FAUNA E FLORA

DEL GOLFO DI NAPOLI

39. MONOGRAFIA:

Anthomedusae/Athecatae (Hydrozoa, Cnidaria) of the Mediterranean

PART I CAPITATA

By ANITA BRINCKMANN-VOSS

with

11 colour-plates drawn by ILONA RICHTER

With contribution from the Office of Naval Research (NONR 2100)
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1970

CONTENTS AND SYNOPSIS OF FAMILIES AND GENERA

PREFACE

This monograph was first planned by the Naples Zoological Station in 1957. My own interest in Hydrozoa was awakened during student excursions under the guidance of Prof. A. PORTMANN (University of Basel, Switzerland) in Villefranche and Banyuls from 1953 to 1958. Finding that literature on this region was extremely poor and scattered, I started to think of writing a comprehensive report on Anthomedusae-Athecatae of the Mediterranean, even as a student. I worked on this monograph in Naples from 1958 to 1963 continuously (BRINCKMANN, 1959-65; BRINCKMANN-VOSS, 1966-67). The five years in Naples were spent collecting live specimens and observing them in the laboratory. From 1963 on I worked on the morphology of the preserved specimens and completion of the monograph in Winnipeg.

The geographical area of this study comprises the Western Mediterranean, including the Adriatic Sea (NEPPI, 1912-22). Almost nothing is known from the Mediterranean east of the Adriatic Sea.

In 1967 I was given the opportunity to look through the athecate hydroid collection of the Agassiz Museum at Harvard University. The specimens there were mostly from collections made by ALEXANDER and LOUIS AGASSIZ and A. G. MAYER and comparison of this material with the Mediterranean forms was most valuable.

Discussions with and letters from the late Dr. W. J. REES, as well as his papers, were tremendously helpful (REES, 1936-66). After the appearance of the Synopsis of Medusae of the World by P. L. KRAMP in 1961, the work on the medusae of this monograph proceeded much faster. KRAMP's generic and specific definitions are often used in this paper (KRAMP, 1911-1968). Although it does not deal with Mediterranean species, RUSSELL's Monograph on the Medusae of the British Isles (1953) strongly influenced this publication, and his descriptions — in cases where the Northern and Mediterranean species are the same — are often cited, because they are so accurate.

The order Athecatae-Anthomedusae should have been completed in a single volume. The plates do in fact include species of the whole order. But the detailed study of each species was so much more time-consuming than anticipated that it was decided by the author and publishers to print the suborder Capitata together with the plates for Capitata and Filifera first and then, in a second publication, the text and text-figs. of the Filifera. (The order Anthomedusae-Athecatae was split into two suborders Capitata and Filifera by KÜHN, 1913. This division is actually only of value for the hydroid stage and I suppose it will be difficult to uphold the two suborders in the future; see REES, ed. 1966, p. 396). So while the division of Capitata and Filifera is maintained in this monograph, it is done for practical reasons only.

The plates and text-figs. 6, 11, 43, 54, 59, 60, 66, 79, 82, 83, 87 89 were drawn by Miss ILONA RICHTER under the supervision of the author. All the drawings by Miss RICHTER were done from living specimens. Dr. M. YAMADA (Hokkaido University, Japan) kindly gave me the permission to publish text-fig. 26 of *Ectopleura larynx*. Dr. K. PETERSEN (Zoologisk Museum, Kopenhagen, Denmark) did the illustration of a living colony of *Ptilocodium repens*, text-fig. 100. Unless stated otherwise, all other text-figs. are my original drawings.

Numerous are the people who helped me in the course of this work. Most of all I am deeply indebted to my former technician, MARIA-SOFIA GIAQUINTO-BOAG (formerly Naples, now Edmonton) for her skill and patience in keeping my hydroids and medusae alive under laboratory conditions. Sincerest thanks are due to Dr. P. DOHRN, director of the Naples Zoological Station for his continuous support and interest in this monograph. I am very grateful to Dr. E. W. STRINGAM, Head of the Department of Animal Science, University of Manitoba and Prof. G. HODGSON for the generous space and facilities I was given at their institute for the final work on this monograph.

A monographic paper involves a tremendous work on literature, especially on old and remote papers. My thanks go to the efficient staff of the interlibrary loan department of the University of Manitoba for their help.

Sincere thanks are due to specialists who sent me comparative material: Dr. C. EDWARDS (Millport), Dr. J. GOY (Villefranche), Dr. U. MONCHARMONT (Naples), the late Dr. W. J. REES (London), Dr. B. WERNER (Hamburg). Many thanks go to Dr. G. MACKIE (University of Alberta, Canada), Prof. Dr. A. PORTMANN (University of Basel, Switzerland), Sir F. S. RUSSELL (Plymouth, England), and Dr. MARTHA VANNUCCI (Institute of Oceanography, University of Sao Paulo, Brazil) for reading the manuscript.

Editing a monographic paper is a troublesome task. It was done by Dr. R. MARTIN (Head of the Zoology Dept., Naples Zoological Station) to whom I owe many thanks for this.

Writing this paper would not have been possible without a generous grant from the Office of Naval Research and the U.S.A. National Science Foundation. The Office of Naval Research grant was given to the Naples Zoological Station to cover the various expenses connected with this monograph as there are payments for the author, technicians, an artist, divers a.s.o. The National Science Foundation grant was given to me for morphological and histological research on the species, drawings and finishing of the monograph after I left Naples. The National Science Foundation grant was sponsored by the Museum of Comparative Zoology at Harvard University. I thank both Foundations for their trust and generous support. I would like to thank also Dr. B. NEWMAN (formerly Museum of Comparative Zoology, Harvard) and Dr. H. LEVI (Museum of Comparative Zoology, Harvard) for their help and advice.

Last not least I would like to thank my husband, Dr. G. Voss, for criticizing this paper sentence by sentence, and who helped to clarify many unintelligible passages.

After I had finished this part of the monograph I found that there were so many unsolved problems in numerous species that I would have liked to start investigations again without publishing anything at the moment. Different reasons compel me to publish now, but I am aware of the incompleteness of some chapters. Therefore my hope is, that through this monograph there will be more interest in Mediterranean Hydrozoa, especially in the life-cycles of Antho- and Leptomedusae.

Winnipeg, Institute of Animal Science,
University of Manitoba, Canada ANITA BRINCKMANN-VOSS
April 1968

INTRODUCTION

Morphology. The morphology of medusae and hydroids is described in numerous text books. See RUSSELL (1953) for all details on medusan morphology, HYMAN (1948), KAESTNER (1967), NAUMOV (1960-64) and BOUILLON (1959-67). Unfortunately, the terminology of the anatomy of hydroids and medusae varies from one textbook to another. Therefore text-fig. 1 shows an anthomedusa and three types of hydroids with an explanation of the terminology of structural details as used in this paper.

The different types of tentacles require mention because they are used as taxonomic criteria. Moniliform tentacles: cnidocysts arranged in several clusters (text-fig. 1, h); capitate tentacles: cnidocysts arranged in a cluster at the tip of the tentacle (text-fig. 1, p); filiform tentacles: cnidocysts scattered along the whole length of the tentacle (text-fig. 1, o); There are transitional stages between these three types as will be noted in the detailed descriptions.

The taxonomic value of cnidocysts has often been discussed in recent years (WEILL, 1931-1935; WERNER, 1965; WESTFALL, 1965, 1966 *a, b*). An excellent review and critical judgment of the different opinions is given by VERVOORT (1966 *b*, p. 389-394). Types and sizes of cnidocysts vary very little from species to species and are therefore of little help if any in identifying the species (VANNUCCI, 1959); but cnidocysts may be quite important in establishing relationships between families (REES, 1957 *a, d*, 1958). Yet, contrary to PICARD (1955 *c*, 1957, 1958 *a*), I maintain that cnidocysts must not be used to the exclusion of every other character in the establishment of families or their relation to one another.

Evolution. This monograph deals with a limited region only, the Western Mediterranean and the Adriatic sea, therefore I do not intend to discuss evolutionary problems here (see UCHIDA, 1960-1964 *b*). While I accept the arrangement of families in accordance with REES' « Evolution of the Capitata » (1957 *a*, 1966), I am thereby not issuing judgment on evolutionary theories. Our actual knowledge of palaeontological facts of evolution in Hydrozoa is quite limited. VERVOORT (1966, p. 373) said: « The study of evolution in Hydrozoa, in contrast to that in many other groups of Metazoa that yield an abundant supply of fossil material, is to a very small extent based on solid facts and, to an unfortunately larger extent, on general and at times imaginary assumptions. As appears from a variety of papers that have recently appeared on the evolutionary aspects of Cnidaria, these are principally based on observations of existing species, and have, by a process of sound reasoning, attained the status of circumstantial evidence of the pathways of evolution in Cnidaria. »

Classification. Classification and nomenclature of the Hydrozoa have been confusing throughout. They differ from one textbook to another even in the higher taxa such as orders and suborders. To illustrate this point, the classifications from some of the modern textbooks are listed here:

HYMAN (1940):

- *Order* Hydroida
  - *Suborder* Gymnoblastea
  - *Suborder* Calyptoblastea
- *Order* Milleporina
- *Order* Stylasterina
- *Order* Trachylina
  - *Suborder* Trachymedusae
  - *Suborder* Narcomedusae
- *Order* Siphonophora
  - *Suborder* Calycophora
  - *Suborder* Physophorida

BORRODAILE & POTTS (1959):

- *Class* Hydrozoa
  - *Order* Calyptoblastea
  - *Order* Gymnoblastea
  - *Order* Hydroida
  - *Order* Trachylina
  - *Order* Hydrocorallina
  - *Order* Siphonophora

HICKMAN (1967):

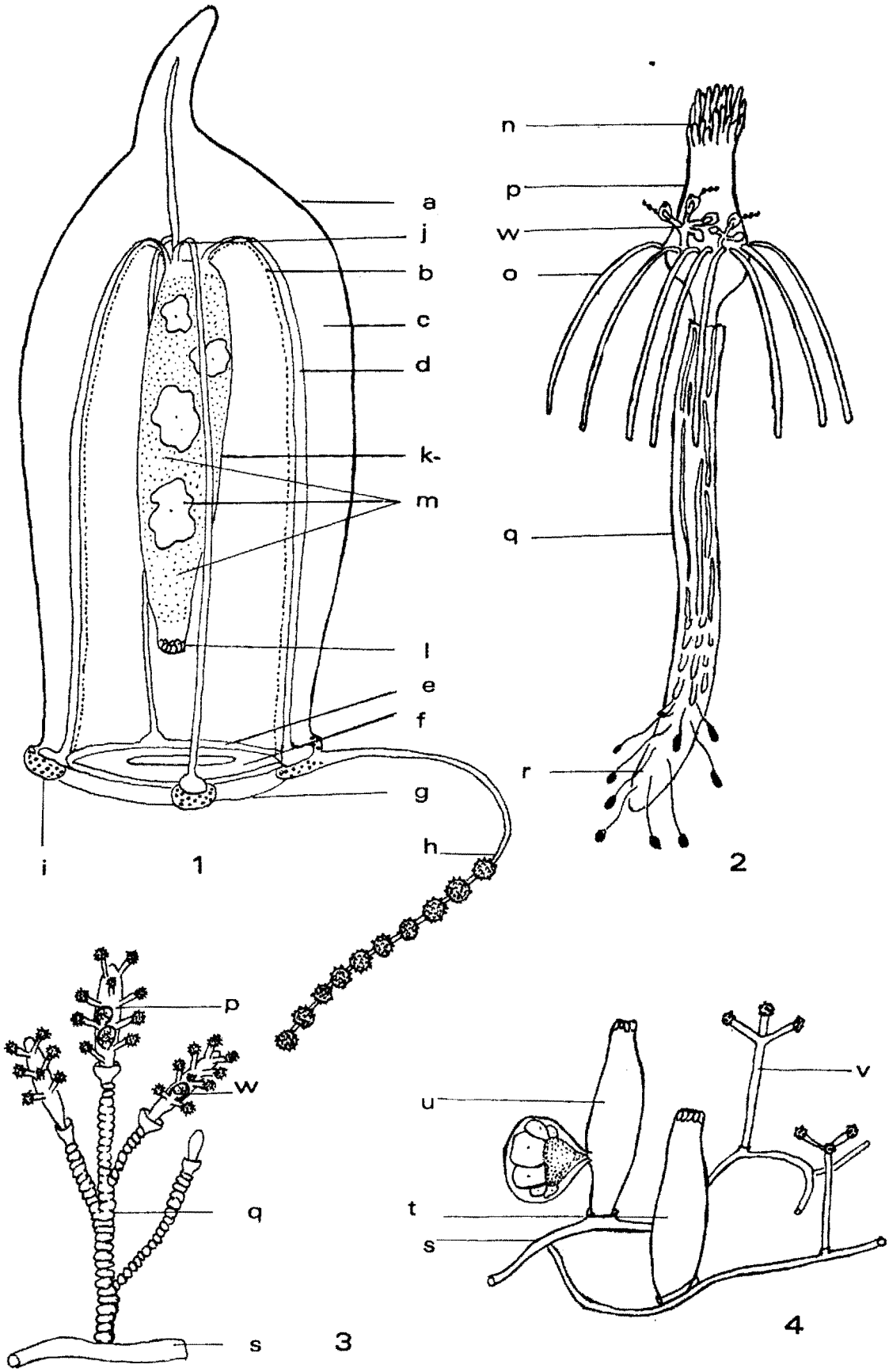
- *Class* Hydrozoa
  - *Order* Hydroida
    - *Suborder* Anthomedusae
    - *Suborder* Leptomedusae
    - *Suborder* Limnomedusae
  - *Order* Milleporina
  - *Order* Stylasterina
  - *Order* Trachylina
    - *Suborder* Trachymedusae
    - *Suborder* Narcomedusae
    - *Suborder* Pteromedusae
  - *Order* Siphonophora

WILMOTH (1967):

- *Class* Hydrozoa
  - *Order* Anthomedusae
  - *Order* Leptomedusae
  - *Order* Limnomedusae
  - *Order* Trachylina
  - *Order* Hydrocorallina
  - *Order* Siphonophora

WERNER (1965):

- *Class* Hydrozoa
  - *Order* Hydroida
    - *Suborder* Athecata
    - *Suborder* Hydrina
    - *Suborder* Thecata
    - *Suborder* Limnohydrina
    - *Suborder* Halamohydrina



TEXT-FIG. 1. - *Terminology for an anthomedusa and three different types of athecate hydroids:* 1 - *medusa of* Corymorpha nutans. 2 - *hydroid of* Corymorpha nutans, *example of a solitary hydroid.* 3 - *hydroid of* Coryne muscoides; *example of a colonial hydroid without polymorphism.* 4 - *hydroid of* Ptilocodium repens; *example of a colonial polymorphic hydroid*: a - *exumbrellar surface,* b - *subumbrellar surface,* c - *mesogloea,* d - *radial canal,* e - *ring canal,* f - *velum,* g - *umbrella margin,* h - *marginal tentacle,* i - *marginal tentacle bulb,* j - *peduncle,* k - *stomach* (j *and* k *together form the manubrium*), l - *mouth,* m -*gonad* (*in this species with amoeboid eggs*), n - *oral tentacle whorl,* o - *aboral tentacle whorl,* p - *hydranth,* q - *hydrocaulus, stem or stolon* (*hydrocaulus used often in not branched species, stem or stolon in branched species*) r - *foot with rooting filaments,* s - *basal stolon or hydrorhiza,* t - *feeding hydranth or gastrozooid,* u - *reproductive hydranth or gonozooid,* v - *dactylozooid or machozooid,* w - *blastostyle carrying either medusae or gonophores.*

During the important symposium « The Cnidaria and their Evolution » (REES, ed. 1966) different specialists on Cnidaria seemed to be inclined to follow the opinion that the class Hydrozoa should be divided into seven orders:

Class Hydrozoa
Order Actinulidae
Order Trachymedusae
Order Anthomedusae (Athecatae)
Order Leptomedusae (Thecatae)
Order Limnomedusae (Limnohydrinae)
Order Siphonophorae

I am inclined to follow this system. VERVOORT (1966 *b*) expressed his opinion that the Milleporidae and Stylasteridae — presently within the Anthomedusae — should be treated as two different orders. This monograph deals with the order Anthomedusae (Athecatae). Grave difficulties in classification and nomenclature are encountered in this order because the medusa and hydroid phases of the same species have often been placed in different genera or even families. As regards our present knowledge of Anthomedusae-Athecatae, there is now no reason for giving hydroids and medusae different names. This is expressed clearly by REES (1957 *a*, p. 456): « In capitate hydroids and medusae the need for maintaining a dual classification has almost disappeared although there are still gaps to be filled. » Therefore, in accordance with REES, the principle of single classification is applied here throughout: *that the definitions and names include the hydroid and medusa phases, from family to species level.*

In cases where the hydroid and medusa stages of the same animal were described under different generic or specific names, the unifying generic or specific name for both stages has been chosen according to the rules of priority.

The principle of classification adopted in this paper does not rule out that one family may contain species with fixed gonophores as well as species with hydroids and free medusae and also species of which but one phase is known.

When it comes to the definition of genera within a family I am inclined to think that the presence of fixed gonophores or free medusae can sometimes be used as a reliable feature to establish two genera (for example *Tubularia* and *Ectopleura*). In this regard, I cannot accept the opinion of BROCH (1916) who principally ruled against this distinctive feature to be significant for a genus, because in some genera it is the only distinguishing character (see p. 47).

The classification applied here for the suborder Capitata of the order Anthomedusae-Athecatae was developed in a study of Mediterranean species. In the meantime, I have had opportunities for comparisons with material from other regions, both Atlantic and Pacific. I begin to think that the single classification can be arrived at for the Anthomedusae and Leptomedusae anywhere.

Synonymy. BEDOT (1901-25) carefully listed all the synonyms of hydroids from 1800 to 1910. His references are not repeated here. Similarly, KRAMP (1961) registered all the medusan synonyms up to the year 1958. His valuable references are not repeated here either.

Throughout this monograph, the synonymy lists show in brackets whether a name is applicable to the hydroid or the medusa stage.

Key. A pictorial key to hydroids and medusae has been included in this publication. It is hoped that it will serve as a useful guide to quick identification.

Methods of collecting. The daily plankton was collected with an open zooplankton net no. 3 with a mesh width of 64 meshes to the inch drawn horizontally for about 20 minutes.

« Posidonia plankton », to collect medusae living on the Posidonia leaves, was gathered with a stramin plankton net. It had to be drawn right over the Posidonia grounds. Stands of Posidonia are plentiful south of Capo Posillipo, but stones prevent collecting there. Posidonia plankton was therefore obtained from the Posidonia grounds around the island of Ischia.

Hydroids from rocky littoral were collected by chiselling off small chunks of rock, with algae and everything else still on them. This was done either from a small rowing boat or by divers. The hydroids from deeper regions were obtained in dredge material. In order to detect the small athecate hydroids, all the material had to be studied in water under the dissecting microscope. Hydroids from the mud surface were collected with a mud-tangle invented by REES (British Museum). It consists of an iron bar 1.5-2.0 m long. Attached to this bar is a rectangular piece of cotton fishing net (width of the meshes 1-2 cm) about 2 m long. This mesh is drawn over the mud-surface, hoisted and then thoroughly washed and beaten in a large tub of water. The tub is brought to the laboratory, the clear water decanted and the muddy sediment placed in petri dishes where the hydroids can be examined the next day standing upright in the mud.

Distribution. a) *Hydroids.* In preparation for this monographic report, samples from different regions and biotopes from the inner and outer Gulf of Naples were collected daily, the exact locations usually depending on the fishing site of the boats of the Station. This general survey was carried out over a continuous period of five years. In addition, in order to obtain a clearer picture of the seasonal variation of hydroids, rock material from the cave of Capo Miseno, Posidonia plants from south of Capo Posillipo and mud-samples from the Gulf of Pozzuoli were examined monthly, in springtime weekly, over a period of two years. The locations are marked in the map, text-fig. 2. It became apparent from this regular sampling that most athecate hydroids not only have fixed periods of medusa or gonophore production but also distinct periods of growth and regression. This seasonal variation is described under

« ecological observations » of the species. In the case of the small athecate hydroids of the rocky littoral, the periods of seasonal growth appear to be related to the seasonal growth of algae. More research on these ecological problems, especially on the relations between hydroid and plant growth, is necessary. The only extensive paper which deals with the ecology of hydroids in the Mediterranean is that of RIEDL (1958), but it is restricted to caves.

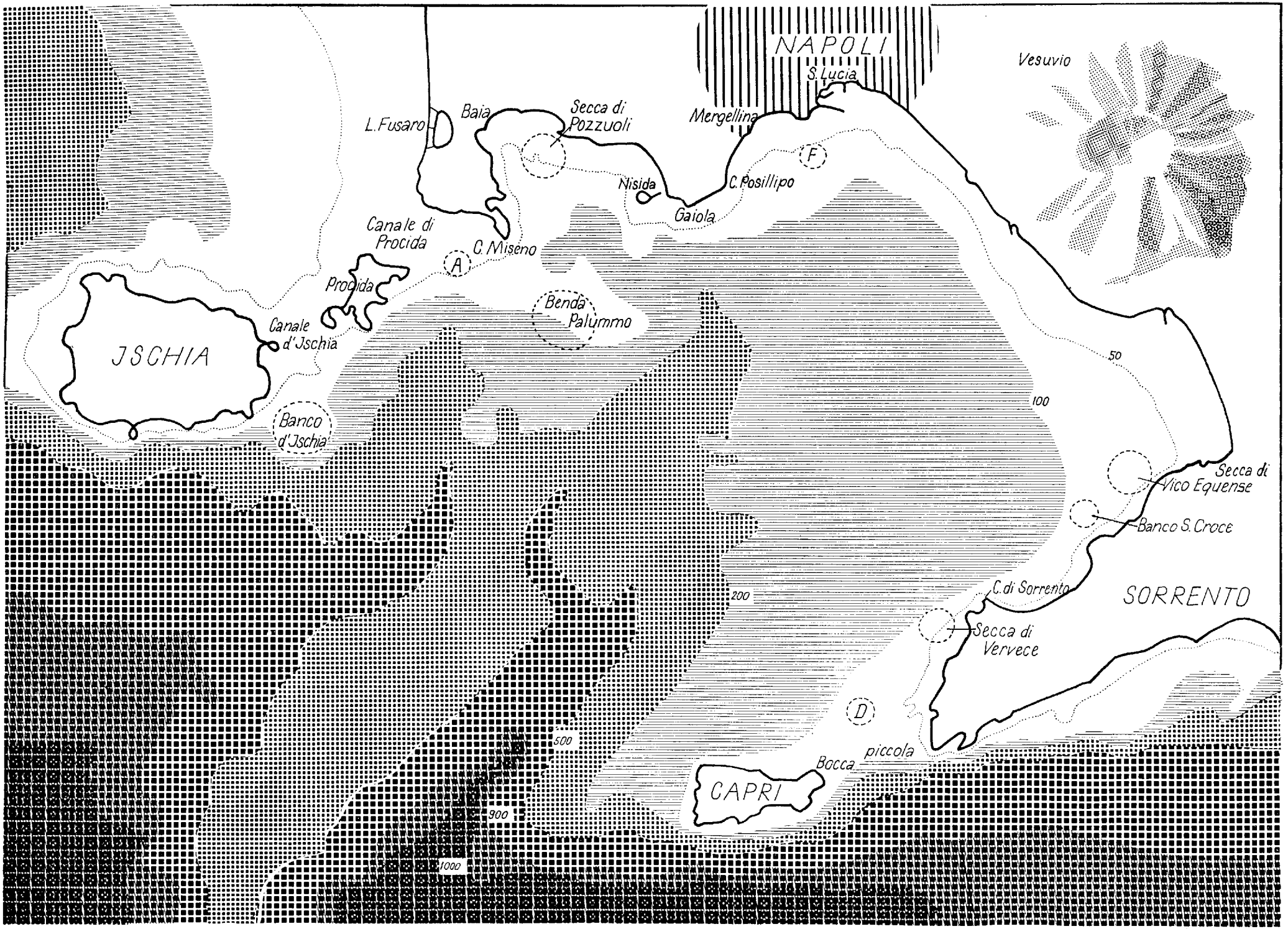
In addition to the collections made in Naples, hydroids were searched for in Villefranche (France) in the springs of the years 1953 to 1957, in the fall of 1958 and in Banyuls (France) in the falls of 1956 and 1957.

b) *Medusae.* Medusae were obtained from plankton, collected inside the Gulf of Naples and around the island of Ischia daily in the early morning hours, because medusae migrate to deeper regions after sunrise (CLARKE, 1954; CUSHING, 1951). The plankton from the inner gulf was fished south of Capo Posillipo over a depth of 150 to 200 m. Usually four horizontal hauls with a cable length of 150, 100, 50 and 10 m were made. (It proved safer to ask for a certain depth in terms of cable length than in actual depth of the net). Plankton from the outer gulf was collected either at the south side of Ischia over a ground of more than 200 m depth with a cable length of 50 and 20 m, or off the north side of Ischia over a ground of 60 m depth with a cable length of 20 m.

Unfortunately plankton from deeper regions could be collected very seldom (pp. 21, 32). Vertical quantitative plankton hauls were made between Ischia and Casamicciola by VANNUCCI (1966) over a period of two years.

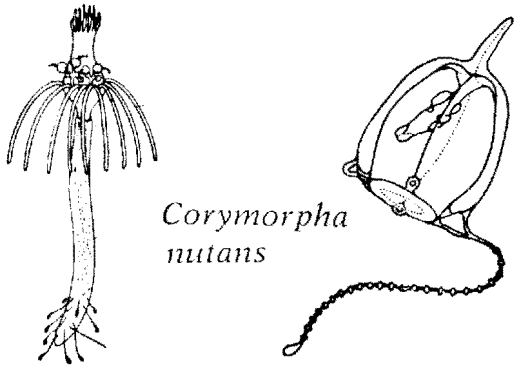
The inner Gulf of Naples provided relatively few Anthomedusae, therefore many hauls had to be checked daily. The plankton in the open parts of the Gulf around Ischia contained far more Anthomedusae. Numerous species were found only in the hauls from near Ischia.

Deposition of specimens. As a rule, the number of specimens deposited was equally divided between the British Museum of Natural History (abbreviated as B.M.N.H. in this paper) and the Naples Zoological Station, Stazione Zoologica di Napoli (abbreviated as S.Z.N.). In the few instances where there was just one specimen available, this one was submitted to the British Museum of Natural History.

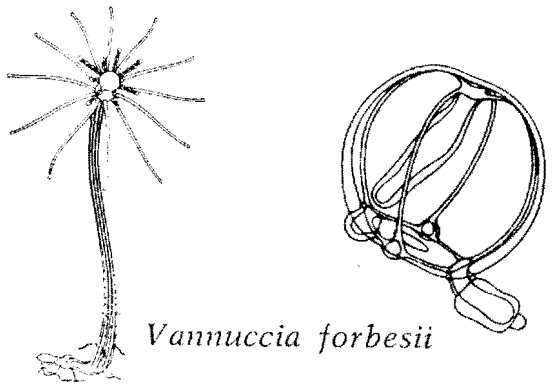


TEXT-FIG. 2. - *Map of the Gulf of Naples and surroundings.*

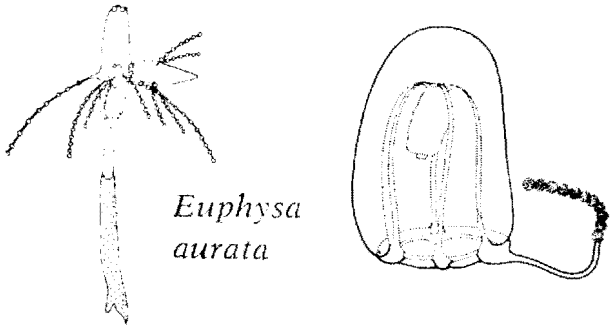
FAMILY CORYMORPHIDAE



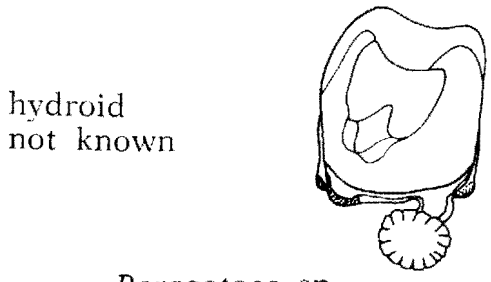
Corymorpha nutans



Vannuccia forbesii



Euphysa aurata

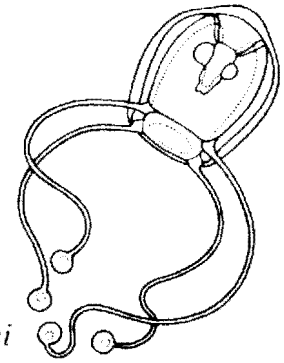


hydroid not known

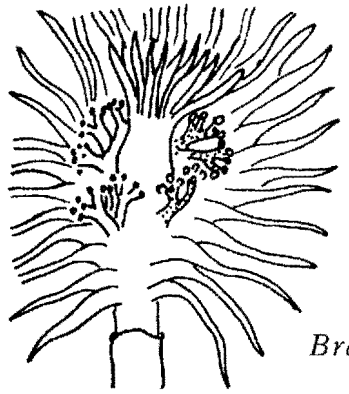
Paragotoea sp.

