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ON A NEW SPECIES OF CRAWLING MEDUSA *(CNIDONEMA HASWELLI)* FROM AUSTRALIA.

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(Plates xvii.-xviii.)

INTRODUCTION.

In a recently published paper Gilchrist[1] has described a new genus and species of crawling Medusa, *Cnidonema capense*,[2] from the Cape of Good Hope. From an examination of both the medusa and the hydroid stage of the Cape species he concludes that the crawling Medusæ of the Southern Hemisphere are generically distinct from the northern forms.

The crawling Medusæ of the Northern Hemisphere belong to the genus *Eleutheria*, which is represented by only two species, *Eleutheria dichotoma*, Quatrefages, and *E. claparedei*, Hartlaub.

The first crawling Medusa to be recorded from the Southern Hemisphere was described by Browne[3] in 1902 as *Eleutheria vallentini*, from a single specimen obtained from Stanley Harbour, Falkland Islands.

Later, specimens of a pelagic animal were taken by the French Antarctic Expedition (1903-5) off Wandel Island, and in a short paper "Sur un Animal pélagique de la Région antarctique" Bedot[4] referred the specimens to a new genus and species, *Wandelia charcoti*.

In 1910 Browne[5] described another new species, *Eleutheria hodgsoni*, which was obtained by the National Antarctic Expedition from McMurdo Sound. At the same time he recognised that the animal of unknown affinities described by Bedot as *Wandelia charcoti* was also a species of *Eleutheria* and changed the name to *E. charcoti*.

In the following year (1911) Vanhöffen[6] described and figured the small crawling Medusa which Chun had previously referred to the genus *Eleutheria* in his "Reiserbericht über die Tiefsee-Expedition." These specimens were collected by the German Deep Sea Expedition on the lobes of the thallus of *Macrocystis* in Gazelle Harbour and Observatory Bay, Kerguelen. As the result of his examination of this material from Kerguelen, Vanhöffen concludes that the three southern species,

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[1] Gilchrist—Quart. Journ. Micro. Sci. (n.s.), lxiii., 4, 1919, pp. 509-529.

[2] Not *capensis*; *Cnidonema* is neuter gender.

[3] Browne—Ann. Mag. Nat. Hist. (7), ix., 1902, p. 279.

[4] Bedot—Expéd. Antarct. Française (1903-5), Charcot, 1908, pp. 1-5.

[5] Browne—National Antarctic Expedition, (1901-1904), Nat. Hist., v., 1910, Cœlenterata, v.-Medusæ, p. 28.

[6] Vanhöffen—Wissen. Ergebnisse der Deutschen Tiefsee-Exped., "Valdivia," xix., 5, 1911, pp. 193-233.

E. vallentini, *E. charcoti*, and *E. hodgsoni* are specifically identical, and explains away the differences between these species and the Kerguelen form by assuming that they are due to mistaken observations by Browne and Bedot made on insufficient material. On this basis he reduces all the southern forms of crawling Medusæ to a single species and, together with his own, refers them to *Eleutheria vallentini*, Browne.

Finally in 1919 Gilchrist found a crawling Medusa in fair abundance in a tank of the Government Marine Laboratory, near Cape Town, and on search being made on the sea shore further specimens were obtained from sea-weed collected at low tide. Gilchrist, moreover, ultimately succeeded in tracing the Cape Medusa to the hydroid stage, which he observed in one of his tanks in which the crawling Medusa had appeared in two successive summers. The characters of both the medusa and the hydroid stage disclosed the necessity for separating generically the southern from the northern forms; Gilchrist, therefore, instituted the genus *Cnidonema*, with *C. capense* for its type, to accommodate the Cape species and probably the other southern species of crawling Medusæ.

The discovery of yet another species of crawling Medusa from the Southern Hemisphere is extremely interesting: a new species of *Cnidonema*, closely allied to *C. capense*, has now been found to occur in Port Jackson, Australia.

Material Investigated.

I am greatly indebted to Professor W. A. Haswell, Emeritus Professor of Zoology in the University of Sydney, for the opportunity of examining and describing this crawling Medusa from Port Jackson. The material placed at my disposal consisted of twenty-seven specimens which had been fixed in sublimate-acetic and preserved in 70% alcohol. Professor Haswell first observed the Medusa in March, 1917, while working over a collection of sea-weeds obtained from the sides of a rock-hewn bathing pool at Point Piper, a sandstone headland on the southern shore of Port Jackson, about two and three-quarter miles from the entrance to the harbour.

In company with Professor Haswell I visited this locality on 10th September, 1919, and succeeded in obtaining twelve specimens which served as a basis for making observations on the living animal. These were examined in small pots in which the sea water was changed each morning and evening. This method was employed until 19th September, when ten specimens were fixed in hot sublimate-acetic and the remainder transferred to a glass vessel containing 150 c.c. of sea water. On 28th September, the Medusæ were still alive though very sluggish in their movements, and the pigmentation showed signs of fading. The sea water had now evaporated to about one-half its original volume; in this concentrated solution the specimens were kept under further observation until 6th October, when they disintegrated after living twenty-six days without any food having been added to the water.

