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Edible Medusae.

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With Plate 13 and 1 figure in text.

In Japan as well as in China some rhizostomatous medusae are used for food. Generally full-grown specimens are selected for that purpose, as their gelatinous layer is thicker and consequently more substantial than that of young specimens. In Japan it is generally the custom to preserve the umbrella only; but in China and sometimes in Japan too the whole animal is preserved. The animal is preserved with a mixture of alum and salt or between steamed leaves of Kashiwa, a kind of oak, with the application of slight pressure. To prepare the preserved medusa for the table, it is soaked in water about half an hour, then taken out and well washed, cut into small pieces and flavoured with some condiments. Thus prepared it is easily masticable and furnishes an agreeable food. The medusa is never eaten fresh. It is also used as a bait for the capture of file-fish (*Monacanthus*) and sea-breams (*Pagrus*). The latter kind of fish is said to accompany shoals of such medusae.

We find the following two kinds of edible medusae in our waters:

Rhopilema esculenta KISHINOUE.

Rhopilema sp. KISHINOUE, 1890, in: Zool. Mag. Tokyo, V. 2, p. 47, tab. 2 (Japanese).

Rhopilema esculenta KISHINOUE, 1891, in: Zool. Mag. Tokyo, V. 3, p. 53 (Japanese with a German diagnosis).

The umbrella is extremely high, about $\frac{3}{4}$ as high as broad. It assumes a hemispherical form when fully expanded. It is very

thick at the centre and becomes gradually thin towards the margin (Fig. 1). The thickness at the centre is nearly equal to $\frac{1}{6}$ part of the umbrella diameter. The margin of the umbrella is cut into about 130—180 lobes, i. e. in each octant about 14—20 velar lobes between two small ocular lobes (Fig. 5). The number and size of these lobes is very variable, even in different octants of one individual. The velar lobes are oval, while the ocular lobes are somewhat lanceolate (Fig. 5).

The exumbrella is smooth, but on the marginal lobes we find numerous minute grooves which run nearly longitudinally (Fig. 5).

In the subumbrella, the muscles are well developed in the form of circular ridges (Fig. 2 *m*). The coronal groove is not distinct. The distance between the centre of the subumbrella and the point of attachment of the oral pillar is about half the distance between the latter and the umbrella margin (Figs. 1, 2). The four oral pillars (Figs. 1, 2 *o. p*) are about quadrate in form, and they are thick and strong. Between these pillars, there are four subgenital cavities (Figs. 1, 2 *s. c*), which are somewhat heart-shaped and almost as broad as the pillars. At the mouth of each cavity and between each two of the oral pillars, there is a large, hemispherical protuberance (Figs. 1, 2 *pr*). The surface of the protuberance is rough and prickly.

The oral disc (Figs. 1, 2 *o. d*) is enormously thick and assumes a prismatic form. Its height exceeds the breadth. Its wall is very thick and of a very firm consistence. Eight pairs of scapulets (Fig. 1 *scp*) originate from the sides of the prism. The upper margin of the scapulets is provided with sucking frills, among which there are numerous hollow filaments. Each scapulet is divided into two parts at the distal end. The sucking frills of the lower surface of the oral disc (Fig. 3) are very characteristic. There they are found as five separate groups — the central cruciform group and four per-radial 3-rayed groups, and at the centre of each group there is a very long hollow filament (Figs. 1, 3). These five filaments are the longest of all the appendages of this medusa.

The eight oral arms (Fig. 1 *o. a*) are large, stout, triangular pyramids. The upper portions are coalesced with each other along half their length (Figs. 1, 3). Among the sucking frills of the oral arm there are two kinds of appendages — one filamentous, the other long and conical or rather long and fusiform (Fig. 1). These appendages are non-contractile and have a central canal, which opens at the distal end. The scapulets lack the fusiform appendage. Both kinds of

appendage are very numerous, and generally the long fusiform appendage is found to be bigger and longer towards the distal end of the lower portion of the arm. Some of them attain the length of 300 mm or more in a full grown specimen. They fall off easily. There is no special terminal appendage which may be distinguished easily from the others by the superiority of its size.

The lower portion of the arm is about twice as long as the free part of the upper portion, but is shorter than the long fusiform appendages. The upper portion is about as long as the scapulets.