FAMILY CORYMORPHIDAE

hydroid not known



Eucodonium brownei

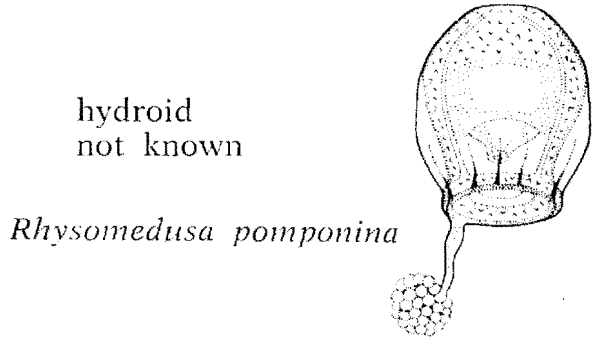


no free medusa

Branchiocerianthus sp.

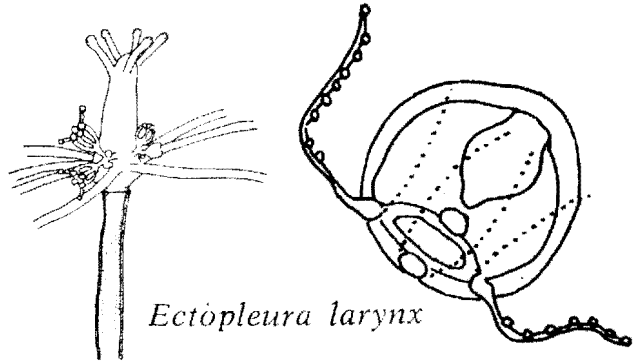
FAMILY TUBULARIIDAE

hydroid not known

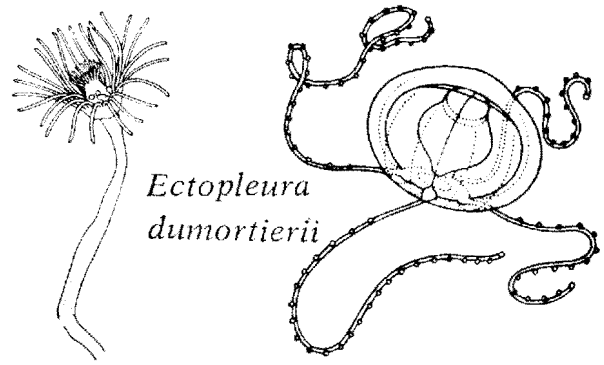


Rhysomedusa pomponina

FAMILY TUBULARIIDAE

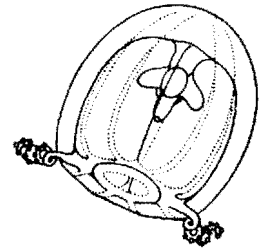


Ectopleura larynx

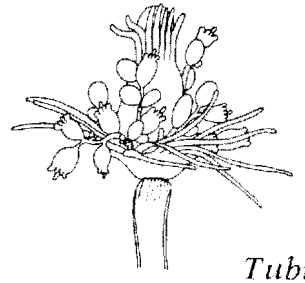


Ectopleura dumortierii

hydroid not known



Ectopleura sacculifera

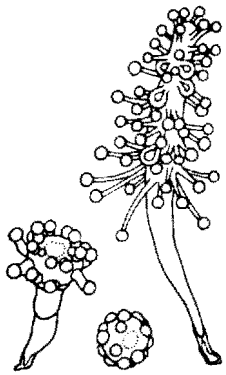


no free medusa

Tubularia crocea

TEXT-FIG. 3. - *Pictorial key* I.

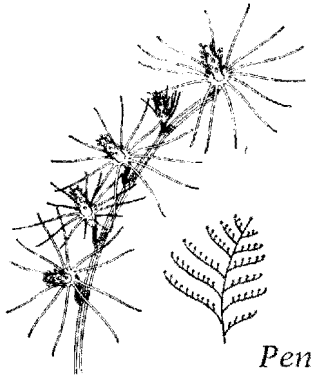
FAMILY ACAULIDAE



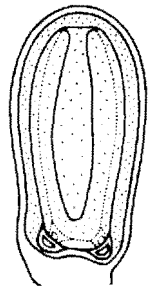
no free medusa

Acaulis ilonae

FAMILY PENNARIIDAE



eumedusoid

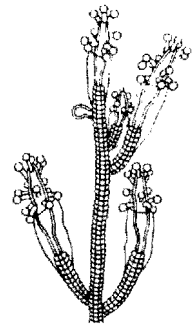


Pennaria disticha

FAMILY CORYNIDAE

no free medusa

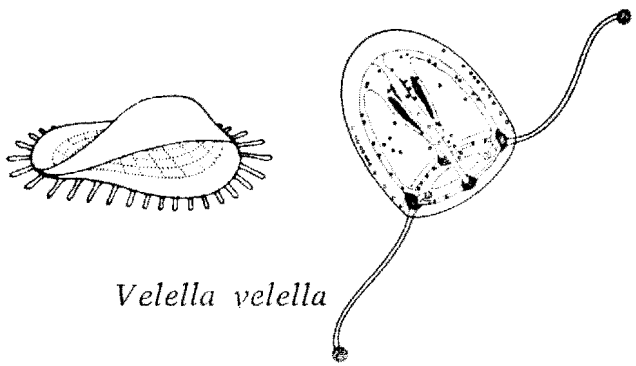
Coryne pusilla



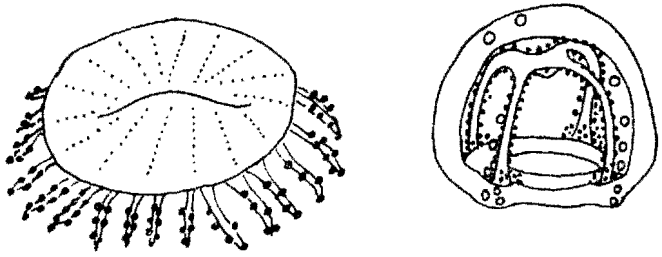
no free medusa

Coryne muscoides

FAMILY VELELLIDAE

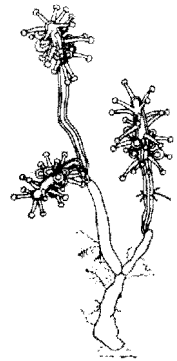


Velella velella



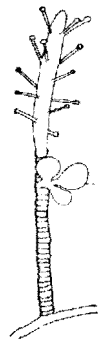
Porpita mediterranea

FAMILY CORYNIDAE



no free medusa

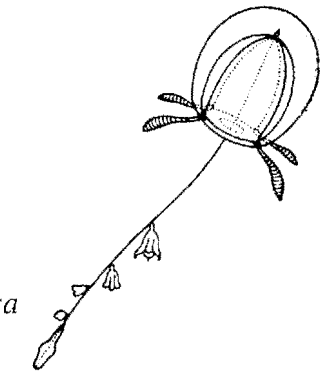
Coryne pintneri



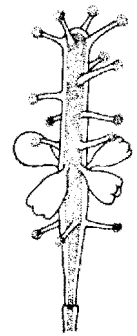
no free medusa

Coryne epizoica

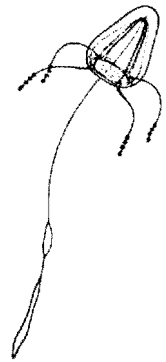
hydroid not known



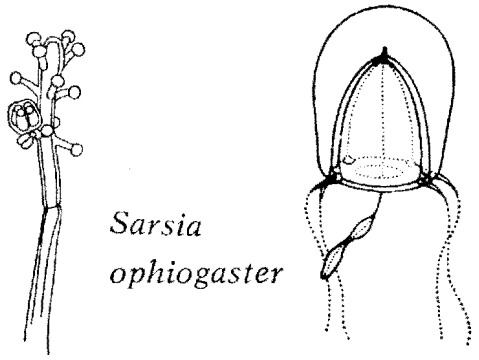
Sarsia gemmifera



Sarsia halterata

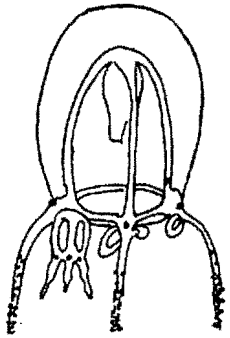


FAMILY CORYNIDAE

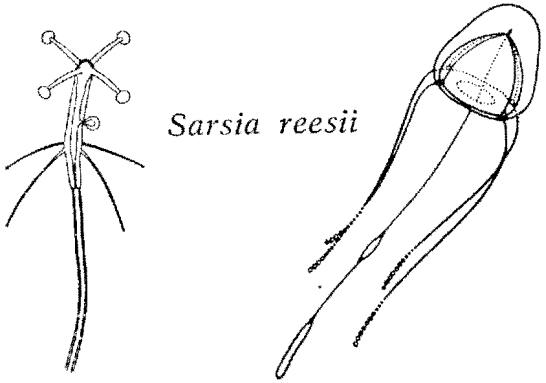


Sarsia ophiogaster

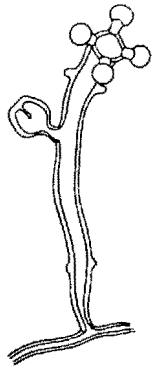
hydroid not known



Sarsia prolifera



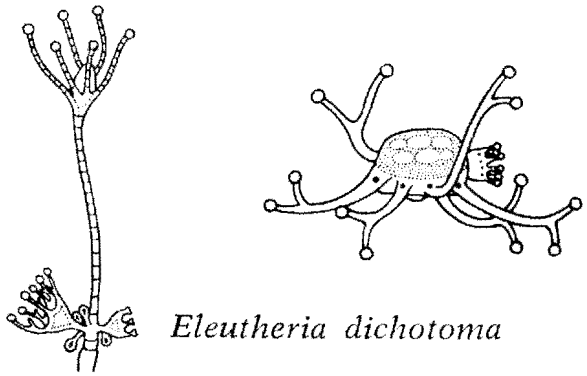
Sarsia reesii



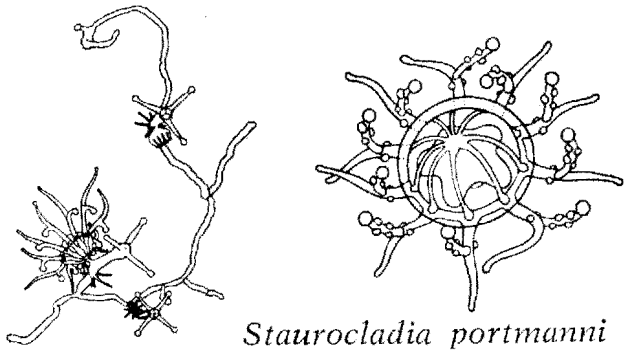
medusa not known

Sarsia sp.

FAMILY ELEUTHERIIDAE

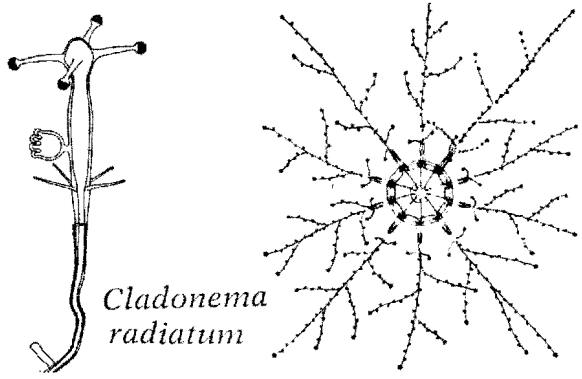


Eleutheria dichotoma



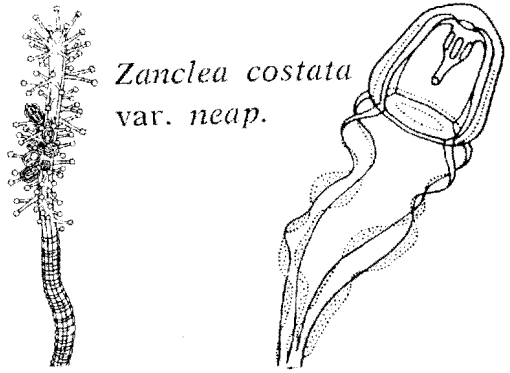
Staurocladia portmanni

FAMILY CLADONEMATIDAE



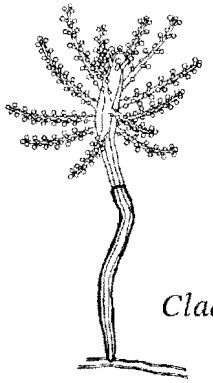
Cladonema radiatum

FAMILY ZANCLEIDAE



Zanclea costata var. *neap.*

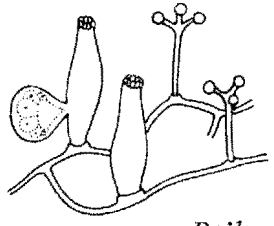
FAMILY CLADOCORYNIDAE



no free medusa

Cladocoryne floccosa

FAMILY PTILOCODIIDAE



no free medusa

Ptilocodium repens

FAMILY CORYMORPHIDAE KRAMP 1949

Introduction

The families Corymorphidae and Tubulariidae were combined in one family, the Tubulariidae until recently. KRAMP (1949) suggested the introduction of two families as their hydroids are quite different. RUSSELL (1953) kept the one family Tubulariidae but proposed two subfamilies Tubularinae and Corymorphinae.

REES (1957 *a*) kept the Corymorphidae and Tubulariidae as two distinct families. In his synopsis of medusae of the world, KRAMP (1961) did not follow his original intention of dividing the Tubulariidae into two families, but left the Tubulariidae and Corymorphidae united in one family, Tubulariidae.

In this monograph I would like to follow KRAMP's original intention as well as REES' opinion and divide the Tubulariidae into two families, Corymorphidae and Tubulariidae, although the differences of the two families may be greater in the hydroid than in the medusa stage.

Definition of the family Corymorphidae

Hydroids solitary with one group of oral tentacles which are either filiform or moniliform. Perisarc feebly developed in the form of a gelatinous perisarcal sheath. Hydrocaulus usually fastened by rooting filaments. Gonophores borne between the two groups of tentacles. Either fixed gonophores or free medusae. Free medusae with one to four tentacles which are either capitate or moniliform. Without exumbrellar nematocyst tracks.

The Corymorphidae are represented by six genera in the Mediterranean: *Corymorpha* M. SARS 1835, *Euphysa* FORBES 1848, *Vannuccia* BRINCKMANN-VOSS 1967, *Paragotoea* KRAMP 1942, *Eucodonium* HARTLAUB 1907, *Branchiocerianthus* MARK 1898.

Genus *Corymorpha* M. SARS 1835

Generic characters

Hydroids solitary, radially symmetrical; with basal anchoring papillae and rooting filaments; all tentacles filiform, oral tentacles in several series; aboral tentacles in one whorl; gonophores borne in the area between the two whorls of tentacles; fixed gonophores or free medusae. Medusae with pointed apex and well developed apical canal; with one moniliform tentacle.

The only species representing this genus in the Mediterranean is *Corymorpha nutans*. Type species: *C. nutans* M. SARS 1835.

Corymorpha nutans M. SARS 1835
Pl. II, fig. 3; text-fig. 6 - 8

Synonymy

Corymorpha nutans M. SARS 1835, p. 6, Pl. I, fig. 3 (hydroid).
Steenstrupia rubra FORBES 1848, p. 73, Pl. XIII, fig. 1 (medusa).
Corymorpha nutans BEDOT (1918, p. 107) (hydroid) listing all synonyms.
Corymorpha nutans REES (1957 *a*, p. 521) (hydroid and medusa).
Steenstrupia nutans KRAMP (1961, p. 45) (medusa), listing all synonyms.

The genus and species have been described for the hydroid stage by M. SARS in 1835 and this name has priority over the description of FORBES (1848) for the medusa stage under the name *Steenstrupia.*

Therefore the generic name should be *Corymorpha* and not *Steenstrupia.*

Specific characters

Hydroid: Large *Corymorpha* with hydrocaulus with short papillary projections, which elongate and form fine filaments towards the base of the hydrocaulus. Stem enclosed in a fine flexible perisarc. Hydrocaulus consists of numerous endodermal canals. About 20 to 32 aboral tentacles and 20 to 80 oral tentacles which are arranged in several irregular whorls. Medusae borne in clusters on branching peduncles just above the aboral tentacle whorl. Free medusae with pointed apical process. Exumbrella without nematocyst tracks. One moniliform tentacle.

Material seen by the author: Villefranche sur mer, France, medusa stage only. Naples, Italy, medusa and hydroid.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: all European coasts (RUSSELL, 1953).
Mediterranean: Naples, Italy (author).

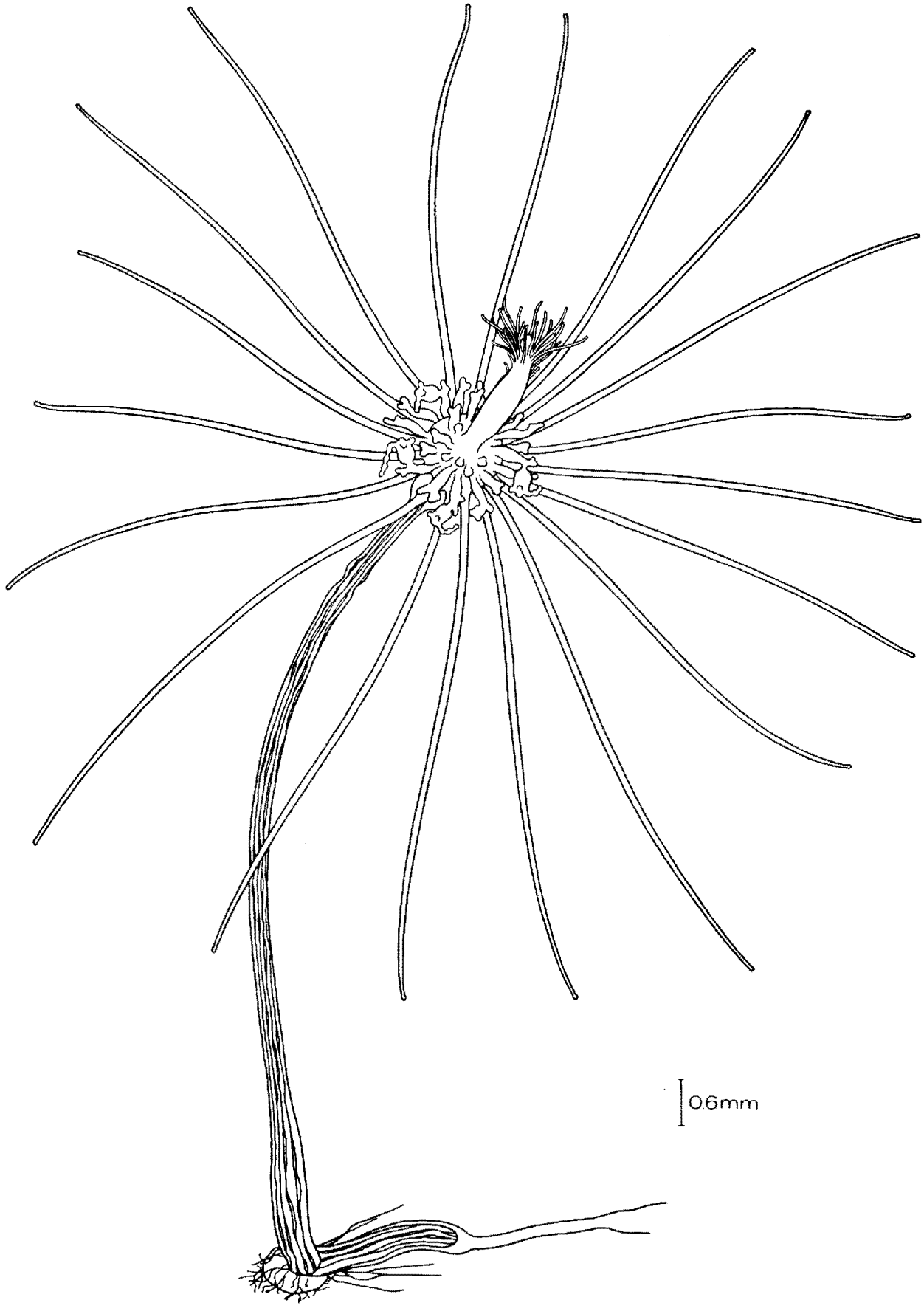
Medusa, outside Mediterranean: see KRAMP (1961).
Mediterranean: Menton, Villefranche, France (RANSON, 1936; KRAMP, 1957 *c*). Adriatic sea (NEPPI & STIASNY, 1913; PELL, 1918; BABNIK, 1948). Naples, Italy (VANNUCCI & SOARES, 1966).

Methods of collection and cultivation

The medusae were taken from the surface plankton in the night or very early morning hours. The medusae were very abundant in Villefranche from 1953-56 and could be taken with a gauze plate directly from the surface of the sea. They were common around Naples in the spring. They were kept at 18° C on a rocking table in large covered boveri dishes without additional air. The water was changed once a day. They were fed with *Artemia* or plankton copepods. However, the medusae did not take food easily and food had to be brought directly to the mouth. Most hydroids were raised from the fertilized eggs of the medusae (see p. 13). The hydroids were kept in 13° C in boveri dishes and fed well on *Artemia salina*. Only one hydroid was taken with the mud-tangle (see p. 5) directly from the sea.

Description of the species

Hydroid: RUSSELL (1953) « Hydrocaulus subcylindrical 50-115 mm in height, solitary. Basal end with short papillary projections, with numerous fine long filaments below. Perisarc a transparent membranous tube. About eighty short oral tentacles arranged in several series, about thirty-two longer aboral tentacles. Medusae borne in clusters on fifteen to twenty branching peduncles above aboral tentacles without ectothecal covering ».



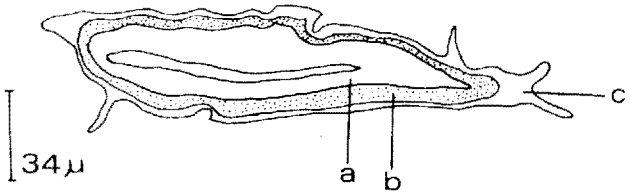
TEXT-FIG. 6. - Corymorpha nutans. *Hydroid with medusa buds, raised in the laboratory from an egg. Drawn by* ILONA RICHTER.

Medusa: The medusa has a height of 5 mm (including the apical projection) and a width of 1.5-2.0 mm. The manubrium hangs on a very short peduncle and extends from two-thirds of the subumbrella up to the velar opening. The gonads surround the stomach in a circle in its whole length. There are 4 perradial tentacle bulbs with a concentration of cnidocysts on their abaxial side. The one marginal tentacle carries 12 to 39 cnidocyst clusters. An umbilical canal is present in young and adult specimens. The radial canal, ring canal and apical projection show a yellow appearance. Marginal tentacle bulbs are pink, the other parts are transparent.

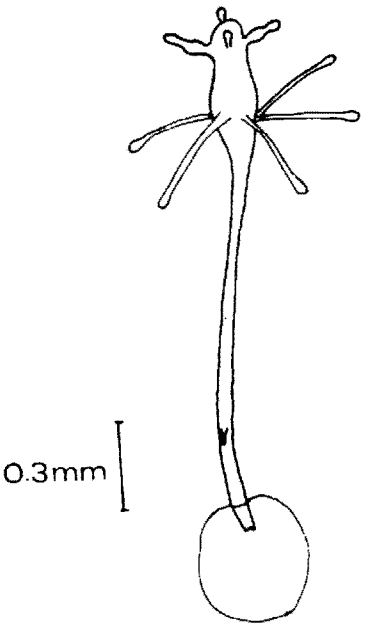
The cnidocysts are: Large and small stenotheles; ? anisorhize heterotrichous haplonemes, ? microbasic mastigophores or microbasic euritheles; desmonemes (RUSSELL, 1953).

Developmental stages

The development of the egg and young hydroid was described by REES (1937) and WERNER (1959) and observed by the author in Naples: The fertilized egg with a diameter of 0.23-0.25 mm leads to a stereogastrula, which sometimes swims around slowly. This gastrula settles and fixes itself on the bottom of the container within 24 hours. It is then covered with a cuticula (text-fig. 7). REES (1937) describes pseudopodia-like protuberances from the gastrula. However, these are only present in a few of the embryos. After three to four days some of the embryos will protrude from their cysts and form small hydranths with three or four oral and eight aboral tentacles. The oral tentacles may be slightly moniliform at this stage of development. However, most of the encysted embryos have a resting period. Of 20 eggs which were laid April 24, 1962, only one had developed into a hydranth by May 1st. All other embryos remained in their cysts, and were placed in 18° C. Sea-water was changed about once a week. No development ocurred in the cysts during the whole summer although we changed the temperature from 18° to 13° C and vice versa. In November the embryos were again exposed to a 13° water temperature. From then on, the water was changed daily and nearly all embryos hatched. It is not clear what actually stimulates the hatching of the embryos and further experimental investigations under more constant conditions would be needed. (For instance the animals were not kept exactly under constant temperatures, because when the water was changed, the animals were placed in laboratories without constant temperatures. The sea-water which was used was brought daily from the sea). WERNER (1959) described the same phenomenon of a resting period of *Corymorpha* embryos for the North Sea and the Atlantic Ocean. (The relation between the embryonic diapause and the seasonal occurrence of this species in the North Sea and the Mediterranean is discussed on p. 14).



TEXT-FIG. 7. - Corymorpha nutans. *Section through a cyst.* a - *endoderm,* b - *ectoderm,* c - *cyst.*



TEXT-FIG. 8. - Corymorpha nutans; *development of young hydroids. Partly after a sketch by* DR. TARDENT.

After liberation from their cyst the development of the hydroids is very quick. In an embryo without diapause the hydrocaulus reached a length of 4-5 cm and medusa buds started to develop one month after the first cleavage stages. Two different hydroids liberated their first medusae at an age of 42 and 46 days. The hydroids had 4-5 irregular oral whorls of tentacles then (text-fig. 6). These hydroids budded medusae in great numbers until the middle of June. Then the medusa production ceased, and the hydroids showed signs of degeneration, such as shrinking of the hydrocaulus and shedding of the aboral tentacles. This degenerative stage lasted until November and December, when the hydroids started to regenerate and developed medusa buds again, at the same time when the hydroid specimens which had undergone a resting stage, started to grow. The hydroids which were producing medusae for a second season did not produce as many as in their first budding period. The young medusae are images of the older ones (RUSSELL, 1953). They are however of smaller size and have fewer cnidocyst clusters on the tentacles. In 6 three day old medusae the number of cnidocyst clusters was 5, 7, 8, 9, 9 and 15. Signs of gonads can be seen a few days after liberation. Unfortunately, the medusae could not be brought to maturity in the laboratory.

Ecological observations and seasonal occurrence

Medusae of *C. nutans* occur regularly around Naples from February to the middle of May. In Villefranche (France), I always found them in March, from 1953 to 1957. (I suppose they were also present there from February through May, however no plankton was collected there except in March). When the water temperature reads 13°-14° C in February, adult medusae are already to be found in plankton near Naples. Thus the development of the hydroid presumably starts in December and January. This coincides with the growth of the young *Corymorpha* hydroids from their cysts in the laboratory. Two young hydroids were found in the sea on March 3, 1961. They started to bud medusae on April 10, 1961. Probably these hydroids hatched from their cysts without diapause. Since the period of medusa production corresponds in the laboratory and in the sea at Naples (late winter or early spring), and since embryos obtained from laboratory medusae remained in cysts through summer and autumn, I conclude that embryos remain in cysts during the warm months in nature as well. In the North Sea and North Atlantic, however, the adult medusae of *C. nutans* are found in July and August, the cyst stage of the embryo lasts there over the winter and the outgrowth of young hydranths takes place in spring when the water temperature rises to 12°-15° C (HARTLAUB, 1907-17; WERNER, 1959). When one compares the findings from the Mediterranean and the North Sea, it becomes aparent that the development of hydroids out of the cyst stage is suppressed below 12° C and above 15° C. This would explain the main outgrowth of hydranths in spring and early summer, medusa production in middle and late summer in northern seas, whereas in the Mediterranean the development of hydroids starts in late autumn, and medusa budding follows in winter and early spring.

