

THE PELAGIC NUDIBRANCH, *CEPHALOPYGE TREMATOIDES* (CHUN, 1889), IN
NEW SOUTH WALES WITH A NOTE ON OTHER SPECIES IN THIS GENUS.

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(Plate xi; eight Text-figures.)

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Synopsis.

The Phyllirhoid nudibranch, *Cephalopyge trematoides* (Chun, 1889), is recorded from Port Jackson, N.S.W. On the basis of variations observed in Australian specimens, the validity of the six species in *Cephalopyge* is discussed and it is concluded that they all should be synonymized with *C. trematoides*. The specimens from New South Wales are described.

In 1936 Dakin and Colefax published a description of a pelagic nudibranch belonging to the family Phyllirhoidae from five specimens taken off the coast of New South Wales which they referred to the genus *Ctilopsis* André, 1906. A year later, on the basis of further investigation of the literature, they reassigned their specimens to the genus *Cephalopyge* Hanel, 1905, with which *Ctilopsis* had been synonymized (Thiele, 1931) and stated, moreover, that they appeared to be a southern variety of *C. orientalis* Baba, 1933.

On the morning of October 27, 1955, many *Cephalopyge* were observed swimming near the end of a small wharf in Camp Cove just inside Inner South Head, Port Jackson, N.S.W. Also present were large numbers of small salps. Approximately one hundred *Cephalopyge* were collected on this and the following day. They appeared to be less abundant on the 28th. The animals were observed and photographed alive and motion pictures were taken of their swimming movements. Some were relaxed with menthol and others were killed without relaxation with dilute glacial acetic acid. All were preserved in alcohol. They were identified as *Cephalopyge trematoides* (Chun, 1889).

One specimen of *Cephalopyge* collected by Dakin and Colefax and two specimens of *Cephalopyge trematoides* collected off the coasts of Southern and Lower California (see Dales, 1953) have been examined by me and compared with my specimens.

In all there have been six species included in the genus *Cephalopyge*. These are based on eleven collections, totalling few more than thirty specimens, with no collection containing more than about five. To my knowledge only one has ever been seen alive (Pierantoni, 1923). Odhner, in his revision of the Dendronotacea (1936), lists five of the species: *C. trematoides* (Chun, 1889), *C. mediterranea* (Pierantoni, 1923), *C. orientalis* Baba, 1933, *C. picteti* (André, 1906) and *C. michaelisarsi* (Bonnievie, 1921). The sixth, *C. arabica* Stubbings, was described in 1937. The genus had been divided into two subgenera by Thiele (1931) on the basis of the development of the foot, but Dakin and Colefax (1937) questioned the validity of this division and the variation in my specimens shows that this character is, as they suggested, dependent on the amount of contraction or expansion at the time of preservation.

The use of the number of hermaphrodite glands in separating species was also thought by these authors and by Stubbings (1937) to be unsatisfactory. Dakin and Colefax found it necessary to make a careful examination of serial sections in order to determine the number of glands and so questioned the findings of previous authors in regard to the number they had recorded. Stubbings felt that the actual number was

apparent only in young animals. He synonymized *C. trematoides* and *C. mediterranea* as the only feature really separating them was a difference in the number of these glands. In my specimens the number of glands varies considerably, thus supporting these authors' contentions.

The differences in the length and shape of internal and external organs which have been used to separate the species in *Cephalopyge* can all be shown to be merely artifacts of preservation if a large enough series of animals is available. On this basis, when I found a radula present in my specimens, I assigned them to *C. trematoides*. However, *C. picteti* had also been found to possess a radula. It has been retained in the genus *Ctilopsis* by Pruvot-Fol (1946) because the teeth in the radula are denticulate and the radular formula is 1.1.1. Under ordinary magnification, the radula in my specimens is identical with that figured by Pruvot-Fol (1929) for *C. mediterranea* (= *C. trematoides*). However, under very high magnification the teeth were seen to be denticulated in the same manner as those figured by André for *C. picteti*. Similarly, the median tooth differs in structure from the laterals, thus giving a formula of 1.1.1. The only difference is in the size of the teeth, André's being larger in smaller specimens. Dakin and Colefax have pointed out the great similarity of their material to André's. The only differences they noted were the length of the anterior and posterior hepatic caeca and the absence of a radula. I have been able to locate a radula in the single specimen of Dakin and Colefax's material available to me and it has been stated above that the differences in the length of internal organs are due to preservation. Despite discrepancy in the size of the radular teeth, I have concluded that there is no reason to maintain *C. picteti* in a separate genus or even as a distinct species and so synonymize it with *C. trematoides*.