As a result of subsequent visits to the same locality during October and November, additional specimens were procured including some which were much younger than those previously found.

The Medusa was also studied by means of fixed material. Serial sections were cut in two directions, transversely and vertically, and were stained with Ehrlich's Hæmatoxylin followed by Eosin. The sections were cut in thicknesses varying from 8 to 10 μ.

Method of Collecting.

The search for the crawling Medusa has been conducted at Point Piper, Port Jackson, from low water-mark down to three to five feet below it. The material was obtained by scraping down the face of a weed-covered wall and collecting the dislodged masses of sea-weed and other marine growths in a small hand dredge provided with a hessian bag weighted with a stone and sunk from three to five feet below the surface of the water. At the same time a net of fine bolting silk attached to a wire ring on the end of a light pole was swept backwards and forwards through the water in order to catch any specimens which may have been set free during the scraping of the wall.

The sea-weed from the dredge along with the contents of the net was emptied into a bucket of sea-water, well broken up, and thoroughly agitated in order to detach any Medusæ which might be adhering to the sea-weed, etc. The contents of the bucket were then poured off into another vessel through a coarse wire sieve in order to remove the more bulky material. The water with its sediment was next filtered through fine bolting silk. The material caught on the silk was finally washed into a small dish of sea-water and examined with a binocular dissecting microscope provided with a black background. The crawling Medusæ were picked out from among the fine débris by means of a pipette and transferred to small pots of sea-water for further observation.

When searching for the hydroid stage a different method was employed, the sea-weeds being removed straight to glass vessels and worked over with a dissecting microscope. I have not, however, succeeded in tracing the Medusa to the hydroid form.

Habits.

Prior to the publication of Gilchrist's observations on living specimens of *C. capense*, very little was known about the habits of the crawling Medusæ of the Southern Hemisphere. Browne had recorded the interesting fact that *C. vallentini* had been observed to swim; and although Vanhöffen examined and sketched the living animals at Kerguelen Island, he did not refer to their habits beyond the brief mention that his specimens were found crawling over the lobes of the thallus of a sea-weed *(Macrocystis)*.

In habits the crawling Medusa from Port Jackson is very similar to the Cape species—the mode of progression, the adhesive power of the tentacles, and the difficulty experienced by the animal in regaining its right position when placed on its back, agree entirely with Gilchrist's description. The latter's remarks on the peculiar jerking movements exhibited by the tentacles when the animal is stationary apply equally well to the form at present under consideration.

The Medusa further agrees in habit with the Cape species since it was never observed to swim; neither could any swimming motion be induced by dropping the specimens into sea-water. They would fall straight to the bottom of the vessel and then move along the surface of the glass by slow crawling movements.

The following observations supplement the published accounts of the habits. During the examination of the living Medusæ in a shallow glass dish on the stage of a microscope the specimens over the area of bright light admitted through the stage aperture were observed to move off to those parts of the dish which were outside the circle of illumination.

The influence of background on the movements of the animal was also noted. Several specimens were placed in a dish of which one-half of the bottom was white, the remainder black. When the dish was so orientated that the two halves were equally illuminated, all the Medusæ gradually passed to the black half.

Family CLADONEMIDÆ.

Genus CNIDONEMA, *Gilchrist.*

Cnidonema, Gilchrist, Quart. Journ. Micro. Sci. (n.s.), lxiii., 4, 1919, p. 525.

The genus *Cnidonema*, with *C. capense* for its type, was founded by Gilchrist for a species of crawling Medusa from the Cape of Good Hope possessing the following characters :—

"Medusa: adapted for crawling or walking; no brood-pouch above stomach; gonads well-developed, in ectodermal inter-radial pockets around stomach; sexes separate; radial canals usually six; tentacles numerous, increasing with age, and not corresponding to number of radial canals, dichotomous; the upper branch with several clusters of nematocysts in addition to a terminal cluster; no oral tentacles; thick nematocyst ring under margin of bell. Hydroid: with one verticil of three capitate tentacles, and a second of six non-capitate tentacles."

On these generic characters Gilchrist separates the Cape species from the crawling Medusæ *(Eleutheria)* of the Northern Hemisphere. He also maintains as distinct species of the genus *Cnidonema* the previously described crawling Medusæ from the Southern Hemisphere, and establishes Vanhöffen's Kerguelen specimens as a new species, *Cnidonema kerguelenense*, characterised by having the nematocyst-clusters lateral in position, the radial canals unbranched, and the nematocyst ring complete.

The propriety of referring all the species of crawling Medusæ from the Southern Hemisphere to the genus *Cnidonema* presents certain difficulties to which Gilchrist has drawn attention. For instance, the hydroid form is known only in the case of *C. capense*, while the ectodermal pouches in which the gonads are partly lodged in the Cape species have not been recognised in the other southern forms except, according to Gilchrist, in the case of the male of *C. kerguelenense*. Gilchrist, however, would seem to have somewhat misinterpreted Vanhöffen's remarks on the arrangement of the gonads in the Kerguelen species.

