5. On a Freshwater Medusa from the Limpopo River System, with a Note on a Parasitic Infusorian.

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(Plate I.* and Text-figures 1 & 2.)

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The medusæ which form the subject of this communication were obtained by one of the authors during January 1913 in the Norquane River, a minor tributary flowing through the Inziza and Umzingwane Rivers to the Limpopo. They were identified as belonging to the genus *Limnocnida*, and the new fact in the distribution of this form was recorded in a letter to 'Nature' in April of the same year (**17**).

A number of specimens were sent to England, and proved to belong to the same species, *Limnocnida rhodesiæ* Boulenger, as those collected during 1908 by Mr. R. H. Thomas in the Hunyani River, a southern tributary of the Middle Zambesi.

Limnocnida rhodesiæ was described in 1912 (**14**) from somewhat scanty and poorly preserved material, so that, in addition to their interest from the zoo-geographical point of view, the Norquane River specimens afford an opportunity of adding to our knowledge of this species.

Species of the genus *Limnocnida* have now been recorded from the five principal river-systems of Africa, as well as from India. The type species, *L. tanganicæ*, discovered by Böhm (**1**) in Lake Tanganyika in 1883 and described by Günther ten years later (**2**, **3**), has been found to occur also in the Victoria Nyanza (**6**–**8**) as well as in the River Niger (**9**, **10**). *L. rhodesiæ* is now known to inhabit Rhodesia both in the Zambesi and Limpopo river-systems; and the Indian species has been described under the name of *L. indica* (**15**) from tributaries of the Kistna River in the Satara district of the Bombay Presidency.

The Norquane River is situated in the Bembesi district of Southern Rhodesia, about 30 miles W.N.W. of Bulawayo. This stream usually contains water throughout the year, but the visible flow is interrupted during the dry season by sandy bars, whereby the course is broken up into a succession of pools.

* For explanation of the Plate see p. 76.

About a mile above its junction with another small stream, the Nongqua or Noonka, the Norquane River is broken by a large granite bar which during the rains forms a small waterfall. No jellyfishes were seen above this bar, but down to the junction of the two streams all the pools contained them. The vegetation of the latter consists of water-lilies and Potamogetons together with a submerged plant (not identified) which forms thick carpets on the bottom. The remainder of the fauna comprises the usual aquatic insect larvæ, freshwater crabs, mussels, and two small species of fish.

The jelly-fish in the living state vary in size from about 6–16 mm. in diameter, the depth of the umbrella varying correspondingly from 3–6·5 mm. when in the uncontracted condition. They are very transparent; the tentacles are, however, of a milky white colour and more opaque, whilst the umbrella-edge and the base of the manubrium are of a pale yellowish-white and also slightly opaque. When, therefore, the animal is viewed from above, at a distance of two feet or so, only a central patch is seen separated by a transparent area from an external opaque ring.

The medusæ move fairly rapidly, at the rate of 12–14 inches per minute; the tentacles usually take part in the wave of contraction whereby locomotion is effected, but are sometimes kept extended during the whole phase. The manubrium, or stomach, appears to aid in locomotion, being emptied and refilled with water at each contraction.

The deeper and larger pools contained far greater numbers of these creatures than the shallow ones: this is no doubt largely due to the difference in temperature between these bodies of water, the temperature being of course higher in the smaller and shallower pools. Careful observation made it clear that the jelly-fish prefer the cooler waters. This was especially seen in the fact that during the hotter hours of the day, *i. e.* from about 11 A.M. to 4 P.M., very few medusæ were to be seen near the surface; they remained at a level of about two feet below the same, where the water was appreciably cooler. In the early morning and in the evening they were as plentiful at the surface as at deeper levels.

It was noticed that the fish in the stream did not attempt to feed on the medusæ—indeed, some of the smaller fish were seen to swim out of the way of an advancing medusa; it is probable, therefore, that their stinging powers render them unpalatable.

Although carefully sought for, no traces of a hydroid stage were found.