Habits

A vivid account of the activities of *Steenstrupia nutans* has been given by FORBES (1848, p. 73). « It is very active and tenacious of life; before dying, assuming all manner of strange shapes, doubling itself up, and turning inside out in a terrific manner, giving up the ghost with convulsions as fearful as those of a popular actor in the death scene of a tragedy ... But then well and uninjured, it is an extremely active and regularly formed creature, though, owing to the weighty and unbalanced tail which is doomed perpetually to drag as its train, it cannot advance through the water with the easy grace and rapidity for which its allies are remarkable, but struggles forward with frantic energy, contracting and expanding rapidly, and without ceasing, reminding us of an escaped felon impeded in its course by the dragging of its heavy fetters. » The medusa has been shown by LEBOUR (1922, p. 661; 1923, p. 84) to feed on copepods, crustacean larvae, *Sagitta*, fish eggs and young fish. (After RUSSELL, 1953).

Discussion of the species

Corymorpha nutans was described by M. SARS (1835) in its hydroid stage. MAYER (1910) united *Steenstrupia lineata* LEUCKART and *Steenstrupia cranoides* HAECKEL with *Corymorpha nutans*. This opinion has been shared by RUSSELL (1953) and KRAMP (1961) and is supported here.

Genus *Vannuccia* BRINCKMANN-VOSS 1967

Generic characters

Corymorphidae with solitary hydroids with one whorl of moniliform oral tentacles and an aboral whorl of filiform tentacles. With endodermal stem canals and basal tuft of rooting filaments. Gonophores borne on blastostyles just above the aboral tentacle whorl. Free medusae with one tentacle and no exumbrellar cnidocyst rows.

Type species: *Vannuccia forbesii* (MAYER 1894).

The genus *Vannuccia* is represented by the species *V. forbesii* in the Mediterranean.

Vannuccia forbesii (MAYER 1894)

Pl. I, figs. 1, 2; text-figs. 9-11

Synonymy

Hybocodon forbesii MAYER 1894, p. 236, Pl. I, fig. 1 (medusa).

Hybocodon forbesi KRAMP 1961, p. 42 (medusa) listing all synonyms.

Vannuccia forbesi BRINCKMANN-VOSS 1967, p. 1, figs. 1-6 (medusa and hydroid).

Specific characters

Hydroid with 12 to 14 oral tentacles and 16 to 20 aboral tentacles. Asexual reproduction by transverse fission of the stem. Free medusae with slight asymmetrical bell, one fully developed tentacle with a large terminal cnidocyst swelling.

Material seen by the author: Naples, Italy.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean:

Mediterranean: Naples, Italy (BRINCKMANN-VOSS, 1967).

Medusa, outside Mediterranean: see KRAMP (1961).

Mediterranean: Naples, Italy (BRINCKMANN-VOSS, 1967).

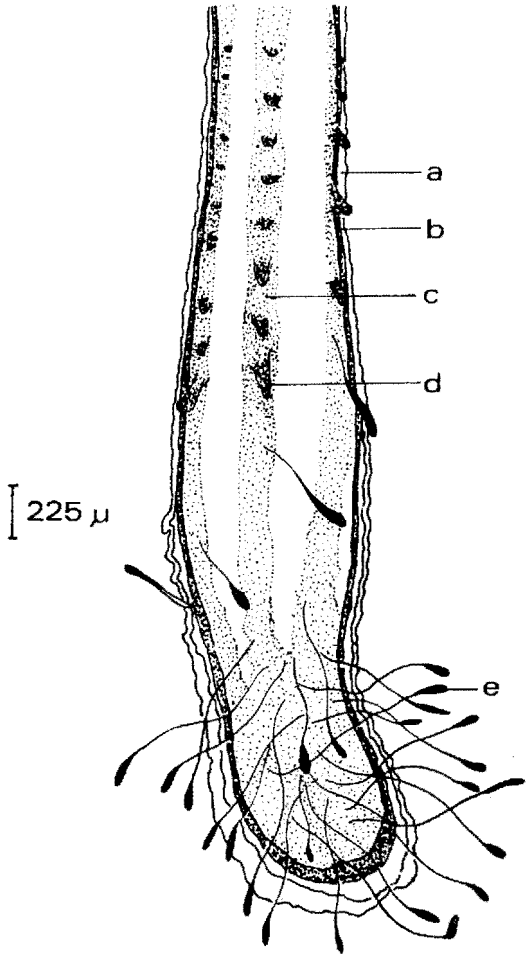
Methods of collection and cultivation

The hydroid was collected with the mud-tangle 30 m deep in the Gulf of Pozzuoli. It thrives under laboratory conditions

at 18°C fed daily with *Artemia* or copepods. The medusa is not easy to rear.

Description of the species

The hydroids of *V. forbesii* are very similar to those of *Corymorpha nutans;* the hydranth of *V. forbesii* consists of a stem or the «foot» (text-fig. 9), which shows a similar arrangement of rooting filaments and endodermal canals as in *Corymorpha nutans.* The whole stem is surrounded by a flexible perisarc which extends up to the constriction of the stem (Plate I, fig. 1).



TEXT-FIG. 9. - Vannuccia forbesii, *base of hydranth stem. The rooting filaments form a dense tuft, but in order to make the figure clearer only a few of them are drawn in this figure.* a - *gelatinous perisarc;* b - *ectoderm;* c - *endodermal ridge;* d - *developing rooting filament;* e - *rooting filament.* (*After* BRINCKMANN-VOSS, 1967).

The length of hydranth and stem measures 2-3 cm for specimens with medusa buds. The length is quite variable on account of the great variability of the length of the stem.

The oral tentacle whorl consists of 12 to 14 tentacles, each carrying 4 to 6 cnidocyst swellings. The aboral tentacle whorl consists of 16 to 20 tentacles. Each aboral tentacle is very long and has a small swelling at its tip which is more or less pronounced depending whether the tentacles are contracted or expanded.

The medusa buds develop in clusters on short blastostyles. As the buds are naked, the one tentacle of each bud can be seen in the more advanced stages of the medusa formation.

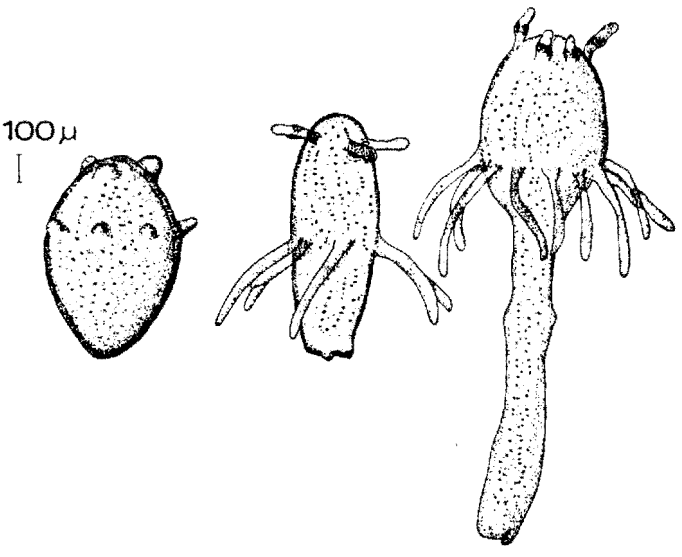
The liberated medusae are 1.8 to 2.0 mm high. The exumbrella is apple shaped and somewhat asymmetrical. The young medusae carry all features of the specific characters of the adult medusae with the exception of the gonads, which develop later. This is commonly so in the *Corymorpha-Tubularia* group.

Young medusae of *V. forbesii* characteristically have one fully developed tentacle and three tentacle bulbs. The tentacle bulb which is opposite the fully developed tentacle is larger than the two other ones. (Plate I, fig. 2). This bulb starts to grow out on the second day after liberation to form a small rudimentary tentacle. MAYER, who gives a description of a fairly young and an adult medusa of *V. forbesii* (MAYER, 1894, 1910), shows that this tentacle may grow longer in mature specimens (MAYER, 1910, pl. III), but never becomes perfectly developed. The one fully developed tentacle has a large swelling at its tip, which is provided with numerous cnidocysts. The manubrium is club-shaped without a peduncle and extends to the velum. Usually the manubrium does not stay in the centre of the subumbrellar cavity as is generally expected of anthomedusan species but is located slightly nearer the tentacle bulb opposite the fully developed tentacle. The velum is thin and narrow. The gonads start to develop soon after the liberation of the medusa. The stomach is completely encircled by the gonads.

Reproduction and development

All my medusae of *V. forbesii* were males. Therefore the sexual reproduction could not be observed.

Hydroids may undergo an interesting type of asexual reproduction. It begins with the base of the foot of the hydroid thickening slightly. This part is then constricted off from the other parts of the stem and freed from the perisarcal sheath. It develops four oral and six aboral tentacle buds after it is freed (text-fig. 10).

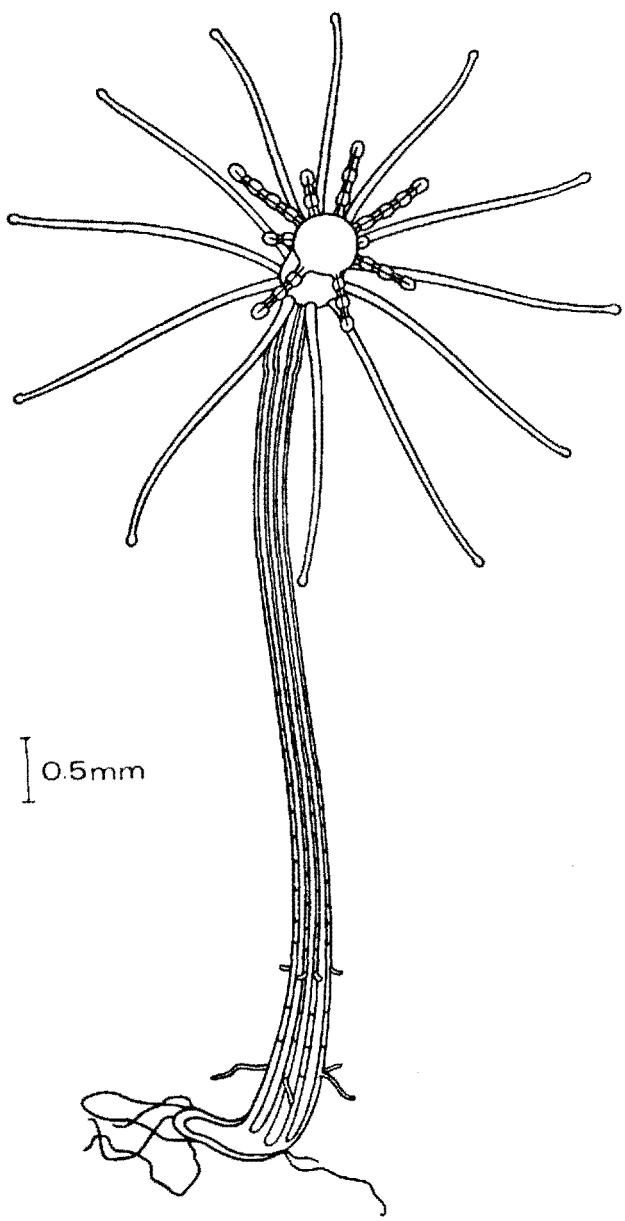


TEXT-FIG. 10. - Vannuccia forbesii, *three developmental stages of young hydranths developed through asexual budding.* (*After* BRINCKMANN-VOSS, 1967).

Sometimes however, the tentacle buds are already developed inside the perisarc of the old hydranth. The liberated hydranths do not settle immediately but move around slowly until they affix themselves after some hours or even one or two days. This asexual reproduction may become so profuse that a whole tuft of hydroids is formed out of one specimen in about a week. A similar type of budding is known in *Euphysa aurata* (FORBES) and *Hypolytus peregrinus* MURBACH. But in *Euphysa aurata* the oral tentacles of the bud develop always distal from the aboral ones in relation to the « mother » stem (see BRINCKMANN-VOSS, 1967, fig. 3).

Ecological observations

The hydroid of *V. forbesii* was found with six oral tentacles and ten aboral ones in May 1962 (text-fig. 11). It was found in mud at a depth of 30 m. In the same region I used to find *Euphysa aurata*, but not other hydroids or medusae of *V. forbesii*. The hydroid was kept at 18° C. The asexual reproduction started at once after the hydroid had been brought to the laboratory. Medusae production took place in autumn and winter. The asexual reproduction did not cease while the development of medusa buds took place.



TEXT-FIG. 11. - Vannuccia forbesii, *young hydroid, directly from the sea, drawn by* ILONA RICHTER.

Discussion of the species

The structure of the hydroid is decidedly different from any *Hybocodon* hydroid. Therefore, a new genus *Vannuccia* was established for the species formerly called *Hybocodon forbesii* MAYER (BRINCKMANN-VOSS, 1967). For detailed systematic discussion see the above mentioned paper.

Genus *Euphysa* FORBES 1848

Generic characters

Hydroids with radially symmetrical hydranths. Hydrocaulus enclosed in a gelatinous perisarcal sheath with few anchoring filaments. Without fully developed stem canals. Oral tentacles capitate or moniliform, aboral tentacles moniliform. Fixed gonophores or free medusae. Free medusae with rounded, domelike apex, no apical canal, one to four tentacles sometimes of unequal length, but always of the same moniliform structure. Type species *Euphysa aurata* FORBES 1848.

The genus *Euphysa* is represented by the species *Euphysa aurata* in the Mediterranean.

Euphysa aurata FORBES 1848
Text-figs. 12-15

Synonymy

Euphysa aurata FORBES 1848, p. 71, Pl. XIII, fig. 3 (medusa).
Corymorpha annulicornis SARS 1860, p. 96 (hydroid).
Corymorpha annulicornis REES (1938, p. 25, figs. 8, 9) (hydroid and young medusa) listing synonyms for the hydroid.
Euphysa aurata REES (1957, p. 521) (hydroid and medusa).
Euphysa aurata KRAMP (1961, p. 36) (medusa) listing all synonyms.

Specific characters

Hydroid with oral tentacles capitate and aboral tentacles moniliform. Anchoring tentacle-like filaments developing below the aboral tentacle whorl. Asexual reproduction through fission of basal parts of the hydrocaulus and through budding of hydranths on the lower part of the hydranth. Medusae produced above the aboral tentacle whorl. Free Medusa with one moniliform tentacle.

Material seen: Gulf of Naples.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: European coasts (RUSSELL, 1953).

Mediterranean: Naples, Italy (REES, personal note, author).

Medusa, outside Mediterranean: see KRAMP (1961).

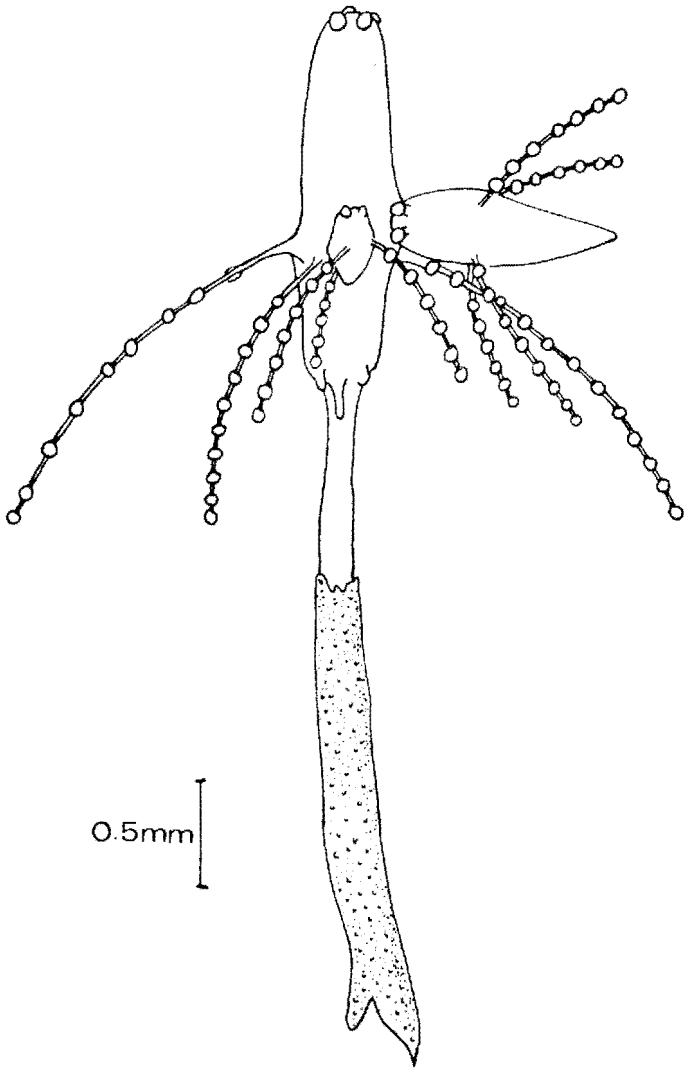
Mediterranean: Adriatic sea (HADZI, 1911 *c*; PELL, 1938). Villefranche, France (KRAMP, 1957 *c*). Naples, Italy (author).

Methods of collection and cultivation

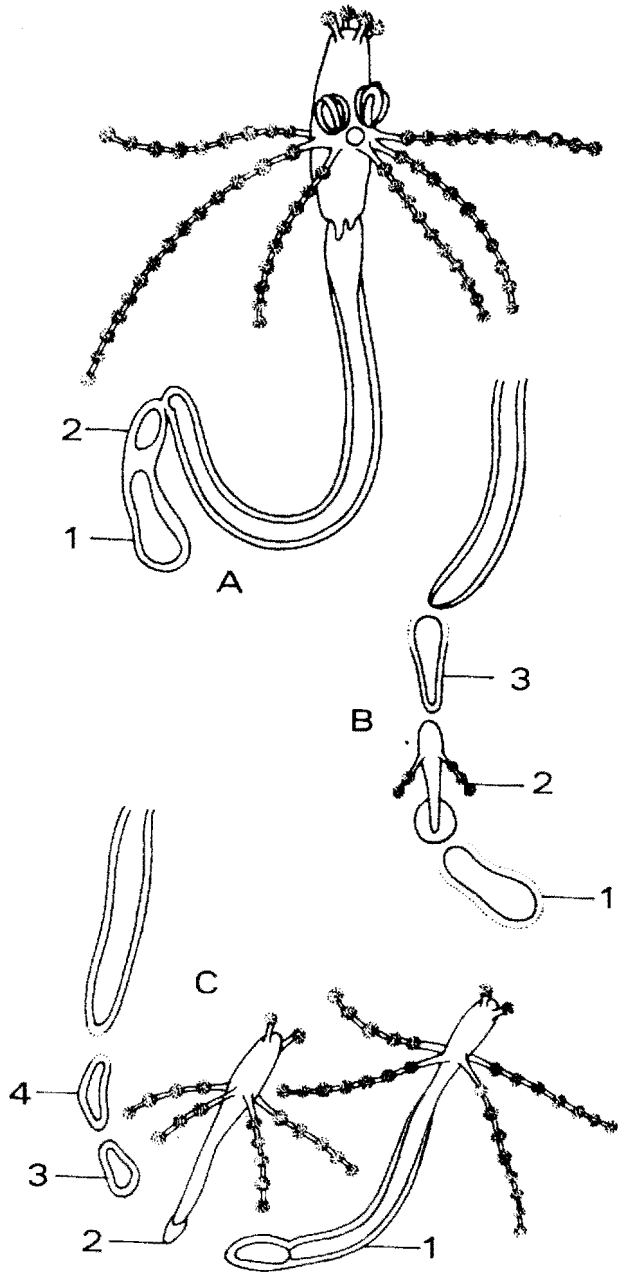
The hydroid is caught with a mud tangle (p. 5) 20 to 50 m deep on muddy bottom. The hydroid is isolated from the mud as described on p. 5. It has to be fed with copepods and about once a week with hepatopancreas of *Mytilus*. Exclusive feeding with *Artemia* will soon lead to degeneration. Kept at 20° C, the hydroids will bud off hydroids as well as medusae.

Description of the species

Hydroid: The polyps are solitary and consist of a hydranth and a hydrocaulus. The hydranth measures 1.25-1.50 mm. The length of the hydrocaulus is two to three times the length of the hydranth, depending on its degree of contraction. The hydrocaulus is enclosed by a soft perisarc, which has a sticky consistence so that it is usually covered with mud particles (text-fig. 12). The hydranth is provided with 4 capitate tentacles and 6 to 8 moniliform aboral tentacles in adult specimens. Pictures of northern specimens seem to show more aboral tentacles than Mediterranean specimens (RUSSELL, 1953, fig. 39). The number of cnidocyst clusters on the aboral tentacles varies from 9 to 12 in specimens found at Naples. Just above the aboral tentacles whorl is the place for either the budding of new hydranths or medusae buds (text-figs. 12, 13). In contradistinction to other hydroids which show hydroid budding on the hydranth (e. g. *Coryne tubulosa*, REES, 1957, fig. 51), the budding of *Euphysa aurata* is reversed; that means the young hydranth is attached with its oral part to the mother-hydranth. Six short tentacle-like processes may be observed below the aboral tentacle whorl; they are interpreted as anchoring filaments by REES (1957 *a*). REES points out that these



TEXT-FIG. 12. - Euphysa aurata, *hydroid with hydroid bud.*



TEXT-FIG. 13. - Euphysa aurata, *hydroid; successive stages of development of young hydroids from the hydrocaulus. 1 - oldest, 4 - youngest hydroid. In C the young hydroid starts to form again a new hydroid from its hydrocaulus.*

processes successively reach the base of the hydrocaulus, after the constriction off of new hydranths from the base of the hydrocaulus (text-fig. 13). However, although having observed a considerable number of *E. aurata* hydroids in the laboratory, each over long periods (more than a year), I never found these tentacle rudiments in another position than at the base of the hydranth below the aboral tentacles whorl. The situation of these « filaments » is quite different from that in *Corymorpha nutans*. There one observes small processes more distal on the hydrocaulus which grow longer into filaments towards its base. Anchoring devices are provided for *E. aurata* at the base of the hydrocaulus which is somehow split into two or three processes (text-fig. 12).

Medusa: The medusa of *E. aurata* from the Mediterranean fits the excellent description which is given by RUSSELL for the northern specimen (RUSSELL, 1953, p. 90):

« Umbrella bell-shaped, higher than broad; apex rounded, without pointed apical process; jelly thick, especially in apical region; umbrella margin at right angles to vertical axis; without exumbrellar nematocyst tracks. Velum fairly wide. Stomach large, cylindrical, about two-thirds the length of subumbrellar cavity; with rounded apex; in full extension never reaching beyond the umbrella margin. Mouth simple and circular, surrounded by nematocysts. Four radial canals and ring canal narrow. Gonads completely surrounding stomach, leaving upper end of stomach and mouth free; eggs amoeboid. One single short perradial marginal tentacle with numerous nematocyst rings; three non-tentacular parradial marginal bulbs, smaller than tentacular bulb, extending as spurs slightly up exumbrellar surface. Height from 3.5 to 6 mm. Colour of stomach yellow, often splashed with crimson at oral end; ring canal occasionally with crimson pigment; tentacular and non-tentacular marginal bulbs yellowish to crimson, sometimes colourles; marginal tentacle yellow ».

Development stages

The development of the egg, embryo and young hydroids of *Euphysa aurata* has not been observed in the Mediterranean yet. However, WERNER (1959) observed the embryonic and postembryonic development at Port Erin (England). He found that the development of *E. aurata* follows the same pattern as *C. nutans*.

The blastula or gastrula stage develops into a cyst and stays unchanged until the next spring when it develops into a primary hydranth (WERNER, 1959). It may be interesting to note at this point that *Euphysa flammea* from the Pacific also undergoes a cyst stage (observation by the author, unpublished).

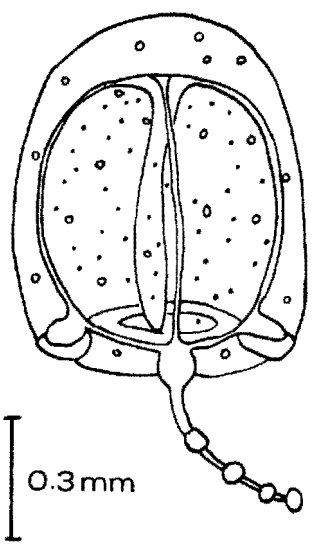
The hydroids show two kinds of asexual reproduction, one already described on p. 17, the other shown in text-fig. 13. In this type the foot is successively constricted off into several pieces. Each piece develops into a new hydranth. It is similar to the type of asexual reproduction observed in *V. forbesii* (p. 15).

The medusa buds develop just above the aboral tentacle whorl on very short blastostyles. As already mentioned by RUSSELL (1953, p. 92), the young medusa is a miniature of the adult one.

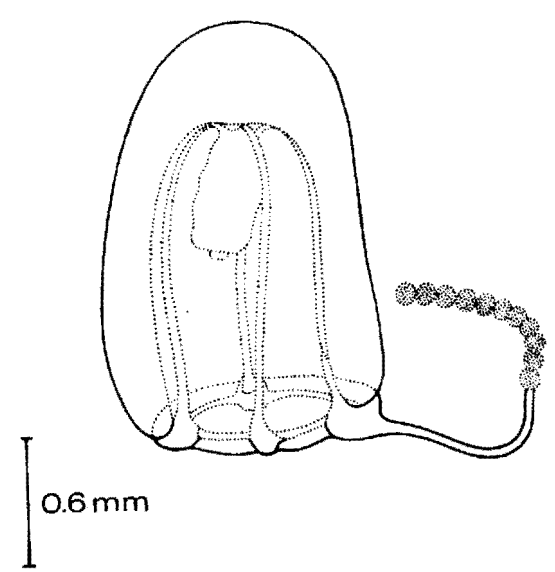
TABLE 1. - Euphysa aurata, *height of the medusa and number of cnidocyst bulbs of the tentacles in different specimens.*

Hcight of the medusa mm	Number of tentacular cnidocyst bulbs
0.6	3
0.7	3
1.3	7
1.6 (gonads)	8
2.0 (ripe gonads)	10

When liberated, medusae have 2 to 3 cnidocyst clusters on their tentacles (text-fig. 14). Table I gives the number of cnidocyst bulbs compared with the size of the medusae, as found in the Mediterranean.



TEXT-FIG. 14. - Euphysa aurata, *medusa, 1 day old; drawn from living specimen.*



TEXT-FIG. 15. - Euphysa aurata, *adult male medusa; drawn from a specimen preserved in 5% formalin.*

Ecological observations

The hydroids of *E. aurata* occur around Naples from November to April. In December and February they are quite abundant and provided with medusa buds. (I suppose that they also abound in January, but was not able to collect then). During an observation period of five years, no *E. aurata* hydroids were found during the summer. *E. aurata* hydroids which were kept in the laboratory, developed medusa buds in February and March at 20° C. The medusae are not plentiful in the plankton. They were found mainly from January to March except one record of five *E. aurata* on June 10 and one medusa in late September. RUSSELL too, reports for the British Isles, that rarely *E. aurata* may be found outside its regular reproductive period (RUSSELL, 1953, p. 93).

Specimens with hydroid buds on their hydranths are found in November, before medusa buds appear.

Habits

The hydroid is very sensitive to sudden movements. Upon the slightest disturbance of the water in an aquarium, its tentacles contract immediately.

Discussion of the species

See RUSSELL (1953, p. 93).

Genus *Eucodonium* HARTLAUB 1907

Generic characters

Corymorphidae with hydroids unknown, medusae without exumbrellar cnidocyst tracks; with stomach attached to peduncle; with asexual budding; with four perradial tentacles, each with a terminal swelling. Gonads surrounding stomach completely. (Partly after KRAMP, 1961, p. 35).

The genus *Eucodonium* has one species *Eucodonium brownei* HARTLAUB 1907.

Type species: *Eucodonium brownei* HARTLAUB 1907.

Eucodonium brownei HARTLAUB 1907

Pl. II, fig. 4; text-figs. 16-19

Synonymy

Eucodonium brownei HARTLAUB 1907 (p. 71, fig. 6) (medusa).

Specific characters

Hydroid not known; medusa very small, pyriform with thin umbrella. Mouth with a simple round opening which may be divided into four very inconspicuous lips. Four tentacles each terminating in a flat, elongated bulb.

