EUNEPHTHYA FROM MIDDLE JAPAN*

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With Plate I and 5 Text-figures

In the course of my researches on the Nephthyid corals of Japan, four species belonging to *Eunephthya*, which is commonly known as a boreal genus, came to my hand. Among the materials, two species *E. spiculosa* KÜKENTHAL and *E. hirotai* n. sp. were taken from the Sagami Bay and are now deposited in the museum of the Zoological Institute of the Tokyo University. The remaining two, *E. serratospiculata* n. sp. and *E. bicolor* n. sp. are from the Kii region, and are now preserved in our Laboratory.

Before going further, I express my cordial thanks to Prof. K. TAKEWAKI of the Tokyo University for providing me with the material. A part of the expense in this study has been defrayed from the research fund supplied by the Ministry of Education.

Discussion on Nomenclature

Among all the families of octocorals, the Nephthyidae is probably the most difficult one as for systematic treatment. Among the commonly recognized genera, *Eunephthya*, *Gersemia* and *Capnella* are without "Stützbündel." These have been frequently confused with one another and also with other genera with "Stützbundel." For details of the very complicated history of the taxonomy of these genera, the reader is referred to KÜKENTHAL (1903–1907), MOLANDER (1915) and BROCH (1923).

The genus *Eunephthya* was established by VERRILL (1869) for two species *E. thyrsoidea* from South Africa and *E. glomerata* from Greenland. KÜKENTHAL (1906) relegated the former species to *Capnella* and retained only the latter in the genus as the logotype. According to BROCH (1939), *E. thyrsoidea* is in all probability identical with *Capnella rugosa* KÜKENTHAL (=*C. gilchristi* THOMSON). He further suggests that *E. glomerata* also is to be referred to the

* Contributions from the Seto Marine Biological Laboratory, No. 167.

genus *Capnella* (sensu KÜKENTHAL) on account of the enormous variation in both the shape and the numbers of spicules in canal-walls, which example was followed by MADSEN (1944, 1948).

If this suggestion be adopted, VERRILL's *Eunephthya* must be included in the genus *Capnella*, the former name being preoccupied by the latter. However, most of the species belonging to *Eunephthya*, as pointed out by KÜKENTHAL, are provided only sparsely with spicules in the canal-walls of the coenenchyma, or they are entirely devoid of spicules.

The genus *Capnella* was established by GRAY (1869) in the same year as VERRILL's *Eunephthya*, but slightly previous to this, for *Alcyonium imbricatum* Q. et G. It is hardly possible, however, to find out any definite differential characters between the genera from the original definitions of GRAY and VERRILL as far as can be judged. KÜKENTHAL (1903) extended the generic concept of *Capnella* to include *Paranephthya* WRIGHT and STUDER (1889); he also proposed *Paraspongodes* (1896), but later merged it into either *Capnella* or *Eunephthya*.

Gersemia, another kindred genus, was established by MARENZELLER (1878) to include *Gorgonia florida* RATHKE and *Gersemia loricata* MARENZELLER. KÜKENTHAL (1906), however, considers that the specimen referred by MARENZELLER to *florida* is not identical with RATHKE's original *florida*, and both are the members of *Eunephthya* (sensu KÜKENTHAL). BROCH (1939), more recently, gave reasons for referring RATHKE's *florida* to *Capnella*. Previous to this, MOLANDER (1915) retained this species in the genus *Eunephthya* and identified *Gersemia loricata* to *G. fruticosa* (=*Eunephthya fruticosa* of earlier authors).

MOLANDER (1915) rejected this generic differentiation between *Gersemia* MARENZELLER and *Eunephthya* VERRILL, based on the presence or absence of a so-called calyx, as proposed by KÜKENTHAL. But he retained both the names for other reasons; that is, *Eunephthya*, according to him, is represented by *Eunephthya nephthyiformes* (sensu KÜKENTHAL) and *Gersemia* is identical with *Eunephthya alcyoniformes* (sensu KÜKENTHAL). If both the genotypes of *Gersemia*, viz. *G. florida* and *G. loricata*, be truly identical with *Eunephthya* (*Gersemia* sensu MOLANDER) *fruticosa* (SARS), as MOLANDER points out, the name of *Gersemia* should be abandoned as a synonym according to the rules of zoological nomenclature.

The diagnostic key to the two genera, *Gersemia* and *Eunephthya*, given by MOLANDER (1915, p. 45), is as follows:

A) Anthocodiae retractile, points of branches with profuse development of coenenchyma, anthocodial spicules rods, spindles and rollers with girdles ... ... *Gersemia* MARENZELLER.

B) Anthocodiae not retractile, points of branches with insignificant coenenchyma, anthocodial spicules clubs, spindles and rods ... ... *Eunephthya* VERRILL.

