

SOME OBSERVATIONS ON THE SCYPHOMEDUSA *ATOLLA*

BY F. S. RUSSELL, F.R.S.

The Plymouth Laboratory

(Text-figs. 1-3)

During the last four years collections of plankton from deep water have been made regularly on the cruises of R.V. 'Sarsia'. The opportunity has been taken to study the biology of the scyphomedusa *Atolla wyvillei*. It was hoped that with material collected from the same area at different times of the year it might be possible to gain some information on the growth and length of life of this medusa. The collections have been supplemented by a number of specimens taken on recent cruises of R.R.S. 'Discovery II', and a total of nearly 300 medusae have been examined. The collections were made with the 2 m stramin ring trawl and the Isaacs-Kidd pelagic trawl mostly from the Bay of Biscay.

On all specimens sufficiently well preserved the following observations were made: diameter of the umbrella in millimetres, including marginal lappets; number of marginal tentacles; and degree of development of the gonads. In assessing the development of the gonad the specimens were grouped into three categories: (1) those in which there were no gonads, or in which the gonads were just appearing as crescent-shaped growths in which the sex could not be distinguished; (2) those in which the gonads were obviously not mature, but in which the two sexes could be determined; and (3) males and females which appeared to be mature or, at any rate, in which the gonads were completely full. In mature females the gonads are always distinctly separated one from the other, but in mature males the gonads become folded and touch one another so as to form an almost continuous ring.

The results of relating size to maturity of 281 specimens are given in Fig. 1. It will be seen that there are two separate peaks of mature specimens, one between 10 and 20 mm and the other between 60 and 70 mm. I first thought that this bimodality might indicate two breeding periods, perhaps at yearly intervals. Further examination of the data showed, however, that the small and the large mature specimens corresponding to the two peaks occurred in all months of the year in which samples were collected, namely February, March, April, May, June, July and November. It was impossible, therefore, to gain any information on rate of growth from these observations. This in

itself was disappointing, but it left the occurrence of the two peaks of maturity to be explained.

There was the possibility either that some specimens mature at an early size and die, or that after spawning they continue growth and, after recovery of the spent gonads, spawn a second time. In the latter event it might have been expected that the two peaks of maturity would not be so completely separated.