Material seen: Naples, Italy; Villefranche, France.

Material deposited: All material available has been used for the morphological investigation.

Distribution

Hydroid: not known.

Medusa, outside Mediterranean: see KRAMP (1961).

Mediterranean: Adriatic sea (NEPPI & STIASNY, 1913). Villefranche, France (TREGOUBOFF & ROSE, 1957; PICARD, 1955 *b*). Naples, Italy (author).

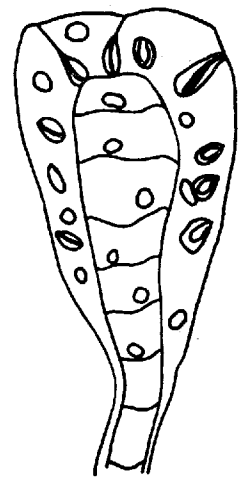
Methods of collection and cultivation

The medusae of *E. brownei* may be caught at 1-3 m depth in the early morning hours. They are difficult to feed, because food has to be given daily and to be brought directly to the mouth. Otherwise they will degenerate soon. *E. brownei* can be kept in 20° C and 13° C as well.

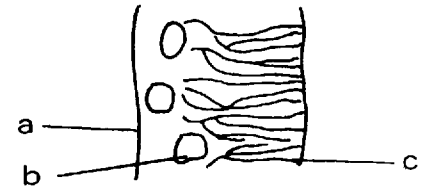
Description of the species

Hydroid unknown.

The medusa is 0.8-1.0 mm high. It has a nearly hemispherical umbrella provided with a slight apical projection. The flask-shaped stomach is attached to a broad conical peduncle. The mouth, described by earlier authors as « tubular » (VANNUCCI, 1957; KRAMP, 1961), has four very inconspicuous lips and is different from the mouth of any other species of Corymorphidae or Tubulariidae (fig. 18). There are four marginal perradial

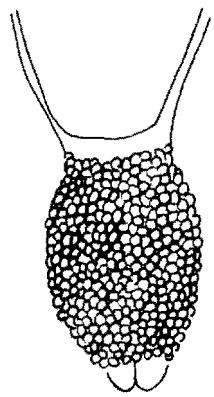


TEXT-FIG. 16. - Eucodonium brownei, *medusa; terminal tentacle cluster.*



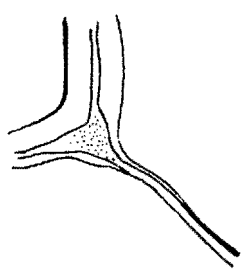
TEXT-FIG. 17. - Eucodonium brownei, *medusa; ectoderm of terminal tentacle cluster showing fibrillar structure;* a - *mesogloea;* b - *nuclei;* c - *fibrils.*

elongated bulbs with four solid marginal tentacles. Each tentacle terminates in a flat, sometimes elongated knob, which is provided with cnidocysts. However, this terminating bulb is not so fully packed with cnidocysts as cnidocyst bulbs of other species. In a microscopical examination, the most conspicuous feature of the bulb is an enormous number of fibres which run from the mesogloea to the periphery. Whether these



TEXT-FIG. 18. - Eucodonium brownei, *female medusa; stomach completely surrounded by gonad.*

fibres belong to the fibrillar system of the cnidoblast or are muscle fibres from the epithelial cells, could not be determined. A histological study based on more material is required (text-figs. 16, 17). Most of the medusae carry 1 to 3 medusa buds on their stomach. The tentacles of older buds show movements (Plate II, fig. 4). Gonads encircle the stomach completely (text-fig. 18). One of the characteristic features of the species is the pigment on the stomach and marginal bulbs. The pigment in the terminal tentacle bulbs varies from pink to violet to black. The cnidocysts are stenotheles, desmonemes and microbasic euritheles.



TEXT-FIG. 19. - Eucodonium brownei, *medusa; marginal tentacle bulb; the dots show the black pigmentation.*

Developmental stages

No free eggs were obtained and no developmental stages observed. Young medusae, derived by budding from the stomach, have all the morphological features of the adult ones including pigmentation; only the tentacles are shorter.

Ecological observations

E. brownei occurs regularly from the end of July to the beginning of October in the outer parts of the Gulf of Naples, mainly near Ischia. Until the beginning of October, immature stages with medusa buds were found. Adult specimens with ripe gonads were collected once, in the middle of October 1958 after heavy storms and a sudden temperature drop. The species was very abundant that year (hundreds of specimens in one plankton haul). It was far less abundant (1 to 2 specimens per haul) in the following years.

E. brownei has been found in no other season of the year, neither in Villefranche (TREGOUBOFF & ROSE, 1957), nor in the Adriatic (NEPPI & STIASNY, 1913). If kept at 20° C in the laboratory, *E. brownei* did not develop gonads but continued to bud medusae. Transferred to 13° C, the medusa ceases further medusan production. However, as it is very difficult to keep *E. brownei* alive for a longer period, specimens with ripe gonads were not obtained in the laboratory. The question arises whether the specimens collected in mid-October were mature, equipped with ripe gonads simply because they were older than specimens collected earlier, or whether the temperature drop caused the gonads to ripen. I presume that falling temperatures were the cause. This assumption is based on the observation in the aquarium where transfer of *E. brownei* medusae from 20° C to 13° C water resulted in cessation of budding, regardless of the date on the calendar; cessation of budding, however, can be considered a pre-condition of gonad ripening.

Another example, though in reverse, of the ripening of gonads depending on changing temperatures is reported by WERNER (1956, 1958, 1962) for *Rathkea octopunctata*: Medusae of this species occur with buds in cool temperatures during the spring; gonads appear with rising temperatures towards the summer. It was possible for WERNER to prove this dependence on temperature in the laboratory.

Systematic discussion

RUSSELL (1953) and KRAMP (1961) place *Eucodonium brownei* in the family Tubulariidae, RUSSELL under the heading « incertae sedis ». VANNUCCI (1957), who accepts the division of Tubulariidae into Corymorphidae and Tubulariidae, suggests placing *Eucodonium brownei* in the Corymorphidae. She discusses but rejects PICARD's view of placing *Eucodonium* in the Oceanidae. On account of gonads encircling the stomach completely, the absence of exumbrellar cnidocysts and the absence of ocelli, assignment to the Corymorphidae seems to be justified for the time being. However, the anatomy of the mouth, which is already shown in BROWNE's original figure, and the structure of the terminal tentacle bulbs makes its allocation to the Corymorphidae somewhat doubtful.

Genus *Paragotoea* KRAMP 1942

Generic characters

Hydroid unknown; medusae Corymorphidae with four radial canals, one well developed solid tentacle

terminating in a large knob of nematocysts and three marginal bulbs of unequal size.

Type species: *P. bathybia* KRAMP 1942.

The genus *Paragotoea* is probably represented by the species *P. bathybia* in the Mediterranean: One specimen was found at 300 m depth which had most of the features described for *P. bathybia*. However, the specimen was very compressed and slightly damaged; therefore not all details described by KRAMP could be seen.

Paragotoea bathybia KRAMP 1942
Text-figs. 20, 21

Synonymy

Paragotoea bathybia KRAMP 1942, p. 26, fig. 7 *a-c.*

The name of the genus and species has not changed since its original description. However, RALPH (1959) did not leave the genus in the Corymorphidae or Tubulariidae, but established a new family Paragotoeidae for *Paragotoea*. (See discussion of the species p. 22).

Specific characters

Hydroid not known. Medusa 1-3 mm high, 1-3 mm wide with flattened top and thin walls; numerous nematocysts on exumbrella, four radial canals, narrow circular canal. Four marginal bulbs, each with an ectodermal abaxial spur. One stiff tentacle with a large knob of nematocysts. (Partly after KRAMP, 1961, p. 44).

Material seen: Naples, Italy.

Material deposited: B.M.N.H.

Distribution

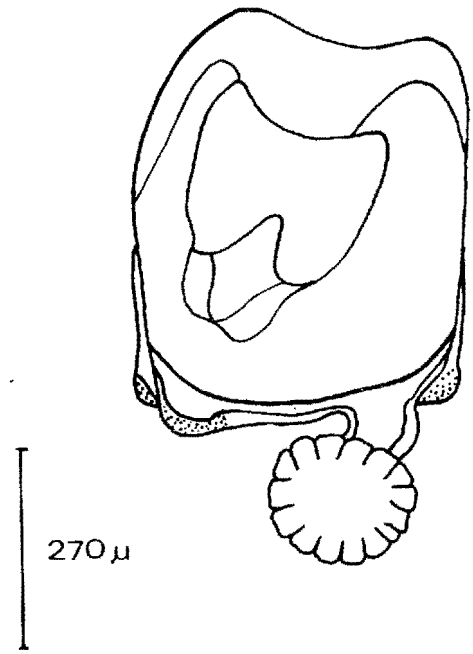
Hydroid, not known.
Medusa, outside Mediterranean: see KRAMP (1961).
Mediterranean: Naples, Italy (author).

Methods of collection and cultivation

The one specimen of *P. bathybia* was collected with a Hensen net from 350 m to the surface. Comparing the compressed condition of the medusa with medusae of other species caught from deeper regions, I conclude that this specimen of *P. bathybia* lived at 300 to 200 m. On account of its bad shape and the rarity of the specimen it was prescrved after one day.

Description of the species

This description is based on the one specimen from Naples. For description of the Atlantic specimens see RALPH (1959) and KRAMP (1942). The medusa is nearly rectangular in shape and it has only a height of 0.5 mm and a diameter of 0.4 mm in a preserved and dehydrated mounted specimen. The stomach hangs on a broad peduncle, its mouth being either circular or a rounded square. It is not clear whether the gonads encircle the mouth completely; there seem to be two large gonadial masses on each side of the stomach. Histological examination could clarify whether these two packages are interconnected. Kramp describes the gonads of his specimen as follows (KRAMP, 1942, p. 28): « In the present specimen from the Davis Strait the manubrium is somewhat damaged and irregularly



TEXT-FIG. 20. - Paragotoea, *medusa. Ischia, St. Angelo, 350 m deep, 10 % formalin.*

crumpled; it is evidently completely surrounded by the gonad which forms some broad dilations, but a regular arrangement of four interradial processes cannot be discerned ». There are four, flat triangular marginal bulbs provided with cnidocysts, each having an abaxial spur of different length. One thick tentacle is provided with a large terminal globular cnidocyst cluster divided into sector-like portions. This terminal cluster measures half of the diameter of the medusa.

TEXT-FIG. 21. - Paragotoea bathybia, *medusa, one section of tentacle knob.*

I am not sure whether the specimen described is actually *P. bathybia*, because the gonads in my specimen may be divided, and the terminal tentacle bulb is divided into sector-like portions, which is not mentioned by KRAMP.

Developmental stages

Not observed.

Habits

Not observed.

Systematic discussion

KRAMP (1942, 1959, 1961) places *Paragotoea* in the family Tubulariidae. With the division of the Tubulariidae into Corymorphidae and Tubulariidae, consequently *P. bathybia* has to be placed in the Corymorphidae, because exumbrellar cnidocyst tracks are absent.

RALPH (1959) made a more detailed study of *P. bathybia* based on four specimens from the Bay of Biscay. According to her, *P. bathybia* should be placed in a separate family because it has a quadrate stomach and stomach pouches which, according to RALPH, are unknown in the Tubulariidae and Corymorphidae. However, the presence or absence of a quadrate stomach base or stomach pouches is not a distinctive character of the family Tubulariidae. There are Tubulariidae with quadrate stomach-bases and stomach pouches: *Euphysilla pyramidata* KRAMP 1955 and *Euphysora furcata* KRAMP 1948 have a quadrate stomach base, and *Ectopleura sacculifera* KRAMP 1957 has very well developed stomach pouches. Therefore, the establishment of a separate family Paragotoeidae does not appear to be justified unless the hydroid stage would prove that *Paragotoea* is neither a Corymorphid nor a Tubulariid.

Genus *Branchiocerianthus* MIYAJIMA 1900

Generic characters

« Hydranths solitary; bilaterally symmetrical with diaphragm with two sets of filiform tentacles; gonophores fixed » (partly after REES, 1957 *a*, p. 522).

Type species: *Branchiocerianthus urceolus* MARK 1898.

The genus *Branchiocerianthus* is represented in the Mediterranean by one species, *Branchiocerianthus italicus* STECHOW 1923.

Only one specimen of this species was found by LO BIANCO at a depth of 300 m on mud bottom in the Gulf of Naples in March 1905 (LO BIANCO, 1909, p. 540). It was identified by LO BIANCO as *Branchiocerianthus* sp. until STECHOW named the species *Branchiocerianthus italicus;* however STECHOW did not give a description of the species. LO BIANCO described only the colour and the height of the animal.

A good synopsis of the different species of *Branchiocerianthus* can be found in BRATTSTRÖM (1957, p. 1 to 9).

FAMILY TUBULARIIDAE

Introduction

As already outlined in the introduction of the Corymorphidae (p. 11), it is not easy to draw a sharp line between the Corymorphidae and Tubulariidae. The hydroids of the Tubulariidae are fastened usually on a hard substrate by a hydrorhiza or basal spurs of the stolon whereas the Corymorphid hydroids are equipped with different types of anchoring devices for their mud biotop. The medusa stage of the Tubulariidae can only be separated from that of the Corymorphidae through the absence of exumbrellar cnidocyst rows in the latter.

According to this distinction *Rhysomedusa pomponina* (p. 32) has been placed provisionally in the Tubulariidae, although it seems in other respects to be more related to genera of the Corymorphidae such as *Paragotoea.*

Definition of the Family

Hydroids solitary or colonial. Stems covered with perisarc. Hyranths with two sets of tentacles; aboral tentacles filiform, oral tentacles also filiform, but slightly capitate or capitate in larval stages. Gonophores borne above the aboral tentacle whorl; either fixed gonophores or free medusae. Medusae, when present, with lines of exumbrellar nematocysts; with two or four perradial tentacles.

The Tubulariidae are represented in the Mediterranean by three genera, *Tubularia* LINNÉ 1758, *Ectopleura* L. AGASSIZ 1862 (this includes the former *Acharadia larynx*, p. 25) and *Rhysomedusa* VANNUCCI & SOARES 1966.

Genus *Ectopleura* L. AGASSIZ 1862

Generic characters

Tubulariid hydroids, solitary or in small colonies. Oral tentacles filiform or somewhat capitate. Medusa buds on short, slightly branched peduncles developing into free medusae. Medusae with two to four simple tentacles, with eight exumbrellar longitudinal rows of nematocysts extending from the four tentacle bulbs to the apex of the exumbrella.

The genus *Ectopleura* is represented by three species in the Western Mediterranean: *Ectopleura dumortierii* (VAN BENEDEN 1844), *Ectopleura larynx* (WRIGHT 1863) and *Ectopleura sacculifera* KRAMP 1957.

Ectopleura dumortierii (VAN BENEDEN 1844)
Pl. II, fig. 1; text-figs. 22-25

Synonymy

Tubularia dumortierii VAN BENEDEN 1844, p. 50, pl. II (hydroid and young medusa).
Ectopleura dumortierii BEDOT (1918, p. 124, listing synonyms) (hydroid).
Ectopleura dumortierii KRAMP (1961, p. 34, listing synonyms) (medusa).

Specific characters

« Hydrocaulus 25 mm or more in height, slender, simple or slightly branched, solitary. Perisarc horn-coloured, sometimes with a few annular constrictions.

About twenty-four short oral tentacles; twenty to thirty longer aboral tentacles. Medusae borne on short, slightly branched peduncles just above aboral tentacles. » (after RUSSELL, 1953, p. 78).

Material seen: Medusae: Naples, Italy. Hydroid: not found.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: Atlantic coasts of North America (MAYER, 1910); English Channel (VAN BENEDEN, 1844, 1866); Plymouth, England (RUSSELL, 1953); Isle of Man, England (THORNELY, 1894); North Sea (WERNER & AURICH, 1955); The Skaw (KRAMP, 1935).

Mediterranean: Naples, Italy (STECHOW, 1921, 1923).

Medusa, outside Mediterranean: see KRAMP (1961, p. 34).

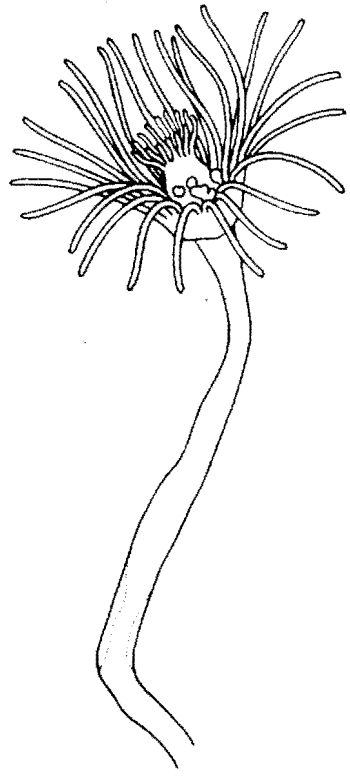
Mediterranean: Naples, Italy (author); not *Ectopleura dumortierii* from Triest, Yugo-Slavia (GRAEFFE, 1884; NEPPI & STIASNY, 1913); see discussion of *E. dumortierii* p. 25.

Methods of collection and cultivation

The medusae were collected at a depth of 1 to 4 m mainly in the early morning hours. Brought into the laboratory, they fed well on *Artemia salina*. However, we failed to get ripe eggs and the medusae would usually die after one month.

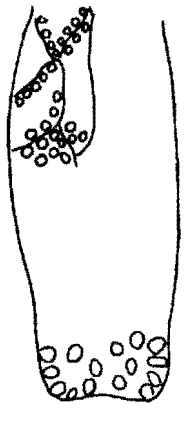
Description of the species

Hydroid: As I did not find the hydroid stage myself, I follow here the description of the *dumortierii* hydroid which is given by WERNER & AURICH (1955, p. 236), translated from German: « The polyp of *Ectopleura* is often attached to other hydroid colonies, mostly solitary, although a side branch has been observed in a few cases. The delicate hydrocaulus which reaches a length of 25 mm according to MAYER (1910), may reach 100 mm according to my own (WERNER'S) observations. The hydrocaulus has a reddish colour and a fine longitudinal striation. The periderm is yellowish and is weakly annulated near the hydranth. The hydranth carries two tentacle whorls, 15 to 25 shorter oral tentacles and 20 to 30 longer aboral tentacles. The budding zone of the medusae lies right above the aboral tentacle whorl. Medusae are developed in groups on slightly ramified blastostyles. » (text-fig. 23, after RUSSELL, 1953).



TEXT-FIG. 23. - Ectopleura dumortierii, *hydroid after* RUSSELL (1953).

Medusa: The shape of the medusa is nearly spherical with a small apical projection (Pl. II, fig. 1). The manubrium is large, spherical at the base and tapering towards the mouth. It may stretch beyond the umbrella margin when the medusa feeds. The mouth is simple, tube-like, armed with a circle of nematocysts (text-fig. 22). The gonads encircle the stomach completely. There is a parenchymatic structure in the upper part of the manubrium (partly drawn in text-fig. 22). The medusae have only one or two ripe eggs at a time. There are four marginal tentacle bulbs each carrying a tentacle with nematocyst clusters on their abaxial sides. (Measurements of the nematocyst clusters of the tentacles in relation to the size of the medusa are given in table 2). Four pairs of nematocyst tracks originate from either side of the marginal tentacle bulb and run to the summit of the umbrella but do not actually meet there. The umbrella of the medusa is colourless. The base of the stomach is usually encircled with a ring of a red or yellow pigment. The marginal bulbs are also coloured yellow, red or brown.



TEXT-FIG. 22. - Ectopleura dumortierii, *male medusa; stomach with cnidocysts around mouth and parenchymatic cells in the upper part of the stomach wall.*

The cnidocysts are stenotheles, desmonemes, anisorhize haplonemes and micro-basic mastigophores.

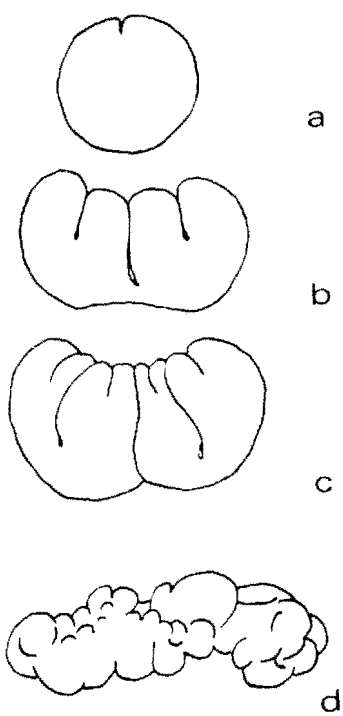
TABLE 2. - Ectopleura dumortierii, *medusa, measurements of five different specimens.*

Diameter of exumbrella mm	height of exumbrella mm	length of manubrium mm	number of cnidocyst clusters on one tentacle
0.88	0.47	0.78	24
0.78	0.69	0.56	tentacle contracted
1.00	0.78	—	35
0.81	0.56	0.78	18
0.66	0.47	0.50	15

Developmental stages

The development from the egg to the young polyp has been carefully studied by WERNER & AURICH (1955) and AURICH (1958).

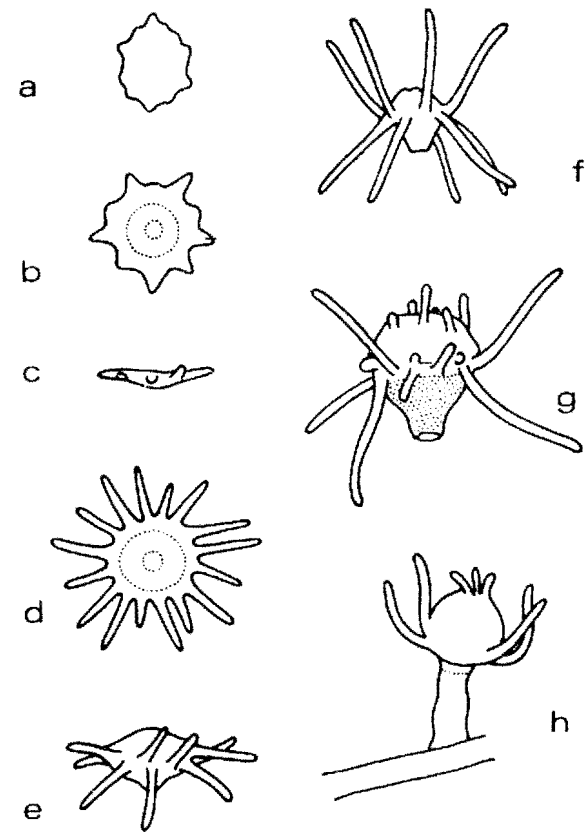
The egg measures 0.322 to 0.325 mm (two eggs measured). The first three divisions are vertical. Four hours after the first division, WERNER observed an aggregation of larger and smaller cells, which however developed into a normal proactinula. This stage is the youngest one which can be found in the plankton.



TEXT-FIG. 24. - Ectopleura dumortierii, *cleavage stages.* a - *beginning of first division,* b - *beginning of second division,* c - *beginning of third division,* d - *aggregation of small and large cells 4 hours after liberation of the egg (after* WERNER & AURICH, 1955).

The flat asteroid like form is typical for this proactinula. (« Sternchenform », text-fig. 24). The tentacles which are present at this stage belong to the aboral tentacle whorl of the later actinula. These tentacles of the aboral whorl are developed simultaneously and do not increase in number during the pelagic phase. The transformation of the proactinula to the actinula proceeds gradually. The tentacles elongate and so does the oral-aboral axis of the animal. The aboral tip of the actinula differentiates into an adhesive organ. Then the oral part of the animal develops its oral tentacles and the mouth opening appears.

Now the typical actinula stage is achieved, the hydrocaulus elongates and the animal settles. (For full description see AURICH, 1958).



TEXT-FIG. 25. - Ectopleura dumortierii; *proactinula, actinula and young polyp stages.* a, b - *proactinulae, oral view,* c - *proactinula, side view,* d - *intermediate stage between proactinula and actinula,* e - *side view of d.* f - *older stage of d where the aboral part starts to elongate,* g - *actinula, developing into a young polyp,* h - *young polyp settled on a thecate hydroid.* (After AURICH, 1958).

Ecological observations

The medusae of *E. dumortierii* were found around Naples from October to April. The only months when I found more than one specimen per month were January and February. The hydroid stage was not found during five years and therefore nothing is known about the time of medusa bud formation in the Mediterranean. However, judging from the occurrence of *E. dumortierii* in January and February, I suppose that the medusa production could take place from December to February. Water temperature is then about 15° C.

Habits

As already mentioned by RUSSELL (1953, p. 78), the medusa of *E. dumortierii* swims actively with its ten-

tacles fully expanded only in the resting phase. Pl. II, fig. 1 demonstrates the medusa in the resting stage. The medusa is very sensitive to light. When light rays hit a specimen in the aquarium, this medusa will immediately take off, swimming rapidly, tentacles coiled.

Discussion of the species

E. dumortierii has been described by VAN BENEDEN (1844) in its hydroid stage. AGASSIZ found its medusa and named it *Ectopleura ochracea* AGASSIZ 1862. However, MAYER (1910) has shown that these two are identical, and since *E. dumortierii* has priority, this name is valid. This view is upheld by RUSSELL (1953) and KRAMP (1961). GRAEFFE, NEPPI & STIASNY (1884, 1913) wrote of an « *Ectopleura dumortierii* » with only two tentacles. As far as I can ascertain, medusae of *E. dumortierii* never have been reported with fewer tentacles the very moment they are liberated from the hydroid. I shall further discuss this puzzle in my discussion of *E. larynx*.

Ectopleura larynx (WRIGHT 1863)
Text-figs. 26-28

Synonymy

Acharadia larynx WRIGHT 1863, p. 788, pl. 17, figs. 7, 8 (hydroid).
Acharadia larynx BEDOT (1910, p. 232, listing synonyms) (hydroid).
Acharadia larynx STECHOW (1923, p. 48) (hydroid).
Ectopleura dumortierii GRAEFFE (1884, p. 354) (medusa).
Ectopleura dumortierii NEPPI & STIASNY (1913, p. 37) (medusa).
(GRAEFFE's and STIASNY's *Ectopleura dumortierii* are not *E. dumortierii* VAN BENEDEN; see discussion of *E. larynx*, p. 27).

Specific characters

Hydroids forming small colonies arising upright from a creeping stolon. As the stolon is very loosely attached to the substratum, the colony may sometimes appear branched. In rare instances, hydroids occur solitary in the sea; when transferred to the laboratory, they quickly develop small colonies. Perisarc encloses stolon and hydrocauli up to the base of the hydranth. Hydranths with one oral whorl of 4 to 7 tentacles which are capitate. Aboral tentacle whorl with up to 16 filiform tentacles. Medusa buds borne above the aboral tentacle whorl on short, branched blastostyles. Free medusae showing the characters of the genus *Ectopleura*: Spherical with four marginal tentacle bulbs, with two perradial tentacles with nematocyst clusters on their abaxial sides. Four pairs of exumbrellar nematocyst tracks originating from the marginal tentacle bulbs and running towards the apex of the umbrella mostly as in *E. dumortierii*.

Material seen: Naples, Italy; Island of Madeira, Portugal. In both places, the hydroid was found in the sea, the medusae liberated in the laboratory. No free medusae found in the plankton.

Material deposited: Hydroid: B.M.N.H.

Distribution

Hydroid, outside Mediterranean: Ilfracombe, England (WRIGHT, 1863).
Mediterranean: Naples, Italy (STECHOW, 1923; author). Villefranche (DU PLESSIS, 1888). Cap Rédécos, Cap l'Abeille (MOTH-KOSSOWSKA, 1905)
Medusa, outside Mediterranean: none.
Mediterranean: Adriatic Sea (GRAEFFE, 1884; NEPPI & STIASNY, 1913); Naples, Italy, liberating from the hydroid (author).

Material and methods

The hydroid was found on *Stylocidaris* spines (Echinoderms), on *Posidonia* roots and on pieces of rock at a depth from 20 to 40 m. The hydroid feeds easily on *Artemia* and starts to develop gonophores at once in the laboratory. But time and time again, the hydroid would shed the hydranth from the stem before the medusa buds had reached an advanced stage. New hydranths regenerate quickly from the stem, start to develop medusa buds and are dropped again. Medusae were liberated only once in the aquarium. In that case hydroids were collected from the sea with buds nearly ready for liberation.