There are no valid characters distinguishing *C. orientalis* from *C. trematoides* other than the absence of a radula. I think it is safe to assume that Baba overlooked this very small structure, as had Dakin and Colefax. Therefore, *C. orientalis* must be considered synonymous with *C. trematoides*.

C. arabica, in which Stubbings was unable to locate a radula, differs from *C. orientalis* in having: (a) a long tail, more rounded than that of the latter and bearing a terminal tuft of setae; (b) three hermaphrodite glands as opposed to four in *C. orientalis*; and (c) an intestine narrow at the base which differs from *C. orientalis* in which it is a broad tube narrowing toward the anus. The question of the hermaphrodite glands has already been discussed and the shape of the tail and of the intestine varies in preserved specimens. If, again, we assume that Stubbings missed the radula (which is quite possible as he apparently did not dissect any of his specimens for the mouth-parts and I have never been able to identify the radula in serial sections) the caudal setae, although they have not been noted by any other author, do not seem to be of sufficient importance to separate this species from *C. orientalis* which has now been synonymized with *C. trematoides*.

C. michaelsarsi is known from a single rather mutilated specimen. It was described as lacking a dorsal anterior hepatic caecum but possessing what has been interpreted as a ventral one. One of the specimens from the North-eastern Pacific which I have examined appeared to lack a dorsal anterior hepatic caecum, but it was found to have only an extremely short one. It is quite possible that this may have been the case in Bonnevie's specimen. The ventral anterior hepatic caecum is poorly defined, as, indeed, is the ventral posterior one. No radula was found. I feel that these differences are not of sufficient strength to warrant the retention of this as a separate species. It appears to me to be nothing more than a badly preserved specimen of *C. trematoides*. However, none of my specimens showed any variation in the structure of the hepatic caeca which could be likened to the condition illustrated by Bonnevie. If subsequent investigation reveals specimens possessing a ventral anterior caecum, then the question of the validity of *C. michaelsarsi* would again be open. Until such a time, however, I prefer to place it in synonymy with *C. trematoides*.

CEPHALOPYGE Hanel, 1905.

Cephalopyge Hanel, 1905, *Zool. Jb.*, 21:460. Type, by monotypy, *Phyllirhoe trematoides* Chun, 1889.

Ctilopsis André, 1906, *Rev. suisse Zool.*, xiv:72. Type, by monotypy, *Ctilopsis picteti* André, 1906.

Dactylopus Bonnevie, 1921 (not Gill, 1859; not Claus, 1862), *Zool. Anz.*, 53:146. Type, by original designation and monotypy, *Dactylopus michaelisarsii* Bonnevie, 1921.

Nectophyllirhoe Hoffman, 1922, *Zool. Anz.*, 54:304. Type, by monotypy, *Dactylopus michaelisarsii* Bonnevie, 1921.

Boopsis Pierantoni, 1923, *Pubbl. Staz. zool. Napoli*, v:84. Type, by original designation, *Boopsis mediterranea* Pierantoni, 1923.

Bonneviia Pruvot-Fol, 1929, *Bull. Soc. zool. Fr.*, liv:570. Type, by monotypy, *Dactylopus michaelisarsii* Bonnevie, 1921.

CEPHALOPYGE TREMATOIDES (Chun, 1889).

Phyllirhoë trematoides Chun, 1889, *S.B. preuss. Akad. Wiss.*, 1889:547. (Type locality: Canary Islands.)

Cephalopyge trematoides Hanel, 1905, *Zool. Jb.*, 21:460; Thiele, 1931, *Handb. Syst. Weichtierkunde*, 2:446; Odhner, 1932, *Ark. zool.*, 23:46; Baba, 1933, *Annot. zool. jap.*, xiv:159; Odhner, 1936, *Mem. Mus. Roy. Hist. nat. Belg.*, 3:1125; Stubbings, 1937, *Sci. Rep. Murray Exped.*, 5:12; Pruvot-Fol, 1946, *Bull. Mus. Hist. nat. Paris*, (2) 18:175; Dales, 1953, *Ann. Mag. nat. Hist.*, (12) 6:193.

