Vol. 76, Part 3, pp. 414–420, 1 Figure, 1 Plate.

The Hydroid and Medusa of *Cnidonema vallentini* (Anthomedusae) from Wellington, New Zealand.

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SUMMARY.

The first New Zealand specimens of the Southern Hemisphere species *Cnidonema vallentini* are described from material found in an aquarium tank in the Zoology Department, Victoria University College, Wellington. The medusae show a marked change in form during the life history. This change is chiefly to be observed in the tentacle, in the appearance of the exumbrella surface and in the number of the radial canals. On account of this change in form during the life history the present specimens are assigned to the type species *C. vallentini*, although at various stages in the life history they show some of the characteristic features of all the other described species. The present specimens differ from all previously described species in having five to six stinging knobs round the mouth of the medusa. The number of both capitate and filiform tentacles in the hydroid is also variable.

INTRODUCTION.

MEDUSAE of the genus *Cnidonema* have not previously been recorded from New Zealand. The present paper describes medusae that have been present in an aquarium tank over a period of three years and the hydroid that has been kept under observation for a shorter period. Numbers of medusae have been seen from November to March each year and a few were present during the winter months. Correlation between hydroid and medusa was delayed till early November of the 1943 season owing to the solitary nature of the hydroid and the fact that for the first season at any rate the hydroid was not obvious on the pebbly bottom of the tank. The genus *Cnidonema* was erected in 1919 by Gilchrist for the Southern forms of crawling or walking medusae which he considered generically distinct from the Northern Hemisphere forms. Crawling medusae of the Northern Hemisphere belong to the genus *Eleutheria*, which is represented by the type species *E. dichotoma* Quatrefages and *E. claparedei* Hartlaub. The Southern forms differ in lacking a brood pouch above the stomach and possess tentacles that increase in number with an increase in age of the medusae. These tentacles bear accessory knobs of stinging batteries in addition to the terminal knob on the dorsal branch of the bifurcate marginal tentacles.

The present specimens when liberated from the hydroid have six bifurcate marginal tentacles which increase to thirty on the adult forms. The radial canals are six in number in the juvenile medusae and in those possessing gonads, but increase to eight simple canals in forms which have shed the sexual products. The radial canals in some of the adult medusae show a tendency to branch. A black ocellus is present at the base of each tentacle. The colour of the medusa is

orange-brown, the pigment being heaviest in the circular canal and gaster of the juvenile forms, but confined mainly to the tentacles in the older medusae. There are six gastric pouches in the younger forms. These specimens may be assigned to *Cnidonema vallentini* for reasons set out on page 419. As further interesting features have been observed which have a bearing on the standing of the genus and its various species, it seems desirable to publish the following account, especially in view of the criticisms of Vanhöffen (1911), Lengerich (1923) and Weill (1937). My specimens of *C. vallentini* show, during the life history, a marked change in tentacle form, in the number of accessory stinging batteries, in the number of radial canals, and in the appearance of the exumbrella surface. They differ from previous descriptions of members of the genus in having nematocyst knobs surrounding the mouth in the adult forms. These stinging knobs are not carried on tentacle stalks, but are very similar in position and form to those figured by Uchida (1927) for the "Eleutheria" stage of *Cladonema radiatum* var. *mayeri*. In fact the present specimens were at first mistaken for the better-known genus *Cladonema* on account of the knobs of stinging batteries round the mouth, the hernia-like gonad pouches similar to *C. perkinsii* and the tendency to branch of the radial canals in the older medusae. Lengerich (1923) considers the genera *Cladonema* and *Cnidonema* as synonyms of *Eleutheria*, but there are three facts that seem to the present writer to set them apart as separate genera, namely, the form of the tentacle and of the bell, and the position of the gonad. All three species of *Cladonema* are figured as having the aboral nematocyst-bearing portion of the tentacle distinctly branched and quite often the oral adhesive portion branched also. This is not the case with *Eleutheria* or *Cnidonema*. Neither the aboral nor the oral portion of the tentacle, whether it be in the young or old medusa, is branched. Also the deep hemispherical bell always figured for *Cladonema* (Hincks, 1868; Allman, 1872; Mayer, 1910, and others) is not found in *Eleutheria* or *Cnidonema*, which have the bell wider than it is high and resembling a shallow saucer in shape. In *Cladonema* the gonads form a continuous band round the stomach, but in *Cnidonema* the gonads are developed in ectodermal interradial pockets round the stomach. In *Eleutheria* the gonads are reduced and lodged in the brood pouch.

