

To Phil Pugh, with my best wishes for 2003

Francesc

The status of three rare siphonophores (Cnidaria, Hydrozoa) described by Tamiji Kawamura: *Bathyphysa japonica*, *Athorybia longifolia* and *Forskalia misakiensis**^{*}

FRANCESC PAGÈS

Institut de Ciències del Mar (CSIC), Passeig Marítim de la Barceloneta 37-49, 08003 Barcelona, Catalunya, Spain.
E-mail: fpages@icm.csic.es

SUMMARY: The holotypes of three *species inquirendae* siphonophores collected in Japanese waters and described by Tamiji Kawamura were re-examined. It is considered that *Bathyphysa japonica* is not a valid species because there are no characters that distinguish it from other *Bathyphysa* species; *Athorybia longifolia* is an incorrectly described specimen of *A. rosacea*; and *Forskalia misakiensis* is a wrongly described and badly preserved specimen, probably of *F. edwardsi*.

Key words: Siphonophorae, Tamiji Kawamura, *Bathyphysa*, *Forskalia*, *Athorybia*.

RESUMEN: EL ESTADO DE TRES SIFONÓFOROS (CNIIDARIA, HYDROZOA) RAROS DESCritos POR TAMJII KAWAMURA: *BATHYPHysA JAPONICA*, *ATHORYBIA LONGIFOLIA* Y *FORSKALIA MISAKIENSIS*. – Han sido reexaminados los holotipos de tres sifonóforos *species inquirendae* recogidos en aguas japonesas y que fueron descritos por Tamiji Kawamura. Se considera que *Bathyphysa japonica* no es una especie válida porque no se observan caracteres que la distingan de otras especies de *Bathyphysa*. *Athorybia longifolia* es un espécimen de *A. rosacea* descrito incorrectamente; y *Forskalia misakiensis* es un espécimen descrito erroneamente y preservado inadecuadamente, probablemente de *F. edwardsi*.

Palabras clave: Sifonóforos, Tamiji Kawamura, *Bathyphysa*, *Forskalia*, *Athorybia*.

INTRODUCTION

Tamiji Kawamura (1954) described three new species of siphonophores collected in Sagami Bay by the ship of His Majesty the Showa Emperor of Japan, namely the physonects *Athorybia longifolia*, *Forskalia misakiensis* and *Sagamalia hinomaru*. The paper also gave additional information on a few more uncommon species from Japanese waters and included the English

translation of the description of the cystonect *Bathyphysa japonica*, which had originally been published during wartime (Kawamura, 1943a, b).

Kawamura's paper (1954) is a rarity amongst his contributions on siphonophore systematics. It was his last paper, published at the age of 71, about 4 decades after his first and main set of studies on siphonophores (Kawamura, 1908-1915). Furthermore, it was the only one written in English and it appeared in a journal with a very restricted distribution, even for Japan.

*Received April 14, 1999. Accepted April 19, 2002.

Nonetheless, Kawamura sent a reprint to A.K. Totton who, in his remarkable book “A Synopsis of the Siphonophora” (1965), dealt with the new species and reproduced some of Kawamura’s original drawings. Totton, without having examined the holotypes, considered *Bathyphysa japonica* and *Forskalia misakiensis* to be *species inquirendae* while *Athorybia longifolia* and *Sagamalia hinomaru* were synonymized with *A. rosacea* (Forskål, 1775) and, tentatively, *Stephalia corona* Haeckel, 1888 respectively. At a later date, the type material of the benthic siphonophore *S. hinomaru* was re-examined by Pugh (1983) and confirmed as a valid genus and species. However, the systematic position of the other three species has remained in doubt.

The four species are known only from the holotypes. After the death of Emperor Hirohito, the four holotypes were removed from the Biological Laboratory at the Imperial Household and deposited in the National Science Museum, Showa Memorial Institute, in Tsukuba (NSMT). Recently, the holotypes of the three doubtful species have been re-examined and conclusions as to their taxonomic status are presented here.

SYSTEMATIC ACCOUNT

Phylum CNIDARIA
 Class HYDROZOA
 Sub-class SIPHONOPHORAE
 Order CYSTONECTA
 Family RHYZOPHYSIDAE
 Genus *Bathyphysa* Studer, 1878

Bathyphysa japonica Kawamura, 1943 (Fig. 1)

Bathyphysa japonica Kawamura, 1943b; 1954: 122-123, pl. VI, fig. 3; pl. VII, figs. 8-9. Totton, 1965: 43-44.

Material examined: *Bathyphysa japonica*; holotype collected in Sagami Bay, Yamaiba on 19 November 1940 (NSMT-Coel R:246; determined by Taku Komai according to the NSMT files). Preserved in alcohol. Japanese name: Komagatamanira.