Ctilopsis picteti André, 1906, *Rev. suisse Zool.*, xiv:72; Vessichelli, 1906, *Mitt. zool. Sta. Neapel*, xviii:131; Pierantoni, 1923, *Pubbl. Staz. zool. Napoli*, v:93; Odhner, 1932, *Ark. Zool.*, 23:47; Bertolini, 1935, *Pubbl. Staz. zool. Napoli*, xv:69; Dakin and Colefax, 1936, *Proc. zool. Soc. Lond.*, 1936:457; Stubbings, 1937, *Sci. Rep. Murray Exped.*, 5:9; Pruvot-Fol, 1946, *Bull. Mus. Hist. nat. Paris*, (2) 18:175.

Ctilopsis trematoides, Vessichelli, 1906, *Mitt. zool. Sta. Neapel*, xviii:131.

Dactylopus michaelisarsii Bonnevie, 1921, *Zool. Anz.*, 53:152.

Nectophyllirhoe michaelisarsi, Hoffman, 1922, *Zool. Anz.*, 54:304; Thiele, 1931, *Handb. Syst. Weichtierkunde*, 2:447; Pruvot-Fol, 1946, *Bull. Mus. Hist. nat. Paris*, (2) 18:175.

Boopsis mediterranea Pierantoni, 1923, *Pubbl. Staz. zool. Napoli*, v:84; Pruvot-Fol, 1929, *Bull. Soc. zool. Fr.*, liv:467; Bertolini, 1935, *Pubbl. Staz. zool. Napoli*, xv:67.

Boopsis trematoides, Pierantoni, 1923, *Pubbl. Staz. zool. Napoli*, v:94; Bertolini, 1935, *Pubbl. Staz. zool. Napoli*, xv:68.

Bonneviia michaelisarsi, Pruvot-Fol, 1929, *Bull. Soc. zool. Fr.*, liv:570.

Cephalopyge picteti, Thiele, 1931, *Handb. Syst. Weichtierkunde*, 2:446; Baba, 1933, *Annot. zool. jap.*, xlv:159; Odhner, 1936, *Mem. Mus. Roy. Hist. nat. Belg.*, 1:1125; Dakin and Colefax, 1937, *Ann. Mag. nat. Hist.*, (10) 19:267; Stubbings, 1937, *Sci. Rep. Murray Exped.*, 5:11.

Cephalopyge mediterranea, Odhner, 1932, *Ark. Zool.*, 23:47; Baba, 1933, *Annot. zool. jap.*, xlv:159; Odhner, 1936, *Mem. Mus. Roy. Hist. nat. Belg.*, 3:1125; Dakin and Colefax, 1937, *Ann. Mag. nat. Hist.*, (10) 19:267.

Cephalopyge orientalis Baba, 1933, *Annot. zool. jap.*, xiv:157; Odhner, 1936, *Mem. Mus. Roy. Hist. nat. Belg.*, 3:1125; Dakin and Colefax, 1937, *Ann. Mag. nat. Hist.*, (10) 19:267; Stubbings, 1937, *Sci. Rep. Murray Exp.*, 5:12; Dakin and Colefax, 1940, *Univ. Sydney Publ. zool. monogr.*, 1:208; Pruvot-Fol, 1946, *Bull. Mus. Hist. nat. Paris*, (2) 18, 175; Baba, 1949, *Opisthobranchia of Sagami Bay*, Tokyo, 19.

Cephalopyge michaelisarsi, Odhner, 1932, *Ark. Zool.*, 23:48; Odhner, 1936, *Mem. Mus. Hist. nat. Belg.*, 3:1126.

Cephalopyge arabica Stubbings, 1937, *Sci. Rep. Murray Exped.*, 5:1; Pruvot-Fol, 1946, *Bull. Mus. Hist. nat. Paris*, (2) 18:175.