Last year several specimens of the medusa were brought into the laboratory on the red seaweed *Ceramium* from Island Bay, Wellington. The number of tentacles in these specimens ranged from 10 to 14, and in most instances the radial canals were difficult to distinguish, but in some appeared branched. The tentacles were similar in form to those of the juvenile medusae in the aquarium, but lacked the conspicuous orange-brown pigment of the aquarium forms.

The writer wishes to express her thanks to Professor L. R. Richardson for much useful advice and kindly encouragement.

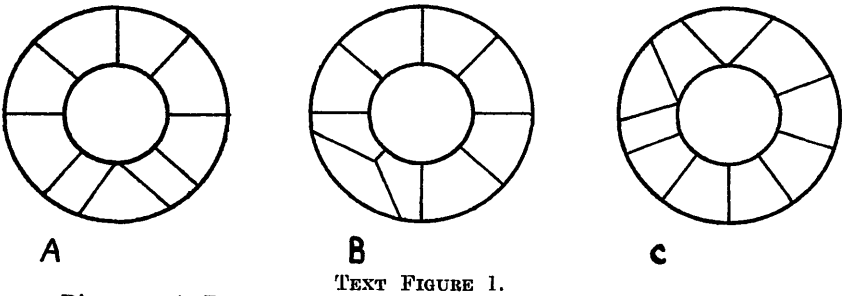
GENERAL ACCOUNT OF THE MEDUSA STAGE.

C. vallentini has been studied from the formation of the gonozooid on the parent hydranth through to adult forms with up to thirty tentacles. The medusae followed a well-defined course of development. The medusa buds grow out from the body of the hydranth between

the filiform and capitate whorl of tentacles, but nearer the capitate verticil. One or two medusa buds may grow from the body of the hydranth at the same time. When two are present, they are generally at the same stage of growth. The youngest medusa buds are simple orange-brown protrusions. Approximately three days later six divisions are clearly discernible opposite the point of attachment to the hydranth. The divisions prove to be the primordia of tentacles. These tentacles become more distinct and a few stinging cells appear at their free end. At this stage the tentacles are equal in length to the height of the bell. The next stage in development is the bifurcation of the tentacles into a lobe bearing a terminal battery of nematocysts and another lobe bearing a small adhesive disc at the distal end. The sucker-bearing lobe appears longer at this stage than the aboral lobe bearing the nematocyst battery. A pigment spot is visible at the base of each tentacle and the tentacles show slight movements. Just before the liberation of the medusa the tentacles are very active, a relatively large manubrium with hypostome is present, and the attachment stalk is very slender with little coenosarc. When liberated from the parent hydranth the juvenile forms appear almost without exception as in Fig. 1. The form of the tentacles is always the same, and the diameter of the bell ranges from 0·3 mm. to 0·5 mm. The radial canals are indistinct in most instances, but in one or two specimens (Fig. 2) the ends of the radial canals where they join the circular canal have been observed and are six in number, i.e., correspond to the number of tentacles as predicted, but not observed, by Browne (1910). The writer has occasionally seen forms liberated from the parent hydranth with eight marginal tentacles and six radial canals. The walls of the gaster, the circular canal, and the tentacles are heavily pigmented at this stage with orange-brown granules. The first accessory stinging battery is usually aboral in position, although there were a few forms in which it appeared oral. The majority of the medusae in the New Zealand specimens have a cluster of nematocysts on the aboral side of the main stem of the tentacles (Fig. 4A). This is not, however, a constant feature and disappeared when the tentacle grew to the form shown in Fig. 4B. Browne (1910) described isolated patches of nematocysts under the bell rim of *Eleutheria hodgsoni* which he considered represented the continuous band of nematocysts under the bell margin of the other species of the genus. No patches of nematocysts have been observed under the bell margin of the present specimens.