The gastrovascular system is very complex. The canal-system of the subumbrella is nearly alike to that of *Rhizostoma hispidum* VANHOEFFEN¹⁾. The circular canal is indistinct in mature specimens; but its original position is indicated by the swollen, middle part of the adradial canal (Fig. 2). Inside of the circular canal, the perradial and interr radial canals anastomose with the canal arcade; but the adradial canals do not. From the lower border of the gastric cavity originate four perradial canals, which correspond to the crucial canal of the *Crambessidae*, and there also originate the canals for the scapulets (Fig. 1). Each limb of the crucial canal is divided into two, so that there are eight canals for the eight oral arms. Each arm canal (Fig. 4) gives off many branches, the largest of which is branched from the middle part of the canal where it is divided into two horizontal branches. The largest branch-canal runs through the longitudinal axis of the lower portion of the arm and gives off a few lateral branchlets; but it is divided into many short branchlets at the distal end. These branchlets are almost equal in size and there is not a specially larger one for the terminal appendage, as it is usually the case with the medusae of the genus *Rhizostoma* (*Pilema* of HAECKEL). Each of the two horizontal branches gives off four or five branchlets. The largest branchlet is situated nearest to the longitudinal axis of the lower portion of the arm. These branchlets are ramified again and again and open in suctorial frills of the dorsal, or abaxial, wing of the lower part of the arm.

The color is generally blue, but sometimes it is dark red. The sucking frills are brown, while the appendages are milky white or colorless and nearly transparent. The genital gland is yellow. The male genital gland is lighter in color than that of the female.

1) VANHOEFFEN, Untersuchungen über semäostome und rhizostome Medusen, 1888, p. 32, tab. 5, fig. 1, 2.

This medusa attains very large size. In a full-grown specimen, the diameter of the umbrella is more than 450 mm.

It is found in the Inland Sea, Bay of Suruga, the Ariakē Bay, etc. It is known by the names of Bizenkuragē, Tōkuragē etc. From the narrative of friends of mine, I am inclined to believe that a kind of medusa called Dōkwankuragē in the Japan Sea is identical with this species, though I have not yet seen any specimen of that kind.

I have specimens of this medusa also from China.

This medusa closely resembles the medusa described by HAECKEL as *Rhopilema rhopalophora*¹⁾; but it may easily be distinguished by the form of the appendage of the oral arm. In the former, the appendage is long and fusiform, while in the latter it is triangular and pyramidal.

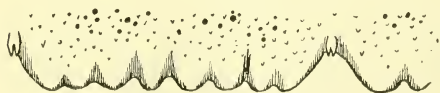
Though the terminal and lateral appendages of the oral arm are morphologically equal in value as VANHOEFFEN²⁾ claims, yet I think it proper to distinguish, as HAECKEL did, the medusae with distinct terminal appendages from those which lack them. In the latter group of medusae, there is no marked difference between the terminal and lateral appendages, neither in shape nor in size. Therefore I do not agree with VANHOEFFEN who thinks it right to withdraw the genus *Rhopilema* of HAECKEL.

Rhopilema verrucosa n. sp.

I found a few specimens of a medusa, differing from the common edible species, among the medusae preserved for food and exhibited at the Second National Fisheries Exhibition at Kōbē, 1897. They were tolerably well preserved, so I was able to examine essential points of structure.

The umbrella seems to be pretty high; but from the preserved specimens it was rather difficult to recognize the shape in the fresh state. In each octant of the umbrella margin, there are 6—8 oblong velar

lobes between two small, lanceolate, ocular lobes, as is shown in the accompanying figure.



1) HAECKEL, System der Medusen, Acraspeden, p. 596.

2) VANHOEFFEN, l. c.

The ocular lobes are much receded from the general umbrella margin.

The exumbrella is pretty thickly covered with fine pointed granules.

The distance between the centre of the subumbrella and the point of attachment of the oral pillar is about half the distance between the latter and the umbrella margin.

The oral pillar is comparatively narrow, its breadth in the middle part being a little less than $\frac{1}{3}$ of its length.

The subgenital cavity is somewhat heart shaped. Its breadth is about 3 times that of the oral pillar. A roughened protuberance is found at the mouth of each subgenital cavity.

There are eight pairs of scapulets. Each scapulet is split into two equal lateral parts at the distal end.

The oral arms are comparatively short. The lower part of the arm is about the same in length as the free portion of the upper arm. The two abaxial wings of the lower part are large. The appendages of the oral arm are the same as in the preceding species.

The gastrovascular system is also very much complicated. The canals of the subumbrella are nearly the same as those of the preceding species.