Although its hydroid stage is at present unknown, the Medusa from Port Jackson is referred to Gilchrist's genus *Cnidonema*, and is described as a new species differing in several well-marked characters from the crawling Medusæ of the Southern Hemisphere. The holotype (Reg. No. Y. 586), and slides of serial sections of the Medusa have been deposited in the Australian Museum, Sydney.

I have much pleasure in associating the name of Professor W. A. Haswell with this new species of crawling Medusa from Port Jackson, Australia.

Cnidonema haswelli, *sp. nov.*

(Pl. xvii., figs. 1-4; Pl. xviii., figs. 1-5.)

External characters.—The largest specimen, when fully expanded, measured 3·5 mm. from tip to tip of the tentacles. When viewed from above, the umbrella appears circular with a diameter of 1·2 mm. None of my specimens are as large as the Kerguelen species, which, according to Vanhöffen, measured 5·5 mm. in breadth in the preserved condition. In the Cape species the breadth of the largest male was 3·3 mm.

In a lateral view of the Medusa, the body appears very slightly flattened; it is not so compressed as in either *C. capense*, in which the height is about one-third of the breadth of the body, or in *C. hodgsoni*, which is considerably flattened, the height being about one-fourth of the diameter of the disc. In the preserved condition, however, there is a marked change in shape, some of the specimens appearing much more flattened than in life, while others are almost spherical in outline.

There is a considerable degree of variation in the colour exhibited by individuals of different ages. The young Medusæ are not heavily pigmented and hence appear lighter in colour than the mature specimens. When viewed by transmitted light the body of the adult is, in most cases, a reddish-yellow colour, but appears bright red or orange by reflected light. This colouration is due to the presence of masses of pigment-granules in the endodermal cells of the stomach and the circular canal. In the specimen figured (Pl. xvii., fig. 1.) there is in the centre of the disc a large reddish-yellow area, which is roughly octagonal in outline with eight radiations extending to the circular canal. In none of my specimens do these radiations become enlarged into saccular structures such as Gilchrist figures in *C. capense*.

On the exumbrellar surface above the reddish-yellow stomach is an octagonal ring which appears cream coloured when viewed by reflected light. In one specimen the octagonal ring was absent, but eight broad radiations of a deep cream colour were present which extended to the circular canal concealing the radiating lines of the stomach.

The gonads vary in colour from cream to pale yellow and lie around and above the reddish-yellow stomach, leaving only a small circular patch of stomach visible in the centre of the disc.

The ocelli occur on the exumbrellar surface at the bases of the tentacles; they are bright red in colour and are surrounded by a circlet of white pigment-granules. A vertical section shows the ocelli, which project slightly on the surface, to be composed of densely packed pigment-granules; a lens is not present.

The tentacles are only very slightly pigmented. Granules of white pigment are grouped in little heaps near the proximal end of the main stem of the tentacle. A row of similar granules extends along the main stem and is continued down the entire length of the lower branch; these white granules are usually absent from the upper branch of the tentacle.

Fixed material is somewhat different in appearance owing to the cream-coloured pattern on the exumbrellar surface, and the white granules of the tentacles disappearing in the preservative.

The tentacles.—The tentacles are very variable in number, ranging from six in the youngest individual to about thirty-one in the largest. In adult specimens the arrangement of the tentacles bears no relation to the radial canals, but in the youngest specimen obtained there are six well-developed tentacles arising from the circular canal opposite the ends of the radial canals, which in this particular specimen are six in number. The development of the subsequent tentacles is apparently quite irregular as there are two young specimens in the collection with ten and thirteen tentacles respectively. The growth of a tentacle is fairly rapid, fully formed tentacles being produced on an individual kept under observation, at the rate of one in every three or four days.

Each tentacle consists of a main stem which is divided at its distal end into two branches, a short upper and a longer lower branch. In living and fully expanded adult specimens the lower branch is a little longer than the upper one. The main stem of the tentacle is slightly shorter than the upper branch. In young specimens the lower branch of the tentacle is markedly longer than the upper; and in the youngest individual obtained the lower branch in the fully expanded condition was twice as long as the upper branch of the tentacle. In mature specimens, however, the branches become more equal in length, so that in adult forms the lower is only slightly longer than the upper branch. In *C. capense*, according to Gilchrist, "the upper branch is about three times the length of the lower branch in the living and fully expanded condition." This difference between the lengths of the upper and lower branches of the tentacles serves at once to distinguish *C. haswelli* from the Cape species.

On the upper branch of the tentacle are borne the nematocyst-clusters, which are aboral and oral in position, their arrangement being very similar to that described by Gilchrist in the case of *C. capense*. Owing to the shortness of the upper branch of the tentacle in *C. haswelli*, the nematocyst-clusters are more concentrated in their relative positions than they are in the Cape species.