As will be found in the following pages, all of the four species in the collection have more or less intergrading characters, which may be referable to either the genus *Gersemia* (sensu MOLANDER) or to the genus *Eunephthya* (sensu MOLANDER). They share the features that: (1) the rather poor development of the coenenchyma in the branches,* (2) the non-retractile anthocodia, (3) the absence of the so-called calyx, (4) the exclusively spindle- or rod-shaped spicules in the anthocodia and (5) the asymmetrical development of the anthocodial armature (except in *E. bicolor*).

Therefore I cannot accept the proposal to divide the genus *Eunephthya* (sensu KÜKENTHAL) into two groups or genera, *E. nephthyiformes* (=*Eunephthya* sensu MOLANDER) and *E. alcyoniformes* (=*Gersemia* sensu MOLANDER). But I do not venture to erect a new genus for these Japanese forms, including *Eunephthya japonica* KÜKENTHAL and *Gersemia marenzelleri* KÜKENTHAL which have never been rediscovered. MOLANDER (1915, p. 15) also finds a more significant morphological transition from *Gersemia* to *Eunephthya* in examples of *E. spiculosa* and *E. japonica*. These morphological features, as well as the geographical distribution, seem to show that the Japanese forms of *Eunephthya* represent transitional stages from the real boreal forms of *Eunephthya* (including *Gersemia*) to the warm-water forms of Nephthyids, such as *Capnella*, *Litophyton* (=*Lithophytum*), *Stereacanthia*, etc.

If BROCH's (1939) suggestion, cited above, as to the identity of the type species of *Eunephthya* VERRILL to the genus *Capnella* GRAY, be generally accepted, the genus *Eunephthya* which name I intend to use here should be applied to a number of species formerly referred to *Capnella*. Incidentally, a great number of species formerly referred to *Eunephthya* and *Gersemia* should be transferred to the genus *Gersemia* MARENZELLER, which is the oldest name subsequent to *Eunephthya* VERRILL. For the present, however, I am willing to retain *Eunephthya* as its generic name, since I have not had the opportunity of investigating *Eunephthya glomerata* and other northern forms to verify whether BROCH's conception is correct or not.

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* In *Eunephthya bicolor*, the terminal branches are rather highly developed, but not contracted in formalin. In *E. hirotai*, the branches are more ramified, and show the poorest development of the coenenchyma.

Description of Species

1. *Eunephthya spiculosa* KÜKENTHAL

(Fig. 1)

Material. Sagami Bay; depth and date unlabelled. A specimen, *Eunephthya spiculosa* det. K. KINOSHITA. Collected by K. AOKI.

An upright, bushy colony superficially resembles *Eunephthya japonica* KÜKENTHAL in its ramification and coloration, but the spiculation seems to agree with *E. spiculosa* KÜKENTHAL. The present specimen is also from the type locality of the latter.