The original description is difficult to cite correctly. It seems that it was Kawamura’s contribution to the 17th Annual Meeting of the Japanese Animal Association since an abstract (Kawamura, 1943a) entitled “On two species of *Bathyphysa*” that mentions *Bathyphysa japonica* n. sp. was published with the rest of the meeting’s abstracts. This abstract does not include either a proper description or illustra-

tions of the specimen. However, I was fortunate to find an original reprint (Kawamura, 1943b) of the proper description including illustrations in the library of the Seto Marine Biological Laboratory in Shirahama. The reprint’s pages are not numbered and, surprisingly, the species is already named *B. japonica* Kawamura 1943. The uncertainties relating to the publication date of the species description is further reflected in Kawamura’s 1954 paper which cites 1942 in the text but 1943 in the bibliography.

Kawamura (1954) published a photograph of the holotype laid out in a Petri dish (Fig. 1A), together with illustrations of the proximal and distal parts of the specimen (Fig. 1B). His description, however, gave few details. He stated that the pneumatophore measured 18 mm in height and 6 mm in width, and originally had some reddish-brown pigmentation at its apex. At three points the stem was branched, and it bore simple, short, cylindrical tentacles, but no gonodendra. Eleven siphons were present with five being ‘hook-shaped’, and six ‘bladder-shaped’, although two of the latter were said to be ‘twin, cocoon-shaped, or two shiphons [sic] united together’. From Kawamura’s (1954, pp. 120-122) earlier description of *Bathyphysa grimaldi*, one can infer that the ‘hook-shaped’ siphons are mature gastrozooids with long pedicles and hepatic villi within the stomach region, while the ‘bladder-like’ ones, referred to as *pneumatosiphons*, based on Bedot’s (1893) terminology that Kawamura adopted, have short pedicles and ‘the kidney-shaped gastric portion is converted to an airbladder-like structure, embracing a gas bubble in their interior’. In truth the pneumatosiphons are nothing more than young gastrozooids, and the use of this terminology is outmoded.

Kawamura argued (p. 123) that “This species [*Bathyphysa japonica*] is distinguishable from the foregoing [*B. grimaldi*] by (1) its lesser dimension of several zooids, and (2) form of the siphons and the pneumatosiphons”. However, the size of the zooids in such a contractile creature does not seem a valid character and, in addition, the morphology of the siphons and pneumatosiphons is not different despite the illustrations, after re-examination of the specimen.

Surprisingly, Kawamura did not mention any of the more important characters of the holotype that are described below. In addition, no comparisons were made with the other valid *Bathyphysa* species, *B. conifera* (Studer, 1878) and *B. sibogae* Lens and van Riemsdijk, 1908. Further, Kawamura did not note the presence of ptera (lateral wings) on the