There is a knob-like terminal cluster of nematocysts, which is followed by a second cluster on the upper or aboral side of the tentacle. This second cluster is separated from the terminal cluster by a short interval; in young individuals the cluster is completely aboral in position, but as

they grow older it extends down a short distance on each side of the tentacle, never, however, reaching so far as to become oral in position. The third nematocyst-cluster occurs on the ventral or oral side of the branch; it is smaller than the second, and is confined entirely to the ventral surface. A fourth cluster is aboral in position and is usually separated from the second by an interval which is either equal to or slightly less than the one which separates the latter from the terminal knob-like cluster. The upper branch of the tentacle is thus armed with four clusters, one terminal, two aboral, one oral; the last lying between the two aboral, but nearer the proximal than the distal.

In all the specimens examined the position of these nematocyst-clusters on the upper branch of the tentacle was found to be constant. In young individuals a small nematocyst-cluster occurs on the dorsal or aboral side of the main stem a short distance from the point where it divides into upper and lower branches, but in most of the adult specimens this cluster is usually absent. It, however, is well developed in one specimen with twenty-four tentacles (Pl. xvii., fig. 1).

Nematocyst-clusters were never observed on the lower branch of the tentacle.

The nematocysts are of two kinds; (1) large oviform nematocysts, their length being 23-25 μ and their breadth 17-19 μ; and (2) smaller, narrowly oval or nearly cylindrical nematocysts, which measure 8 μ in length and 4 μ in breadth.

The lower branch of the tentacle, which is used for crawling, ends in a sucker-like extremity. This expanded terminal part is strongly adhesive owing to the presence of glandular cells in the ectoderm, while its sucker-like action is brought about by the arrangement of the muscles in this part. By means of these suckers and the secretion of the glands the animal is able to adhere so firmly to the smoothest surface that it is difficult to detach it.

Fixation of specimens with hot sublimate-acetic causes very little shrinkage of the tentacles; both the upper and lower branches undergo a slight but equal amount of contraction, so that in the preserved state they present almost the same appearance as in the living animal. This is contrary to the condition found in the Cape species, for here, according to Gilchrist, the upper branch of the tentacle, which in the living animal is about three times the length of the lower one, "contracts much more in preservative, and is then only about the length of the lower branch."

The tentacles are hollow outgrowths from the outer wall of the circular canal, the endodermal cells of which pass directly into the endodermal lining of the tentacle. The lumen of the tentacle extends along both the upper and lower branches. In the main stem the endoderm consists of columnar cells, the nuclei of which lie close together near the cell margins which border upon the narrow lumen of the tentacle. The lumen of the lower branch is also very narrow, but the upper branch contains a wide lumen, which is a conspicuous feature in sections through a tentacle.

Nematocyst ring.—The thick nematocyst ring is a very conspicuous structure in the form of an uninterrupted cushion of nematocysts under the circular canal. The nematocysts are tensely packed in a continuous ring, which is distinctly marked off from the base of the tentacles. In vertical sections the ring appears oval in outline with its outer margin placed just beneath the circular canal and its long axis directed inwards and downwards. The nematocysts are of two kinds. There are large oviform nematocysts which measure 23-25 μ in length and 17-19 μ in breadth. Besides these large forms there are smaller, narrowly oval or nearly cylindrical nematocysts, their length and breadth being 8 μ and 4 μ respectively. The two types are similar to those which occur in the clusters of nematocysts on the tentacles.

The nematocyst ring has no connection with the base of the tentacles in any of the species of *Cnidonema*, except *C. hodgsoni*, in which the basal portion of each tentacle is covered on its under side with a thick pad of nematocysts.

Velum.—The velum is not clearly discernible in the living or preserved whole specimens, but is readily made out in vertical sections when it is seen to be composed of a double layer of ectoderm separated by mesoglœa. The ectoderm consists of a layer of much flattened cells. The velum is broad, covering in the whole of the subumbrellar cavity, and is perforated by a circular aperture through which the manubrium may be protruded. The rim of the velar aperture usually fits closely around the manubrium but does not fuse with it; or the velum may become drawn out into a funnel-shaped structure through which the manubrium is protruded so that the mouth is carried well beyond the aperture of the funnel. Sometimes the velum is appressed to the body, at others it is curved outwards thereby considerably enlarging the subumbrellar cavity.

Alimentary tract.—The manubrium is a very mobile part of the alimentary tract, and is capable of being extended through the aperture of the velum and protruded for a considerable distance beyond the edge of the umbrella. The mouth is situated at the free extremity of the manubrium. There are no oral tentacles. Around the edge of the mouth the ectoderm forms a thickened ridge, which bears large, well developed nematocysts. The endoderm of the manubrium is thrown into eight ridges which reach their maximum extent about the middle of the manubrial region. These ridges are of a muscular nature and are arranged in the shape of a star with eight rays. The lumen of the manubrium thus presents a stellate appearance in transverse sections through this region. The rays of the star are narrow and acute; in the endoderm between them occur large nematocysts. The cells of the wall of the manubrium are free from pigment-granules. In the upper part of the manubrium the muscular ridges pass into the endodermal ridges of the stomach, while the rays of the star become continuous with the stomach diverticula.