The gonads were clearly discernible in most medusae with 12 to 22 tentacles and the exumbrella surface appeared as in Fig. 3. The gonads form six pouches extending beyond but underlying the stomach pouches and radial canals. Browne (1910) describes seven to eight swellings in *E. hodgsoni*, but in the present specimens six is a constant feature. In all medusae in which the gonads were discernible there were six simple radial canals. The presence of gonads and the number of radial canals seem interrelated, for, when the content of the gonads has been shed the number of radial canals increases to eight or more as the case may be in medusae with branched canals. A distinct ring (a portion of the gaster) is visible above the stomach pouches and the six radial canals enter the stomach at points on the

circumference of the ring. The tentacle form of medusae with 12 to 22 tentacles varies. The younger medusae (those with 12 to 18 tentacles) have tentacles as figured in 4A and the others as in Fig. 4B. The bell diameter of medusae with 12 to 22 tentacles ranges from 0·75 mm. to 1·5 mm. and oral stinging knobs are obvious in these medusae. Finally, the oldest medusae, i.e., those with 23 to 30 tentacles appear as in Fig. 5, and have a bell diameter of 1·6 mm. to 3 mm. The predominant orange-brown pigment of the younger medusae is greatly reduced, being confined to granules in the tentacles. The velum is large, fitting closely round the manubrium, as described by Gilchrist in 1919, and shows distinct concentric striations. The gaster of these forms no longer shows the six prominent pouches of the younger forms, but the ring of the gaster remains, the radial canals again entering the stomach at the circumference. These medusae with 23 to 30 tentacles usually have eight simple radial canals and the gonad pouches are no longer visible. In all these forms the tentacle is divided practically to the base, the aboral and oral branches being the same length, and the number of accessory stinging batteries ranges from six to ten. The radial canals of some of these medusae show a tendency to branch, as sketched in Text Fig. 1. The branching may take place from the outer edge of the gaster ring (A. and C.) or nearer the edge of the bell (B.).



TEXT FIGURE 1.
Diagrams A, B, and C, to show the branching of the radial canals.

Medusae observed during the winter months showed an exumbrella surface similar to the spring medusae with 23 to 30 tentacles, but, in general, possessed not more than 22 tentacles.

On the 26th April of this year (1946) two specimens of adult medusae with 32 marginal tentacles and eight simple radial canals were found in an aquarium tank containing *Haliotis iris*. The water for the tank had been brought from Island Bay, Wellington, about two months prior to the date the medusae were observed. These medusae differed from the adult medusae described above in possessing six large mobile gastric pouches, a distinct hexagon above the pouches instead of the usual circular ring, and were predominantly creamy-yellow in colour instead of orange-brown. The pouches viewed from the exumbrella surface were creamy-yellow in colour, but with black pigment at the base. From the umbrella surface the pouches were orange-yellow in colour with a creamy streak down the centre. The pouches extended about halfway across the diameter of the bell when fully expanded. The hexagon was white in colour. Six of the

eight radial canals entered the stomach at the points of the hexagon. The remaining two appeared to enter between the stomach pouches as shown in Fig. 6. Six distinct oral stinging knobs were present in both specimens on the rim of the manubrium. Whether six gastric pouches is a typical feature of adult medusae of this species and that lack of these in medusae present in an aquarium over a period of years is due to the artificial environment is a debatable point. Summarising the position, it appears that medusae in the aquarium tank over a period of years have young forms with six gastric pouches which are lost in the change to the adult form. In *Eleutheria hodgsoni* Browne (1910) and *Cnidonema haswelli* Briggs (1920) there are no stomach pouches. In *C. capensis* Gilchrist (1919) six distinct stomach pouches are present. The two adult medusae brought into the laboratory in sea-water for aquaria showed six distinct stomach pouches. This was the major feature distinguishing these adults from those that had been present in the aquarium over a period of years. Until more material is available from Island Bay, the author wishes only to point out the differences existing between the two adult forms observed in New Zealand and note the conditions existing in this and other genera.

The Hydroid.

The hydroid is similar to that described by Gilchrist (1919), except that there is a greater variation in the number of capitate and filiform tentacles. The normal number in those described by Gilchrist was six capitate and six filiform tentacles, but one out of every 20 specimens had four capitate, and in one instance a specimen had four filiform tentacles. In the present specimens, hydranths with five capitate and seven filiform tentacles were observed quite frequently. It might be suggested that the present wide range of variation in the number of tentacles may be due to aquarium conditions, but over a three-year period there has been no marked change in the nature of the variations, although the salinity of the tank has been increasing slowly throughout that period. Both medusoid and hydroid stages were transfered to another tank of lesser salinity, but in all cases failed to survive. Experiments designed to vary the salinity of the tank have proved unsuccessful, and no constant change has been observed to take place in the number of tentacles of the hydroid.