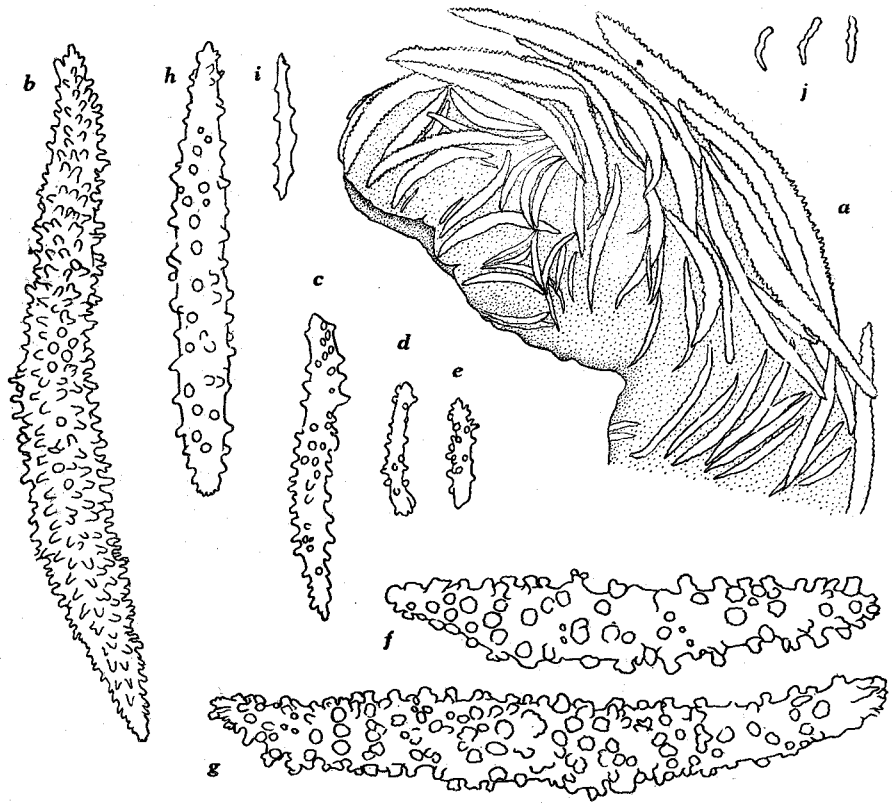

Fig. 1. Eunephthya spiculosa KÜKENTHAL. *a*, Polyp, ×20; *b*, polyp spicule, on abaxial side, ×50; *c*, polyp spicule, on lateral side, ×67; *d*, *e*, tentacle base spicules, ×67; *f*, *g*, cortical spicules of stalk, ×67; *h*, *i*, spicules from canal-wall, ×67; *j*, tentacle spicules, ×67.

The colony has a total height of 4.5 cm of which 1 cm is the sterile stalk. The base spreads over sand and shell particles; it measures about 1.6 cm in thickness. From the upper two-thirds of the colony arise about twenty branches which give off many short polyp-bearing branchlets. The color of the colony is light brown.

The polyps are in clusters, rather large, club-shaped, with incurved head. They are about 2–4 mm in total height, and 1–1.3 mm in diameter of the head which is up to 1.5 mm in length. The anthocodial armature consists of closely packed larger spicules of the abaxial side and sparsely set smaller ones of the adaxial and lateral sides (Fig. 1*a*).

All these spicules are warty spindles, either straight or bent, and of various sizes. In the uppermost part of the polyp the spicules are more or less regularly disposed in 8 double rows, and pass on to the converging smaller (0.3–0.6 mm long) spindles which lie at the base of infolded tentacles over the mouth. These uppermost spicules on the lateral sides are 0 8–1.2 mm long and 0.08 mm wide (Fig. 1*c*). On the abaxial side they are more warty, larger, about 1.2–1.8 mm long and about 0.17–0.2 mm wide (Fig. 1*b*), and the distal pointed end of 2 or 3 larger ones projects beyond the surface of the polyp.

The tentacles are all infolded over the mouth, and provided with flat rodlets (Fig. 1*j*), about 0.1 mm long, transversely arranged on the aboral side, but not on the pinnules, which number 10 in a row on each side.

The cortical spicules of the branch and stalk are warty spindles as in the polyp, but with larger, often forked warts and with blunt or dentate ends (Fig. 1*f, g*). The canal-walls are thin and sparsely filled with warty spindles up to 0.9×0.1 mm in size (Fig. 1*h, i*). All these spicules are colorless. No other type of spicules is found.

THOMSON and DEAN (1931, p. 182) recorded this species from the Siboga collection, but referred it to the genus *Stereacanthia* on account of the canal-walls being thickly filled with spicules. Very likely the specimen represents a different species. BROCH's (1935, p. 18) view regarding the identity with the Arctic and North Pacific form *E. rubiformis* (EHRENBERG) is also incredible.

2. *Eunephthya hirotai* n. sp.

(Fig. 2)

Material. 1.5 miles off Niisima, south of Sagami Bay; depth unlabelled. Two fragments without basal stalk. Collected by Sadamori HIROTA. August 10, 1893.

Terminal branches in one of the specimens examined stand about 1.5 cm

in height and has a maximum spread of 2.6 cm. The polyps, clustered on the ends of slender branchlets or scattered singly on all sides of branches, are small, coral-red in color, club-shaped, with strongly bent head, up to 2.8 mm in height and 0.85 mm in diameter. The stalk of the polyp is longer than the head, though not distinctly demarcated, and about 0.5–0.85 mm in diameter (Fig. 2*a*).