The mouth leads into a large sac-like stomach, which at its widest occupies the greater part of the body. The endoderm of the stomach is of very great thickness and is raised up into eight longitudinal ridges. The endoderm consists of numerous cells heavily laden with pigment-granules,

and gland cells, but no nematocysts such as Gilchrist found in the wall of the stomach of *C. capense*. The gland cells are very widely distributed throughout the endoderm.

The cavity of the stomach is produced into eight angular embayments forming the stomach diverticula, which are narrow, acute-angled pouches lying between the longitudinal endodermal ridges. These diverticula give a very characteristic star-like appearance to transverse sections through the region of the stomach. From the apex of each of the stomach diverticula is given off a short radial canal, which passes directly to the circular canal.

The arrangement of the diverticula in *C. haswelli* agrees exactly with Vanhöffen's figure of a transverse section through a male specimen of the Kerguelen species. In *C. capense*, on the other hand, the stomach diverticula are always six in number and take the form of wide pouches, which are more or less rectangular when fully developed, although in younger specimens they may be small and acute.

The stomach diverticula in *C. haswelli* are eight in number in all except two young individuals, in which there are six and seven respectively.

Radial canals.—The radial canals are usually eight in number; of two young individuals, however, one had only six, while the other, which was more mature, possessed seven. The radial canals are very short, and being unpigmented or nearly so, can only be made out with certainty in sections. An examination of the living animal as well as preserved specimens cleared in cedarwood oil did not reveal the true arrangement of these canals. Owing to the stomach diverticula reaching almost to the circular canal, there is, in the whole specimens, an appearance of pigmented radial canals; in sections, however, the apices of these diverticula are seen to communicate with the circular canal by very short radial canals, the endodermal lining of which is devoid of pigment-granules.

The number of radial canals present in the several species of *Cnidonema* varies very considerably. In the case of *C. vallentini*, Browne states that "according to Mr. Vallentin, the Falkland species has four radial canals," and that *C. charcoti* (Bedot) is distinguished from all the other crawling Medusæ of the Southern Hemisphere "by the radial canals having slender lateral branches with a tendency towards anastomosis." The latter statement by Browne is based presumably on his examination of specimens of *Wandelia charcoti* received from Professor Bedot.

The radial canals of *C. hodgsoni* are variable in number. Browne found that out of six specimens examined, three had eight radial canals and the remaining three had six, ten and eleven canals respectively. Vanhöffen does not state the number of radial canals present in the Kerguelen specimens, but an inspection of his figure of a transverse section through a male shows eight radial canals. He describes, however, the endoderm of the stomach as forming six, eight or ten folds which come into communication with the circular canal by short radial canals. This arrangement of the stomach diverticula would seem to indicate that the radial canals are also variable in number, and are

represented in his several specimens by six, eight or ten canals respectively. Gilchrist found the radial canals of *C. capense* to be invariably six in number.

Circular canal.—The circular canal, which is a prominent feature in vertical sections of the Medusa, is wide and lies directly above the nematocyst ring. The endoderm of the outer wall of the circular canal consists of columnar cells the nuclei of which lie close together near the cell margins, which border upon the lumen of the canal. These columnar cells pass over directly into the endodermal lining of the tentacle.

The endoderm of the inner wall of the circular canal is formed of small cells which contain pigment-granules. These cells pass directly into the endoderm cells of the radial canals, which, however, are unpigmented, and so come into relation with the endoderm of the stomach.

The pigment-granules lodged in the cells of the inner wall of the circular canal form a ring of pigment, the inner margin of which is well defined. Its outer margin is irregular and sends projections into the columnar endoderm cells of the outer wall of the circular canal. These projections lie in the intervals between the bases of the tentacles, and do not extend into the endodermal lining of the tentacles, which as a consequence are unpigmented.

Gonads.—The sexes are separate. The gonads were studied in both male and female Medusæ by means of serial sections cut in two directions, vertically and transversely. The gonads are very well developed and are lodged in the subumbrellar cavity. They occupy almost the whole of the subumbrella, extending from the velum upwards alongside of the stomach and to a considerable extent above it. They do not, however, extend to the apex of the body, but leave a small circular area above the stomach quite devoid of gonads.

The gonads form a ring around the stomach below the radial canals and extend upwards into the subumbrellar space where they are separated for a short distance by vertical partitions of ectoderm, above which they unite once more to form a continuous ring around the stomach. There is no brood-pouch above the stomach.

The arrangement of the gonads in *C. haswelli* is thus associated with the radial canals and their relation to the subumbrellar cavity. The radial canals are short and are given off from the stomach diverticula at a very low level. Consequently there is a large subumbrellar space, lined throughout by ectoderm, between and above the radial canals. This ectodermal lining of the subumbrellar cavity comes into contact above and below the radial canals and so forms low vertical partitions composed of a double layer of ectoderm and a middle one of mesogloea.