The Validity of **Cnidonema vallentini** as a Species.

The writer agrees with Gilchrist (1919) that the crawling or walking medusae of the Southern Hemisphere constitute a different genus (*Cnidonema*) from those of the Northern Hemisphere (*Eleutheria*). Therefore, for the reasons given above, the type species of the Southern Hemisphere becomes *Cnidonema vallentini* Browne. In 1911 Vanhöffen considered the Southern species *charcoti* and *hodgsoni* together with the new specimens he found at Kerguelen as identical with the type species *C. vallentini*. Gilchrist (1919), however, considers it wiser to keep *C. charcoti* and *C. hodgsoni* as separate species and adds Vanhöffen's Kerguelen specimens as a new species *C. kerguelense*. Gilchrist (1919) describes Cape of Good Hope specimens as *C. capensis* n.sp. Briggs (1920) considers as valid all the

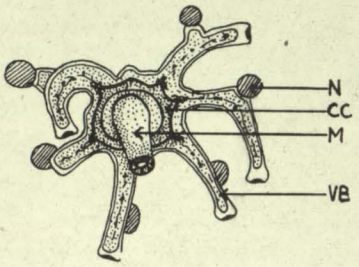


Fig. 1.

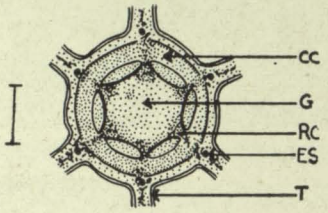


Fig. 2.

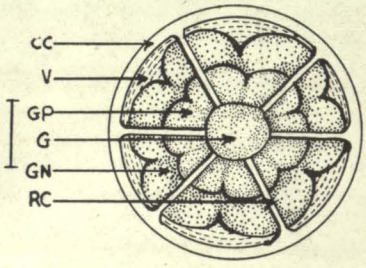


Fig. 3.

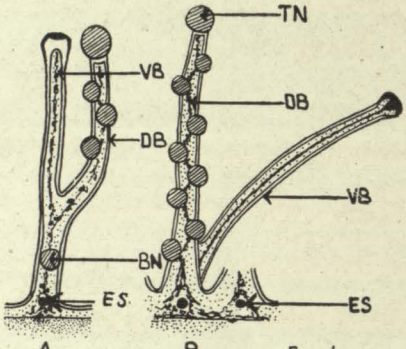


Fig. 4

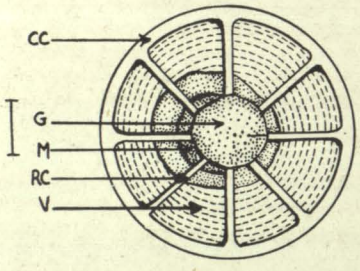


Fig. 5

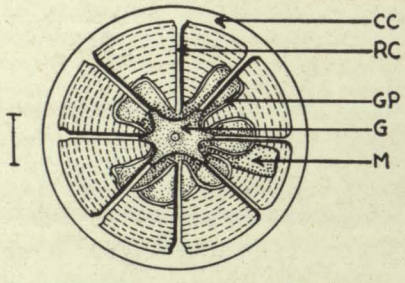


Fig. 6.

FIG. 1.—Juvenile medusa just liberated from the parent hydroid.

FIG. 2.—Juvenile medusa exumbrella surface.

FIG. 3.—Exumbrella surface, mature medusa, with gonads.

FIG. 4.—A. Tentacle form of medusa with up to 18 tentacles. B. Tentacle form of medusa with more than 18 tentacles.

FIG. 5.—Exumbrella surface of adult medusa present in aquarium tank over a period of years.

FIG. 6.—Exumbrella surface of adult medusa from Island Bay, Wellington.

ABBREVIATIONS

BN, basal nematocyst knob; CC, circular canal; DB, dorsal branch of tentacle; ES, eye spot; G, gaster; GN, gonad pouch; GP, gastric pouch; M, manubrium; N, nematocyst knob; RC, radial canal; T, tentacle; TN, terminal nematocyst knob; V, velum; VB, ventral branch of tentacle.

Scale line in Figs. 1, 3, 5, and 6 represents 0.25 mm.