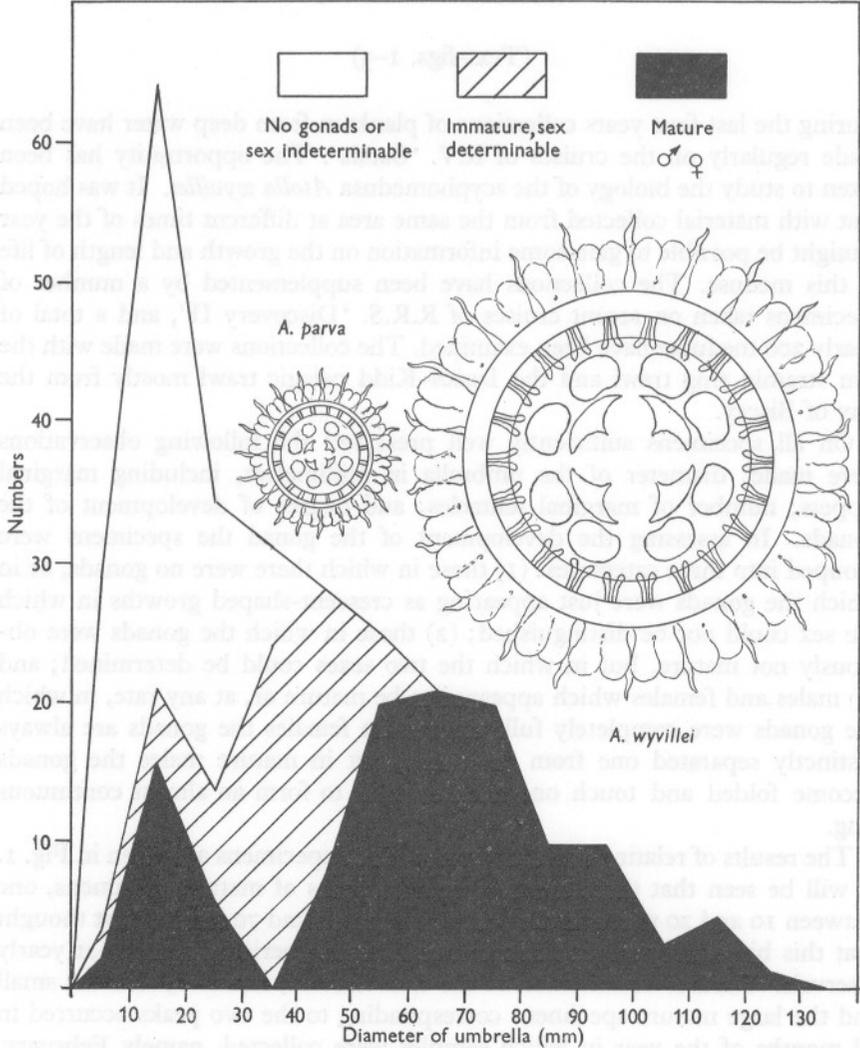


Fig. 1. Graph showing numbers of *Atolla* at different stages of maturity plotted against the diameter of the umbrella in millimetres. Diagrammatic outline drawings are given to show roughly the average natural size of mature female specimens of *A. parva* and *A. wyvillei*.

But when a comparison of the number of marginal tentacles in relation to the diameter of the umbrella was made a curious anomaly was noticed. Table 1 shows that the normal number of tentacles in full-grown medusae is 22, the number characteristic of *A. wyvillei*. Furthermore, this number was never exceeded in large specimens. There are, however, a few specimens less than 35 mm in diameter with as many as 24 tentacles. A special examination was therefore made of these specimens, and it was found that they were mature or already had gonads which were sexually distinguishable. Now, if these specimens were to continue growing it is most improbable that their marginal tentacles would be reduced in number, which alone would account for the complete absence of any larger specimens with more than 22 tentacles. If, on the other hand, these small medusae died after spawning, why should they grow more tentacles than the normal large adult?

The only reasonable explanation seemed that these medusae which mature at a small size are a different species from *A. wyvillei* which form the bulk of the collection.

Examination was made of the numbers of tentacles in all those specimens less than 35 mm in diameter with mature or sexually determinable gonads, or with more than 22 marginal tentacles. The results are given in Table 2, from which it can be seen that the number of tentacles ranges from 18 to 24; and that seventeen out of thirty-seven specimens have 20 tentacles, twelve have 24, and only one has 22.

All these specimens, and a number of others with 20 marginal tentacles, were then examined to see whether any morphological character could be found to distinguish them from *A. wyvillei*, other than size at maturity or number of tentacles.

A distinctive character which appears to be constant was found in the septa which separate the tentacular and rhopalar canals (Fig. 2). In *A. wyvillei* these septa tend to diverge widely towards the gastric sinus with their ends turning slightly inwards again. The thin part of the coronal muscle does not reach the ends of the septa so that there are always appreciable portions of the septa projecting centripetally beyond the muscle margin. In the medusae which mature at a small size the septa are nearly straight; some of them tend to have pointed ends and they only diverge slightly if at all near the gastric sinus. The thin portion of the coronal muscle covers the septa almost completely to their ends and some septa do not project at all centripetally beyond the muscle margin.¹ This continuation of the muscle ring to the ends of the septa emphasizes the points of entry of the tentacular and rhopalar canals into the gastric sinus and tends to increase the geometrical regularity of the colour pattern round the umbrella in this region (Fig. 3). The thin portion of the muscle itself also appears to be more strongly developed than in *A. wyvillei*. In some specimens, probably due to contraction, the ends of the

¹ I have examined specimens of *A. vanhoeffeni* and find that they also have this character.

septa extend farther than usual beyond the margins of the coronal muscle. These, however, can still be distinguished by the straightness of the septa themselves; usually also they have the typical number of 20 or 24 marginal tentacles.