The partitions below the radial canals extend downwards for a very short distance. Those above the radial canals are developed to a greater extent, but are not carried up to the apex of the subumbrella as in *C. capense*, where they form complete septa between the gonads, so that the ovaries or testes come to occupy six pouches or vertical diverticula of the subumbrellar cavity. The arrangement of the gonads in *C. haswelli* thus differs considerably from that described by Gilchrist in the Cape species.

In transverse sections through a male of *C. haswelli* at the level of the ectodermal partitions above the radial canals, the testes are seen to be reduced to inter-radial masses, each of which is partly cleft by a vertical slit into two adradial portions lying in the angle between the stomach diverticula. Vanhöffen describes and figures a similar arrangement of the testes in the Kerguelen species, and the same condition is shown in Gilchrist's figures of transverse sections through a male Medusa.

In the female of *C. haswelli*, the ovaries occupy a corresponding position in the subumbrellar cavity to that occupied by the testes in the male. The ovaries, however, show no trace of segregation into two adradial parts. The ova are closely packed together and, when mature, measure 0·06 mm. in diameter. In the females of the Kerguelen species, Vanhöffen found scarcely any trace of segregation of the ovaries into two adradial parts although he suspects that originally the ovaries were separate, and that later, through the growth of the ova, they became merged for lack of space.

Gilchrist has apparently misinterpreted Vanhöffen's remarks on the arrangement of the gonads in *C. kerguelenense*. Gilchrist writes:—"Whether or not such partitions between the gonads exist in other southern Eleutheria is not known, except in the case of the male of Vanhöffen's species. The females of this species do not appear to have them, though Vanhöffen suspects they may be present in the young females." Vanhöffen, however, does not mention the presence of partitions or septa between the gonads in the Kerguelen species; his remarks refer simply to the tendency in the male for the testes to occur as two adradial portions, which are united by a narrow bridge of ectoderm *in the angle* ("in dem Winkel") between the stomach diverticula. Gilchrist has evidently mistaken this bridge of ectoderm ("Ektodermbrücke") for a septum; the true septa, however, are clearly figured by Vanhöffen on Plate xxx., fig. 5c, where they are shown as double folds of ectoderm with a middle one of mesoglœa.

Asexual reproduction.—Besides producing gonads, *C. haswelli* multiplies asexually by budding, the buds arising from the circular canal between the tentacles and the nematocyst ring. Gilchrist found medusa buds occupying a similar position in young specimens of the Cape species. Although the buds were not observed in living specimens of the Medusa from Port Jackson, transverse sections of a male revealed six, all of which have reached about the same phase of development. Only very young buds are present and these consist of hollow outgrowths which are nearly cylindrical or slightly tapered at their distal ends. The ectoderm of the bud is composed of several layers of cells. The endodermal cells, in which pigment-granules are recognisable, are arranged in a single uniform layer lining the narrow lumen of the bud.

Affinities.—The Medusa from Port Jackson has been referred to the genus *Cnidonema*, on account of its crawling habits; the absence of a brood-pouch above the stomach; the distinct sexes; the numerous tentacles, which increase with age and do not correspond in number with the radial canals; the dichotomous tentacles, the upper branch of which carries several

clusters of nematocysts in addition to a terminal cluster; the absence of oral tentacles; the presence of a thick nematocyst ring under the margin of the bell. The gonads are well developed and are partly separated by low ectodermal septa. Crawling Medusæ of this type have hitherto been recorded only from the Falkland Islands, the Cape of Good Hope, Kerguelen Island, and Antarctica. The discovery of a new species on the coast of New South Wales is, therefore, of special interest. The species is a well-marked one, and differs considerably from the previously-described members of the genus. It is readily distinguished from *C. charcoti*, *C. kerguelenense*, and *C. hodgsoni*, by its nematocyst-clusters, which are oral and aboral in position; from *C. vallentini* by its gonads not being entirely above the stomach; and from *C. capense* by *(a)* the upper branch of the tentacle being shorter than the lower branch, *(b)* the radial canals, which are usually eight in number, *(c)* the shape of the stomach diverticula, which are narrow, acute-angled pouches, and *(d)* the poorly-developed septa between the gonads.

Key to the species of the genus *Cnidonema*.

a. Nematocyst-clusters oral and aboral in position.
  b. Gonads entirely above stomach.....*C. vallentini* (Browne).
  bb. Gonads not entirely above stomach.
    c. Upper branch of tentacle longer than lower branch.....*C. capense*, Gilchrist.
    cc. Upper branch of tentacle shorter than lower branch.....*C. haswelli*, sp. nov.
aa. Nematocyst-clusters lateral in position.
  d. Radial canals branched.....*C. charcoti* (Bedot).
  dd. Radial canals not branched.
    e. Complete nematocyst ring.....*C. kerguelenense*, Gilchrist.
    ee. Incomplete nematocyst ring.....*C. hodgsoni* (Browne).

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EXPLANATION OF PLATE XVII.

Cnidonema haswelli, Briggs.

REFERENCE LETTERS.