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species recorded by Gilchrist, i.e. *C. vallentini, charcoti, hodgsoni, kerguelense* and *capensis* and adds the Australian form as *C. haswelli* n.sp. Lengerich (1923) follows Vanhöffen (1911) and considers all the known species of *Cnidonema* as referable to *C. vallentini.*

Edmondson (1930) records four new species of *Eleutheria* (Northern Hemisphere genus) from Hawaii and states that " the species of the Southern Hemisphere, if the several forms are to be considered identical, is more closly allied to the Hawaiian ones than are the Hawaiian to those of Europe. An affinity between *Cnidonema vallentini* and the Hawaiian species is seen in that all possess clusters of nematocysts on the dorsal branch of each mature tentacle in addition to the capitate group at its extremity." The chief characters on which Edmondson erects his species are the position of the accessory stinging batteries and the form of the tentacle. Weill (1937) considers this insufficient evidence to separate the Northern Pacific species, i.e. Edmondson's species of *Eleutheria,* from the Australo-antarctic (species of *Cnidonema*). Weill further considers the form he found at Bermuda definitely *Cnidonema* without corresponding exactly with any of the numerous species of the genus. He thinks it premature to call the Bermudan specimens a new species as those already existing are in his opinion justifiably questioned. Weill refers the Bermudan specimens, which he considers juvenile, to the type species *C. vallentini.* The external form of the *Cnidonema* figured by Weill is very similar to the juvenile form of the present material, except that in the New Zealand specimens asexual budding has not been observed.

From the evidence of my material I agree with Vanhöffen (1911), Lengerich (1923), and Weill (1937) in uniting the various species of *Cnidonema* under the type species *C. vallentini.* It should be noted, however, that *C. vallentini* is the only southern species that has been described as having the gonad entirely above the stomach. This point cannot be checked until further material is described from Stanley Harbour, Falkland Islands. As all the other species agree in not having the gonad above the stomach and differ mainly in tentacle form and structure, which is a feature that has been shown to change within the life history, it seems best at present to conclude that the southern species are all identical and referable to *C. vallentini.* Gilchrist (1919 appears to be the only writer up to the present who has observed the hydroid of *Cnidonema.* The outstanding feature from all descriptions of the genus is its extreme variability. The present paper shows how considerably the medusa changes its form when passing from the juvenile to the adult stage. Great difficulty is therefore created for the worker who may have to depend for his description on a few specimens probably of one phase of the life cycle only. For instance, some forms in the life cycle of the New Zealand specimens (particularly features in relation to the number of accessory stinging batteries and tentacle form) correspond very closely indeed with three of Edmondson's species, namely, *E. oahuensis, E. bilateralis,* and *E. alternata.* The probability is that the Hawaiian species are stages in the development of the genus *Cnidonema.*

C. charcoti and *C. hodgsoni* are separated as species because *C. charcoti* has radial canals that tend to anastomose, otherwise the two forms are identical. As branching of the radial canals is a feature of some of the adult forms of the New Zealand specimens, it seems probable that these two species at least are identical one with the other and with the New Zealand specimens. The present writer feels that it is not sufficient to erect species on features that vary within the life cycle, as, for instance, the position and number of nematocyst knobs on the aboral portion of the tentacle (Edmondson's species) or the length of the aboral and oral branch of the tentacle, i.e. the tentacle form (Gilchrist and Briggs). *Cnidonema* appears to parallel the closely allied genus *Cladonema*. Weill (1937) gave a full review of the three existing species of *Cladonema* and came to the conclusion that *Cladonema radiatum*, the type species, was cosmopolitan and that the existing species were geographical races.

The present material shows a novelty apparently not observed by other workers. In all specimens where satisfactory observations could be made, a ring of five or six stinging knobs can be seen arranged around the manubrium. It may be possible that other workers did not observe these stinging knobs because of the difficulty of recognising them in preserved material and even in fresh material if the manubrium is in rapid motion or at all contracted. Apart from this, the specimens fall well within the wide range of *C. vallentini*. In ordinary circumstances this novelty might be considered sufficient to establish a new species, but because of the extreme variability of the specific characters and the difficulty of observing the knobs under the circumstances described above, the writer does not feel justified in erecting a new species on this feature alone. If in the future oral stinging batteries should prove to be a novelty in the genus, it may be necessary to establish a new species.

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