The exumbrella and the oral arms have small, round, brown spots irregularly distributed.

The diameter of the umbrella: 340 mm.

The specimens examined were from the Ariakē Bay in Kūshū.

Dec. 12, 1898.

Explanation of Plate.

<i>adr</i>	adradial canal	<i>o. p</i>	oral pillar
<i>g</i>	genital gland	<i>perr</i>	perradial canal
<i>intr</i>	interradial canal	<i>pr</i>	round protuberance
<i>m</i>	muscle	<i>s. c</i>	subgenital cavity
<i>o. a</i>	oral arm	<i>scp</i>	scapulet
<i>o. d</i>	oral disc		

Plate 13.

Rhopilema esculenta KISHINOUE.

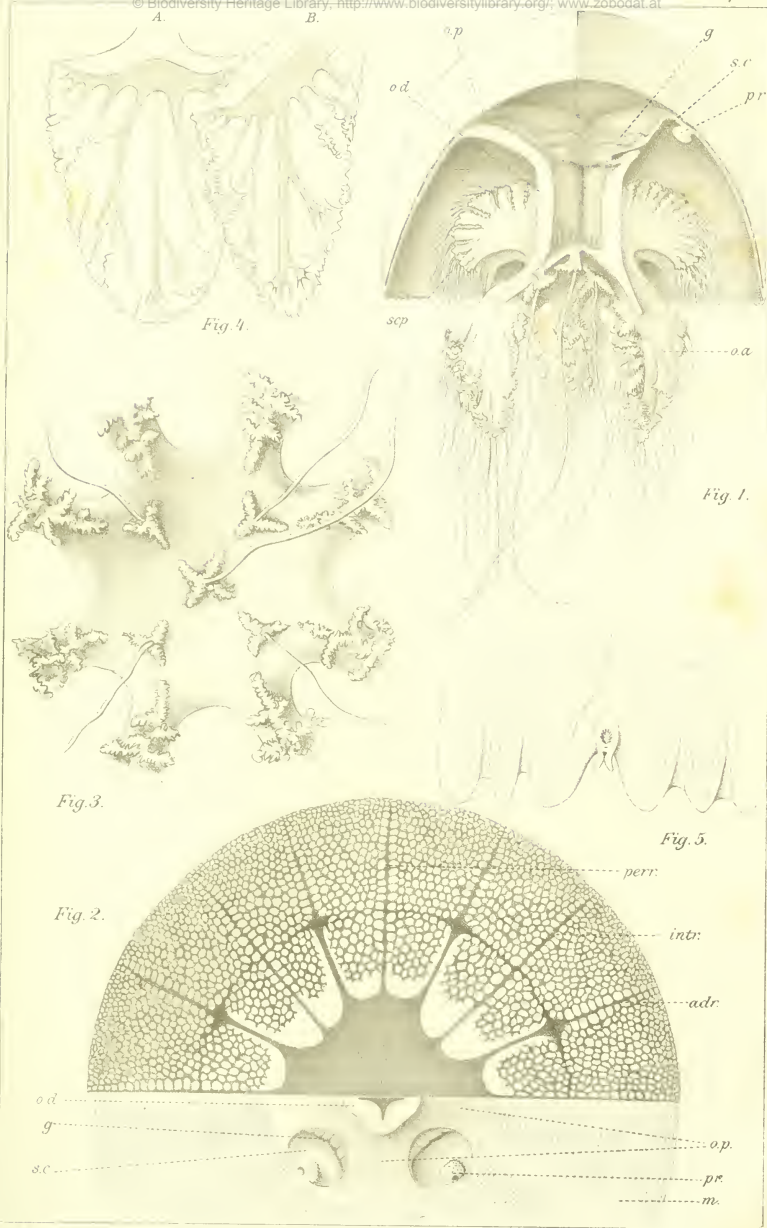
Fig. 1. Longitudinal section. $\frac{1}{7}$ natural size. The left half represents a section through a perradial plane, and the right half a section through an interrarial.

Fig. 2. Subumbrella. $\frac{1}{7}$ natural size. The peripheral portion, outside the central gastric portion is a little unnaturally extended to show the canal system clearly.

Fig. 3. Lower surface of the oral disc. ca. $\frac{1}{5}$ natural size.

Fig. 4. Oral arm. ca. $\frac{1}{3}$ natural size. A Front view, B Side view.

Fig. 5. Portion of the umbrella margin. Natural size.



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