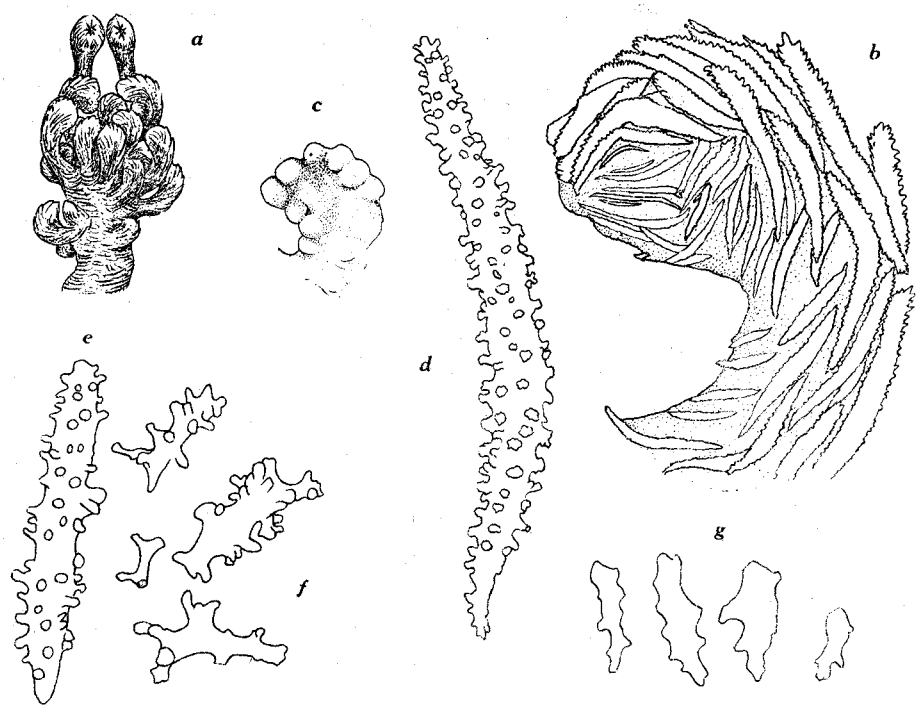

Fig. 2. *Eunephthya hirotai* n. sp. *a*, Terminal branchlet with polyps, ×7; *b*, polyp, ×17; *c*, tentacle, contracted, ×63; *d*, polyp spicule of coral-red color, ×80; *e*, *f*, colorless cortical spicules of branches, ×80; *g*, tentacle spicules, ×150.

The polyp armature is almost like that of the preceding species, but the arrangement of polypal spicules is somewhat more irregular (Fig. 2*b*). The abaxial side of the head is thickly covered with stouter thorny spindles (Fig. 2*d*), up to 1.1 mm long by 0.4 mm wide; the upper end of 2 to 4 longer ones is jagged, and a little projects above the surface, giving the polyp a very rough appearance. All of these spicules are coral-red in color.

The tentacles are completely infolded over the mouth, each bearing 5 pairs of short, contracted pinnules. Its aboral side is armed transverselv with small, colorless, flat rodlets with irregular processes, up to 0.12 mm in length (Fig. 2*c*, *g*.)

The cortical spicules of the branch are closely arranged transversely. These are all colorless spindles, mostly 0.5–0.9 mm in length. Smaller thorny spindles or rods with blunt ends and irregular projections which are the derivatives of spindles, are also found (Fig. 2*e. f*). The canal-walls are apparently devoid of spicules.

This species is unique in its coloration and ramification of the colony, as well as in the shape of polyp armature.

3. *Eunephthya serratospiculata* n. sp.

(Figs. 3 & 4)

Material. Off Seto, Kii Coast; depth and data unlabelled. One specimen.

A small, dirty-white colony (Fig. 3*a*), with short lobate branches thickly beset with incurved polyps, resembling the figure of *E. spiculosa* in KÜKENTHAL (1906, pl. 3, fig. 17), took it for the latter by mere superficial examination. But the spiculation is quite different.

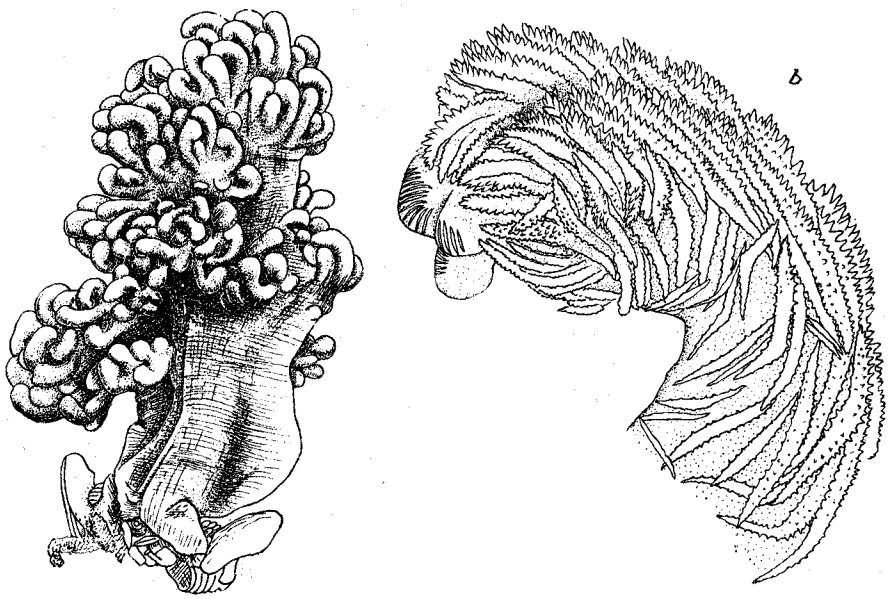

Fig. 3. *Eunephthya serratospiculata* n. sp. *a*, A colony, ×2.7; *b*, polyp, ×27.