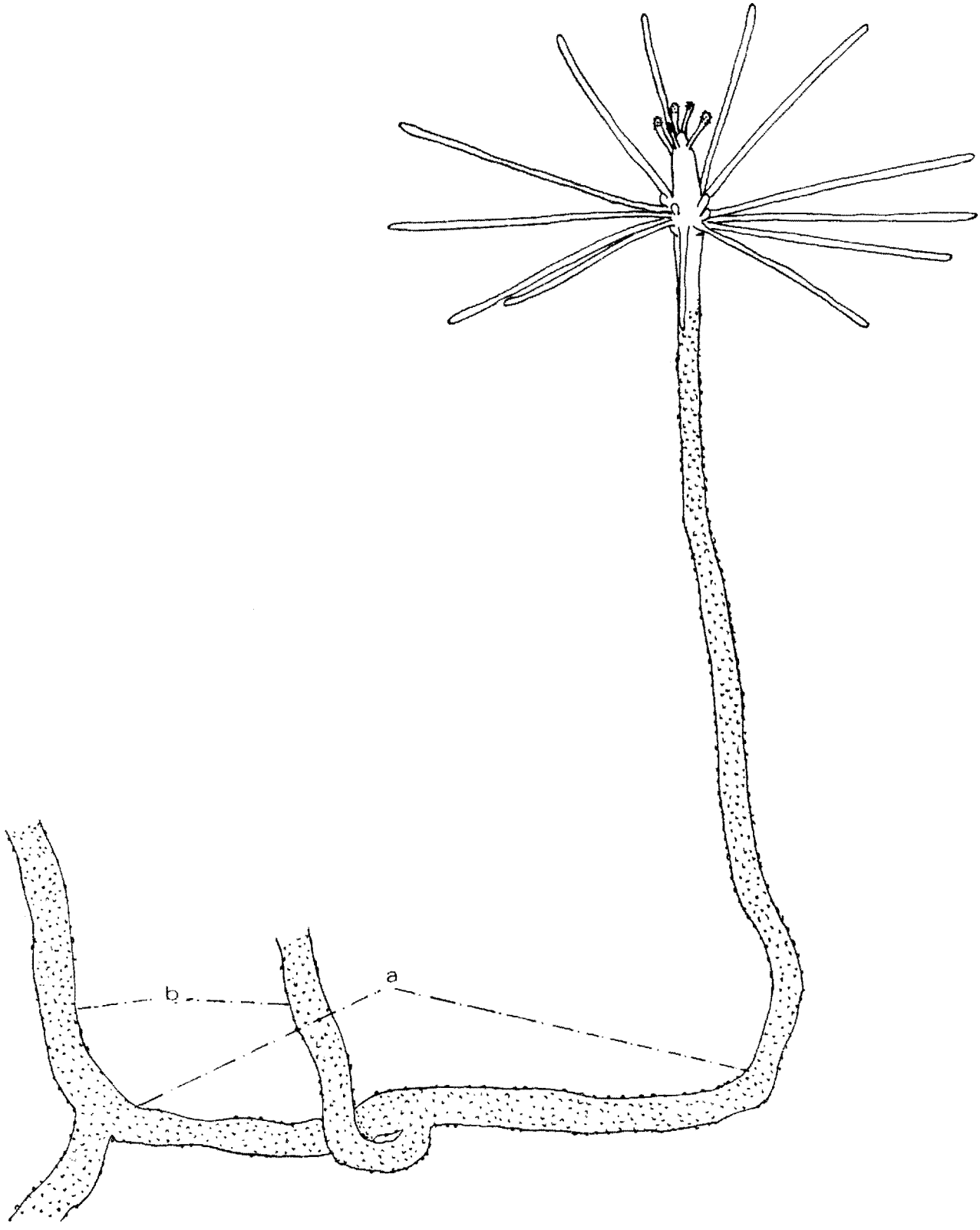
Description of the species

The hydroid of *E. larynx* consists of small colonies in which the number of hydranths usually does not exceed five. Single, not ramified hydrocauli develop from a linear hydrorhiza (text-fig. 26). Their height varies between 10 and 20 mm. The hydrorhiza and the hydrocauli are enclosed by a thin, flexible perisarc which extends up to the base of the hydranth. The oral whorl of the hydranth consists of 5 to 7 short tentacles and the aboral whorl of 12 to 16 filiform tentacles. A significant character of the species is that the oral tentacles are slightly capitate. A comparison between the oral tentacles of *E. larynx* and *T. crocea* is given on p. 27 (text-fig. 28). The medusa buds are carried on short branched blastostyles. In stages near liberation of the medusa, the two tentacles of the medusa are already free and their terminal cnidocyst bulb and one abaxial cluster can be observed. The liberated medusa is almost spherical with an umbrella height of 1 mm and a diameter of 1 mm. The manubrium has a length of 0.35 mm. The umbrella margin carries 4 perradial tentacle bulbs and two perradial tentacles with one terminal cluster and one abaxial cnidocyst knob. As in *E. dumortierii*, there are four pairs of exumbrellar cnidocyst rows.

When the medusa is two weeks old, each tentacle carries 2 or 3 cnidocyst bulbs besides the abaxial one, and a whitish gonad encircles the stomach completely. The colour of the marginal tentacle bulbs is whitish, those of the radial canals yellow. The material was not abundant enough to examine the cnidocysts.

Ecological observations

Hydroids of *E. larynx* with small buds can be found throughout the year. Only once, in June 1962, did we



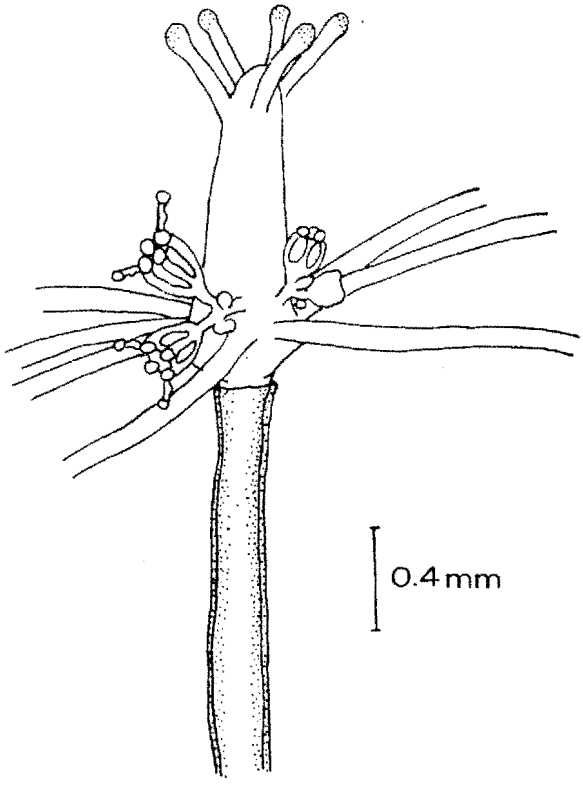
TEXT-FIG. 26. - Ectopleura larynx, *hydroid colony,* a - *part of the stolon which is attached to the substrate,* b - *growing stem with hydranths. (partly after a sketch from* DR. YAMADA).

succeed in finding a colony with medusa buds ready for liberation. The colony was detected on a *Posidonia* rhizome north of Ischia at a depth of 40 m.

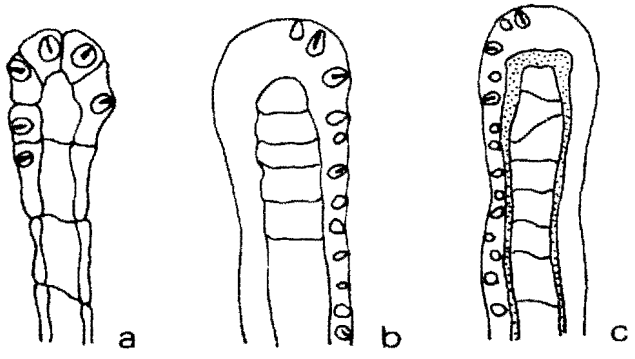
Discussion of the species

The hydroids of *E. larynx* were described under the genus *Acharadia* by WRIGHT (1863). WRIGHT mentions that the stems « are sparingly branched ». But the stems were usually not branched according to ALLMAN's and STECHOW's descriptions (ALLMAN, 1871, 1872; STECHOW, 1923). It is very difficult to decide whether STECHOW, ALLMAN and WRIGHT mean the same species, because their descriptions are very short and rather incomplete. In any case the « *Acharadia larynx* » found by me in Naples seems to be identical with the speci-

mens described by ALLMAN (1872), MOTZ-KOSSOWSKA (1905), and STECHOW (1923). As I obtained medusae from this hydroid in the laboratory clearly belonging to the genus *Ectopleura*, the genus *Acharadia* is not valid any more because *Ectopleura* has priority. BRINK (1925) considered *Acharadia larynx* to be a young *Tubularia larynx*. This is ruled out by the formation of



TEXT-FIG. 27. - Ectopleura larynx, *hydroid with medusa buds.*



TEXT-FIG. 28. - a - Ectopleura larynx, *oral tentacle of the hydroid with cnidocysts only at the tentacle tip,* b - *oral tentacle of a young* Tubularia crocea *with ectodermal thickening at the tentacle tip, but cnidocysts present along the whole side of the tentacle.*

free medusae in *Acharadia* (= *Ectopleura*) *larynx* WRIGHT.

GRAEFFE (1884) reported an *Ectopleura* medusa with two tentacles from the Adriatic Sea. He identified his specimen as *E. dumortierii*. MAYER (1910) however, was of the opinion that GRAEFFE'S specimen was *E. minerva* MAYER, a species typified by the possession of two tentacles, and not *E. dumortierii*. NEPPI & STIASNY (1913 *b*) reported an *E. dumortierii* with two tentacles from the Adriatic Sea too. Therefore RUSSELL (1953) and KRAMP (1961) suggest the same as MAYER did before, that NEPPI'S & STIASNY'S *E. dumortierii* with two tentacles should be considered a specimen of *E. minerva* MAYER. Carefully comparing the shape of *E. minerva* MAYER with the illustration of the Adriatic *Ectopleura* by NEPPI & STIASNY, I have come to the conclusion that the two cannot be the same species. Rather, the illustration of NEPPI'S & STIASNY'S Adriatic specimen matches a young medusa of *E. larynx*. I am therefore convinced that the « *E. dumortierii* » of NEPPI & STIASNY and probably also GRAEFFE'S *Ectopleura* specimen belong to the species *E. larynx* and not to *E. minerva*.

Ectopleura sacculifera KRAMP 1957
Plate II, fig. 2; text-fig. 29

Synonymy

Ectopleura sacculifera KRAMP 1957 *b*, pp. 7, 96, 105; pl. II, fig. 3.

Specific characters

Hydroid: not known.
Medusa: Ectopleura with slightly conical umbrella, jelly thick; exumbrella with eight nematocyst tracks issuing in pairs from the four marginal bulbs, continued almost to apex. Manubrium half as long as bell cavity; the gonad surrounds the stomach and has four large interradial pouches. Two opposite moniliform tentacles and two rudimentary marginal bulbs. (Partly after KRAMP, 1961).

Material seen: Naples, Italy, one male only.

Material deposited: B.M.N.H.

Methods of collection and cultivation

The one specimen was caught in the early morning hours with a cable length of 10 m. It fed well on *Artemia*.

Distribution

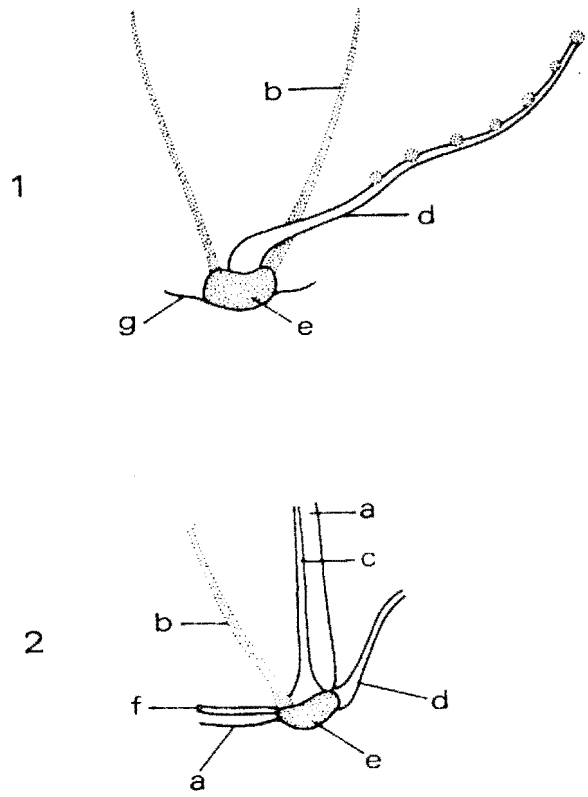
Tropical East Pacific (only one specimen), KRAMP (1957 *b*).
Gulf of Naples, Italy (one specimen, author).

Description of the species

The living medusa is 3.0 mm high and 2.8 mm in diameter in its widest part. Preserved it measures 1.65 mm in height and 1.5 mm in diameter. KRAMP'S specimen was 3.00 mm high and 1.75 mm wide in the lower part of the umbrella. Eight nematocyst tracks run in pairs originating from each marginal bulb. KRAMP describes the cnidocyst tracks as « running along the edges of eight prominent adradial ridges, separated by well-marked perradial and interradial grooves » (KRAMP,

1957 *b*, p. 7). However, comparing the living and the preserved specimen I found that the perradial and interradial grooves occur only after preservation. The manubrium is half as long as the umbrella cavity. The gonads surround the stomach completely and bulge out into four large interradial pouches, suspended from the middle portion of the manubrium almost to the level of the mouth. There is no apical canal. The margin of the umbrella is provided with two perradial marginal bulbs from which the tentacles originate and two rudimentary marginal bulbs (fig. 29, I). The two tentacles carry 6 to 7 abaxial cnidocyst clusters, which are situated in the more distal part of the tentacle. The subumbrella is pale green; the marginal bulbs carry red and yellow pigment. The same pigment is found on the mouth and the base of the stomach.

Most of the cnidocysts of the tentacles are stenotheles, a very few desmonemes. The cnidocysts of the exumbrellar tracks were not identified in order to avoid damage to the rare specimen.



TEXT-FIG. 29. - Ectopleura sacculifera, *section of a medusa with tentacle, marginal tentacle bulb and exumbrellar cnidocyst track. 1, frontal view, 2, side view.* a - *exumbrella,* b - *exumbrellar cnidocyst track,* c - *ring canal,* d - *tentacle with abaxial cnidocyst clusters,* e - *marginal bulb,* f - *ring canal,* g - *umbrella margin.*

Developmental stages

Not known.

Ecological observations

The medusa was caught in February in the surface plankton at the same period of the year when *Corymorpha nutans* was common in the plankton. The specimen was caught in a year when the plankton was extremely rich in Anthomedusae in February.

Habits

Like all *Ectopleura* species, *E. sacculifera* swims with the tentacles spirally coiled up (Pl. II, fig. 2). When resting, it expands the tentacles.

Discussion of the species

The species is easy to distinguish from other *Ectopleura* species by its sac-like gonads. The Naples specimen has all the characters of KRAMP's specimen from the Pacific.

Genus *Tubularia* LINNÉ 1758

Generic characters

Colonial hydroids with either single or moderately ramified stems. Hydranth with an oral and an aboral whorl of filiform tentacles. The oral whorl may look capitate in young specimens. Gonophores born on blastostyles in a circlet above the aboral tentacle whorl. No free medusae. Development through an actinula stage.

Type species: *Tubularia indivisa* LINNÉ 1758.

Three species are reported from the Mediterranean: *Tubularia crocea* AGASSIZ 1860-1862, *Tubularia larynx* ELLIS 1755, and *Tubularia indivisa* LINNÉ 1758.

Of these three species the only one which occurs definitely in Naples and has been regularly found in different Mediterranean localities is *T. crocea* (until now *T. mesembryanthemum* ALLMAN, see p. 31). TARDENT (1955-65) described the physiology and morphology of a *Tubularia* from Naples in several excellent papers and named it *T. larynx*. However, having checked the *Tubularia* from the locations where TARDENT got his material, I am convinced that the species he worked with was not *T. larynx* but *T. crocea*.

Tubularia crocea AGASSIZ 1862
Text-figs. 30-34

Synonymy

Tubularia crocea L. AGASSIZ 1860-1862, p. 249, pl. 23, 23a (hydroid).
Tubularia mesembryanthemum ALLMAN 1871-1872, p. 418 (hydroid).
Tubularia polycarpa, ALLMAN 1871-1872, p. 413 (hydroid).
Tubularia mesembryanthemum FENCHEL (1905, p. 570) (hydroid).

Specific characters

Hydroid with expanded distal tentacles with aboral (« inner », REES, 1963) side provided with broad nematocyst band. Proximal tentacles thickly covered with nematocysts. Female gonophores with 6 to 8 laterally compressed ridges. Male gonophores with four small

rounded tentacular rudiments or no indication of tentacles. The presence or absence of tentacular rudiments in the male depends on the age of the gonophores and varies even then in different specimens.

Material seen: Naples, Italy; Plymouth, England; Villefranche, France; Charleston Harbor, U.S.A., material from the Museum of Comp. Zoology, Harvard.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: Atlantic coast of North America (AGASSIZ, 1860-1862); Roscoff, France (BEDOT, 1911); Plymouth, England (REES, 1963).

Mediterranean: described as *T. mesembryanthemum*: Cette, France; Monaco, Monaco; Genova, Italy (STECHOW, 1919); Naples, Italy (LO BIANCO, 1909); described as *T. crocea*: Naples, Italy (FENCHEL, 1905; author); Villefranche, France (MACKIE, 1965; author); described as *T. larynx*: Naples, Italy (TARDENT, 1955-65).

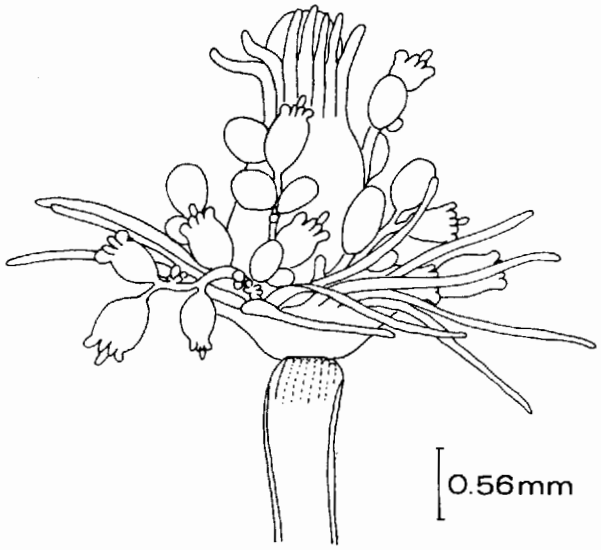
No medusa stage.

Methods of collection and cultivation

T. crocea is found around Naples near St. Lucia harbour on barrels used for cultivation of mussels and beneath boats and rafts in the commercial harbour. From Monaco and Villefranche it is reported from floating wood and under rafts (STECHOW, 1919; MACKIE, 1965). It has been reported from the stem of a sailing boat in Plymouth. The species is difficult to keep in the laboratory. Only MACKIE (1965) succeeded in keeping *Tubularia* for three months well. Generally it will shed its hydranths a few days after transfer to an aquarium, regenerate from the hydrocaulus and shed again before growing gonophores (TARDENT, 1956). *Tubularia crocea* shares this habit of shedding the hydranth with *Ectopleura larynx* (p. 27) and most *Eudendrium* species (TARDENT, 1962; and observations of the author).

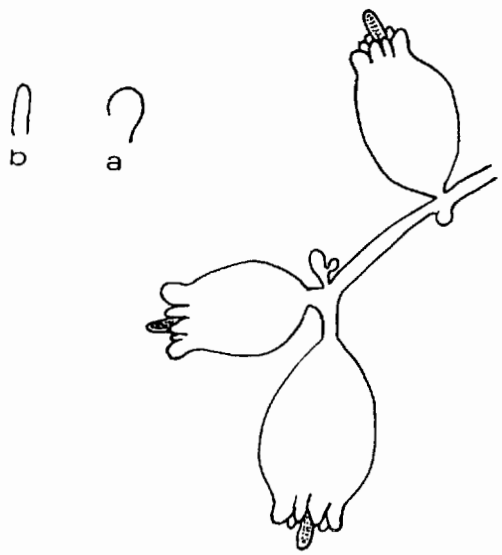
Description of the species

The stems of the adult *T. crocea* hydroids have a length of 4 to 5 cm. The length of the hydranth is 2 to 4 mm. Its diameter measures 2 to 3 mm at the broadest part. Adult specimens carry 17 to 20 oral tentacles. Sometimes the oral whorl seems to be arranged in two circlets; however, this impression is only created by the alternating position of the tentacles. The oral tentacles are thickly covered with nematocysts. The aboral tentacle whorl consists of up to 28 long filiform tentacles. They carry more cnidocysts on their abaxial side than on their adaxial side. The ectoderm is a little thicker on the abaxial than on the adaxial side of the tentacle. The relation of cnidocyst numbers of the adaxial to the abaxial side is 1 against 4 to 5 as can be clearly seen in a stained and mounted tentacle. The gonophores bearing blastostyles are arranged in one circlet. AGASSIZ illustrated this situation correctly, but described an arrangement of blastostyles in several whorls in the text (AGASSIZ, L., 1862). The hydrocaulus is covered with a flexible perisarc up to the base of the hydranth. Very often actinulae and young hydranths of different sizes may be attached to the stem of older hydroids. This gives the impression



TEXT-FIG. 30. - Tubularia crocea, *adult female hydroid preserved in formalin.*

of ramification. However, a stained and mounted stem proves that the coenosarc in these « ramified » stems does not communicate (text-fig. 32). Conversely, RUNGGER (personal communication) claims to have observed real ramifications exceptionally under culture conditions. This same « false branching » was also observed

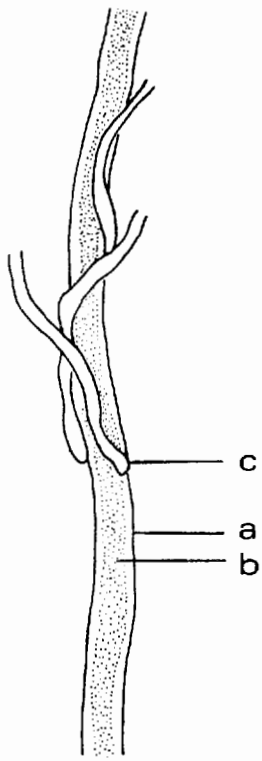


TEXT-FIG. 31. - Tubularia crocea, *female, detail of blastostyle with gonophores carrying 8 laterally compressed marginal protuberances.* a - *marginal protuberance from the side,* b - *marginal protuberance frontal.*

by HINCKS for *Tubularia indivisa* (1868, p. 116): « The embryos (of *T. indivisa*, author) on exclusion from the ovisac not unfrequently fix themselves on the stem and develop themselves in this position, so as to give the

appearance of branching. I have seen whole colonies of young of all ages grouped on the older stem ».

The cnidocysts are stenotheles and desmonemes.



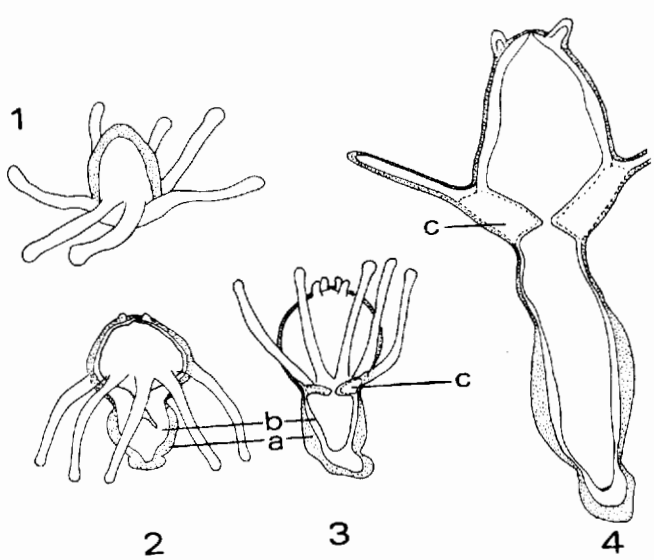
TEXT-FIG. 32. - Tubularia crocea, *stem of an adult hydroid with stem of a young hydroid attached;* a - *perisarc of adult hydroid,* b - *coenosarc of adult specimen,* c - *stem of young specimen.*

Developmental stages

The embryonic development of the genus *Tubularia* has been studied by several authors (for example BENOIT, 1925; NAGAO, 1960, 1965). Less has been published on the postembryonic development. In *T. crocea*, several actinulae are developed per gonophore. The actinula emerges from its gonophore with no oral tentacles and 4 to 7 aboral tentacles, depending on the size of the embryo (text-fig. 33,1). The mouth is still closed. This first stage after liberation from the gonophore is usually floating, sometimes « semi-attached » on the hydranth or on the hydrocaulus of the « mother » hydranth. The next stage is marked by a prolongation of the aboral part of the actinula which later forms the hydrocaulus. This primary hydrocaulus has a very thick ectoderm. At its base it secretes the perisarc which serves as the attaching agent to the substrate. The histology and development of the young hydroid would need further careful examination.

The very young hydroid has four small protuberances orally, the first sign of oral tentacles. The next stage (tex-fig. 33,3) is marked by a prolongation of the hydrocaulus, a prolongation of the oral tentacles and the development of the parenchymatic cushion which is typical of *Tubularia* (see also BERRILL, 1952). The oral tentacles of the young *Tubularia crocea* show a thickening at their tip (text-fig. 28 *b*) much like those of *Ectopleura larynx* (p. 27). Examination of mounted and stained tentacles of these two species reveals the difference. The ectodermal cells of the tentacle tip are enlarged in young *T. crocea;* however cnidocysts are present along the ectoderm of the whole tentacle just as in other filiform tentacles (text-fig. 28 *b*). Contrary to that, only the enlarged ectodermal cells of the tentacle tip contain cnidocysts in *E. larynx* (text-fig. 28 *a*).

The ectoderm in the tip of the oral tentacle becomes more flattened, typically filiform, in the adult *T. crocea.* (tex-fig. 28 c).



TEXT-FIG. 33. - Tubularia crocea; *four stages of development from the actinula to the young hydranth.* a - *ectoderm;* b - *endoderm;* c - *parenchymatic cushion.*

Ecological observations and seasonal variation

The hydroids of *T. crocea* may be found with gonophores throughout the year (TARDENT & EYMANN, 1958). This was also found by RUNGGER (1969) who made a detailed study about the autotomy (shedding of the hydranths) of *Tubularia crocea* under natural and laboratory conditions. He reports that liberated hydranths may survive autotomy for up to 30 days. They may be fertilized, mature and liberate actinulae while in this floating stage. Already HINCKS reports for *T. indivisa:* « After a storm I have seen this spot (rocks covered with *T. indivisa* colonies, author) looking like a stubble-field, the heads all gone, and the straw-like tubes only left » (HINCKS, 1868, p. 118).

Habits

Little is known about the habits of *T. crocea.*

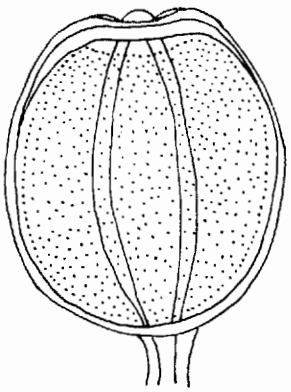
Discussion of the species

Tubularia crocea was described by L. AGASSIZ from Boston Harbor U.S.A. in 1862 under the genus *Parypha.* ALLMAN (1871-1872) described a species from La Spezia (Italy) and called it *Tubularia mesembryanthemum.* This latter species was also reported by LO BIANCO for

Naples (1909). These descriptions are not detailed enough to decide whether the two species are different or not. From the original descriptions, they appear to be at least very similar. TARDENT (1956-65) named the species with which he worked in Naples *T. larynx*. I reexamined the *Tubularia* from TARDENT's location and found it to be not *T. larynx* but *T. mesembryanthemum*. MACKIE (1966) worked with *T. crocea* in Villefranche. MACKIE's specimens were identified by REES at the British Museum, but REES mentioned to me in litt. that he was not sure of his identification because the female gonophores of MACKIE's specimens were not ripe. Two questions seem to overlap here. (1) Are the species from Villefranche and Naples the same, no matter whether called *mesembryanthemum* or *crocea*? (2) Is the species *T. mesembryanthemum* described by ALLMAN from La Spezia synonymous with *T. crocea* AGASSIZ described from the East of North America?