Plate 1. shows the appearance of the living animal; after fixation the natural shape of the medusa is not easily appreciated, preserved specimens presenting the flattened umbrella and widely open mouth so generally associated with the genus *Limnocnida*.

The specimens received in England had been fixed with various reagents, chiefly corrosive sublimate and osmic acid: all, unfortunately, had the umbrella-edge, the tentacles, and the manubrium

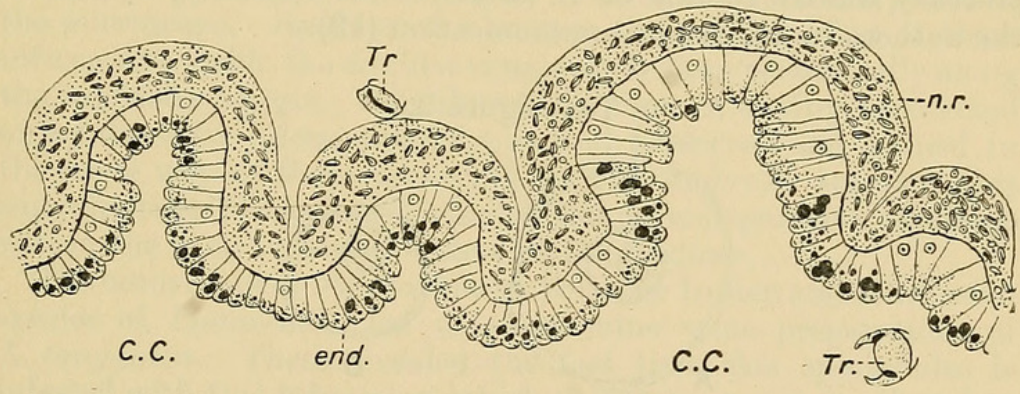
much contracted, so that the largest specimens measured no more than 6·5 mm. in diameter, exclusive of the tentacles.

Umbrella.—In all the preserved specimens from the Norquane River, the umbrella is disk-shaped and considerably flattened at the top; it is about $3\frac{1}{2}$ times as broad as high.

Manubrium and Mouth.—The manubrium is also much contracted in all the individuals, and the mouth appears as a wide circular aperture. Observations on the living animal showed, however, that the mouth could be completely closed. In this connection it will be recalled that one of the Zambesi specimens of *L. rhodesiæ* was described as possessing an almost conical manubrium and a nearly completely closed mouth. Gravely and Agharkar (16) have shown that *L. indica* is also capable of closing the mouth, small specimens doing so more frequently than large ones.

Gonads.—The gonads are poorly developed in all the individuals; so far as could be ascertained the majority belong to the male sex. The Norquane specimens were collected about the same time of the year as the originally described specimens of *L. rhodesiæ*; these also had the gonads poorly developed except in one instance, where a fairly well-formed ovary occurred.

Text-figure 1.



Longitudinal horizontal section through part of the nettle-ring of *Limnocnida rhodesiæ*, × about 150.

c.c., circular canal; *end.*, endoderm; *n.r.*, nettle-ring; *Tr.*, parasitic *Trichodina*.

Tentacles.—In structure and arrangement the tentacles are precisely similar to those of the Zambesi specimens. The number of these organs varied in the different individuals from about 85 to 110; owing to the state of contraction of the umbrella-edge they appear very closely crowded together, and are therefore somewhat difficult to count with any accuracy. As in the other species the tentacles are arranged in series, according to size—the perradial, interradial, and adradial being the largest. The larger tentacles have long narrow bases attached to the exumbrella surface of the bell and devoid of nematocyst batteries; the smaller ones are more cylindrical in shape and are only attached

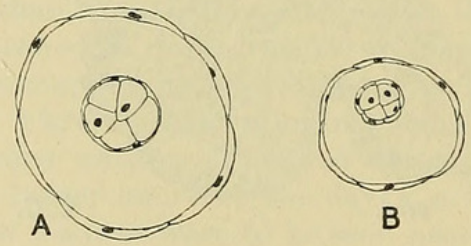
to the umbrella for a short distance. The nematocysts are similar to those of *L. tanganicæ*.