New localities: Camp Cove, Port Jackson, N.S.W., Australia, 27th and 28th October, 1955 (33° 50' S, 151° 17' E); North-eastern Pacific, 11th March, 1951, 0-140 metres in net tow (28° 38.1' N, 115° 15.9' W); North-eastern Pacific, 22nd January, 1952, 0-132 metres

in net tow (33° 24' N, 117° 55' W). *Other localities*: Canary Islands (Chun, 1889); Amboina (André, 1906); North Atlantic (47° 34' N, 43° 11' W) (Bonnievie, 1921); Gulf of Naples (Pierantoni, 1923; Bertolini, 1935); Villefranche sur Mer, France (Pruvot-Fol, 1929); South-west of Canary Islands (20° 35' N, 23° 29' W) (Odhner, 1932); Shimizu Bay, Japan (Baba, 1933); off coast of New South Wales (Dakin and Colefax, 1936); John Murray Expedition Sta. 96, Central part of Arabian Sea; Sta. 131d, Southern part of Arabian Sea (Stubbings, 1937); North-eastern Pacific, 28° 30' N, 117° 58' W (Dales, 1953).

Specimens from New South Wales have been deposited in the National Museum of Victoria, the British Museum and the United States National Museum.

External Features.

The body is elongate and laterally compressed. Viewed from the side it is seen as a very elongated ellipse. The tail is slightly truncate in life, but may become rounded during fixation. The largest animal collected measured 25 mm. in length and 3½ mm. in height and the smallest measured 10 mm. in length and 2 mm. in height.

In life the body wall was transparent and colourless. It has become less so in preservation, but the internal organs can still be distinguished easily. There are many glandular epithelial cells distributed throughout the body wall. They are especially concentrated along the dorsal and ventral margins of the body and show up as bands of opaque spots (Text-fig. 1, UG). The longitudinal bundles of muscle fibres which run nearly the entire length of the body are seen more clearly in preserved specimens. They are quite conspicuous in cross serial sections.

With the exception of the intestine which is pinkish and a reddish-brown organ in the reproductive system (the ampulla), the internal organs of the living animal are nearly colourless, differing only in opacity. The main masses of the hermaphrodite glands are the most opaque, the rest of the reproductive organs being less so. The hepatic caeca and stomach are quite translucent as are the finger-like processes of the hermaphrodite glands, the renal organs and the buccal mass.

The rhinophores (Text-fig. 1, R) are long, smooth and usually held erect or directed slightly anteriorly (Plate xi, fig. B). They may sometimes be directed laterally (Plate xi, fig. A). They are almost completely contractile into pockets below and laterad to the cephalic disc (Text-fig. 1, CD) which is situated above the mouth. There are no other external appendages. The mouth is a longitudinal slit surrounded by somewhat fleshy lips containing many unicellular glands. A longitudinal groove (Text-fig. 1, LG) runs from the base of the mouth ventrally and posteriorly to the foot. The walls of this groove contain many glandular cells, but no ciliated cells could be distinguished.

The foot (Text-fig. 1, F) is located below the posterior region of the pharynx and is capable of considerable contraction and expansion. Variations in the appearance of this structure may be seen in Plate xi. The large muscles controlling the foot can be seen running down to the small pedal gland. This gland is rounded and consists of cells staining similarly to those found in the longitudinal groove. Stubbings (1937) says that no such groove was visible in his specimens but he indicates darkly-staining cells in the region where it is found in mine.

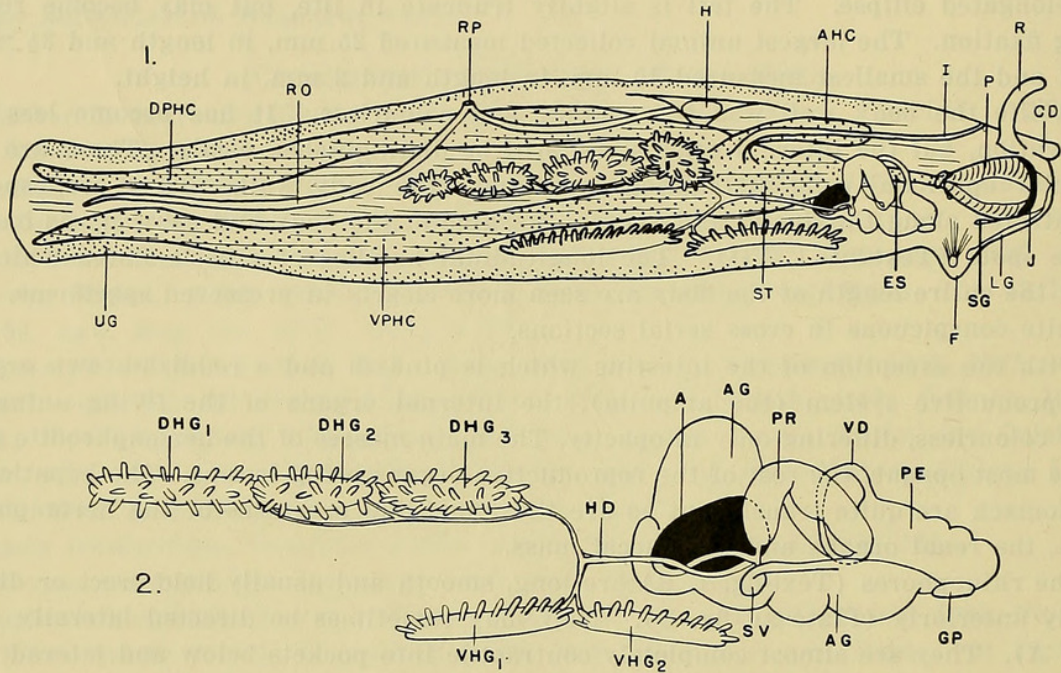
Alimentary Canal.