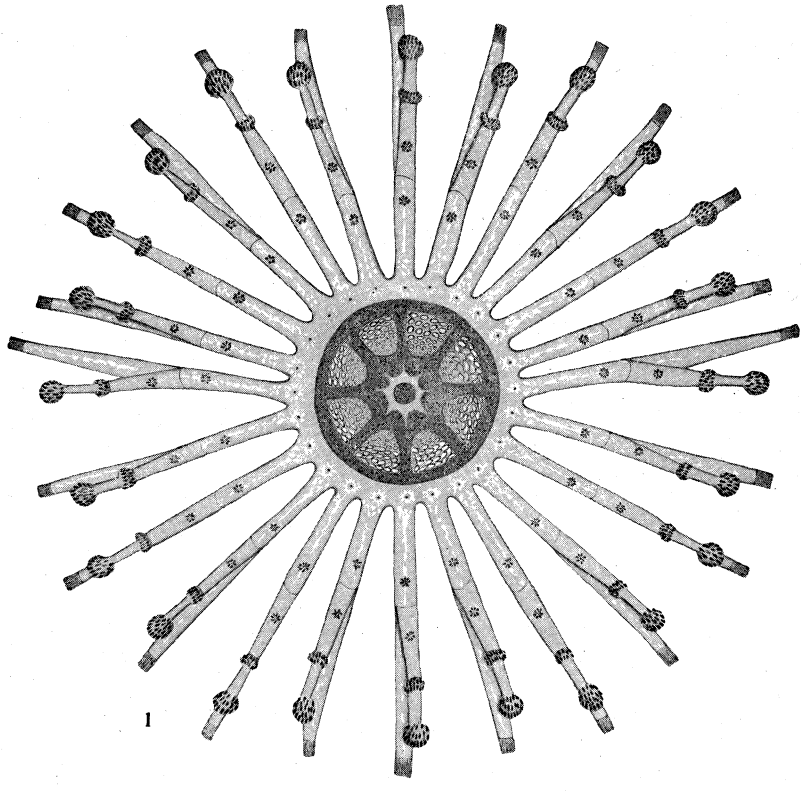
c.c., Circular canal. *m.*, Mouth. *ov.*, Ovary. *r.c.*, Radial canal. *s.*, Septum. *s. um. c.*, Subumbrellar cavity. *t.*, Testis. *v.*, Velum.

Fig. 1. Mature Medusa viewed from above, with tentacles fully expanded.

,, 2. Male Medusa; transverse section passing through the circular canal (*c.c.*) on the right, and below the circular canal on the left. The section shows the septa (*s*) separating the testes at a level just below the radial canals. The cavity of the stomach is shown produced into seven angular embayments forming the stomach diverticula. × 74.

,, 3. Vertical section passing through the mouth (*m.*) at the free extremity of the manubrium, which is protruded through the aperture of the velum (*v.*). × 74.

,, 4. Female Medusa; transverse section passing through the ovary (*ov.*), a radial canal (*r.c.*), and the circular canal (*c.c.*). × 74.



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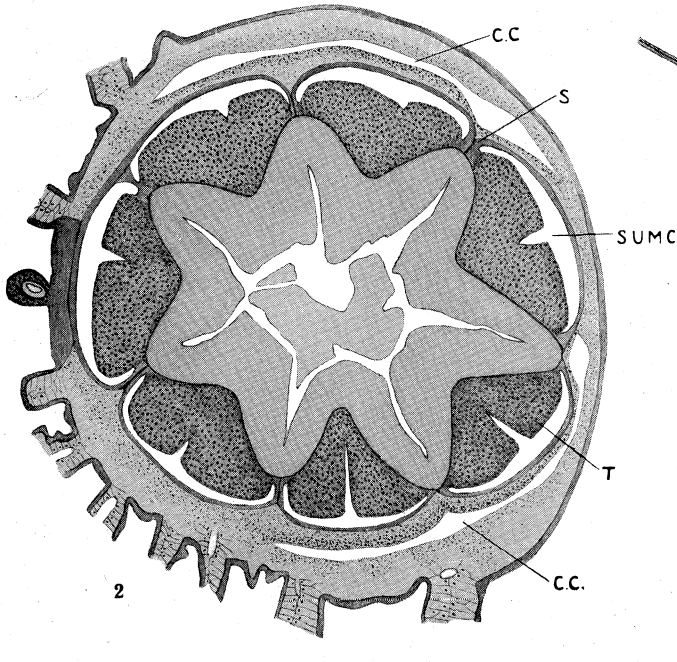

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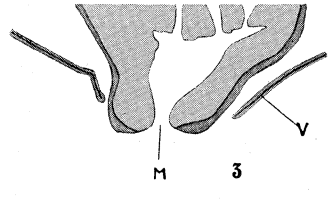

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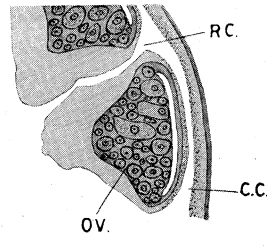

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EXPLANATION OF PLATE XVIII.