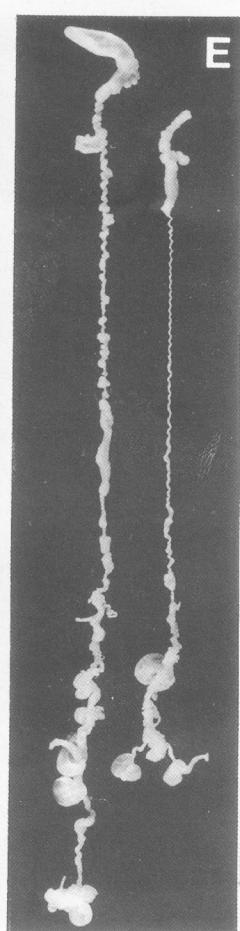
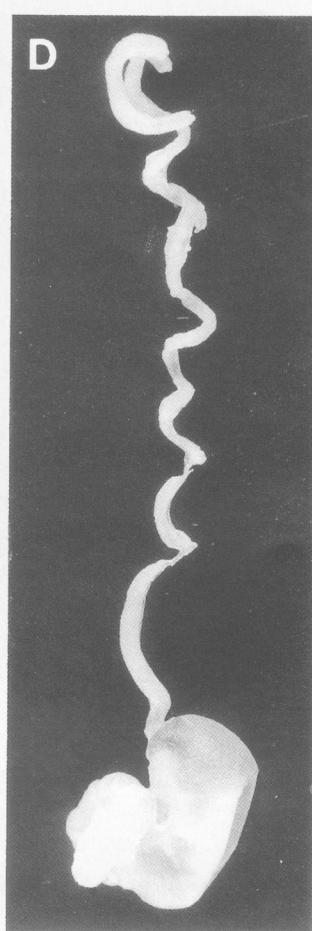
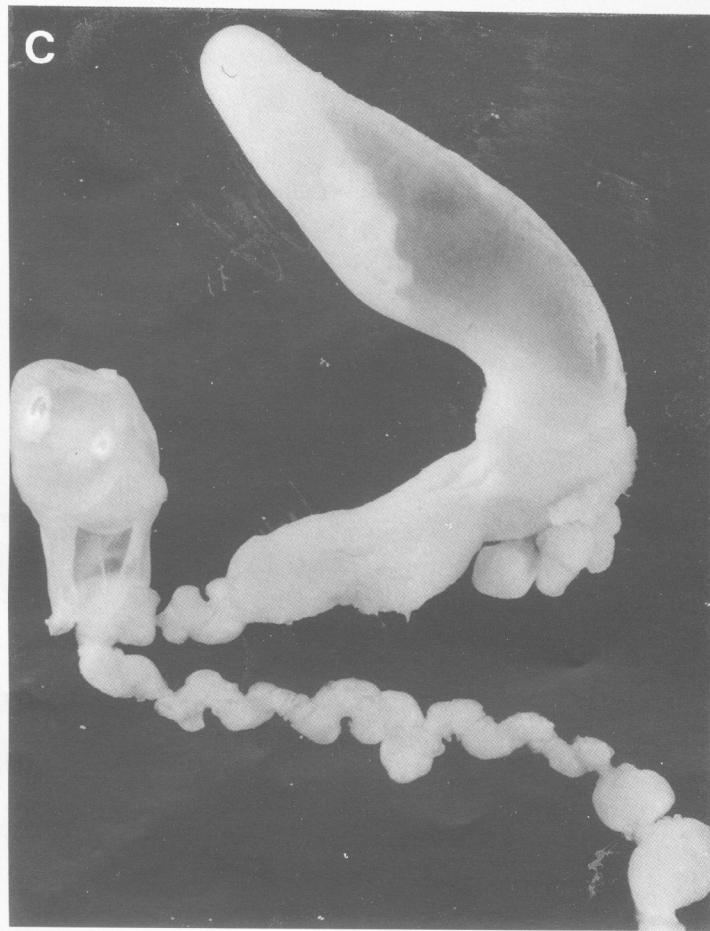
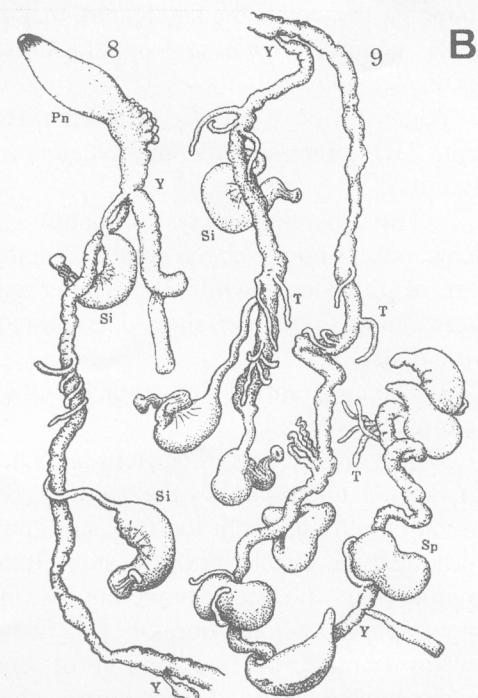
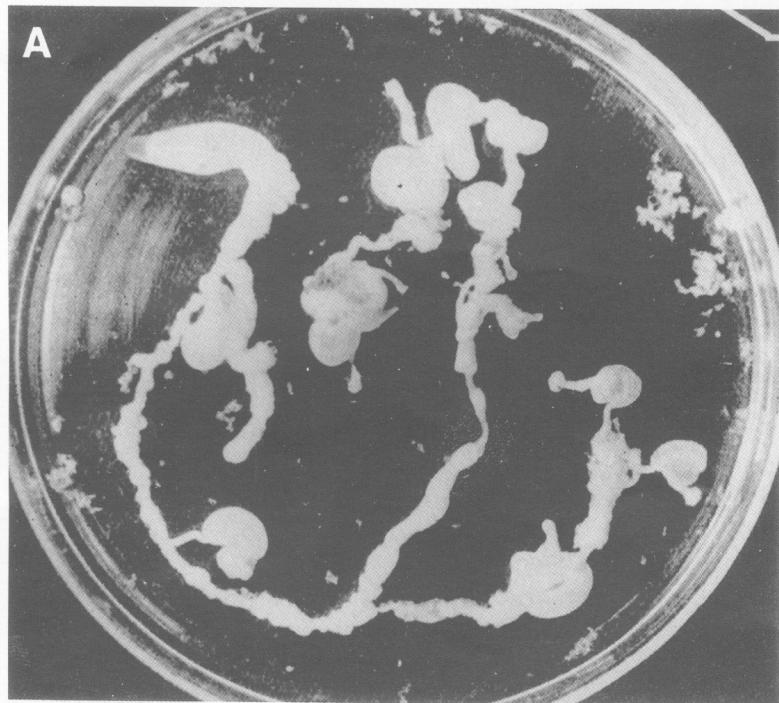


FIG. 1. – *Bathypysa japonica*, illustrations of the holotype, **A** (from Kawamura 1954: plate VI, fig. 3), **B** (from Kawamura 1954: plate VII, figs. 8, 9). **C**, pneumatophore and first gastrozooid after re-examination of the holotype. **D**, gastrozooid with tentacle after being disentangled from the stem. **E**, view of the holotype after the unravelling of the two stem parts that originated the misguided idea of stem branching.

young gastrozooids, the key feature that distinguishes the genus *Bathyphysa* from the closely related genus *Rhizophysa*.