The pharynx (Text-fig. 1, P) is very muscular and is roughly oval in outline, the broadly rounded end being anterior and covered by the jaws (Text-fig. 1, J; Text-fig. 3). These are chitinous and well developed but lack a process masticatorius. The edges where they are joined dorsally are smooth except for a large triangular projection on the inner side. The cutting edge bears a membranous strip which is loose at its ventral end and which contains many small spicules arranged vertically in irregular rows (Text-fig. 4). The ventral edge of each jaw may be seen in cross section to bear about 7-9 small inwardly-directed teeth, which may be interlocking.

The radula is located at the tip of a very small laterally compressed papilla, the odontophore (Text-fig. 5), which lies just inside the base of the jaws. The odontophore

rests on a platform of muscular tissue which lies below the jaws. In cross section there may be seen a shallow groove at the tip of the odontophore in which the radula probably lies. The teeth could not be seen in sections and it was only with great difficulty that I eventually demonstrated their presence. The radula consists of about twelve rows of three hooked teeth each (Text-fig. 6). There is no radular sac. The laterals in the third row of teeth appear to be denticulate on the inner side of the large spine only with four to eight denticles. The median tooth is denticulated on both sides of the central spine with six denticles. The radular formula is $12 \times 1.1.1$.

The salivary glands (Text-fig. 1, SG) lie beneath the pharynx and enter that organ just below and behind the odontophore. They appear to be flattened ellipses in cross section. The pharynx opens into a short muscular oesophagus (Text-fig. 1, ES) which



Text-fig. 1.—*Cephalopyge trematoides* (Chun, 1889). $\times 5$. UG, unicellular gland; R, rhinophore; CD, cephalic disc; LG, longitudinal groove; F, foot; P, pharynx; J, jaw; SG, salivary gland; ES, oesophagus; ST, stomach; AHC, anterior hepatic caecum; DPHC, dorsal posterior hepatic caecum; VPHC, ventral posterior hepatic caecum; I, intestine; RO, renal organ; RP, renal pore; H, heart.

Text-fig. 2.—Diagram of reproductive system. $\times 14$. VH1-2, ventral hermaphrodite glands; DHG 1-3, dorsal hermaphrodite glands; HD, common hermaphrodite duct; A, ampulla; SV, seminal vesicle; PR, prostate gland; VD, vas deferens; PE, penis; AG, accessory glands; GP, genital pore.

leads into the stomach (Text-fig. 1, ST). This is a rather large sac-like structure into which three hepatic caeca (digestive diverticula) and the intestine open. The anterior hepatic caecum (Text-fig. 1, AHC) arises from the stomach dorsally and slightly to the left of the median line. It consists of a finger-like projection running anteriorly above the stomach and the oesophagus. It is quite variable in both length and breadth in preserved specimens (Plate xi, figs. C, D, E), and in life was seen to contract and expand to some degree. In most of my specimens it is a little more than half the length of the intestine but may be nearly as long as that organ or very short. The other two hepatic caeca (Text-fig. 1, DPHC, VPHC) arise posteriorly from the stomach and run, one dorsally and one ventrally, down the length of the body. They reach nearly to the end of the tail in living and in most preserved specimens but may be contracted to varying degrees in the latter. Peristaltic waves were seen to be almost continually passing down these diverticula in the living animals.