The colony attached to sands and shell particles measures up to 2.6 cm in height and 1.8 cm in the maximum spread on its upper branchings. From the top and upper portion of the stem arise a number of short branches consisting each of a solid mass of polyp-bearing lappets. Each lappet bears mostly 5 or 6 incurved polyps grouped closely together. The lower half of the stem, about 1 cm in length, is sterile, and has a diameter of 7 mm at the somewhat shrunken base.

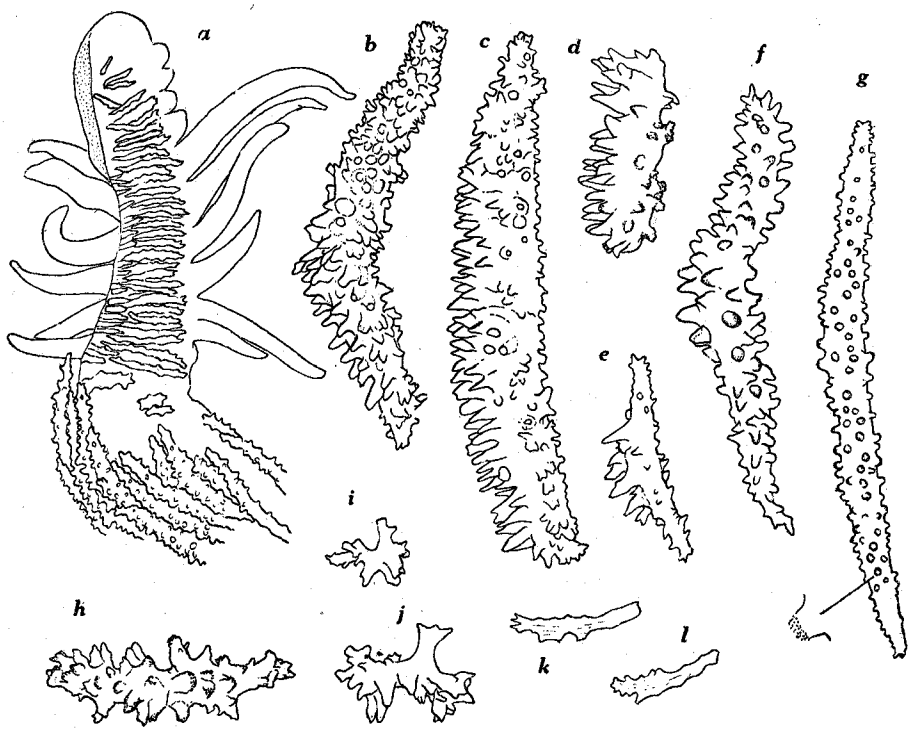

Fig. 4. *Eunephthya serratospiculata* n. sp. *a*, Tentacle, aboral side, ×67; *b–d*, polyp spicules, showing the serrated appearance on the outer side (left in the figure), ×67; *e–g*, spicules from upper part of stalk, ×80; *h–j*, spicules from basal part of stalk, ×80; *k*, *l*, tentacle spicules, ×150.

The polyps are rather large, club-shaped, and appear very rugose, being thickly armoured with very thorny spicules (Fig. 3*b*). The head is about 1.4–1.7 mm in length and 1.2 mm in diameter. The stalk, shorter than the head, is about 1.0–1.5 mm in length and 0.8–1.0 mm in diameter. The polyp spicules are arranged obliquely, converging into 8 points at the uppermost ends. They

are all thorny spindles, straight or curved; those of the abaxial side are stronger than those on other sides. Each spicule is heavily armed with long and sharp denticles on the outer side, which give it a serrated appearance, while on the inner side it is armed only with minute thorns; the upper end is not sharp, but jagged, and does not project so strongly above the surface as in other species (Fig. 4*b*, *c*).

The general appearance of the polyp armature is thus suggestive of 8 longitudinal sierra-like ridges. The abaxial half of the polyp wall is also armed with spicules to a varying degree, but here the spicules are more slender, sharply ended and set more apart from one another than on the abaxial side. These anthocodial spicules measure: 1.1×0.2 mm; 0.8×0.1 mm; 0.4×0.05 mm.