When I first examined Kawamura's drawings (Fig. 1B) three features immediately caught my attention:

1. The apparent presence of mature gastrozooids (Kawamura's hook-shaped siphons) on the proximal part of the stem, while the young gastrozooids (Kawamura's bladder-shaped pneumatosiphons) were distal;

2. The apparent lack of tentacles attached to the mature gastrozooids;

3. The presence of three stem branches (labelled Y), one located just below the budding zone, the second at ca. 80 mm from the first, and the very short third, near the distal end of the stem. It is important to note that the stem branching is theoretically impossible in siphonophores.

Nevertheless, re-examination of the holotype specimen also provided many surprises:

1. The first prominent zooid, located just below the pneumatophore and the budding zone, is actually a young gastrozooid (Fig. 1C). Why Kawamura drew it as a mature gastrozooid, with a long pedicle, is beyond my comprehension.

2. The second zooid, a mature gastrozooid (Fig. 1D), actually was not attached to the stem but coiled around it. Close examination of Kawamura's drawing (Fig. 1B, 8) reveals that there is no clear attachment point, just two free ends. Examination of the remaining mature gastrozooids showed that none were actually attached to the stem, but that their tentacles were coiled around it. The young gastrozooids were attached directly to the stem, and not by a short peduncle as Bedot (1893, plate 1, fig. 8) illustrated for *Bathyphysa grimaldi*. It is believed that Bedot was mistaken and that this apparent short peduncle is, in fact, a small tentacular bud, as seen on some of the young gastrozooids of the present specimen.

3. The portion of the main stem between the supposed first and second lateral branches was tightly coiled into a spiral but at one point, an unexpected gap was clearly discernible. It took some time to unravel the specimen and to show that the first two stem branches figured by Kawamura were in fact the extremes of a more distal portion of the original stem which had broken off and subsequently become entangled with the proximal part (Fig. 1E). The longest part, 23 cm in length, included the pneumatophore and six young gastrozooids, five of which were coiled toward its distal end. The shorter

section, 15.5 cm long, bore no young gastrozooids but the tentacles of three mature gastrozooids were wrapped around it.

The re-examination of the holotype confirmed nevertheless, that it belongs to the genus *Bathyphysa* due to the occurrence of proximal young gastrozooids with ptera. These gastrozooids are all typically bent into C- or kidney-shape due to the contraction, on preservation, of the muscles within the ptera. In life, they are straight, but dorso-ventrally flattened (see Biggs and Harbison, 1976). However, to what species of *Bathyphysa* does Kawamura's specimen actually belong? Totton (1965) followed Leloup (1936) in recognizing only two species: *B. conifera* (Studer, 1878) and *B. sibogae* Lens and van Riemsdijk, 1908. Leloup had synonymized *B. grimaldii* with *B. conifera* on the basis of the absence of tentilla on the tentacles. For *B. sibogae*, Biggs and Harbison (1976) made *in situ* observations of young colonies and noted that mature gastrozooids were attached to the stem by pedicles. They described a succession of 3 morphological types along the first 25 gastrozooids of the apical stem. The first seventeen gastrozooids possessed ptera, but their tentacle had not yet begun to differentiate. Gastrozooids 18-22 also had ptera but each also had a small basal tentacle bud; the ptera had disappeared on the more distal gastrozooids (23-25), which had more pronounced tentacles with tentilla, and were attached to the stem by pedicles.

Bathyphysa japonica has long, smooth tentacles without tentilla, but their absence might be a preservation artifact and does not prove that it did not have tentilla when alive. The presence of C-shaped young gastrozooids, together with the apparent lack of pedicles or traces of them, could suggest that it might belong to the species *conifera*. However, the situation is confused. Totton (1965) noted for *B. conifera* that "In early growth stages the sessile gastrozooids bear two longitudinal ridges or ptera". But he makes no mention of how the mature gastrozooids are attached. Lens and van Riemsdijk (1908, pl. XIX as *Pterophysa grandis*) appeared to believe that pedicles were present for all gastrozooids. However, as with *B. sibogae* (see Biggs and Harbison, 1976), it is probably all a matter of the developmental state of the gastrozooid with the youngest ones being sessile, while with growth a pedicle is gradually developed.

As mentioned above, Kawamura (1943b, 1954) also described one specimen of *Bathyphysa grimaldii* Bedot 1893, apparently collected in Suruga Bay and

deposited at the nearby Mitsui Oceanographical Laboratory in Shimoda. The description was complemented with photographs of the specimen and a text-figure suggesting how the animal might have looked in life. The latter, again, shows some very strange features: three stem branches from the main stem, the lack of tentacles at the base of most gastrozoooids and the attachment of tentilla to the main stem and lateral branches. Unfortunately, my efforts to locate this important specimen have failed. Shortly after World War II ended, the laboratory was closed and converted into an Imperial Villa (Masakazu Aoki, Shimoda Marine Research Center, pers. comm.). Mayumi Yamada (Hokkaido University, pers. comm.) suggested that the specimen might be at the National Science Museum, but it has not been found there (Hiroshi Namikawa, pers. comm.). Like many other siphonophore genera, *Bathyphysa* requires a thorough review based on complete specimens.