The intestine (Text-fig. 1, I) originates from the stomach to the right of the anterior hepatic caecum. It parallels the course of this organ, passes it, and eventually terminates

dorsally just behind the rhinophores. None of my specimens had the anus raised on a papilla. The intestine is usually broad at its base, tapering to a narrow tube, but may be narrow at the base too.

Reproductive System.

There are two groups of hermaphrodite glands, one lying between the body wall and the ventral parts of the alimentary canal (Text-fig. 2, VH 1-2) and the other lying between the dorsal and ventral posterior hepatic caeca (Text-fig. 2, DH 1-3). A membrane of connective tissue lies horizontally over the lower group of glands, separating them from the rest of the body cavity. The dorsal group of glands are also separated from the rest of the perivisceral cavity by membranes of connective tissue. Each gland in the upper group consists of a solid centre mass which bears numerous finger-like projections. Sperm are formed in the central core and eggs develop in the projections. The number of glands varies considerably as, apparently, they increase in number as the animal grows older. As few as two and as many as six have been observed, but it is difficult to determine the number by observation in a whole specimen or by serial sections. If the glands are dissected out they can be separated and each will be seen to have a small duct leading out from it anteriorly. The duct of each gland passes under the gland anterior to it and then joins a common duct. The glands, if there are more than two, do not usually lie singly in a straight line but overlap somewhat, giving the impression in the whole animal of there being just one gland or, as is more often the case, the appearance of only two glands.

The ventral group usually consists of two rather elongate glands each bearing two longitudinal rows of finger-like processes. There may be a very small, nearly spherical gland lying between the two larger ones whose duct joins that of the anterior gland. Figure D in Plate xi shows a specimen with a ventral mass consisting solely of a single spherical gland displaced dorsally.

The ducts from both groups of glands unite to form a common tube (Text-fig. 2, HD) which runs forward into the large reddish ampulla (Text-fig. 2, A). It enters this organ anteriorly and ventrally. The larger ovo-sperm duct emerges from the ampulla posteriorly and ventrally. It runs anteriorly the length of the ampulla where it bifurcates into a short oviduct which enters the seminal vesicle (Text-fig. 2, SV) and an even shorter sperm duct which enters a thickened prostate region (Text-fig. 2, PR). A comparatively short vas deferens (Text-fig. 2, VD) leaves the prostate ventrally and curves up behind it. It enters the penis (Text-fig. 2, PE) which is muscular and unarmed. When everted this organ bears a fleshy wing-shaped structure proximally.

The oviduct becomes closely associated with the accessory glands (Text-fig. 2, AG) a short distance after it leaves the seminal vesicle. The accessory glands appear to be two in number and lie below the main genital mass as well as on the left side of it and the stomach. The oviduct can be traced through serial cross sections but cannot be followed in a dissection. It runs straight forward in direct contact with the lower accessory glands and toward the end of its course the inner wall of the oviduct becomes glandular. It eventually opens to the exterior through a genital pore (Text-fig. 2, GP) in common with the penis.