Cnidonema haswelli, Briggs.

REFERENCE LETTERS.

c.c., Circular canal. *n.r.*, Nematocyst ring. *r.c.*, Radial canal. *s. um. c.*, Subumbrellar cavity. *t.*, Testis. *v.*, Velum.

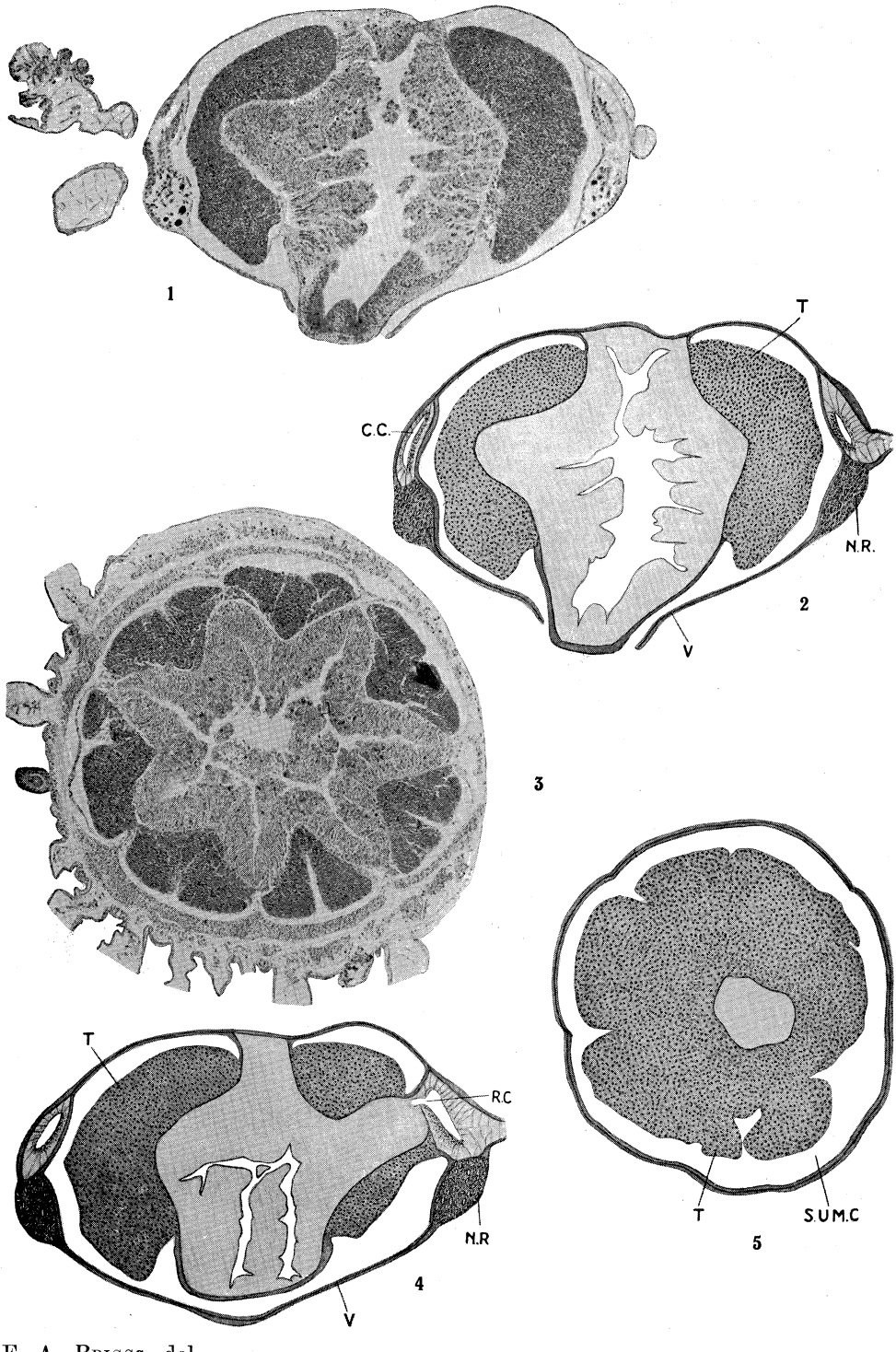
Fig. 1. Male Medusa; micro-photograph of a vertical section passing through inter-radial region. × 64.

„ 2. Male Medusa; vertical section passing through inter-radial region. The section shows the testes (*t.*) occupying almost the whole of the subumbrellar cavity, extending from the velum (*v.*) upwards alongside of the stomach and to a considerable extent above it. × 64.

„ 3. Male Medusa; micro-photograph of a transverse section passing through the circular canal on the right, and below the circular canal on the left. × 64.

„ 4. Male Medusa; vertical section passing through a radial canal (*r.c.*) on the right. × 64.

„ 5. Male Medusa; transverse section above the stomach showing the testes (*t.*) in the form of a continuous ring. × 64.



E. A. BRIGGS, del.
W. GRAHAM, Photo.