Suborder PHYSONECTA

Family ATHORYBIIDAE

Genus *Athorybia* Eschscholtz, 1829

***Athorybia longifolia* Kawamura, 1954**

Athorybia longifolia Kawamura, 1954: 113-115, pl. III, figs. 1-7.

Material examined: *Athorybia longifolia*; holotype taken at the surface by the boat of His Majesty the Emperor Showa of Japan, on 19 February 1950 off Hayama, in Sagami Bay (NSMT-Coel R:327; determined by Tohru Uchida on 6 April 1950). Preserved in alcohol. Japanese name: Nokishinogo kurage.

Description: Corm measuring ca. 15 mm in length and 7 mm in width; slightly smaller than the measurements given by Kawamura (1954). Pneumatophore large, obliquely oval with dark red-pigmented apical part, more intense in the centre. The area of attachment of larval bracts and subsequent budding zone of the siphosome is densely crowded with the basal muscular lamella. At least 16 elongate bracts, up to 11 mm in length and 3 mm in width, rounded distally. The oldest are soft, thin and fragile showing numerous folds due to preservation. Ten ribs present along the dorsal surface, perfectly visible on small and medium sized bracts but invisible on the larger ones; possibly as a result of preservation. A central bracteal canal runs longitudinally in the mesogloea and is enlarged slightly near its distal end. Gonodendra formed by gonopalpons with palpaeles and gonostyles. Gonopalpons are very numerous, cylindrical in shape and tapering near their distal ends, and armed with many cnidocysts.

Gastrozoooids, eight in number; arranged on the corm to form a slight curve. One was found detached and kept separate in a vial. Tentacles highly contracted, with numerous tentilla attached as described by Kawamura, all being of the involucrate tricornuate type.

Remarks: Kawamura (1954) distinguished *Athorybia longifolia* from both *A. ocellata* Haeckel, 1888 and *Anthophysa rosea* Brandt, 1835 on the basis of the "long flat tape-like" shape of the bracts and the lack of longitudinal ridges bearing nematocysts on their dorsal surface. The two latter species were synonymised with *Athorybia rosacea* (Forskål, 1775) by Totton (1954) and, at a later date (Totton, 1965, pp. 87, 89), he also synonymised *A. longifolia* with it because he suspected that the flexibility of the bracts was due to the state of preservation and, therefore, not a specific difference. I have examined some preserved specimens of *A. rosacea* from different seas and found that the bracts had a variable shape and texture according to their state of preservation. For instance; the distal end can be more or less pointed or even rounded. The present re-examination of Kawamura's holotype has demonstrated the existence of 9 longitudinal rows of cnidocysts on the dorsal surface of the younger bracts. This number is greater than the 5 and 7 rows noted by Bigelow (1911) and Totton (1954, 1965) respectively, but it appears that this is a variable feature. Nonetheless, it is worth noting that the tentilla figured by Kawamura (plate III, fig. 7) correspond to those of *A. rosacea* (Bigelow, 1911; plate 20, figs. 3, 5)

In conclusion, it is considered that Totton (1965) was correct to synonymise *Athorybia longifolia* Kawamura, 1954 with *A. rosacea*. The genus *Athorybia* thus currently comprises two species, *A. rosacea* and *A. lucida* Biggs 1978, the latter being distinguished from the former by both its curved club-shaped tentilla and the small pneumatophore which is not overlain by bracteal muscular lamellae (Biggs, 1978).

Family FORSKALIIDAE Haeckel, 1888

Genus *Forskalia* Kölliker, 1853

***Forskalia misakiensis* Kawamura, 1954**
(Fig. 2, 3)

Forskalia misakiensis Kawamura, 1954: 106-107, pl. I, figs. 2, 7-11; Totton, 1965: 109-110.

Material examined: *Forskalia misakiensis*; Holotype collected at the surface by the boat of His Majesty the Emperor Showa of Japan, on 9 January 1952 off Aburatsubo, in Sagami Bay (NSMT-Coel R:

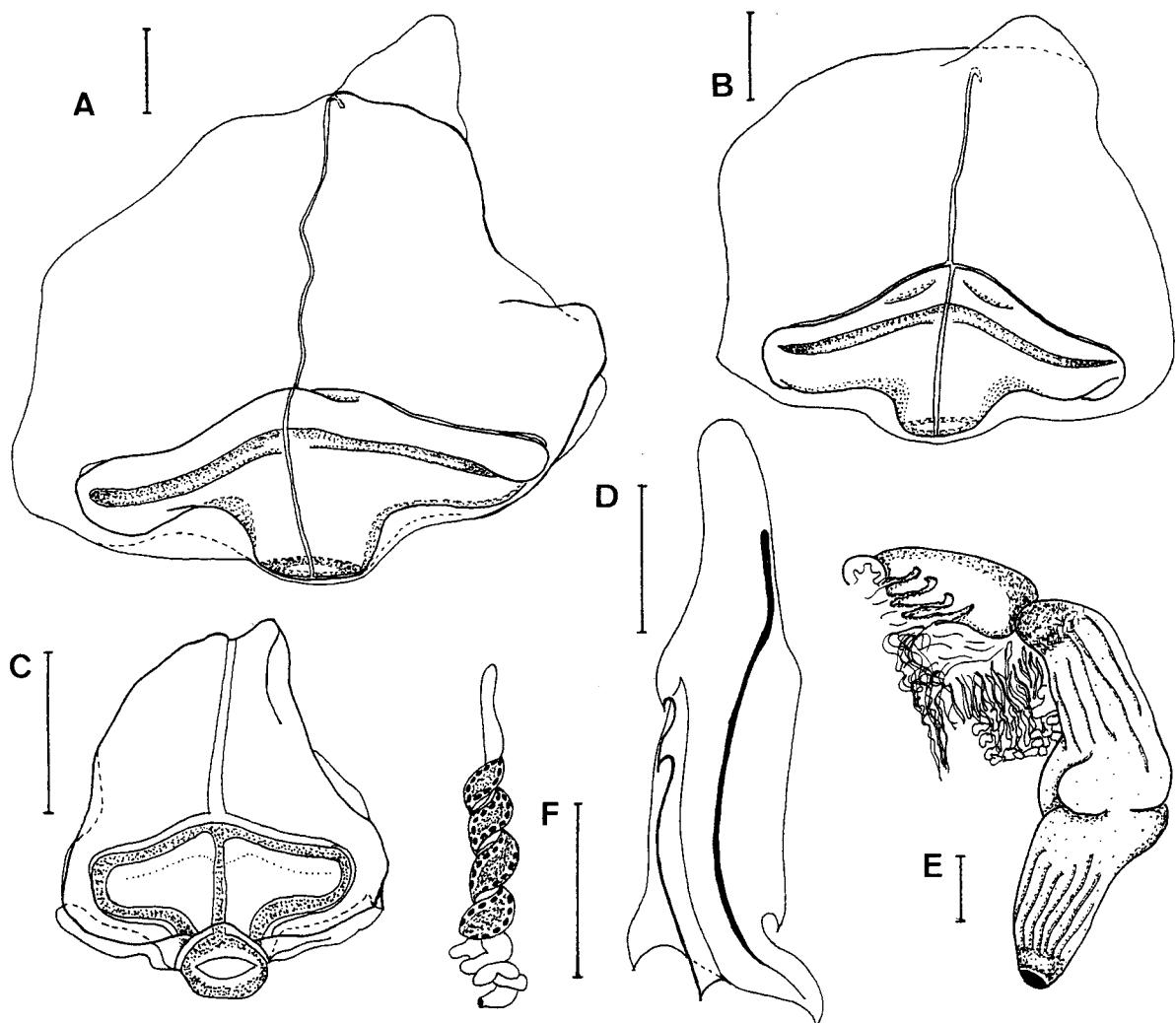


FIG. 2. — *Forskalia misakiensis*. Figures made after re-examination of the holotype: A and B. Lower view of adult nectophores. C. Lower view of young nectophore. D. Gastrozooid bract. E. Gastrozooid. F. Tentillum. Scale: 1 mm.

424; determined by Tamiji Kawamura on 30 April 1953). Preserved in alcohol.

Description: Specimen measuring 23 cm in total length. It appears to be complete and has been kept upside down inside a jar, as shown in the original photograph. All siphosomal parts have formed into a rather compact mass, probably as a result of having been preserved in alcohol. Pneumatophore pear-shaped, 2.0 mm in height by 1.5 mm in maximum diameter, not surrounded by nectophoral buds, which lay slightly below. No visible apical pore but a small reddish apical pigment spot. The nectosome measures 12 mm in length and 10 mm in width. It is composed of 10 young and 25 adult nectophores arranged around the stem to form a cylinder. The upside down position of the preserved holotype has caused the upper part of the adult nectophores and their muscular lamellae to stretch. As Kawamura

mentioned, there were 5 detached nectophores which are assumed to show their original morphology. The following description is based on them. Nectophores asymmetrical, dorso-ventrally flattened, lower half wider and left axial wing longer, up to 7 mm in length and width (Figs. 2A, B). Nectosac less than half the nectophore's length, cross-shaped, with upper and lower extensions much shorter than lateral ones. Pedicular canal long and thin, giving rise to all four radial canals on the nectosac. Lateral canals straight. The young nectophores (Fig. 2C) show the same basic features as the adult ones.