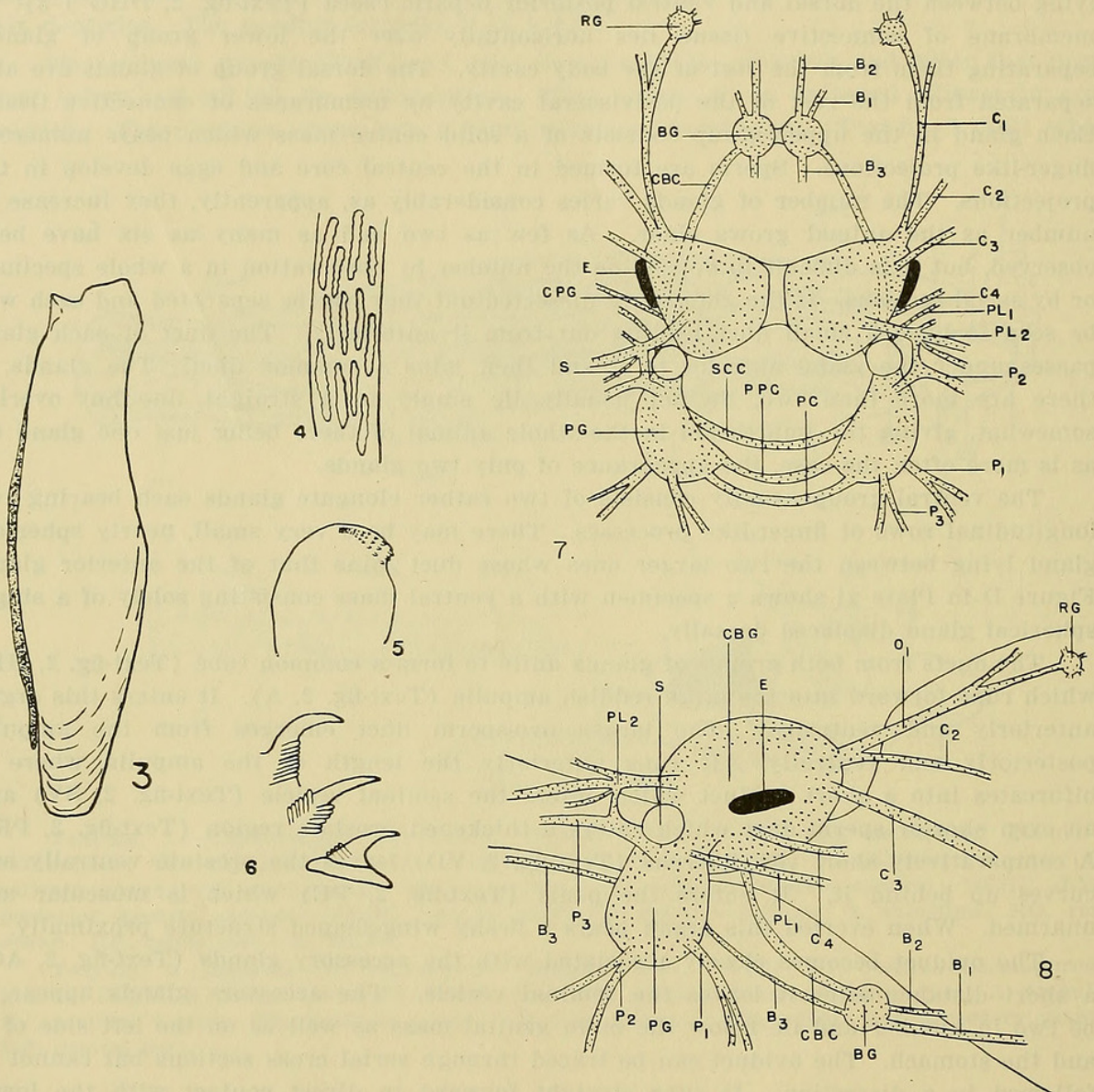
Renal Organ and Heart.

The renal organ (Text-fig. 1, RO) lies between the two posterior hepatic caeca in the posterior region of the body. Anteriorly it curves dorsally and opens to the outside by a small pore (Text-fig. 1, RP) located to the right of the median line. A branch continues forward to the region of the heart (Text-fig. 1, H). This structure is located above the stomach.

Nervous System.

The nervous system of *Cephalopyge trematoides* is very similar to that of *Phyllirhoe bucephala* Peron and Lesueur, 1810, as described by Vessichelli (1906), but shows a number of small differences. The central ganglia are situated at the posterior end of the pharynx in a circumoesophageal ring (Text-figs. 7 and 8). This consists dorsally

of a large pair of cerebro-pleural ganglia (CPG) connected by a short commissure and postero-laterally of a slightly smaller pair of pedal ganglia (PG). The cerebro-pleural ganglia are rounded and the limitations of the two regions of which they are composed are obscured. The pedal ganglia are also somewhat rounded. A small pair of buccal ganglia (BG) located below and slightly anterior to the cerebro-pleural ganglia are



Text-fig. 3.—Right jaw seen from inside. $\times 25$.

Text-fig. 4.—Portion of membrane along inner edge of jaw. $\times 450$.

Text-fig. 5.—Odontophore and radula. $\times 50$.

Text-fig. 6.—Teeth of third row of radula. $\times 750$.

Text-fig. 7.—Diagram of central nervous system seen from above. CPG, cerebro-pleural ganglion; PG, pedal ganglion; BG, buccal ganglion; CBC, cerebro-buccal commissure; E, eye; S, statocyst; PC, pedal commissure; PPC, parapedal commissure; SCC, subcerebral commissure; RG, rhinophore ganglion; C_{1-4} , cerebral nerves; PL_{1-2} , pleural nerves; P_{1-3} , pedal nerves; B_{1-3} , buccal nerves.

