *C. henrici* Eliot (1916) from the Chilka Lake. *C. annandalei* is distinguished by the presence of a large number, up to 17, of tufts of cerata of peculiar shape, with a prominent bulging beneath the tip, and of a radula with teeth having very broad bases and numerous lateral denticles on either side of a low central cusp. Even a mere comparison of the general contour of *C. henrici*, as given by Eliot (1916) with that of the present form figured here will show that these two species are distinct. *C. henrici* has only a small number of four pairs of tufts of cerata which are thick and ovate; and its teeth have a moderately strong median cusp with about seven lateral denticles on each side, of which the one close to the central cusp and the outermost one are considerably smaller and sometimes hardly visible. These characters of *C. henrici* distinguish it from the present form. Of the purely marine species mention may be made of *Cratena capensis* Barnard (1927) from the Cape Peninsula of South Africa. It is undoubtedly referable to the genus *Cuthona*, and possesses peculiar fusiform, red cerata with white tips, in 8 to 9 lateral groups and a small number of 15 horse-shoe-shaped radular teeth, having a strong and prominent

* Bergh 1864 & 1882, Gray 1846 and Trinchese 1879 as referred by O'Donoghue 1920.

central cusp and 5 to 7 lateral denticles. *Aeolis tristis* of Kelaart (1858) was referred to the genus *Cuthona* by Eliot (1910 c) who also considered that it might probably be synonymous with *Cratena cucullata* Bergh (1905). Prominently marked dark rings on the tentacles and similar bands on either side of the head and body, such as are described by Kelaart (1858) and Bergh (1905) are absent in *Cuthona adyarensis*.

V—Summary

A small aeolid occurring in the algal beds of the Adyar estuary near Madras is described as a new species of the genus *Cuthona* Alder and Hancock. It is named *C. adyarensis* after the locality of its occurrence. An account of its anatomy is given.

VI—Acknowledgment

The writer takes the opportunity of expressing his gratitude to Dr. N. K. Panikkar, Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, for going through the manuscript and suggesting improvements.

VII—References

- ALDER, J. and HANCOCK, A., 1855. A Monograph of the British Nudibranchiate Mollusca. Pt. 7. *Ray Soc., London*.
- 1866. Notice of a Collection of Nudibranchiate Mollusca made in India by Walter Elliot, Esq., with descriptions of several new Genera and Species. *Trans. zool. Soc., London*, 5, Pt. 3, pp. 113-147.
- BARNARD, K., 1927. South African Nudibranch Mollusca with descriptions of new species, and a note on some specimens from Tristan d'Achunha. *Ann. S. African Mus.*, 25, pp. 171-215.
- BERGH, R., 1870-1875. Malacologische Untersuchungen. *Semper's Reisen im Archipel der Philippinen I Bd. II*.
- 1873-1876. Report on the Nudibranchiata dredged by H.M.S. Challenger during the years 1873-76. *Rep. Sci. Res. Expl. Voy. H.M.S. Challenger, Zool.* 10, pp. 1-154.
- 1905. Die Opisthobranchiata der Siboga Expedition. *Siboga Exped. Monogr.* 50, Leiden.
- ELIOT, C., 1903. On some Nudibranchs from East Africa and Zanzibar. Pt. II. *Proc. zool. Soc. London*, pp. 250-257.
- 1904. On some Nudibranchs from East Africa and Zanzibar. Pt. VI. *Ibid.*, London, pp. 268-298.
- 1906a. Notes on some British Nudibranchs. *Journ. Mar. Biol. Assoc. U.K. Plymouth*, 7 (N.S.), pp. 333-382.
- 1906b. On the Nudibranchs of Southern India and Ceylon, with special reference to the Drawings made by Kelaart and the Collections belonging to Alder and Hancock preserved in the Hancock Museum at Newcastle-on-Tyne. *Proc. zool. Soc. London*, pp. 636-91.
- 1906c. The Nudibranchiata, with some remarks on the families and genera and description of a new genus *Doridomorpha*. Stanley Gardiner's *Fauna and Geography of the Maldives and Laccadive Archipelagoes*, 2, pp. 540-573.
- 1910a. Notes on Nudibranchs from the Indian Museum. *Rec. Indian Mus. Calcutta*, 5, pp. 247-252.
- 1910b. A monograph of the British Nudibranchiate Mollusca, Pt. 8 (Supplementary). *Ray Society, London*, pp. 1-197.