Nettle-Ring.—As in the type specimens of *L. rhodesiæ*, the nettle-ring is comparatively narrow and thickened and folded round the bases of the tentacles in such a way as to form structures resembling the tentacle-bulbs which occur in so many craspedote medusæ. These "tentacle-bulbs" are particularly conspicuous in the specimens from the Norquane River: this is probably due, in part, to the great contraction of the umbrella-margin, which is thus thrown into folds.

As the structure of the nettle-ring and other organs of the umbrella-edge forms the chief distinguishing character between *L. rhodesiæ* and *L. tanganicæ*, it seemed important to ascertain by means of sections whether the peculiar appearance of the tentacle-bases in the former species is due entirely to this folding of the nettle-ring whilst the medusa is in a contracted condition. A series of sections was cut in a longitudinal horizontal direction through the umbrella-margin, and such sections show quite clearly that, although the nettle-ring is a continuous structure, it is considerably thickened at the base of each tentacle, these thickenings forming the characteristic basal swellings which resemble the tentacle-bulbs of other medusæ.

In its histological structure the nettle-ring of *L. rhodesiæ* is precisely similar to that of *L. tanganicæ* as described by one of the authors in a previous communication (12).

Text-figure 2.



Sense-organs of *Limnocnida rhodesiæ* (A) and *L. tanganicæ* (B) viewed under the same magnification. × 170.

Sense-Organs.—The sense-organs are only slightly less numerous than the tentacles: for instance, in the case of an individual with 96 tentacles, 84 of these organs were counted. This is due to the very definite relation between the arrangement of the sense-organs and that of the tentacles in this species: a pair of the former being situated at the base of each of the larger tentacles near the velar margin of the nettle-ring, whilst a single sense-organ occurs in a similar position at the base of each of the other tentacles with the exception of the smallest, which are without these organs.

In the description of the Hunyani River specimens of *L. rhodesiæ* (14), mention was made of the fact that the sense-organs

of this species appeared to be somewhat larger than those of *L. tanganicæ*. This statement is correct also with regard to the specimens from the Norquane River. A number of the sense-organs from different individuals of *L. rhodesiæ* were measured with care, and the average diameter found to be 135 μ; examination of preparations of *L. tanganicæ* showed the diameter of the sense-organs of this species to average 70 μ and not to exceed 90 μ (at least in the few specimens at our disposal). The latter measurements were taken from some medusæ collected by Dr. Cunnington in Lake Tanganyika in 1905.

There seems to be no definite statement as to the size of the sense-organs in any of the numerous descriptions of the Tanganyika medusa. Günther (**3**), however, figures two of these organs × 1000, which by calculation gives the diameter as 60 μ, this agrees fairly well with the measurements given above.

Parasitic Infusorians.—Annandale (**15**) recorded the occurrence of numerous examples of *Trichodina pediculus* Ehrenberg on the manubrium of specimens of *L. indica*.

A peritrichous infusorian belonging to the same genus was found in great abundance on many of the specimens of *L. rhodesiæ* from the Norquane River, occurring not only on the manubrium but also on the velum, the tentacles, and the surface of the umbrella, sometimes in such numbers as to give the whole medusa a spotted appearance when viewed under a lens or a low power of the microscope. Sections of a medusa showed a number of these infusorians inside the circular canal which runs peripherally along the umbrella-margin; they showed no signs of having been acted on by digestive juices, and were as well preserved and stained in the same way as those occurring on the umbrella surface: this suggests that *Trichodina* is able to lead an endoparasitic existence within the gastrovascular system of the medusæ.

The occurrence of *Trichodina* on both the Indian and Rhodesian species of *Limnocnida* led us to examine some preparations of *L. tanganicæ*. These revealed the fact that this species also is infested with this infusorian, which in warmer countries therefore turns out to be a fairly constant associate of freshwater jellyfish, and must play much the same rôle with regard to these organisms as it does in the case of the species of *Hydra* in this country.

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EXPLANATION OF THE PLATE.

Limnocnida rhodesiæ. Specimen from the Norquane River, Southern Rhodesia. × about 8.