The siphosome measures 20.8 cm in length and 1.4 cm in maximum width. Numerous, densely crowded cormidia form a mass that is difficult to examine. The stem bracts are very thin, laterally flattened and almost triangular in outline. They

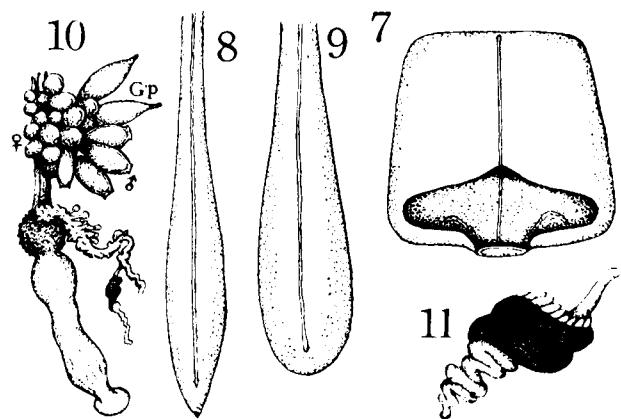


FIG. 3. — *Forskalia misakiensis*. Holotype (from Kawamura 1954: plate I, figs. 7-11). 7, nectophore; 8 and 9, bracts; 10, cormidium composed by a gastrozooid and a gonodendron; 11, tentillum.

overlap and are stuck one to another to form a single glutinous mass. Most of the larger peduncular bracts are damaged and do not show any notable feature. They are elongate (up to 9 mm in length) and a close examination reveals some slight indentations to their margins. However, the best preserved ones have a leaf-like shape with 5 teeth (Fig. 2D) that are most easily seen in the youngest ones, which are attached close to the basigaster of a gastrozooid. The bracts appear to be arranged in enantiomorphic pairs, as Totton (1965) found in *F. edwardsi* Kölleker, 1853.

Just over 100 gastrozooids (Fig. 2E) were counted. The basigaster is tubular with thick walls and occupies about one third of the length (excluding the peduncle) of the gastrozooid. The stomach region is elongate, sometimes inflated, and with visible hepatic stripes. The distal part tapers, terminating in the mouth. The tentacle attached to the basigaster is long with numerous tentilla measuring about 2 mm in length. Each tentillum (Fig. 2F) consists of a proximal white pedicel, a spirally coiled cnidoband (2-4 turns) without an involucrum and a highly contracted terminal filament. On either side of the cnidoband is a lateral row of oval cnidocysts. A single gonodendron is present between each two gastrozooid peduncles. Many small warts, probably vacuolar cells, are present in the central and distal parts of the gonopalon.

Remarks: The original, brief description of *Forskalia misakiensis* was accompanied by a photograph of the whole colony (Kawamura, 1954: plate 1, fig. 2) and drawings of a nectophore, a gonodendron, a gastrozooid, two bracts and a tentillum (Fig.

3). It was considered to be a new species on the basis of the symmetrical quadrangular shape of the nectophores and the shape of the bract, which was described as being “lobate, or spoon-shaped, with smooth margins and no denticulation at all”.

These morphological features, together with his figures (Fig. 3) do not match my observations. The nectophores are actually asymmetrical in shape (Fig. 2, A-C), and the best preserved peduncular bracts are leaf-like (Fig. 2D) resembling those of *F. edwardsi* (Totton, 1954; Kirkpatrick and Pugh, 1984). The young nectophores (Fig. 2C) are very similar to those figured by Totton (1965, fig. 52 D) for *F. edwardsi*. For the mature nectophores, the main differences between my observations on those of *F. misakiensis* and the description of those of *F. edwardsi* given by Totton (1965) lies in the shape of the nectosac, the nectosac:nectophore length ratio, the length:width ratio which is c. 1:1 (Fig. 2 A,B), but more like 2:1 for *F. edwardsi* and finally, the greater extent of the left axial wing, which is relatively small in *F. edwardsi*. The presence in the latter of the characteristic yellow pigment spot at the junction of the dorsal radial canal with the ostial ring canal was not observed. All these differences were probably caused by the preservation in alcohol, which is a bad medium for siphonophores.

Very recently, the genus *Forskalia* was reviewed by Pugh (in press). Specific differences are observed in the shape of the bracts, but they are difficult to discern in poorly preserved material. It seems that the best morphological feature to distinguish preserved specimens is the structure of the nectophore. The description of the nectophore given by Kawamura was wrong. The re-examination of the holotype shows that the nectophores do not look like any of the ones described and figured by Pugh (in press). However, the holotype of *F. misakiensis* does not show any significant and convincing feature that distinguish it from the rest of the *Forskalia* species. In conclusion, *F. misakiensis* is considered not to be a valid species, but a badly preserved specimen, possibly of *F. edwardsi*.