I will attempt to investigate these two question separately. To solve question no. one, freshly preserved *Tubularia* from Naples (sent by Dr. MONCHARMONT) and from Villefranche (sent by Dr. GOY) were examined and compared with culture material raised by MACKIE in Villefranche and with *Tubularia* from the collections of the Agassiz Museum labelled as « *Tubularia larynx* from the Mediterranean ». All four samples proved to be the same species, only the culture material from MACKIE was not adult and therefore did not show the female gonophores; however the concentration of cnidocysts on the aboral side of the aboral tentacles could be seen which was also present in the other samples.

It is therefore most likely that the species with which TARDENT and MACKIE worked are identical regardless of the specific name applied.



TEXT-FIG. 34. - Tubularia crocea, *male gonophore with sperm.*

The second question, whether *T. mesembryanthemum* and *T. crocea* are synonymous, was already discussed by FENCHEL (1905). He made a very careful and often overlooked study on the variability of specific characters in the genus *Tubularia*. Based on meticulous and extensive measurements he found that most of the so-called specific characters of *Tubularia* are very variable and useless as specific characters. However one good specific character is that laterally compressed ridges are present in *T. mesembryanthemum* and *T. crocea* and in no other species of *Tubularia*. Therefore FENCHEL suggested uniting *T. mesembryanthemum* with *T. crocea*. REES (1963) nearly reached the same conclusion. However he hesitated to declare them synonymous outright because BEDOT (1911) had found small tubercles in the male medusoids of *T. mesembryanthemum* and not in *T. crocea*. I think *T. mesembryanthemum* and *T. crocea* are synonymous, because the presence of tubercles in the male medusoids is very variable in the some colony.

Tubularia larynx ELLIS 1755

Synonymy

Tubular coralline, wrinkled like the windpipe, ELLIS (1754, p. 504, pl. VII, fig. 1) (hydroid).
Corallina Tubularia Laryngi-similis ELLIS 1755, p. 39 (hydroid).
Tubularia larynx SOLANDER (1786, p. 31) (hydroid).
Tubularia larynx BEDOT (1918, p. 288, listing synonyms from 1800 to 1900) (hydroid).
Tubularia larynx FENCHEL (1905, p. 507) (hydroid).
Tubularia coronata FENCHEL (1905, p. 507) (hydroid).
Tubularia larynx STECHOW (1919, p. 10) (hydroid).

Specific characters

Colonies with branching stems, perisarc more or less distinctly annulated. Oral whorl of 14 to 20 tentacles, aboral whorl with 20 tentacles. Oral tentacles with few scattered nematocysts. Aboral tentacles with an inconspicuous band of nematocysts on their abaxial sides. Gonophores with four marginal rounded tubercles less developed in the female than in the male.

Material seen: Preserved specimens (British Museum) from Plymouth, England.

Material deposited: None.

Distribution

Hydroid, outside Mediterranean: All European coasts (ALLMAN, 1871-72; PYEFINCH & DOWNING, 1949).
Mediterranean: Portofino near Genova, Italy (STECHOW, 1923); Naples, Rapallo, Italy (CARUS, 1884; ROSSI, 1950).

Although CARUS (1884) mentioned *T. larynx* for Naples, it has not been found around Naples since then. STECHOW found only colonies with male medusoids near Portofino, which are not a good character for the species. ROSSI (1950, p. 200) writes that she is not sure of her identification of *T. larynx*, because her material was a stained, mounted, but fragmented colony. Therefore the occurrence of *T. larynx* in the Mediterranean remains doubtful, until it will be found again.

Description of the species

« Trophosome: Hydrocaulus consisting of numerous branching stems having a diameter of about 1/30th of an inch, and rising from a creeping stolon to a height from one inch and a half to two inches, or even more; stems presenting at intervals more or less distinctly marked annulations; coenosarc forming a collar-like expansion just below the hydranth. Hydranths about one fifth of an inch across the widest part of the body, with a circlet of from fourteen to twenty distal tentacles in two closely approximate alternate series, and with the proximal tentacles about twenty in number, and about two fifth of an inch in length.

Gonosome: Gonophores in pendulous clusters, forming in the male long simple racemes, which when mature, surpass the proximal tentacles in length, while in the female the much shorter clusters do not equal these tentacles in length and the peduncle is here branched, so as to form a sort of panicle or compound raceme. The gonophores are destitute of gastro-vascular canals, and are crowned with four conical tentaculiform tubercles, larger in the female than in the male, which are of an elongated oval form. Oral tentacles of Actinula not developed at the time of its liberation » (after ALLMAN, 1871-72, p. 407).

Discussion of the species

See discussion for *T. crocea* (p. 31).

Tubularia indivisa LINNÉ 1758

Synonymy

Tubular coralline, like oaken pipes, ELLIS (1754, p. 504, pl. VII, fig. D) (hydroid).
Tubularia indivisa LINNÉ 1758, p. 1301 (hydroid).
Tubularia indivisa FENCHEL (1905, p. 570) (hydroid).
Tubularia indivisa BEDOT (1901-18, listing synonyms) (hydroid).
Tubularia indivisa STECHOW (1923, p. 48) (hydroid).

Material seen: English coast (from preserved material from the British Museum)

Material deposited: None.

Specific characters

« Stems clustered, simple, erect, without annulation, narrowed and twisted at the base, horn-coloured, rising to a height of from 6 to 12 inches; polypites deep red; oral tentacles short and very numerous, aboral long, white, tapering, about 40 in the adult; gonophores on branched peduncles, forming large and very numerous clusters, springing from the base of the lower tentacles; sporosacs with four radiating canals and four small tubercles at their terminations ». (HINCKS, 1868, p. 115, 116).

Distribution

Hydroid, outside Mediterranean: Red Sea (EHRENBERG, 1837); Coasts of Scandinavia as far as the North Cape, Greenland; English coasts (HINCKS, 1868).
Mediterranean: Naples, Italy (STECHOW, 1923).

Description of the species

For a detailed description see ALLMAN (1871-72, p. 401) and HINCKS (1868, p. 115-118).

Discussion of the species

This species is distinguished from other *Tubularia* species by the presence of a ring canal and radial canals in the gonophores.

Genus *Rhysomedusa* VANNUCCI & SOARES 1966

Generic characters

Hydroid not known; « Medusae: Tubulariidae with a single hollow tentacle ending in a terminal cluster of nematocyst capsules; with four perradial longitudinal rows of nematocysts on exumbrella with additional interradial and adradial rows; with vacuolated cells along radial canals, at the apex of the manubrium and around the umbrella margin; marginal bulbs absent » (after VANNUCCI & SOARES, 1966, p. 8).

The genus *Rhysomedusa* has one species *Rhysomedusa pomponina* VANNUCCI & SOARES.

Type species: *Rhysomedusa pomponina* VANNUCCI & SOARES 1966.

Rhysomedusa pomponina
Text-fig. 35

Synonymy

Rhysomedusa pomponina VANNUCCI & SOARES 1966, pp. 7-12, figs. 1-4.

Specific characters

Hydroid not known; medusa with the characters of the genus.

Material seen: none.

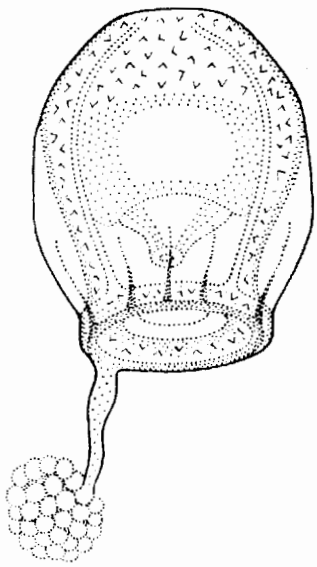
Material deposited: The type specimen is kept in the Zoology Museum in Sao Paulo (VANNUCCI & SOARES, 1966, p. 9).

Distribution

Gulf of Naples, Italy.

Description of the species

« The largest specimen is 1.4 mm high; this is probably about the maximum size achieved. Apex rounded, domelike. Bell nearly spherical, slightly higher than wide, gelatinous substance very thin or absent at apex but present on the sides. Umbrella margin thick. A single hollow perradial tentacle springs from the margin without marginal bulb. A large knob full of cnidophores laden with nematocyst capsules is always present at the distal end of the tentacle. In the younger specimens the tentacle is very short or contracted in such a manner that the knob lies close to the umbrella margin. In the largest specimen the tentacle is about



TEXT-FIG. 35. - Rhysomedusa pomponina, *medusa* (*After* VANNUCCI *and* SOARES, 1966).

half as long as the umbrella height and the diameter of the knob is about half the diameter of the umbrella opening. In the second largest specimen the tentacle is almost twice as long as the umbrella. The velum is clearly visible only in the holotype. Ocelli absent. Four large exumbrellar perradial nematocyst tracks extend almost to the tip of the umbrella. They are pale rust in colour in specimens that have been preserved in 4 % formalin for five years. In the smaller specimens four interradial shorter and slender nematocyst tracks are visible. In the larger specimen, the holotype, there are, in addition to the four perradial thick tracks and the four short interradial ones, also two extra short adradial tracks in two adjacent quadrants, while there is only one track in the other two quadrants. The other specimens show an irregular distribution of nematocyst rows in adjoining quadrants. There are some scattered nematocysts on the exumbrella as well as on the umbrella margin and on the mouth rim.

The manubrium is short and thick. It was found to extend beyond the umbrella margin in a single immature specimen, the umbrella of which appears to be rather unusually contracted. Normally it does not reach the umbrella margin. The mouth is simple and circular. Externally to the radial cannals the umbrella is lined with highly vacuolated cells that are present also above the stomach and around the umbrella margin.

The gonad completely surrounds the manubrium but is thicker perradially reducing the cavity of the same to a cross shape » (VANNUCCI & SOARES, 1966).

Ecological observations

All four specimens found by VANNUCCI were collected on the east side of the island of Ischia (Gulf of Naples) in vertical plankton hauls from 200 m to surface over a depth of 220 m. They were taken in April, May, September and January (VANNUCCI & SOARES, 1966).

Discussion of the species

Rhysomedusa pomponina is similar to *Paragotoea bathybia* (p. 21) recorded from Naples, but, vacuolated cells and nematocyst tracks on the exumbrella, which are typical for *R. pomponina*, could not be found in *P. bathybia*. Unfortunately my comparison of the two species was inadequate, because my specimen of *P. bathybia* was very contracted and I was not able to obtain a specimen of *R. pomponina*. Although *Rhysomedusa pomponina* and *Paragotoea bathybia* are similar generally, I am compelled by the definitions of families (see p. 11 and REES, 1957 *a*) to place *R. pomponina* with the Tubulariidae and *P. bathybia* with the Corymorphidae.

FAMILY VELELLIDAE ESCHSCHOLTZ 1829

The Velellidae consist of three genera, *Velella* L., *Porpita* L. and *Porpema* HAECKEL. The systematic position of these peculiar animals has been discussed in numerous papers for longer than a century. Earlier workers considered *Velella* and *Porpita* to belong to the athecate hydroids (AGASSIZ, 1883; KÖLLIKER, 1853; VOGT, 1854). But for a long time after this early period, the Velellidae were included in the order Siphonophora and in text-books of Zoology they are still listed under Siphonophora (HUXLEY, 1859; HAECKEL, 1888). TOTTON (1954) realized the profound differences between Velellidae and Siphonophora and established an order of its own, Chondrophora, for *Velella* and *Porpita*. This line is followed by VERVOORT (1965). REES agreed with TOTTON in his paper on the evolution of capitate hydroids (REES, 1957 *a*). But in 1962 REES told me personally that he was then convinced that *Velella* and *Porpita* belong to the Anthomedusae-Athecatae. Recently several other authors stressed the hydroid and medusa characters of *Velella*, *Porpita* and *Porpema* (BRINCKMANN, 1964; EDWARDS, 1966; LELOUP, 1929, 1954; MACKIE, 1959; PICARD, 1955 *c*, 1957; PREVOST, 1959). Although all of these authors agree on *Velella* and *Porpita* belonging to the Anthomedusae-Athecatae, there is much disagreement on their position within the order. LELOUP

(1929, 1954) and MACKIE (1959) try to homologize the floating hydroid stage of *Velella* (text-fig. 36) and *Porpita* (text-fig. 40) with a tubulariid hydroid. PICARD (1955 *c*, 1957) points out that *Velella* is a hydroid colony and that it is related to the Zancleidae on account of their macrobasic euritheles and the structure of the hydroid. PICARD bundled the Velellidae and Zancleidae and several other divergent families into a superfamily Pteronematidae, on account of their common macrobasic euritheles. REES (1957) and VERVOORT (1966) have already pointed out that a superfamily Pteronematidae is held to be invalid and VERVOORT discussed the uncertain value of the macrobasic euritheles as a taxonomic tool, because it connects families which are very different in other morphological characters. Besides that, only *Velella* has macrobasic euritheles and *Porpita* not. PICARD supports the supposed relationship between Zancleidae and Velellidae by two simplified drawings of the polyps of *Velella* and *Zanclea*, so simplified indeed that they could be any corynid hydroid figured in an abstract form (PICARD, 1955 *c*, text-fig. 2 *a*, *b*). EDWARDS (1966) stressed the colonial nature of *Velella*, pointing out that « the chondrophores are true colonies and their zooids are true polyps ». However the presence of the central mouth (or central polyp), the arrangement of coryniform blastostyles (or gastrogonozooids) with a mouth and the hollow tentacles (or dactylozooids) at the margin of the animal (or colony) makes the comparison between *Velella* and other true colonies somewhat difficult. Instead of insisting on either the term solitary or colonial for *Velella*, I would prefer to say that *Velella* and *Porpita* are primary solitary polyps which have achieved colonial character through the presence of feeding blastostyles (or gastrogonozooids) and dactylozooids.

Considerably less is known about the genus *Porpita* than about *Velella*. Especially the medusa stage of *Porpita* deserves more study.

Tentatively, the Velellidae are placed between the Tubulariidae and Pennariidae. However as I did the final review and drawings of the Velellidae after all other families had been finished, I found that there are numerous reasons speaking against an allocation of the Velellidae between the Tubulariidae and Pennariidae:

The gonads of the medusa of *Velella* are divided (BRINCKMANN, 1964, text-fig. 39). This is unknown in Corymorphidae, Tubulariidae and Corynidae, which are supposedly the « lower » Capitata. The polymorph character of the hydroid colonies of *Velella* and *Porpita* is shared by the Hydractiniidae, Milleporinidae, Halocoryrinidae and Ptilocodiidae. The lateral cnidocyst patches and cnidocyst bands of the dactylozooids of *Velella* are similar to those in *Halocoryne* HADZI. On account of such diverse characters, the Velellidae should be placed between the Capitata and Filifera. The Velellidae thus appear in a conglomeration of families such as Hydractiniidae, Ptilocodiidae, Solanderiidae and Rhysidae, whose relationships to each other remain obscure. All of them have in common that they are neither « good » Capitata nor Filifera. This kind of an interpretation was formerly expressed in a discussion on the position of the Solanderiidae in the Symposium on the Evolution of Cnidaria by REES and VERVOORT (1966, p. 396).

Genus *Velella* LAMARCK 1801

Generic characters

Floating hydroid colonies with an upright sail; with a central gastrozoid, numerous feeding gonozooids and dactylozooids. Free medusa with exumbrellar cnidocyst rows, with two perradial solid tentacles each with a large terminal cnidocyst cluster, with two perradial marginal bulbs without tentacles; with stomach with tubular mouth. Gonads in the male divided. Female with one egg.

Type species: *Velella velella* (LINNÉ 1758).

Synonymy

Medusa velella LINNÉ 1758, p. 660.
Velella spirans MOSER (1925, p. 458).

Material seen: Naples, Italy; Villefranche, France.

Material deposited: B.M.N.H.; S.Z.N.

Specific characters

As there is only one species in the genus *Velella* the generic characters apply to the specific characters too. *Velella velella* is commonly known as « Little Sail ».

Distribution

Hydroid, outside the Mediterranean: Pacific, Atlantic, Indian Ocean (for full details see TOTTON, 1954; EDWARDS, 1959; ANKEL, 1951, 1962).
Mediterranean: Mediterranean coast of Spain (EDWARDS, 1963, 1966); Villefranche, France (EDWARDS, 1963, 1966; TOTTON, 1954; BRINCKMANN, 1964; TREGOUBOFF and Rose 1957); Naples, Italy (EDWARDS, 1963, 1966; LO BIANCO, 1909; BRINCKMANN, 1964); Messina, Italy (METSCHNIKOFF, 1886 *a*).

Medusa, outside the Mediterranean: none.
Mediterranean: Messina, Italy (METSCHNIKOFF, 1874).

Methods of collection and cultivation

As the hydroids of *Velella velella* occur in swarms they can be easily detected floating on the surface and may be caught with a simple gauze plate. The hydroids cannot be kept alive for more than a few days. The « Chrysomitra » medusae which are liberated in immense numbers from the *Velella* hydroids can be kept on a rocking tray at 13° to 18° C for over a month. As the mouth of the medusa is closed for the first 5 to 6 days after liberation, feeding starts only after this period. Then the medusae will feed on squeezed *Artemia* and the intestines of

copepods; however the food has to touch their lips, brought there with fine forceps, and has to be kept there for several seconds until the medusae start to take it. It is possible to raise the medusae to maturity by this method (BRINCKMANN, 1964).

Description of the species

Hydroid: (Although the arrangement of a central polyp, gastrozooids and tentacle-like dactylozooids of *Velella* remind us of the general structure of a corymorphid or tubulariid hydroid, the terms used in this description apply to the terms of a colonial hydroid because the gonozooids are feeding).

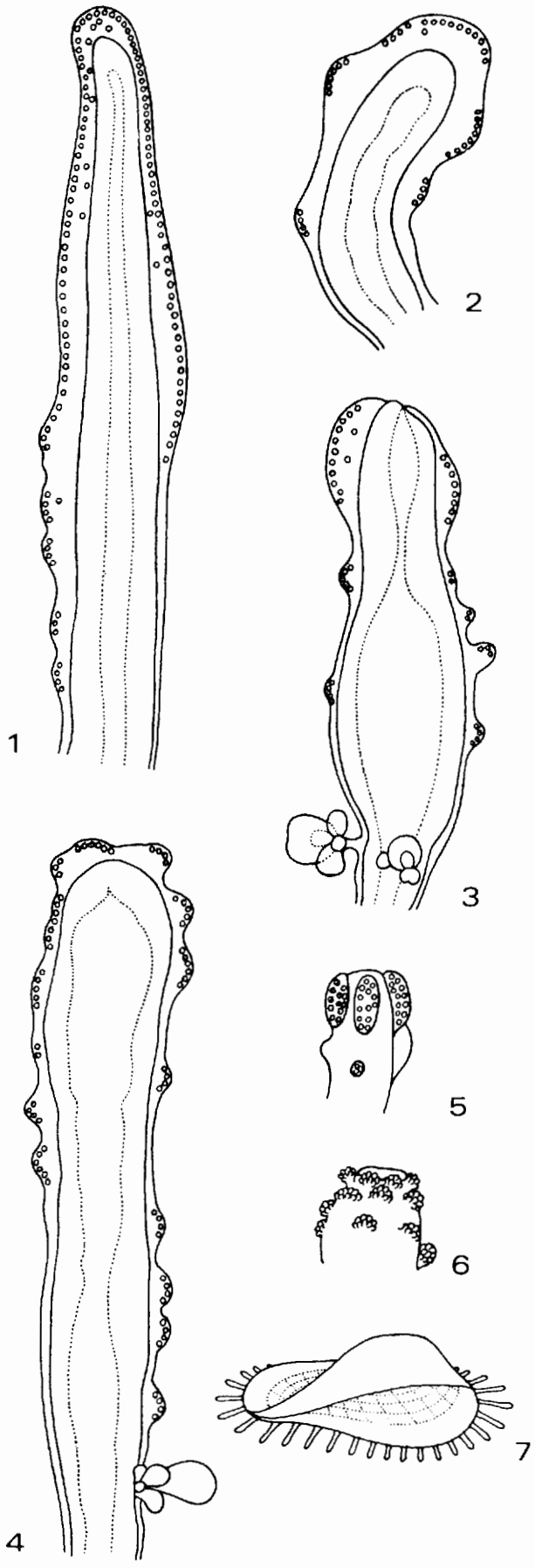
The hydroid colonies of *Velella* float on the water surface.

Their unsubmerged part consists of an oval disc-like float with an upright triangular sail. There are two mirror image forms of the species, the sail situated along either of the two diagonals of the rather oblong float (EDWARDS, 1966). The float consists of a complicated structure of air chambers and gastrodermal channels.

The central polyp, the feeding gonozooids and the dactylozooids are suspended from the underside of the float which is submerged in water. The central polyp lacks any tentacles or medusa buds.

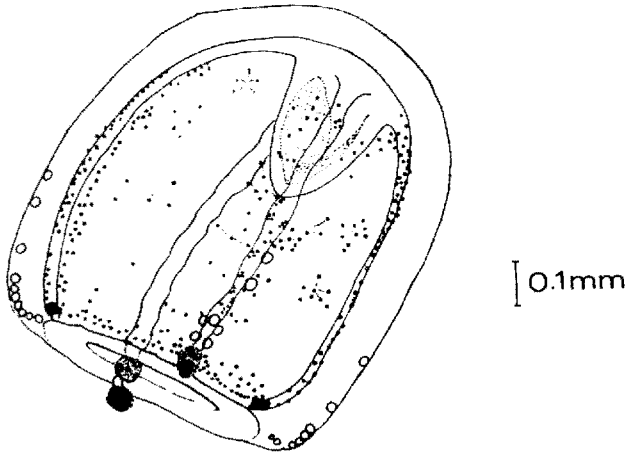
Around the central polyp are arranged the feeding gonozooids. Feeding gonozooids have irregularly distributed clusters of cnidocysts. The cnidocyst clusters are densely concentrated around the mouth but also present in the more basal parts of the polyps. Below the base of the cnidocyst clusters there are numerous medusa buds growing in bundles on short blastostyles (text-fig. 36/4,6). Gonozooids towards the periphery of the float as illustrated in text-fig. 36/3 and 5, have fewer but larger cnidocyst patches around the mouth than gonozooids in more central positions. The polyp in text-fig. 36/2, from a peripheral position, represents an intermediate stage between the gonozooids and dactylozooids; it lacks a mouth opening, cnidocysts are concentrated in large patches. Text-fig. 36/1, shows a dactylozooid from the margin of the colony; cnidocysts are concentrated in two lateral bands in the distal half of the polyp. On the one side of the polyp this band continues in the form of cnidocyst patches, on the other side the cnidocyst band is much shorter. These lateral cnidocyst bands and lateral rows of cnidocyst clusters are similar to the lateral cnidocyst clusters of the Halocorynidae (p. 84).

Medusa: The liberated medusa is bell-shaped and has an umbrella that is slightly higher than wide (height 1.23 mm; diameter 1.01 mm). It has two large and two small perradial marginal bulbs. The former carry rudimentary tentacles each of which bears a large terminal knob. Four rows of nematocysts extend from each of the four tentacle bulbs. There are four radial canals and a ring canal. Large numbers of zooxanthellae are concentrated mainly in the region of the radial canals and the ring canal, but are also



TEXT-FIG. 36 - Velella velella, *hydroid colony;* 1-6, *polyps from different regions of the colony;* 7, *sketch of an entire colony as it is seen swimming on the water surface:* 1, *dactylozooid from the margin of the colony;* 2, *developing polyp which lies central to* 1; 3, *gonozooid in a position midway between the dactylozooids and the central polyp;* 4, *gonozooid near the center of the colony;* 1-4, *are optical sections drawn under the microscope with transmitted light;* 5, *same polyp as* 3 *but drawn with reflected light;* 6, *same polyp as* 4 *but drawn under reflected light.*

found in the other regions of the subumbrella. The zooxanthellae are arranged in groups although their concentration is not as great as in older stages.



TEXT-FIG. 37. - Velella velella, *medusa 6 days old with* Artemia *in its stomach (drawn after a sketch from* DR. P. KRAMER).

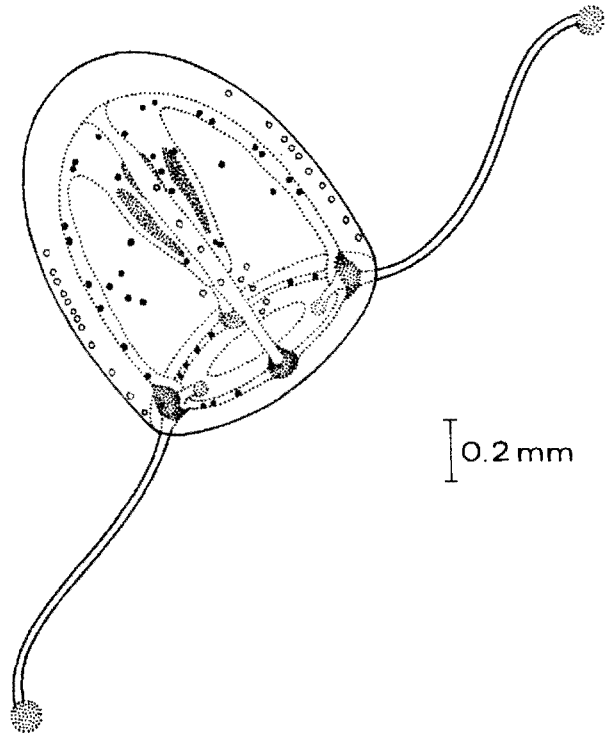
The manubrium is short (0.22 mm), conical and closed as determined from histological sections. The cnidocysts are macrobasic eurithetes and stenotheles.

If during the first four days following liberation food is placed near the still unopened mouth, the medusa does not react. But by the fifth day the entire stomach shows some movement when the food is brought near the manubrium. The mouth opens and food is accepted by the following day, although, depending upon individual variation, these events may occur on the fourth or fifth days. During the first non-feeding period the medusae shrink slightly, but from the time feeding begins, growth is steady (text-fig. 37).

The tentacles do not seem to grow gradually, but undergo a rapid elongation during the eleventh to twelfth days. When the medusa is touched, the tentacles curl inwards, exhibiting high contractility. The tentacles consist of one row of endodermal cells and a very thin layer of ectoderm. They terminate in a large cnidocyst bulb.

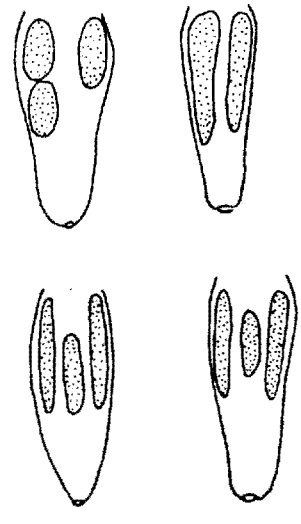
From the 14th to 16th day two second tentacles, which grow adaxially to the primary one, appear on the perradial bulbs provided with tentacles. Each new tentacle has a termnial knob and is of the same structure as the primary one. They are, however, very short and always curved inwards. Probably because of their small size these tentacles have previously been overlooked.

At this same time the gonads begin their development on the manubrium, bending inwards towards the stomach in the form of opaque protuberances. The gonads vary in number and position in different specimens: There may be either three or four perradial gonads; aboral from them there may be two or even three additional interradial ones (text-fig. 38, 39). By the 22-25th day the gonads become white and with a phase contrast microscope one can observe ripe, moving sperm within them. Sections after the 25th to 27th day show the gonads empty. After spawning the medusae do not feed well and die within a few days.



TEXT-FIG. 38. - Velella velella, *male medusa, 18 days old with gonads developing on its stomach.*

As I had more medusae than could be fed, many were allowed to remain unfed on the rocking table for about one month. The medusae pulsated continously becoming only slightly smaller with time. Upon being fed, they and their sexual products developed normally. Table 1 is the record of development of four medusae whose feeding was begun after 21 days of starvation.



TEXT-FIG. 39. - Velella velella, *manubrium with gonads of two adult medusae; left, one side of stomach; right, other side of stomach.*

By this one sees that there are two distinct periods of development: (1) an « atrophic period » lasting from 5 to 30 days, during which maturation of gonads is inhibited, and (2) a « trophic growing period » during which growth of the medusa and development of its sexual products take place. The latter period lasts 20 to 24 days, independant of the duration of the first period. Although numerous anthomedusan species have been observed in culture, an atrophic period like that in *Velella* occurs in no other medusa. *Eucodonium brownei* HARTLAUB and *Sarsia gemmifera* FORBES die if not fed every day. Other medusae, for example *Podocoryne carnea* M. SARS, *Podocoryne hartlaubi* NEPPI & STIASNY, *Leuckartiara octona* (FLEMING), *Pandea conica* (QUOY & GAIMARD) etc., may live two or three days without food. « Resistant » species like *Cytaeis tetrastyla* ESCHSCHOLTZ and *Zanclea* may live up to seven days without being fed. The consequences of « delayed development » manifested in the singularly extended atrophic period of *Velella* will be discussed below. (After BRINCKMANN, 1964, p. 328-330).