The tentacles are mostly infolded over the mouth. None are fully expanded, but about 1 mm long tentacle with 10 pairs of long pinnules could be seen. Tentacular spicules, arranged transversely in double rows on the aboral side, are flat rods, measuring 0.06–0.15 mm in length; its abaxial end is blunt, while another end towards the pinnules are dentated (Fig. 4*a*, *k*, *l*). The pinnules are up to 0.45 mm in length and entirely devoid of spicules. At the base of tentacles there are 8 chevroned masses of small thorny spindles up to 0.5×0.05 mm in size which pass almost insensively into those of the crown.

In the upper portion of the stalk, the cortical spicules are arranged transversely. These are all straight or curved thorny spindles with pointed ends and covered with rugged warts or simple thorns (Fig. 4*e*, *f*, *g*). They measure about 0.3×0.03 mm to 1.0×0.07 mm. Towards the basal part of the stalk the spindles become shorter and develop higher warts and thorns, also some small triradiates and small irregular types with jagged thorns measuring up to 0.1 mm across (Fig. 4*h–j*). All these spicules are colorless, only one polyp showing a faint rosy color at the top. The canal-walls seem to be free from spicules.

4. *Eunephthya bicolor* n. sp.

(Plate I; Fig. 5)

Material. Osima, Kii Coast, 8 m deep. One specimen, Collected by Y. SAIKA. May 4, 1938.

A dark red, flaccid colony, very large for the genus *Eunephthya*.

The colony has three main branches arising erect from a short, sterile,

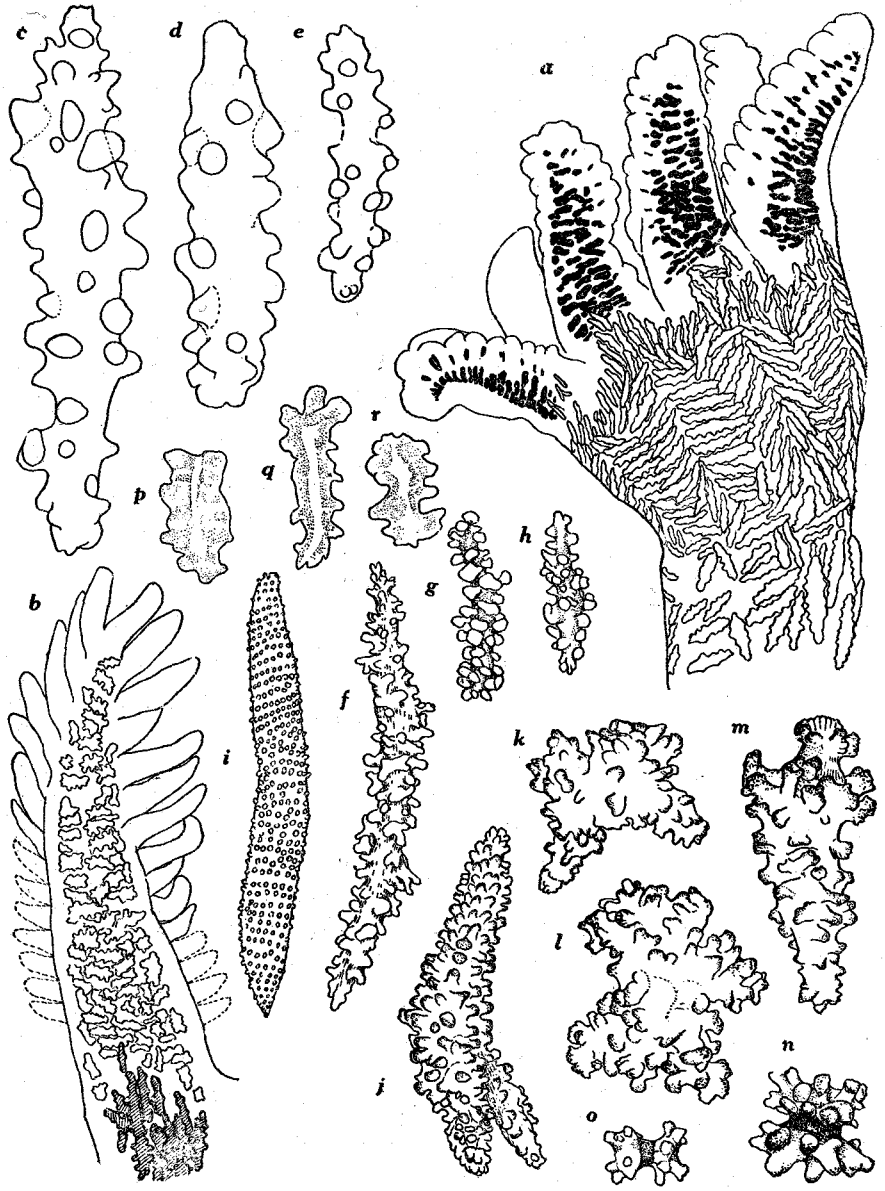

Fig. 5. *Eunephthya bicolor* n. sp. *a*, Polyp, fully expanded, ×53; *b*, tentacle, aboral side, ×80; *c*, *d*, dark red polyp spicules, ×330; *e*, dark red point spicule, ×330; *f–h*, dark red spicules from branches, ×96; *i*, bright red large spindle from upper part of stalk, ×33; *j*, *k*, white spicules from inner layer of stalk cortex, ×80; *l–o*, red spicules from outer layer of stalk cortex, ×96; *p–r*, flat rods from tentacles, ×330.