ACKNOWLEDGMENTS

This study was enriched by the invaluable comments made by P.R. Pugh. I wish to express my sincere gratitude to Hiroshi Namikawa, National Science Museum, Showa Memorial Institute in Tsukuba, for all the facilities given for the examination of

the holotypes. Thanks to Masaya Toyokawa for the English translation of the original description of *Bathyphysa japonica*. This study was sponsored by the Japanese Society for the Promotion of Science.

REFERENCES

- Bedot, M. – 1893. *Bathyphysa grimaldii* (nova species), siphonophore bathypélagique de l'Atlantique Nord. *Res Camp. Sci. Monaco* 5: 1-9.
- Bedot, M. – 1904. Siphonophores provenant des campagnes du yacht Princesse-Alice (1892-1902). *Res Camp. sci. Monaco* 27: 1-27.
- Bigelow, H.B. – 1911. The Siphonophorae. Reports of the scientific research expedition to the tropical Pacific Albatross 23. *Mem. Mus. Comp. Zool. Harvard*, 38:173-402.
- Biggs, D.C. – 1978. *Athorybia lucida*, a new species of siphonophore (Physonectae Athorybiidae) from the North Atlantic Ocean. *Bull. Mar. Sci.*, 28: 537-542.
- Biggs, D.C. and G.R. Harbison. – 1976. The siphonophore *Bathyphysa sibogae* Lens and van Riemsdijk, 1908, in the Sargasso Sea, with notes on its natural history. *Bull. Mar. Sci.*, 26: 14-18.
- Fewkes, J.W. – 1884. Report on the médusae collected by the U.S. Fish. Comm. Steamer 'Albatross' in the region of the Gulf Stream in 1883, 1884. Rep. U.S. Fish Comm.: 927-977.
- Kawamura, T. – 1908. On Siphonophores. *Zool. Mag. Tokyo*, 20: 77-83.
- Kawamura, T. – 1908. On Siphonophores. *Zool. Mag. Tokyo*, 20: 101-109.
- Kawamura, T. – 1908. On Siphonophores. *Zool. Mag. Tokyo*, 20: 139-148.
- Kawamura, T. – 1910."Bozunira" and "Katsuwo no Eboshi". On *Rhizophysa* and *Physalia*. *Zool. Mag. Tokyo*, 22: 445-454.
- Kawamura, T. – 1910. "Batei kurage" *Hippopodius unguilatus*. *Zool. Mag. Tokyo* 22: 468-471.
- Kawamura, T. – 1911. Genus *Agalma* and *Crystallomia*. *Zool. Mag. Tokyo*, 23: 1-10.
- Kawamura, T. – 1911. *Physophora hydrostatica* Forskål. *Zool. Mag. Tokyo*, 23: 309-323.
- Kawamura, T. – 1911. "Shidarezakura Kurage" and "Nagayoraku Kurage" *Cupulita picta* Metschnikoff and *Agalmopsis elegans* Sars. *Zool. Mag. Tokyo*, 23: 359-363.
- Kawamura, T. – 1915. Calyconectid Siphonophorae (I). *Zool. Mag. Tokyo* 27: 135-142.
- Kawamura, T. – 1915. Calyconectid Siphonophorae (II). *Zool. Mag. Tokyo* 27: 191-198.
- Kawamura, T. – 1915. Calyconectid Siphonophorae (III). *Zool. Mag. Tokyo* 27: 317-324.
- Kawamura, T. – 1915. Calyconectid Siphonophorae (IV). *Zool. Mag. Tokyo* 27: 428-440.
- Kawamura, T. – 1915. Calyconectid Siphonophorae (V). *Zool. Mag. Tokyo* 27: 577-586.
- Kawamura, T. – 1943a. On two species of *Bathyphysa*. *Zool. Mag. Tokyo* 55: 80-81 (abstract).
- Kawamura, T. – 1943b. On two species of *Bathyphysa*. *Zool. Mag. Tokyo*, 3 pp.
- Kawamura, T. – 1954. A report on Japanese siphonophores with special reference to new and rare species. *J. Shiga Pref. Jun. Coll. A* 2: 99-129.
- Kirkpatrick, P.A. and P.R. Pugh. – 1984. Siphonophores and Velellids. *Synopses of the British Fauna (New Series)*: 1-154.
- Leloup, E. – 1936. Siphonophores Calycophorides (suite) et Physophorides provenant des campagnes du Prince Albert 1er de Monaco. *Res Camp. sci. Monaco* 93: 3-36.
- Pugh, P.R. – 1983. Benthic siphonophores: a review of the family Rhodalidiidae (Siphonophora, Physonectae). *Phil. Trans. Roy. Soc. London*, B, 301: 15-300.
- Pugh, P.R. – (in press). A revision of the family Forskaliidae (Siphonophora; Physonectae). *J. Nat. Hist.*
- Totton, A.K. – 1954. Siphonophora of the Indian Ocean. *Discovery Rep.*, 27: 1-162.
- Totton, A.K. – 1965. A *Synopsis of the Siphonophora*. British Museum (Natural History): 1-230.

Scient. ed.: J.M. Gili