Unfortunately I only observed the structure and development of the male medusa. The adult female was found in the plankton only once — by METSCHNIKOFF (1886 *a*). It had one red amoeboid egg.

Developmental stages of the hydroid

The fertilization of the egg of the *Velella* medusa and the earliest stages of the embryo are not known. The earliest stage which is known of the *Velella* hydroid was found by WOLTERECK in plankton hauls from deeper regions in Villefranche (WOLTERECK, 1904). He named this early stage « Conaria », which develops into a Ratarula and Rataria (WOLTERECK, 1904; LELOUP, 1929). LELOUP (1954), TOTTON (1954) and GARSTANG (1946) try to homologize the development of the Actinula larva of *Tubularia* with the Conaria and Rataria stages of *Velella* thus establishing the relationship between *Velella* and the Tubulariidae. I question however if this comparison is not too simple: The Conaria stage of *Velella* for instance has no tentacles like the actinula, but has morphological characters which are lacking entirely in *Tubularia*. The only similarity between the Rataria and actinula are the so-called aboral tentacles which however become feeding gonozooids or dactylozooids in *Velella*. I repeat my opinion as explained in the introduction to the Velellidae that attempts should not be made to squeeze *Velella* into one or the other relationship by comparing only one or two morphological or developmental features.

Ecological observations

The *Velella* polyps occur in winter and spring swarming on the surface. WOLTERECK (after LO BIANCO) noted that the polyps of *Velella* occur from April to June and October to December. WOLTERECK himself observed (1904, p. 351) « 1903 konnte in Villefranche konstatiert werden: Ende Januar im Auftrieb einzelne " Conarien " and Übergangs-stadien zur Rataria. Ende Februar: ein Velellenschwarm, dessen Leichen bis Mitte März an der Oberfläche trieben. Im Auftrieb Chrysomitren. Anfang März: Conarien und junge Ratarien, an Zahl bis Mitte des Monats zunehmend, die meisten in Tiefenfängen, einige im Auftrieb. Ende März: auf dem Meer eine ungeheure Menge junger und jüngster Ratarien, zwischen denen dann mehr und mehr grössere Velellen auftraten, bis auch dieser Schwarm Anfang Mai zu Grunde ging ». LO BIANCO (1904) noted that the medusae and the Conaria and Rataria stages can be found during the whole year, but he does not give more precise data. Because they disagree with all other observations those of LO BIANCO may be erroneous. TREGOUBOFF and ROSE (1957) found that the occurrence of *Velella* and its developmental stages is strictly seasonal.

In May 1956 I found the *Velella* polyps at Villefranche. They did not occur there in March and April in the years 1953-1956.

In December 1958, February to May 1960 and February 1961 they were found off the south coast of Ischia. (I suppose that also in 1961 *Velella* occurred in March and April, but at that time I was absent from the Naples Zoological Station). From January to July in 1962 there was not one *Velella* observed off Ischia. For many years *Velella velella* has not been observed in the inner part of the Gulf of Naples. Only on one day in November 1961, they occurred there in large numbers.

METSCHNIKOFF found adult *Velella* medusae in the plankton of Messina. He gives no indications of the depth at which these animals were taken, but it is said that at Messina « deep water currents » rise to the surface. There is, therefore, a widely held opinion in the literature, that *Velella* medusae develop their sexual products in deep water, although it has never been captured for certain there. Until *Velella* medusae are taken with closing nets, one may question the deep water occurrence of *Velella* medusa. There is another strong objection to the occurrence of *Velella* in deep water (DELSMAN, 1923): How *Velella* can retain its zooxanthellae at depths where no algae occur is difficult to envisage.

From observations of WOLTERECK and the occurrence of *Velella* off Ischia it seems probable that the occurrence of *Velella* is cyclic, although further field observations are necessary to determine whether there are one or two seasons of prevalence. Based on the periodical occurrence of *Velella* hydroids WOLTERECK presumed that *Velella* must have something like a resting stage, especially because the hydroid colonies of *Velella* die very quickly. He thought that this resting stage might be an encysted egg or « unreif bleibende Chrysomitren » (immature *Velella* medusa). The fact described on p. 36 that medusae of *Velella* can remain in the juvenile stage for one month without feeding, gives strong evidence that the theory of WOLTERECK is right, young medusae representing a kind of « pelagic resting stage ».

Although I did not carry out experiments on the nutritional role of the zooxanthellae I believe them to be involved in the nutrition of the medusa during this period. It is known that *Hydra* can live without food and that there the zooxanthellae are involved in nutrition (GOTSCH, 1924; after BRINCKMANN, 1964, p. 331-333).

TREGOUBOFF & ROSE (1957) note that there are small quantities of *Velella* off Villefranche in September. EDWARDS (1966) made a detailed account of the distribution of the left and right sailing form of *Velella* in relation to the current and wind system from different oceans. He states that the left-sailing form is predominant in the Mediterranean.

Discussion of the species

TOTTON (1954) pointed out that there is only one somewhat variable species of *Velella*.

Genus *Porpita* LAMARCK 1816

Generic characters

Velellidae with circular flat or slightly arched disc-like floats. Without sail. Dactylozooids with three rows of stump-like tentacles.

Type species: *Porpita porpita* (LINNÉ 1758).

MOSER (1925) examined large numbers of *Porpita* from different Oceans carefully and reached the conclusion that the different « species » of *Porpita* are only variations of the one species *Porpita porpita* (LINNÉ 1758).

Porpita porpita (LINNÉ 1758)
text-fig. 40-42

Synonymy

Medusa porpita LINNÉ 1758, p. 659.
Porpita mediterranea ESCHSCHOLTZ 1829, p. 177.
Porpita umbella CHUN 1897, pp. 90-92.
Porpita mediterranea LO BIANCO (1909, p. 462).
Porpita porpita TREGOUBOFF & ROSE (1957, p. 357).

Specific characters

See generic characters.

Material seen: Naples, only two specimens.

Material deposited: B.M.N.H.

Distribution

Hydroid, outside the Mediterranean: Pacific, Indian, Atlantic Ocean (MOSER, 1925; TOTTON, 1954).

Mediterranean: African coast, Villefranche, France (TREGOUBOFF & ROSE, 1957); Naples, Italy (LO BIANCO, 1909).

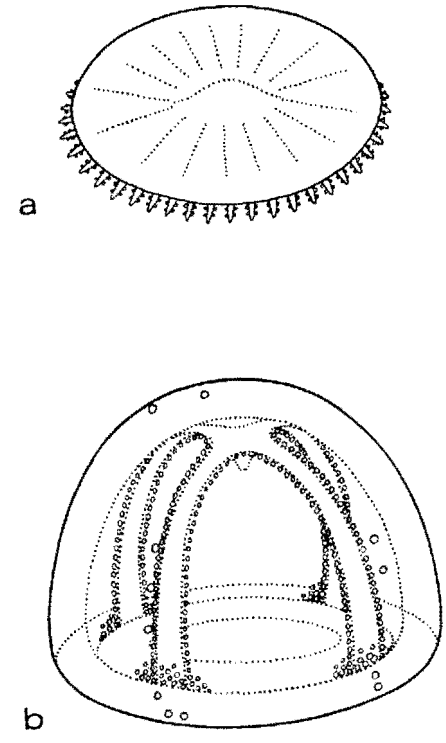
Medusa: not kown.

Methods of collection and cultivation

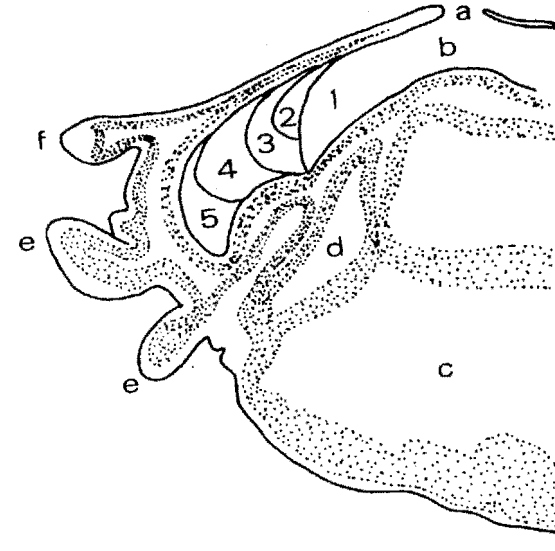
As the *Porpita* hydroids float on the water surface they can easily be caught with a gauze plate. The hydroids can not be kept alive in the laboratory for longer than two days. Young medusae are shed in immense numbers from their hydroids in the laboratory. But the medusae also die after a few days. No adult medusae have been found in the sea up to now.

Description of the species

Porpita hydroids show numerous features different from those of *Velella*.



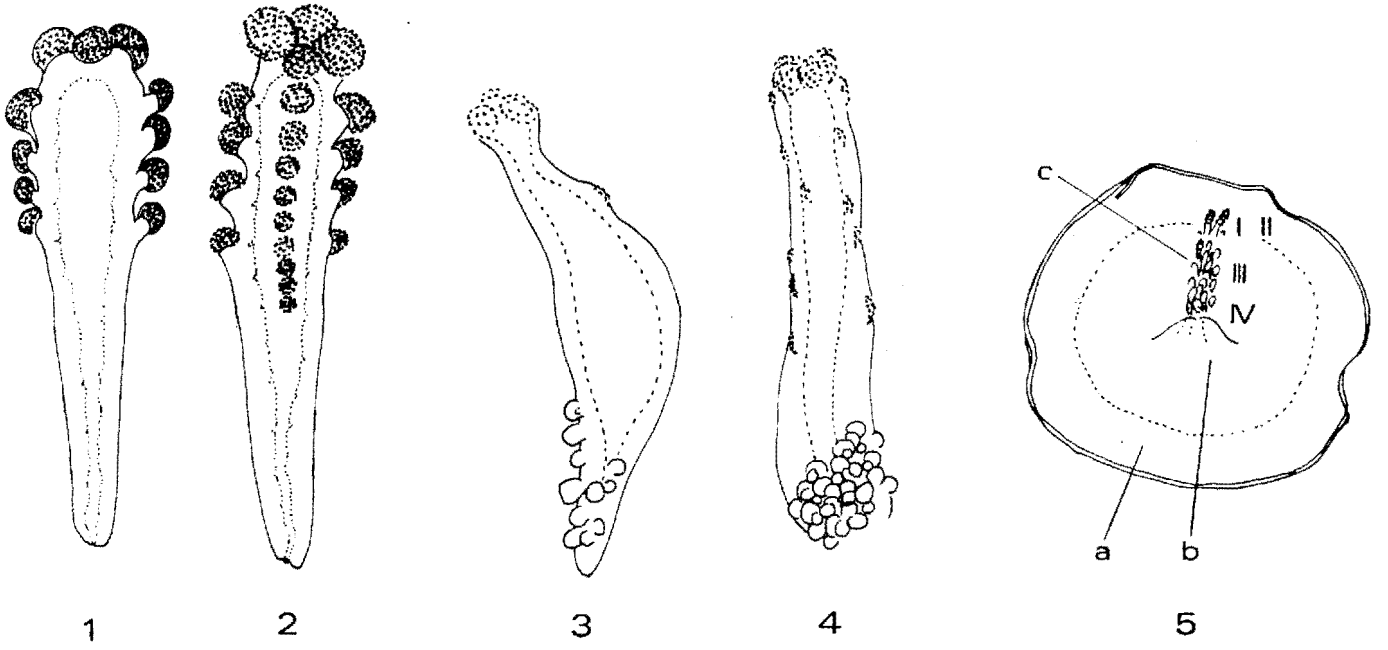
TEXT-FIG. 40. - a Porpita porpita; *hydroid; sketch of a colony floating on the water surface;* b Porpita porpita; *sketch of a young medusa* (*After* DELSMAN, 1923).



TEXT-FIG. 41. - Porpita porpita; *sagittal section through half of a young hydroid colony* (*after* DELSMAN, 1923). a - *primary pore;* b - *pneumatophore;* c - *endoderm of stomach;* d - *cells of the cnidocyst ring;* e - *tentacles;* f - *marginal gland;* 1-5 - *chambers of the pneumatophore.*

The *Porpita* float, swimming on the water surface is flat and circular with a small elevation in its center (text-fig. 41). The float consists of a soft margin (text-fig. 42/5, a) and a central part with concentric air chambers. The air chambers open to the air exposed of the dactylozooids. The gastro-gonozooids carry numerous medusa buds basal from the cnidocyst patches.

Medusa: After being liberated from their hydroids the young *Porpita* medusae sink to the bottom of the aquarium and start to swim after several hours. The



TEXT-FIG. 42. - Porpita porpita; *hydroid colony with polyps from different regions of the colony.* 1-4 - *single polyps;* 5 - *underside of a colony;* I, II - *position of polyps shown in* 1, 2; III - *position of polyp shown in* 3; IV - *position of polyp shown in* 4.

surface of the float through a central pore (text-fig. 41, a), a circle of pores at the periphery of the air-chamber part of the float, and irregularly distributed pores between the central and the marginal ones.

There is a complicated system of endodermal channels below the air chambers. These endodermal channels are connected with the central polyp and the gonozooids hanging from the underside of the float. The endodermal channels touch a mass of cells filled with cnidocysts in the region around the central polyp. As earlier workers like WOLTERECK (1904) and DELSMAN (1923) tried to homologize the *Velella* and *Porpita* hydroids with a medusa, they called these cnidocyst concentration « Nesselringpolster » (marginal cnidocyst ring).

The periphery of the underside of the *Porpita* float (text-fig. 42/5) consists of the soft margin. Central to this margin lies a circle of dactylozooids (text-fig. 42/5, between a and c). These dactylozooids lack a mouth: they have, distally, a circle of 4 large cnidocyst clusters; laterally, there are vertical rows of small tentacles with large terminal cnidocyst clusters (text-fig. 42/2).

Inwards from the dactylozooid zone, there are 1 or 2 circlets of gastro-gonozooids with 3 or 4 oral cnidocyst clusters and only very few lateral cnidocyst patches. Gastro-gonozooids more towards the centre have 5 to 6 oral cnidocyst patches (text-fig. 42/4) and irregularly distributed small cnidocyst patches below the oral ones. The cnidocysts of the gastro-gonozooids are much smaller than the cnidocyst clusters

umbrella is bell-shaped and slightly wider than high (text-fig. 40 *b*). There are four rudimentary perradial marginal bulbs, but no tentacles. The endodermal system consists of large vacuolated cells which are present in the rudimentary stomach and radial canals. There is no gastrocoel in either of them. A ring canal is missing. The endodermal cells in the region of the radial canals are filled with zooxanthellae.

There are four exumbrellar rows of cnidocysts. Unlike *Velella, Porpita* has no macrobasic euritheles.

Developmental stages

The development of the *Porpita* hydroids was observed by DELSMAN (1923). The conaria, ratarula (called disconula by LELOUP, 1954) and rataria of *Porpita* may be compared with the corresponding stages of the *Velella* embryos. The development of the medusa after its liberation from the hydroid, the adult medusa and the earliest development of the hydroid are not known.

Ecological observations

LO BIANCO (1909) reported *Porpita* with medusa buds around Naples in May and June and October. He mentions that they are abundant after strong southwest winds « especially in summer ». TREGOUBOFF & ROSE (1957) observed young *Porpita* together with *Velella* off Villefranche in September and October.

Discussion of the species

MOSER (1925) united all species of the genus *Porpita* in one species *Porpita porpita* (LINNÉ 1758) leaving *Porpema* HAECKEL as a separate genus. TOTTON (1954) united *Porpita* and *Porpema* in one genus with two species *Porpita porpita* and *Porpita prunella*. However as we know very little about *Porpema prunella* I think it would be better to leave the genus *Porpema* separate for the time being.

FAMILY PENNARIIDAE HINCKS 1868

The Pennariidae are the only athecate hydroids with a complicated structure of the colony, comparable to the Plumulariidae among the thecate hydroids. The structure of the hydranth of Pennariidae resembles that of the Corymorphidae and the Tubulariidae.

Definition of the family

Hydroids with branched upright colonies and with firm tubular perisarc up to the base of the hydranth. Hydranths with an oral whorl of capitate tentacles and an aboral whorl of long filiform tentacles, with scattered capitate tentacles between these two whorls. Medusa buds borne between the capitate tentacles, usually directly above the aboral tentacles. Medusae eumedusoid, either breaking free or remaining on the hydroid; with simple circular mouth; with four radial canals; with manubrium not extending beyond umbrella margin; with gonads completely surrounding stomach; with four permanently rudimentary tentacles, usually reduced to mere bulbs, with or without ocelli.

Genus *Pennaria* OKEN 1815

Generic characters

With characters of the family.

Type species: *Pennaria disticha* GOLDFUSS 1820.

The genus *Pennaria* was established by OKEN (1815) for several thecate hydroids, known today as *Plumularia, Aglaophenia* a.s.o. GOLDFUSS (1820) placed his *P. disticha* in the genus *Pennaria* OKEN because its colonial structure was similar to the above mentioned thecate hydroids. The separation between thecate and athecate hydroids was not recognized that time.

ALLMAN (1871-72) established the genus *Halocordyle* for the species *Halocordyle tiarella* (AYRES) of the Atlantic Coast of North America. This species is cogeneric with *Pennaria disticha.*

STECHOW (1923, p. 47) argued that ALLMAN's genus *Halocordyle* with the type species *Halocordyle tiarella* is held to be valid, because the name *Pennaria* was originally chosen by OKEN for a genus whose species are nowadays named *Hydrallmannia falcata, Plumularia setacea, Schizotricha frutescens, Lytocarpa myriophyllum* and *Aglaophenia pluma.* One can emphasize as well that GOLDFUSS placed his *P. disticha* in one established genus, *Pennaria,* and I favour this approach.

All the species except *Pennaria disticha* GOLDFUSS have been, in the course of time, removed from the genus *Pennaria* OKEN and *Pennaria disticha* is left as the type species. KRAMP (1959, 1961) follows this line too maintaining *Pennaria* as the valid genus with *P. disticha* GOLDFUSS as type species.

The genus *Pennaria* is represented in the Mediterranean by the species *P. disticha* GOLDFUSS.

Pennaria disticha GOLDFUSS 1820
Text-fig. 43-50

Synonymy

Pennaria marina IMPERATO 1599, p. 747 (hydroid).
Sertolaria pennaria CAVOLINI 1795, p. 134 (hydroid).
Pennaria disticha GOLDFUSS 1820 [BEDOT, 1901 and KRAMP, 1961, list p. 89 in GOLDFUSS as the page for the original description. I suspect that the book reference (GOLDFUSS, 1820, Handbuch der Zoologie) is correct but the page number is not Unfortunately I cannot substitute the correct page].
Pennaria cavolini EHRENBERG 1837, p. 297 (hydroid).
Halocordyle tiarella ALLMAN 1871-72, p. 369 (hydroid).
Pennaria disticha KRAMP (1961, p. 47) (medusa).

Specific characters

Branched upright feather-like colonies with firm tubular perisarc. Hydranths bearing ramuli lying in one plane and of equal length throughout one side branch. Medusa eumedusoid, may be liberated or not (in the same colony), with four small rudimentary bulbs, no ocelli.

Material seen: Naples, Italy; Banyuls, France.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: Amboina, Malay Archipelago (MAYER, 1910).
Mediterranean: Naples, Italy (MAYER, 1910); Banyuls, France (author).

Methods of collection and cultivation

Colonies of *P. disticha* are easy to collect on account of their large size. They may be found on stones or *Balanus* shells 2 to 5 m below surface on steep rocks. Colonies are very common in nearly all outer parts of the Gulf of Naples, for instance Nisida, Capo Miseno, Ischia, and elsewhere.

Kept in the laboratory, the hydranths degenerate after some days.

Description of the species

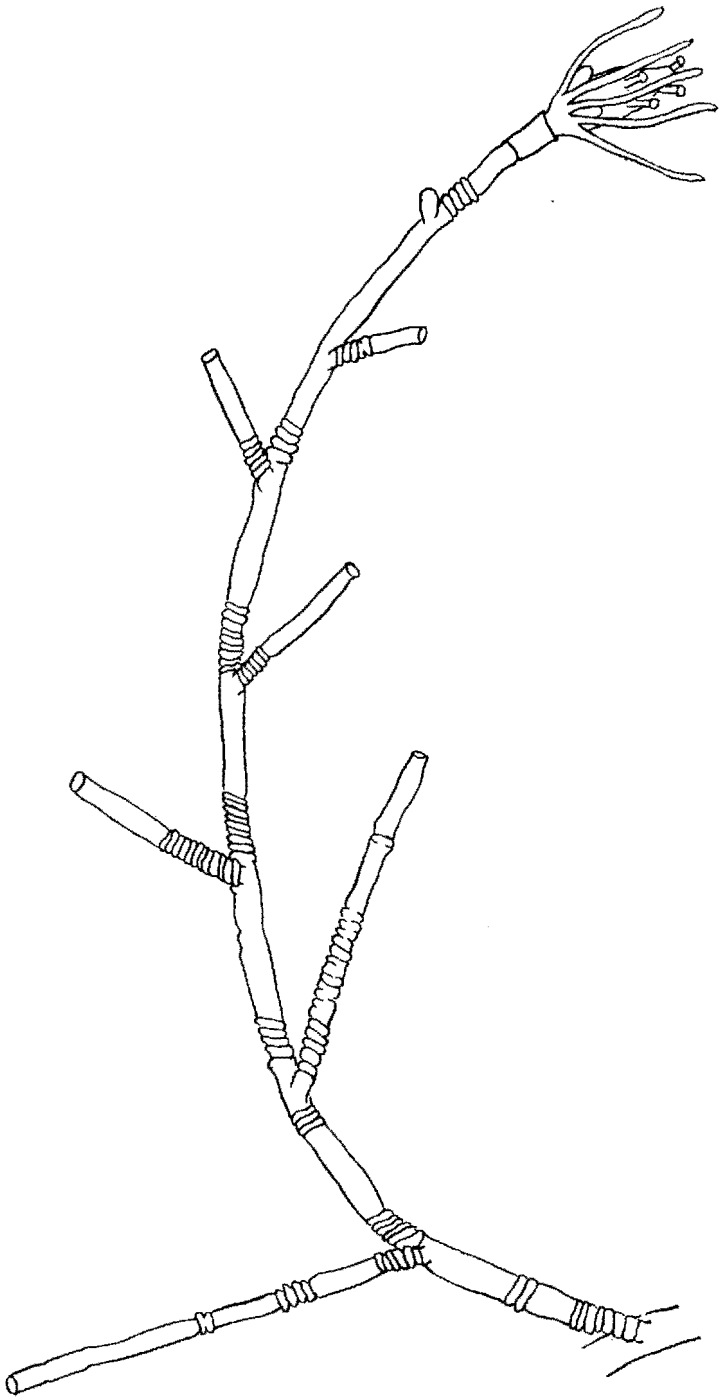
Colonies of *P. disticha* may reach a height of 30 to 40 cm.

They consist of a network-like hydrorhiza from which the feather-like colonies arise (text-fig. 45, 50). Each « feather » is composed of a main branch from which the side-branches grow alternately. The side branches of one side form an angle of abouth 120° with those of the other side. The side branches become longer from the tip of the feather to about the middle, whilst from the middle of the feather to the base the side branches usually get a little shorter. Every side-branch terminates in a hydranth and gives off numerous ramuli, each one also terminating in a hydranth (text-fig. 43).

TEXT-FIG. 43. - Pennaria disticha; *side branch with hydranths; drawn by* ILONA RICHTER.

The ramuli of each side branch are nearly of equal length. The perisarc of the ramuli is annulated throughout. The perisarc of the side-branches is annulated only distal to the junction of a ramulus with a side-branch (text-fig. 43). The length of a hydranth is 1.0 to 1.3 mm. It has an oral whorl of usually four capitate tentacles and an aboral whorl of 12 to 14 « filiform » tentacles, however with a slight concentration of cnidocysts at their tips. The filiform tentacles show an ectodermal thickening on their aboral or outer side, much as in some *Tubularia* species (text-fig. 49). Between the oral and aboral tentacle whorl there are two or three irregular whorls of short tentacles. These tentacles may be capitate or any intermediate stage between capitate and filiform. (The same structure of tentacles has been observed by BERRILL (1952) for *Pennaria tiarella*). Below the aboral whorl of long filiform tentacles there is a slight thickening reminiscent of what is known as the parenchymatic cushion in *Tubularia* (p. 30). Below this thickening there is a circular constriction similar to the diaphragm of *Tubularia* (text-

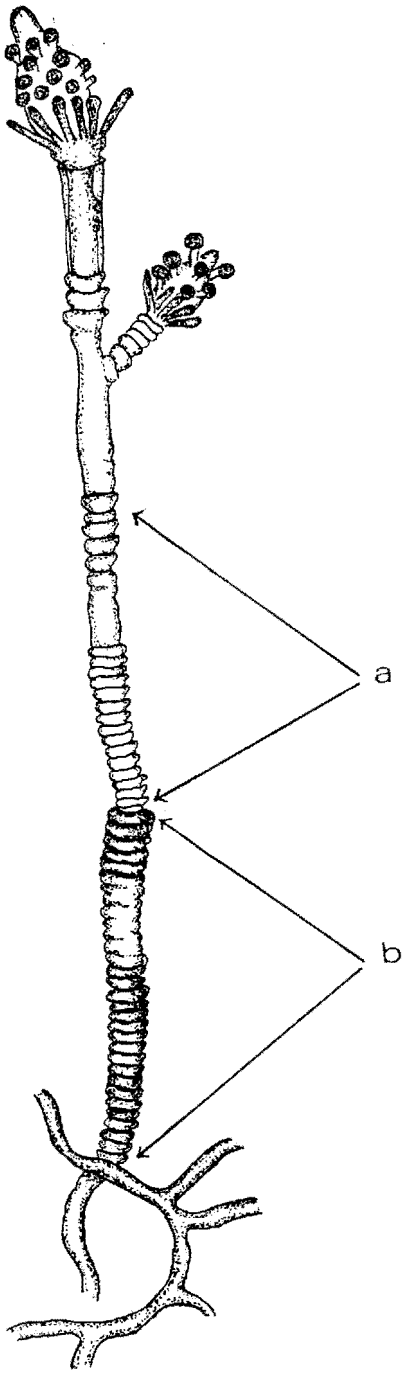
fig. 49). The medusa buds grow in the region above the aboral tentacle whorl. They develop into eumedusoids with a closed mouth, four perradial tentacle bulbs and no ocelli. The sexes are separated per colony. The medusae may shed their sexual products while still attached to the hydranths or they may break free; they do not swim but sink immediately to the bottom.



TEXT-FIG. 44. - Pennaria tiarella; *side branch with hydranths; material from the Museum of Comparative Zoology, Harvard.*

Liberated and non-liberated medusae occur on the same colony.

Shedding of sexual products takes place during the night. The medusa buds are covered by an ectodermal sheath which covers the medusae even when they are liberated (text-fig. 46).