TABLE 1. RELATION OF NUMBER OF MARGINAL TENTACLES TO DIAMETER OF UMBRELLA IN *ATOLLA*

Diameter (mm)	Number of marginal tentacles							
	17	18	19	20	21	22	23	24
1-9	.	.	.	5	.	6	.	1
10-19	.	2	3	19	5	28	1	5
20-29	.	.	1	7	.	27	.	5
30-39	.	.	.	3	2	23	.	1
40-49	1	.	2	3	4	18	.	.
50-59	.	.	1	1	1	23	.	.
60-69	1	.	.	3	2	17	.	.
70-79	.	.	.	4	2	10	.	.
80-89	.	1	1	.	1	15	.	.
90-99	.	.	.	1	.	8	.	.
100-109	.	.	.	.	.	4	.	.
110-119	.	.	.	.	.	3	.	.
> 120	.	.	.	.	1	4	.	.
Totals	2	3	8	46	18	186	1	12

TABLE 2. SPECIMENS OF *ATOLLA* LESS THAN 35 mm, INCLUDED IN TABLE 1, WITH MATURE OR SEXUALLY DETERMINABLE GONADS, OR 23 OR 24 TENTACLES

Diameter (mm)	Number of marginal tentacles							
	17	18	19	20	21	22	23	24
1-9	.	.	.	2	.	.	.	1
10-19	.	2	3	11	.	.	.	5
20-29	.	.	.	4	1	1	1	5
30-35	1
Totals	.	2	3	17	1	1	1	12

On the above characters I concluded that the small mature specimens were a distinct species and published a brief description under the name *Atolla parva* (Russell, 1958).

In the north-eastern Atlantic we thus have three species of *Atolla*: *A. wyvillei*, *A. vanhoeffeni* and *A. parva*. There can, I think, be no doubt that the large medusae with 22 tentacles are *A. wyvillei* as they agree well with Haeckel's original description of the species based on five specimens 38-68 mm in diameter, all of which had 22 marginal tentacles except the smallest in which there were 19 (Haeckel, 1880, p. 488; 1881, p. 113). It is most unlikely that any of the existing specific names could be used for *A. parva*, although it must be present in other collections as it is generally stated that mature specimens are found at all sizes. Indeed, among the eight specimens on which Fewkes (1886, p. 939) based his description of *A. verrilli* there were

two specimens 14 and 25 mm in diameter, each of which had 24 marginal tentacles.

As far as I have found at present *A. parva* differs from *A. wyvillei* only in its smaller size, the characteristic number of 20 or 24 marginal tentacles, and the form of the septa and their almost complete covering by the coronal muscle. The coloration of *A. parva* seems to be similar to that of *A. wyvillei*, and in some specimens the stomach alone is deeply pigmented.

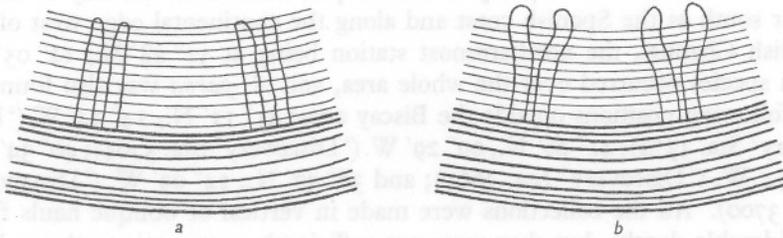


Fig. 2. Diagrammatic drawings to show the shapes of the septa separating the tentacular and rhopalar canals and their positions in relation to the thin portion of the coronal muscle: a, *Atolla parva*; b, *A. wyvillei*. Note that in *A. parva* the sides of the tentacular canals are approximately straight, and in *A. wyvillei* they are converging and constricted at the entrance to the gastric sinus.