- ELIOT, C., 1910c. Notes on a Collection of Nudibranchs from Ceylon. *Spolia zeylan.*, **6**, pp. 79-95.
- 1916. Fauna of Chilka Lake: Mollusca Nudibranchita. *Mem. Indian Mus.*, Calcutta, **5**, pp. 373-379.
- FARRAN, G. P., 1905. Report on the Opisthobranchiate Mollusca collected by Prof. Herdman at Ceylon in 1902. *Rep. Pearl Oyster Fish. of the Gulf of Manaar*, **3**, pp. 329-364.
- KELAART, E. F., 1858. New and little known species of Nudibranchiate Molluscs and Zoophytes. *J. Ceylon Branch roy. Asiatic Soc.*, **3**, pp. 76-124.
- O'DONOGHUE, C. H., 1926. On the Status of the Nudibranch Genera *Amphorina Cratena*, *Eubranthus* and *Galvina*. *Proc. Malac. Soc.*, London, **17**, pp. 127-131.
- 1932. Notes on Nudibranchiata from Southern India. *Ibid.*, London, **20**, pp. 141-166.
- RAO, K. V., 1936. The Morphology of *Kalinga ornata* Ald. & Han. *Rec. Indian Mus.*, Calcutta, **38**, pp. 41-79.
- 1937. Structure, Habits and early Development of a new Species of *Stiliger* Ehrenberg. *Ibid.*, Calcutta, **39**, pp. 435-464.
- THIELE, J., 1931. Handbuch der Systematischen Weichtierkunde, Gustav Fischer, Jena, Bd. I.

VIII—Key to the lettering of the figures

a.k.d., anterior kidney diverticulum; *an.*, anus; *an.l.d.*, anterior left diverticulum of the digestive gland; *an.r.d.*, anterior right diverticulum of the digestive gland; *a.p.*, anal papilla; *au.*, auricle; *b.w.*, body-wall; *c.b.c.*, cnidoblast cells; *c.ep.*, ciliated ectodermal epithelium; *c.pl.g.*, cerebro-pleural ganglia; *c.n.s.*, central nervous system; *cn.sa.*, cnidosac; *ex.c.*, excretory cells of kidney; *gl.c.d.*, gland cells of digestive gland; *g.p.*, genital pilla; *h.r.d.*, hermaphrodite duct; *ht.*, heart; *l.t.*, labial thickening; *m.*, mouth; *m.g.a.*, male genital aperture; *mu.a.gl.*, muco-albuminous gland; *ot.*, otocyst; *ov.ac.*, ovular acinus; *ov.ap.*, oviducal aperture; *p.c.*, pericardium; *p.d.*, posterior diverticulum of the digestive gland; *p.d.l.*, lateral branch of posterior digestive gland diverticulum; *pe.*, penis; *p.ep.*, pedal epithelium with mucous glands; *pe.s.*, penis sheath; *p.g.*, pedal ganglia; *ph.b.*, pharyngeal bulb; *ph.gl.*, pharyngeal glands; *pr.gl.*, prostate gland; *rect.*, rectum; *rh.g.*, rhinophoral ganglia; *r.p.p.*, reno-pericardial passage; *s.gl.*, salivary gland; *sp.ac.*, spermatic acinus; *sp.am.*, seminal ampulla; *sp.re.*, sperm receptacle; *v.*, ventricle; *va.*, vaginal passage; *v.ap.*, vaginal opening.