common stalk. The total height is about 60 cm of which about 7 cm belongs to the common stalk; the main branches are ca. 20 cm, 33 cm and 40 cm respectively in height. The lateral and terminal twigs which are borne on the primary and secondary divisions of the main branches consist of numerous polyp-bearing terminal lobes.

The common stalk, with a broad basal attachment, is very plump, flaccid and about 10 cm across at the base. The top of the sterile stalk is provided on one side with many foliaceous branches, which form a somewhat continuous collar separating the sterile stalk from the main branches. Thus the growth approaches more nearly to the type of *Dendronephthya* than in most species of *Eunephthya*.

The polyps are closely set in groups on the top of the short-stalked lobes, as many as 10 in a group. They are all fully expanded, non-retractile and distinctly divided into three parts, tentacles, polyp-head and polyp-stalk, by the arrangement and coloration of spicules. The polyps, of medium size, is about 1–2 mm long, excluding the tentacles, and 0.8–1.0 mm wide. The polyp head is somewhat swollen, as long as the stalk or a little shorter. They are slightly curved inwards but not so club-shaped as in the preceding species (Fig. 5*a*).

The polyp head is armoured with 8 converging double rows of dark red spicules (Fig. 5*c*, *d*). Towards the stalk the polypal spicules become larger in size and somewhat irregular and sparse in arrangement and insensibly merge into those of the branch cortex. These spicules are all spindles with simple rounded warts and rounded ends; they measure as follows:

Polyp head	0.08×0.02 mm; 0.16×0.03 mm.
Polyp stalk	0.07×0.02 mm; 0.22×0.04 mm.

On the uppermost part of the head there are smaller, up to 0.06 mm long, red-colored point spicules (Fig. 5*e*), which are arranged longitudinally and converging into the base of tentacles. The development of these polypal spicules is symmetrical on all sides.

The polyps arising from the lower part of the main branches and the foliaceous collar at the top of the sterile stalk are, however, pure orange; this gradually merges downwards into a white or red color. This is due to the coloration of the spicules of polyps and branch cortex. These orange-colored polyps are usually somewhat smaller than the red-colored polyps.

The tentacles in a fully expanded state are about 1 mm in length by 0.28 mm in basal breadth and bear mostly 14 long pinnules on each side. They are translucent and bear on the aboral side very numerous small spicules, arranged transversely, but not forming any regular row (Fig. 5*b*). These tenta-

cle spicules are white, flat rodlets with dentate margin, measuring 0.04-0.06mm in length and 0.015-0.018 mm in width (Fig. 5*p-r*). Often one or a few rodlets are also seen between the bases of pinnules, but not on the pinnules themselves. This is similar in both polyps of different coloration mentioned above.

The cortex of the main branch and stalk shows apparently two-layered spiculation with different coloration as follows:

(*a*) Smaller, dark-red spindles with simple or forked warts; 0.2×0.06mm, 0.6×0.03 mm, 0.9×0.1 mm. These form the great majority and superficial layer (Fig. 5*f-h*).

(*b*) Larger, bright red spindles with minute simple warts and pointed ends; 1.5×0.2 mm, 2.0×0.24 mm, 2.4×0.3 mm, 3.5×0.5 mm, 4.0×0.4 mm. These lie somewhat deeper and sparsely (Fig. 5*i*).

Downwards the color of the cortical spicules becomes paler and whitish, especially below the collar surrounding the base of main branches. But at the base of the common stalk again it becomes more reddish, and here the spiculation is generally similar to that of the upper part. However, various types of spicules derived from the spindles are also found as follows:

(*a*) The outer layer consists of numerous, small, white or reddish thorny rods, clubs and capstans; 0.1×0.05 mm, 0.2×0.13 mm, 0.3×0.16 mm. (Fig. 5 *l-o*).

(*b*) The inner layer consists of few, white stout warty spindles, clubs, triradiates, quadriradiates or irregular stellate forms with large compound warts; 0.2×0.04 mm, 0.5×0.12 mm. (Fig. 5*j-k*).

When the outer and inner layers of the cortex is indistinct, the latter spicules are sparsely scattered between the colored smaller ones. In the canal-walls there is no spicule whatever.