Text-fig. 8.—Diagram of central nervous system seen from right side (see Text-fig. 7 for explanation).

joined by a short commissure and are connected to the upper ganglia by a long slender cerebro-buccal commissure (CBC). In *Phyllirhoe bucephala* the buccal commissure is no longer distinguishable. A pair of eyes (E) are located laterally on the surface of the cerebro-pleural ganglia and a pair of statocysts (S) lie at the cerebro-pleuro-pedal connective.

The pedal commissure (PC) and the parapedal commissure (PPC) connect the two pedal ganglia under the oesophagus. While these ganglia are somewhat widely separated, the commissures are nearly straight and so cannot be seen in a lateral view. They are much longer in *P. bucephala*. The subcerebral commissure (SCC) connecting the cerebro-pleural ganglia runs below the anterior part of the pedal ganglia and anterior to the parapedal commissure. As is the case in *P. bucephala*, no nerves arise from this commissure.

The nerves originating from the circumoesophageal ganglia on the right side are as follows: a large rhinophore nerve (C1) runs forward from the antero-dorsal region of the cerebro-pleural ganglion. A small branch of this nerve leads to the body wall at the base of the rhinophore. The main branch ends in a rhinophore ganglion (RG) at the base of the rhinophore. This appendage is innervated from this ganglion as is the cephalic disc. The next nerve, C2, is thinner than C1 and appears to originate from the base of this nerve. It innervates the dorsal mouth parts. The bases of nerves C1 and C2 are further apart in *P. bucephala*. C3 leaves the cerebral region of the ganglion anterior to the eye and runs antero-ventrally to the lower mouthparts. It was not seen to anastomose with PL1 as it occasionally does in *P. bucephala*.

Nerve C4 is a slender nerve originating just below the posterior end of the eye. It runs anteriorly to the mouth. The cerebro-buccal commissure arises just below this nerve. Neither an optic nor a statocyst nerve can be observed. In *P. bucephala* the statocyst is raised on a short nerve. The first pleural nerve (PL1) comes from the cerebro-pleuro-pedal commissure and runs below and parallel to nerve C4. It innervates the body wall in the region of the posterior part of the pharynx. PL2 arises from the extreme posterior region of the cerebro-pleural ganglion just above the statocyst. It is connected to the nerve P3 by a vertical branch a short distance out from its base. PL2 also gives off a small branch ventrally just past this connection which parallels the course of the main nerve and probably innervates the anterior region of the stomach. It occasionally was seen to arise from the connection between PL2 and P3 rather than from PL2 itself. PL2 runs posteriorly through the body, sending branches to the body wall. The first branch is given off just past the connection to P3 and runs vertically up to the body wall.

Of the nerves originating from the pedal ganglion, P1 arises antero-ventrally and runs down to the foot. P2 comes off postero-ventrally and sends one branch to the foot and another back to the ventral body wall. The nerve P3 arises dorsally just below the statocyst and, as has been mentioned, is connected to nerve PL2. It sends one main branch ventrally to the anterior region of the genital organs. The main stem continues back into the body. I was unable to follow its several branches to their termination.

The buccal ganglion gives off two nerves anteriorly, the outer one (B1) innervating part of the pharynx and the inner one (B2) running to the salivary gland. The single nerve arising from the posterior part of the ganglion (B3) runs backward toward the oesophagus. There is no indication of a gastro-oesophageal ganglion.

The nerves on the left side of the circumoesophageal ring are identical with those on the right side in so far as their origin from the ganglia is concerned. There may be differences in the paths of the branches, however, especially in the case of nerves PL2 and P3.

Acknowledgements.

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EXPLANATION OF PLATE XI.

- A. Photograph of living *Cephalopyge trematoides* (Chun, 1889). × 7.
- B. Photograph of anterior portion of a preserved specimen showing extended rhinophores and foot. × 9.
- C. Photograph of anterior portion of a preserved specimen showing a short anterior hepatic caecum: 1-2. × 8.
- D. Photograph of anterior portion of a preserved specimen showing an anterior hepatic caecum of medium length: 1-2; 3, displaced spherical ventral hermaphrodite gland, × 8.
- E. Photograph of anterior portion of a preserved specimen showing a long anterior hepatic caecum: 1-2, × 8.



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