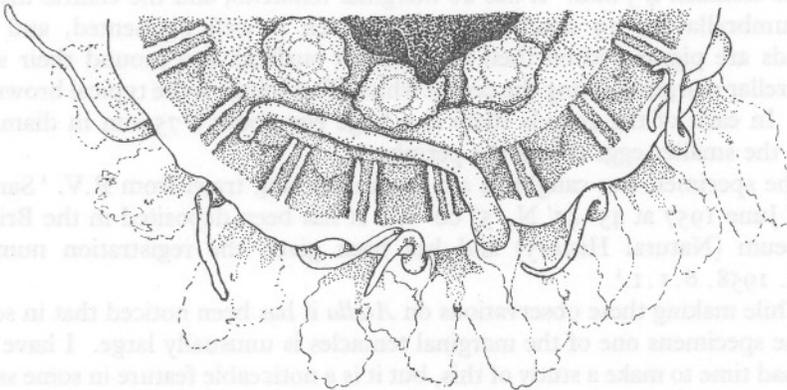


Fig. 3. Drawing of portion of the type specimen of *Atolla parva* to show the large marginal tentacle.

Since number of marginal tentacles is evidently a specific character the question naturally arises whether those specimens with 24 tentacles are specifically distinct from those with 20. I have examined the specimens carefully and can find no other character in which they differ, except that there is a tendency for those with 24 tentacles to be larger. I have now seen nearly fifty specimens: while the majority are between 9 and 21 mm in diameter there are four specimens which measure 25, 26, 29, and 30 mm in

diameter respectively; each of these has 24 tentacles. Of these the largest, 30 mm in diameter (paratype B.M. 1958, 6.1.8), has only the stomach pigmented. As it cannot be said for certain that the medusae with 24 tentacles may not be a separate species I have selected as the holotype specimen of *A. parva* one with 20 tentacles.

From the data available there does not appear to be any difference in distribution between *A. wyvillei* and *A. parva* in the area from which the collections were made. The majority of the samples came from the Bay of Biscay as far south as the Spanish coast and along the continental edge west of the English Channel, the northernmost station being at $51^{\circ} 28' \text{ N.}, 12^{\circ} 05' \text{ W.}$ Both species occurred over the whole area, and *A. parva* was also found at the following positions outside the Biscay area: $41^{\circ} 11' \text{ N.}, 14^{\circ} 34' \text{ W.}$ ('Discovery' Sta. 3374); $41^{\circ} 26' \text{ N.}, 09^{\circ} 29' \text{ W.}$ ('Discovery' Sta. 3704); $40^{\circ} 34' \text{ N.}, 19^{\circ} 42' \text{ W.}$ ('Discovery' Sta. 3661); and $36^{\circ} 37' \text{ N.}, 14^{\circ} 09' \text{ W.}$ ('Discovery' Sta. 3700). All the collections were made in vertical or oblique hauls from considerable depths, but they were not sufficiently systematic to throw light on the vertical distribution of the medusae.

I have selected as the holotype a mature female specimen 18 mm in diameter. In this specimen the diameter to the periphery of the coronal muscle is about 13 mm; the diameter of the central umbrella disc is 7 mm and that of the base of the stomach 4.3 mm. It has 20 marginal tentacles, and the central disc of the umbrella has 19 notches. The specimen is well pigmented, and the gonads are pigmented on their exumbrellar surfaces and around their subumbrellar margins leaving the centre white. The colour is the typical brownish red. In each of the gonads there is a large egg about 0.75 mm in diameter with the smaller eggs round the periphery.

The specimen was caught in a 2 m stramin ring trawl from R.V. 'Sarsia' on 3 June 1957 at $45^{\circ} 47' \text{ N.}, 5^{\circ} 00' \text{ W.}$ It has been deposited in the British Museum (Natural History) and has been given the registration number B.M. 1958. 6.1.1.¹

While making these observations on *Atolla* it has been noticed that in some of the specimens one of the marginal tentacles is unusually large. I have not yet had time to make a study of this, but it is a noticeable feature in some small

¹ I have also deposited the following specimens as paratypes, B.M. 1958. 6.1.2-8:

	13.vi.56.	$48^{\circ} 29' \text{ N.}, 9^{\circ} 5' \text{ W.}$	R.V. 'Sarsia'
2.	16 mm diameter	19 tentacles	Female
3.	26 mm diameter	24 tentacles	Immature
4.	7 mm diameter	20 tentacles	Immature
	4.vii.56.	$47^{\circ} 02' \text{ N.}, 5^{\circ} 53' \text{ W.}$	R.V. 'Sarsia'
5.	20 mm diameter	20 tentacles	Male
6.	20 mm diameter	20 tentacles	Immature
7.	7 mm diameter	24 tentacles	Immature
	29.ii.57.	$41^{\circ} 11' \text{ N.}, 14^{\circ} 34' \text{ W.}$	('Discovery' Sta. 3374)
8.	30 mm diameter	24 tentacles	Female (stomach only pigmented)

specimens and is a further indication of the bilateral symmetry indicated by the number of notches or grooves in the central disc of the umbrella, which is usually one less than the number of marginal tentacles (Stiasny, 1934, p. 370). It will be necessary to get very young specimens to see whether this bilateral symmetry is a significant indication of the sequence of early development in the number of marginal tentacles.

The type specimen of *A. parva* has one such tentacle very much larger and more heavily built than the others (Fig. 3); and this is situated opposite the widest of the sectors of the central disc of the umbrella, that is at its point of asymmetry.

Luminescence has been observed in *A. parva* by Nicol (1958, p. 719).

My thanks are due to Captain C. A. Hoodless and the crew of R.V. 'Sarsia', the captain and crew of R.R.S. 'Discovery II', and a number of members of the staff of the Plymouth laboratory and the National Institute of Oceanography for their care in picking out some of the specimens from the catches.

SUMMARY

In a study of the biology of *Atolla* it has been found that at any time of year the population from the Bay of Biscay shows two peaks at maturity, one between 10 and 20 mm diameter and the other between 60 and 70 mm.

It is shown that the smaller of the two peaks is composed of specimens of *A. parva*, while the larger specimens are *A. wyvillei*.

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Note added in proof

Through the kindness of Dr P. L. Kramp I have been able to see additional specimens which were picked out by Dr Kay Petersen from the collections of *Atolla* from the Atlantic in the Universitetets Zoologiske Museum in Copenhagen. Many of these were in rather poor condition with gonads missing; but the fact that none of these specimens had 22 tentacles confirms their identification. Of these eight had 20 tentacles,

eight had 24, and four had 26, the highest number so far seen. It is interesting to note that the four specimens with 26 tentacles came from the farthest north stations in the Norwegian Sea, and that one of these was 33 mm in diameter.

			Metres wire	Diameter (mm)	Sex	No. of tentacles
<i>Ingolf</i>						
20. vii. 1896	St. 112	67° 56' N., 6° 44' W.	—	15	♀	26
				22	—	26
				23	—	24
				25	—	26
<i>Tjalfe</i>						
3. v. 1909	St. 322	60° 07' N., 48° 26' W.	2000	22	—	24
8. v. 1909	St. 336	64° 06' N., 55° 18' W.	1040	c. 13		
			-1100	(damaged)		
				14	—	24
<i>Thor</i>						
28. ii. 1909	St. 68	36° 13' N., 9° 44' W.	3000	13	—	20
				13	—	20
				16	—	24
				20	—	20
4. iii. 1909	St. 71	39° 35' N., 9° 45' W.	1600	11	—	24
				13	♀	24
9. ix. 1910	St. 232	36° 28' N., 9° 06' W.	2000	7	—	? 20
				10	♀	24
				(shrunk)		
				15	—	24
<i>Dana</i>						
24. v. 1934	St. 5143	65° 14' N., 6° 06' W.	2400	33	♂	26
<i>Atlantide</i>						
29. i. 1946	St. 82	5° 27' N., 0° 07' E.	1700	8	—	20
2. iv. 1946	St. 139	1° 30' N., 10° 10' W.	1750	10	—	20
				10	—	20
				12	—	20
				25		
				(damaged)		

Notes added in proof

Through the kindness of Dr F. J. Klumpp I have been able to see additional specimens which were picked out by Dr Kay Peterson from the collections of tads from the Atlantic in the University Zoological Museum in Copenhagen. Many of these were in rather poor condition with gonads missing; but the fact that none of these specimens had 22 tentacles confirms their identification. Of these eight had 20 tentacles.