In the ramification of the colony and large size, this species is most like *Litophyton* (=*Lithophytum*), a Nephthyid genus commonly known from tropical shallow waters, while in the spiculation it is more nearly related to cold-water form *Eunephthya* than to the former. The spicular arrangement of the anthocodia is, however, more regular and symmetrical on all sides than in other known species of *Eunephthya* as well as the above described three species. It differs from all other *Eunephthya*-species in the colony form, especially the formation of the foliaceous collar on the top of the stalk, like that of some species of *Dendronephthya*. But for the present I provisionally retain this species in the genus *Eunephthya*.

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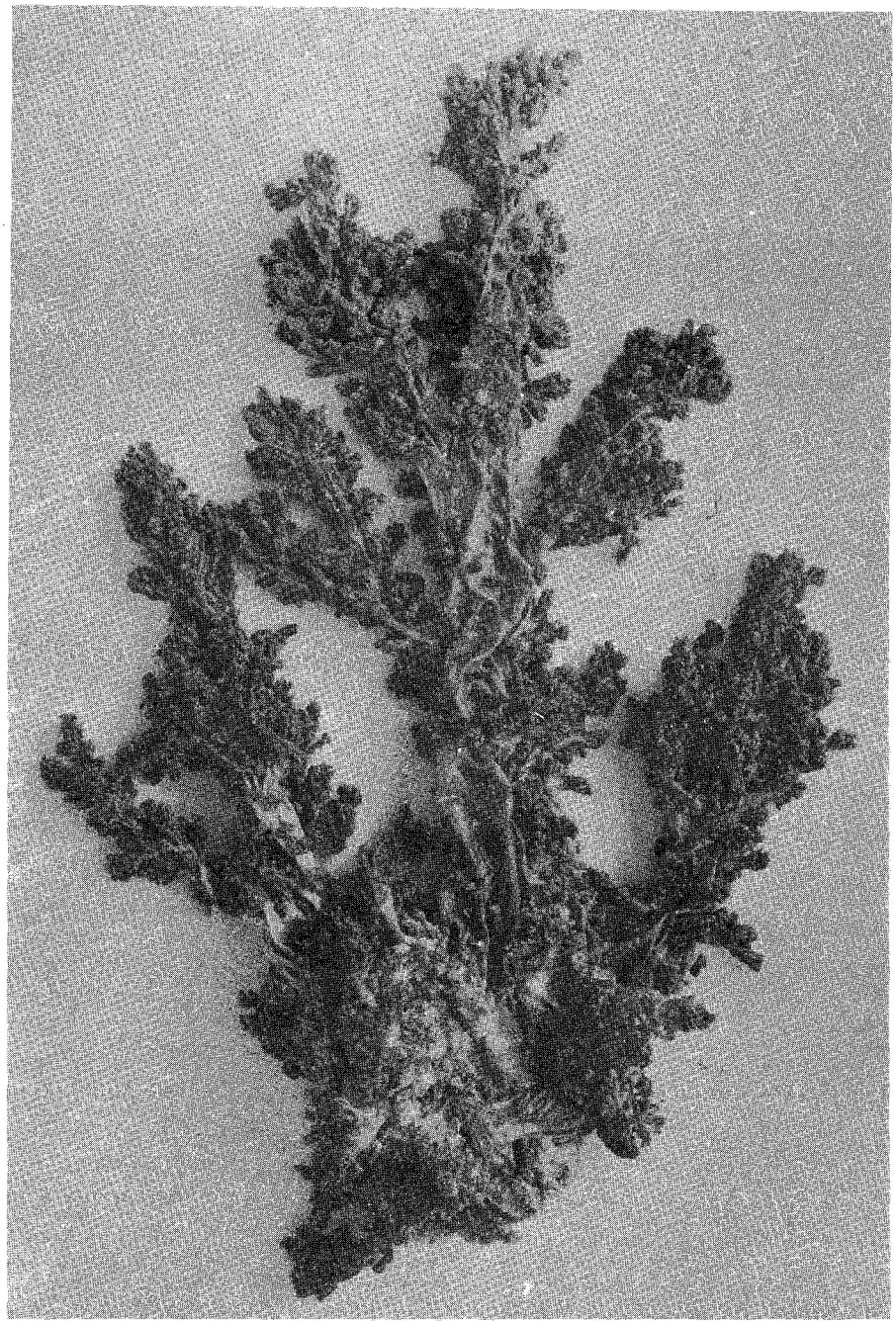
(* not seen directly.)

EXPLANATION OF PLATE I

Fig. 1. *Eunephthya bicolor* UTINOMI (n. sp.) ×1/4.



H. UTINOMI; *Eunephthya* FROM MIDDLE JAPAN.