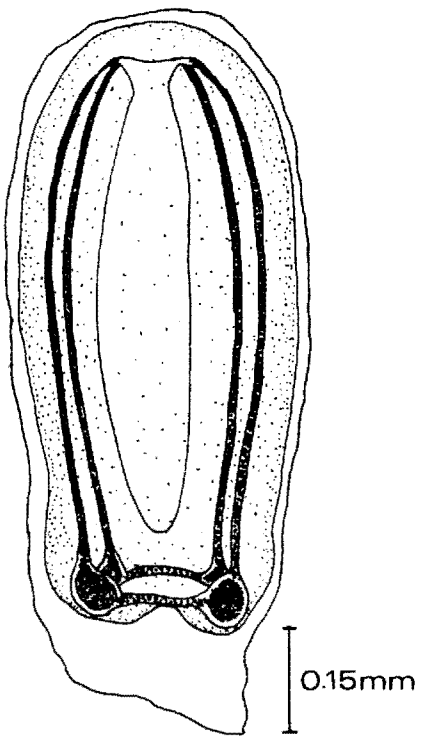
TEXT-FIG. 45. - Pennaria disticha; *regenerating; spring branch from old stolon;* a - *regenerating transparent stolon;* b - *stolon from the year before with brown and thick perisarc.*

Developmental stages

The development of the egg and the early development of the embryo have been studied in detail by HARGITT (1904 *a, b*, 1909) for *P. tiarella* and in part for *P. disticha.* The regeneration was studied by GAST & GODEWSKI (1903) and TARDENT (1963, 1965). BERRILL (1952) has given a detailed account of the gonophore development and the hydranth in adult colonies of *P. tiarella.* However nothing is known about the planula development and the primary hydranth in *P. disticha* and *P. tiarella.*

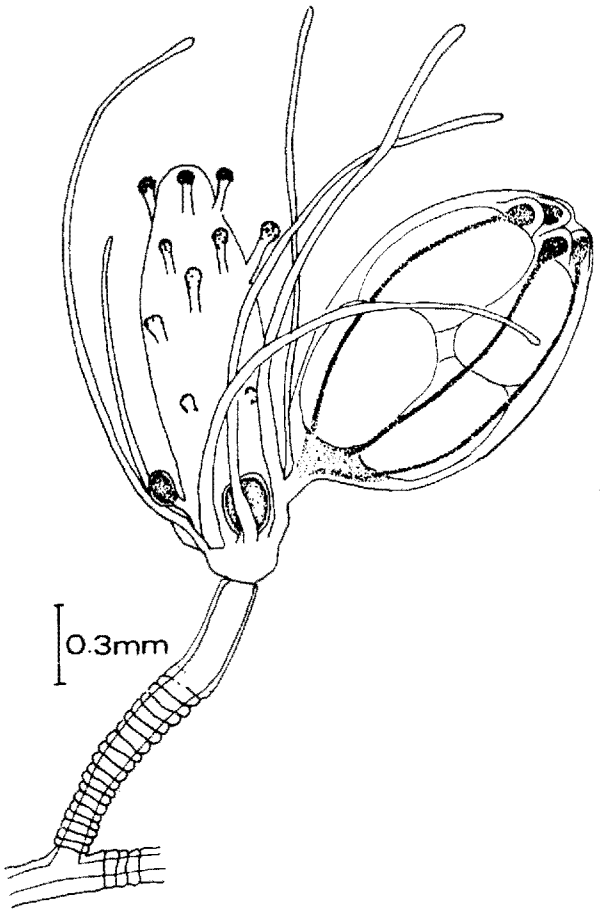
Ecology

Lo Bianco (1899, p. 460, 461) states that colonies of *P. disticha* (in his paper *P. cavolini*) can be found from May to November and then the polyps « die » and the colonies are covered by animals and algae. After having checked the occurrence of *P. disticha* throughout the year, I found that *P. disticha* is always present, but from November to February only in the hydrorhizal part, which can be easily distinguished from other species because no other hydroid has stolons so thick.



Text-fig. 46. - Pennaria disticha; *male liberated medusa after discharge of sperms; 12 hours after liberation with cover still present.*

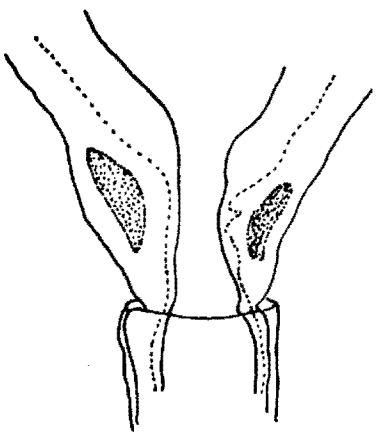
Collections of scrape material in February show the network-like hydrorhiza with parts of rising but broken off stems and with new stems growing from some of the old ones. The border between the old and the regenerating colony can easily be detected by the difference in the thickness of the perisarc and its colour (text-fig. 45): The old perisarc is dark brown and very thick; young perisarc thin and light brown. These regenerating hydranths grow to the typical feather-like *Pennaria* colonies in spring and start to produce gonophores in July. In October and November, probably through stormy weather, but perhaps through « aging » of the perisarc, the old colonies break away at the basal part of the main stem or even at the hydrorhiza (see also Tardent, 1963). As the Mediterranean waters have their minimum temperature in February, the start of regeneration can not be caused by rising spring temperatures.



Text-fig. 47. - Pennaria disticha; *hydranth with female medusa buds.*

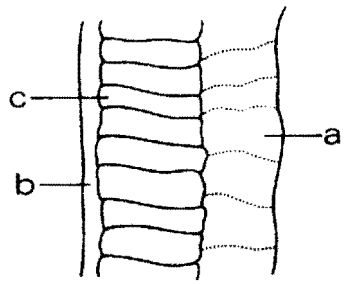
Discussion of the species

Mayer (1910, p. 24, 25) suggested that *P. disticha* Goldfuss and *P. tiarella* (Ayres 1854) might be subspecies, because only the degree of annulation varies in the two species. Fortunately I could obtain material of *P. tiarella* (Ayres) from the Museum of Comparative Zoology at Harvard University and compare it with the Mediterranean material of *P. disticha* Goldfuss. The following are the differences between the two species as shown in text-fig. 43 and 44.



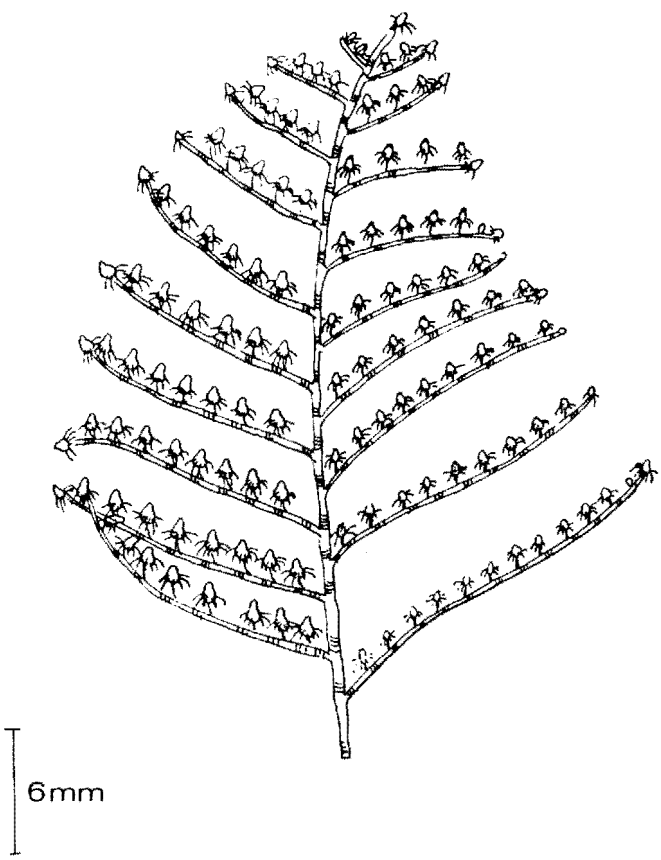
Text-fig. 48. - Pennaria disticha; *part of the hydranth below the aboral tentacle whorl with « parenchymatic cushion ».*

Pennaria tiarella (AYRES): Ramuli of one side branch elongating from distal (young) to basal (old). Basal ramuli may be three times as long as distal ones. Successive ramuli do not lie in one plane but diverge at an angle of 60° to 90°. Through this arrangement of the ramuli the appearance of the whole colony is more bush-like than in *P. disticha.*



TEXT-FIG. 49. - Pennaria disticha; *arboral tentacle showing thickening of ectoderm on its abaxial side.* a - *abaxial ectoderm;* b - *adaxial ectoderm;* c - *endoderm.*

P. disticha GOLDFUSS: Ramuli of one side branch do not significantly elongate from distal to basal. All ramuli of one side branch lie in the same plane. Appearance of the colony featherlike.



TEXT-FIG. 50. - Pennaria disticha; *general picture of a colony.*

FAMILY ACAULIDAE FRASER 1924

Introduction

The family Acaulidae was established for the genus and species *Acaulis primarius* STIMPSON 1854 from the Atlantic in the year 1923. Another species of *Acaulis, Acaulis ilonae,* has been described from the Mediterranean (BRINCKMANN-VOSS, 1965). The establishment of the family Acaulidae by FRASER has been accepted by most authors of today.

Definition of the family

Solitary hydroids with gelatinous perisarc which may split at its base to serve as an anchoring device. Numerous capitate tentacles are scattered distally to the aboral whorl of tentacles. The tentacles of the aboral whorl are either capitate or large and fleshy with scattered nematocysts.

The Acaulidae have one genus *Acaulis* STIMPSON 1854.

Genus *Acaulis* STIMPSON 1854

Generic characters

With characters of the family.

Type species: *Acaulis primarius* STIMPSON 1854.

The genus *Acaulis* is represented by one species, *Acaulis ilonae,* in the Mediterranean.

Acaulis ilonae BRINCKMANN-VOSS 1965

Pl. I, figs. 4-6; text-fig. 51

Synonymy

Acaulis ilonae BRINCKMANN-VOSS 1965, pp. 291-301, figs. 1-10.

Specific characters

Adult: Solitary hydroids with gelatinous perisarcal tube. One whorl of short oral tentacles and one whorl of long aboral tentacles. Between them a large number of scattered tentacles which increase in length towards the aboral region. All tentacles are capitate. Fixed gonophores in the axils of the tentacles of the middle region of the hydranth body.

Young: Same as adult, but fewer tentacles, nearly all of the same length and shorter than in the adult polyps.

Material seen: Gulf of Naples.

Material deposited: S.Z.N.; B.M.N.H., type B.M. No. 1963. 12.97.

Distribution

Acaulis ilonae has been found so far in the Mediterranean in the Gulf of Naples and in the English Channel near Roscoff (found by Dr. SWEDMARK according to a personal note from REES).

Material and Methods

The polyps were taken with a « mud-tangle » (p. 5) 20 to 80 m deep. Young stages of *A. ilonae* are to be fed with *Artemia*

salina, more adult ones with copepods and *Sagitta*, at least twice a week. The species is very easy to keep in the laboratory; it divides itself at 18° C and develops gonads in 13° C (p. 46).

Description of the species

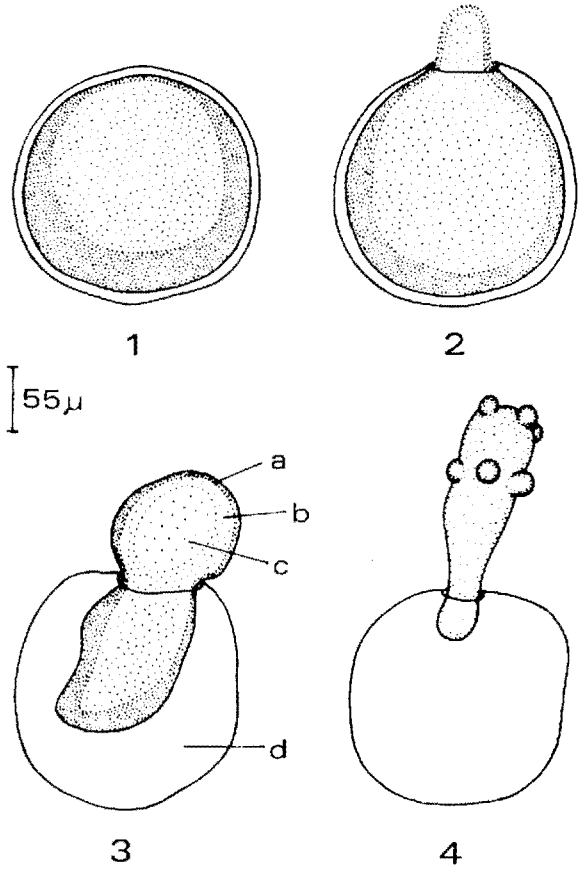
(For histological details see BRINCKMANN-VOSS, 1965).

The adult, sexually mature specimens have a height of 10.0 mm.

The hydroid is divided into two parts, the upper and tentacle bearing zone and the basal zone without tentacles, here called the « foot » of the hydroid. The tentacle bearing zone consists of an oral whorl of short and an aboral whorl of long, capitate tentacles. Both whorls consist of 4 to 5 tentacles each. Between the two circlets there are a number of scattered capitate tentacles; these are often arranged in groups of two or three around a gonophore.

The tentacles are solid. The gonophores are always situated in the axils of the tentacles. The oldest and largest gonophores lie in an area about halfway between the oral and the aboral whorl of tentacles. The younger gonophores are located above or below this region. Male and female sexual products are derived from different animals, the species is gonochoristic. The foot of the hydranth is surrounded by a gelatinous sheath, which sticks by its base to the bottom of the glass dish or on to small mud particles. The ectoderm of this region is very thin and the endoderm is highly vacuolated. The colour of the animals is pink to orange. There are a number of white dots on the surface. Very old specimens show a brownish colour. The cnidocysts are stenotheles, microbasic euritheles and desmonemes.

Developmental stages from the egg to the adult polyp. The eggs are usually shed during the night and the early morning hours. The eggs are 150 µ in diameter. The fertilization takes place in the seawater. The first division is equal and total. From the second division on, the divisions are irregular, but remain equal. Three to four hours after the first division a morula is formed. The morula stage does not swim, but lies on the bottom of the glass dish. Within twelve to twenty-four hours after the first division the morula attaches itself to the bottom of the dish. A flattened stage follows, which is covered with a thin, transparent cuticula. The cells show a sector-like apearance with their nuclei near the periphery. During the following day the cuticula hardens; since no stains penetrate into the cyst any more, it becomes difficult to observe the changes in the embryo. The cysts remain attached for about one month. After this period the differentiation of endo- and ectoderm inside the cyst can be seen (text-fig. 51). Two to three days later a small piece of the embryo begins to protrude from a small hole at the margin near the bottom. It takes the embryo two days to get out of the cyst, except for a small piece of its foot, which remains in it. The embryo is still without tentacles; only small bulbs in the oral and aboral region can be seen. Out of these protuberances the oral and the aboral tentacle whorls are developed within the next few days. Both tentacle whorls grow at the same time. In some specimens there is one tentacle more in the aboral than in the oral whorl.



TEXT-FIG. 51. - Acaulis ilonae; *hydroid;* 1-4 - *developmental stages from the embryo in its cyst to the young hydranth;* a - *ectoderm;* b - *endoderm;* c - *gastrocoel;* d - *empty cyst.*

One or two new tentacles between the primary tentacle whorls are formed three to four days after the first appearance of the oral and aboral tentacle whorl. If two tentacles appear, they are also arranged in a whorl. The following tentacles, however, are located in a scattered manner all over the body of the hydranth between the primary two tentacle whorls. There is no tentacle above the oral and below the aboral tentacle whorl. During the next two or three months (the exact date can not be given, because the time of development depends on food, temperature, etc.) the polyps attain a height of about 2.0 mm and develop a total of 29 to 35 tentacles. At this stage the polyps begin to show a slight circular constriction in the middle of the hydranth body. Just below this constriction a whorl of small tentacle bulbs is formed. Usually one day after this constriction has been observed, the hydroid is divided into two parts. The level of division is at the constriction observed before.

The formerly basal part of the hydroid remains attached (Plate I, fig. 5), whereas the formerly oral part of the hydranth assumes a spherical shape and lies unattached at the bottom of the glass dish (Plate I, fig. 6). After two days it loses its spherical appearance and the basal part of it grows in length to form a new

foot. It is attached to the bottom of the glass dish three to six days after the division. New tentacles begin to develop among the old tentacles in both hydroids. When the divided polyps reach a stage of 18 to 35 tentacles each (average 27 in 11 divisions observed), they undergo a new division in the same way as the first one. Ten to 45 days may pass between two divisions (average 19.3 days in 11 divisions observed). All these observations of the division stages were made at a temperature of 20° C. If the animals are kept at the same temperature, these divisions appear to go on and on, the polyps do not outgrow a maximum size of 2-3 mm and do not develop sexual products.

But polyps which had undergone one or two divisions in water at 20° C and which were then transferred into water at 13° C do not divide any more. They begin to grow in length, get more tentacles and develop gonophores in the axils of the tentacles. Likewise, specimens were observed that were put in 13° C water immediately. They also underwent one or two divisions, then grew in length, got more tentacles and developed gonophores. No example was so far seen to reach this stage without having first performed one asexual division. The first gonophores appear always in the middle region of the hydroid, followed by younger ones in the more oral and aboral region. New tentacles are formed very often on the side of the gonophores. Finally the fully developed and mature hydranths bear a number of the tentacles in groups around the gonophores.

Female and male hydroids continue to produce their sex cells for more than half a year. This is made possible because (1) young gonophores are still developed, when the older ones have shed their eggs or sperm for a longer period; (2) each gonophore has eggs or sperm in different maturation stages. A gonophore will contain all kinds of developmental stages from primary oocytes to fully developed eggs, or from primary spermatocytes to ripe sperm cells. Intervals of two to three days were noted between the shedding of mature sexual products and the next one, by one gonophore.

Half a year after the first complete development of sexual products the polyps do not eat well any more. They become reddish brown in colour. The tentacles begin to shrink. Finally the whole polyp undergoes a process of dissolution from which it does not regenerate.

Ecology

Acaulis ilonae is found on the surface of mud from 20 to 80 m depth. The species occurs in abundance around Naples in the winter months from November to April. So far it has not been found there from July to October.

Most of the specimens were found in a period of four years. The process of liberation of the hydroid from the cyst, as described above, is performed only when the cysts are kept in water at 13° C. If they are kept at 20° C, the percentage of liberated hydroids is very low. Concluding from the fact that the gonophores develop only in lower temperatures in the laboratory, it is supposed that the adult hydroid may be found in deeper regions. In the summer period. when no hydroid findings are recorded, the animals are probably present in their cyst stage. This assumption is supported by the fact that the cysts remain unchanged and the animals do not get free when the cysts are kept at 20° C in the laboratory. The cyst stages have not been found in nature, probably because they are too small.

Habits

Acaulis ilonae is able to make slight movements. As it moves, the tip of the ectoderm of the foot detaches itself from the surrounding gelatinous tube. Thus an empty space is formed between the ectoderm and the tube. During the movement, new tube material is formed successively at the more upper region of the hydranth foot and the polyp leaves a spur behind which is composed of the remnants of the empty tube.

When food is put in the glass dish, the polyp elongates considerably. As soon as copepods or *Sagitta* get into contact with the tentacles of the polyp they stick to the tentacles and become motionless. Then the oral region of the outstretched polyp bends around to the food and moves the mouth opening right over its prey.

Systematic discussion

Acaulis ilonae differs from *A. primarius* STIMPSON in that it has no filiform tentacles. *A. ilonae* differs from a third species of *Acaulis*, thought to be the adult stage of *A. primarius* by STIMPSON and FEWKES, in having small capitate tentacles in the mouth region and longer tentacles towards the aboral region of the hydranth, whereas *A.* sp. only has very small capitate tentacles throughout. Also, tentacles in the aboral region of *A. ilonae* are two to three times larger than the gonads, whilst in *A.* sp. the gonads are larger than the tentacles (FEWKES, 1890). No other species of the genus *Acaulis* has been described.

FAMILY CORYNIDAE JOHNSTON 1836

Introduction

The family, Corynidae, poses extraordinary difficulties for a natural classification of its genera. This is caused by the fact that there are very few characters for hydroid and medusa stages which are constant and would allow a consistent separation into genera. RUSSELL (1953, p. 47-49) explained these difficulties clearly in his monograph. PICARD (1958) suggested uniting all but two species of the Corynidae into the one genus *Coryne*, while the remaining two species would belong to the only other genus, *Sphaerocoryne*, which has only one tentacle whorl in the middle of the hydranth and is not Mediterranean (see also VANNUCCI, 1949). I am inclined to favour PICARD'S opinion with one exception.

Having extensively studied certain and uncertain species of the Mediterranean Corynidae, I am presenting this family in two genera for the Mediterranean: *Coryne*, corynid hydroids with fixed gonophores; *Sarsia*, corynid hydroids with free medusae. (In a revision of Corynidae of the world there should be five genera: *Coryne, Sarsia, Sphaerocoryne, Hydrocoryne* and *Linvillea;* but the systematic position of *Linvillea* within the Corynidae remains doubtful, on account of its exumbrellar cnidocyst tracks). I am perfectly aware that « fixed gonophores or free medusae » is not the ideal generic character generally; however in the Corynidae it is a much more constant character than for instance « with reduced filiform tentacles or not » or « tentacles arranged in whorls or not ». Both these later features have been used to separate genera up to now. But I have observed that these characters can vary in one colony. PICARD (1958 *b*) and PENNYCUIK (1959) made similar statements about the variability of tentacles in the Corynidae. In defense of my decision to uphold *Sarsia* as a genus of its own and not unite it with *Coryne*, may I point out that, basically, the possession of free medusae is the distinctive characteristic between *Ectopleura* and *Tubularia* and has never been challenged. I am not trying to outrule RUSSELL'S monograph (1953) or KRAMP'S synopsis (1961). However as far as any of the Mediterranean Corynidae are concerned, I consider them to represent two genera, *Coryne:* corynid hydroids with attached gonophores, and *Sarsia:* corynid hydroids with free medusae. (These two generic distinctions are only valid for the Mediterranean species). Besides these two genera *Coryne* and *Sarsia* there is a genus *Dicodonium* HAECKEL which has been kept within the Corynidae until now. But the type species of *Dicodonium, D. cornutum* HAECKEL is not a corynid at all, therefore the whole genus needs a revision. The only species of *Dicodonium* reported for the Mediterranean is *D. adriaticum* GRAEFFE. This species is also not a corynid, but bears all the characters of a young pandeid and will therefore be described in the Pandeidae.

It should go without saying that there has to be one generic name for hydroids and medusae of one and the same species. This basic fact has not always been respected as yet. See for example, the so-called genus *Syncoryne*, which actually is nothing but the hydroid phase of a *Sarsia,* and the generic name *Sarsia* has priority and should therefore be retained. There are more examples which I have come across by observation of total life-cycles.

Definition of the Family Corynidae JOHNSTON 1836

Hydroids branched or unbranched rising from a creeping stolon or encrusted base; with capitate tentacles only or with an additional whorl of small filiform tentacles always situated below the capitate tentacles. Fixed gonophores or free medusae; medusae « with simple circular mouths, with four radial canals, with gonads completely surrounding stomach, with four equally developed hollow marginal tentacles, with ocelli on marginal tentacle bulbs » (RUSSELL 1953, p. 47).

Genus *Coryne* GAERTNER

Generic characters

Upright colonies with branched or unbranched stems. Perisarc enclosing the colonies up to the base of the hydranth. Capitate tentacles either scattered or in whorls. With or without filiform tentacles below the capitate ones. Fixed gonophores either in the axils of the tentacles or between them or below the tentacle whorls. The following species of the genus *Coryne* have been recorded from the western Mediterranean: *Coryne caespes* ALLMAN, *Coryne epizoica* STECHOW, *Coryne muscoides* (LINNÉ), *Coryne pusilla* GAERTNER, *Coryne vanbenedeni* HINCKS, *Coryne fucicola* DE FILIPPI, *Coryne pintneri* (SCHNEIDER).

Type species: *Coryne pusilla* GAERTNER 1774.

Coryne caespes ALLMAN 1871

Synonymy

Coryne caespes ALLMAN 1871, p. 270 (hydroid).

Specific characters

See description of the species.

Material seen: None.

Material deposited: None.

Distribution

Outside the Mediterranean: none.

Mediterranean: Described only from the Gulf of La Spezia, Italy (ALLMAN, 1871-72).

Description of the species

ALLMAN (1870-71, p. 70): «Trophosome — Hydrocaulus scarcely exceeding a quarter of an inch in height, unbranched, or occasionally with one or two simple branches; irregularly annulated, the stems all closely crowded upon a hydrorhiza, which is formed by a creeping entangled mass of tortuous tubes. Hydranth elongated with about twenty-five tentacles. Gonosome — Sporosacs globular, scattered on the lower portion of the hydranth, where they spring by short peduncles from the axils of the tentacles ».

Ecology

ALLMAN writes that this species lives about two feet (0.6 m) below the surface of the sea at low water in the zone of the *Cystoseira.* It spreads over the surface

of submerged rocks and forms a dense moss-like growth. Gonophores were observed in March.

Discussion of the species

Although this species has not been described again since ALLMAN, it is apparently distinguishable from other species of *Coryne* by its moss-like growth.

Coryne epizoica STECHOW 1921
Text-figs. 52, 53

Synonymy

Coryne sp., GRAEFFE 1884, p. 351 (hydroid).
Coryne epizoica, STECHOW 1921c, p. 248 (hydroid).

Specific characters

Single hydroids arising directly from a creeping stolon.

Hydroid stem enclosed in a brown, annulated perisarc which extends up to the base of the hydranth. No enlargement of the perisarc below the tentacles. Hydranth with capitate tentacles which are usually scattered but show a tendency towards arrangement in whorls. Gonophores borne in groups of one to five below the tentacle zone in the perisarcal zone. Only young gonophores are known; whether these remain fixed or develop into free medusae is not known yet.

Material seen: Naples, Italy; Villefranche sur mer, France.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Outside Mediterranean: none

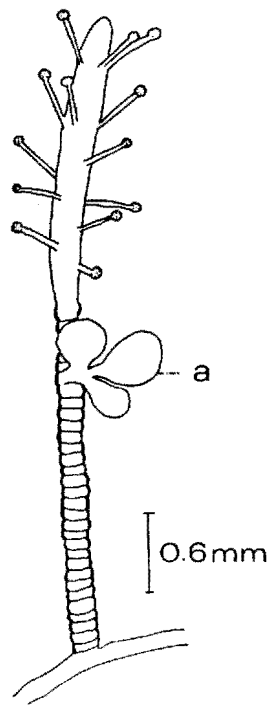
Mediterranean: If GRAEFFE's *Coryne* sp. was a *Coryne epizoica* then *C. epizoica* was found at Trieste, Yugoslavia (GRAEFFE, 1884), Naples, Italy (STECHOW, 1921, 1923; author). Villefranche sur mer, France (author).

Methods of collection and cultivation

The colonies, which are exclusively found on small prosobranch shells in the Posidonia beds, 20 to 40 m deep, can be obtained with a coarse stramin net which is drawn over the Posidonia grounds. The colonies stay well alive at 20° C either left on the shells or detached from the shells and growing on glass. Sterile colonies soon start to develop gonophores in the laboratory, but the gonophores stop growth before sex cells become distinguishable. No colonies with ripe gonophores were found in the sea either. The species feeds well on *Artemia*.

Description of the species

The stem of the hydroid measures 1-3 mm. The hydranth is 1-2 mm long. The surrounding brown perisarc is annulated throughout, even under culture conditions. This is one good character for the species. It is very difficult to decide whether the tentacles are scattered or arranged in whorls: Usually the five or six oral tentacles are arranged in one whorl. Basal to this oral whorl tentacles are arranged so that usually two, sometimes three tentacles lie in one plane. The gonophore-like buds do not develop on the hydranth but on the upper part of the stem which is already enclosed in perisarc (text-fig. 52). Nothing is known about the production or type of the mature gonophores. Young gonophores were obtained several times from cultures and also from animals taken from the sea. However ripe gonophores have not been seen. Therefore it is still unknown whether the gonophores grow into free medusae or remain sessile.



TEXT-FIG. 52. - Coryne epizoica; *hydranth with gonophores;* a - *gonophores.*

However sections through these buds (text-fig. 53) indicate clearly that they must be sexual organs, because they consist of an ectodermal layer, entocodon and gastrodermis. The sections look similar to the young gonophore stages of *Coryne pusilla* figured by KÜHN (1910, pl. 5, fig. 23). A careful histological study of different stages would be necessary for clarification.

When taken from the sea the colour of the hydranth is a reddish brown. The perisarc is light to dark brown. Perisarc which develops under laboratory conditions is much lighter.

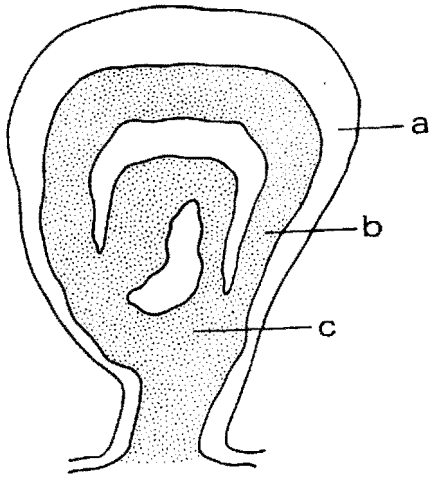
Cnidocysts are stenotheles and desmonemes.

Developmental stages

Nothing can be said about the development of the eggs, embryo and primary hydroids because these stages have not been seen as yet. In regenerating hydroids, the one or two oral tentacle whorls are the first to appear and later the more aboral ones are formed.

Ecological observations

Around Naples and Villefranche, this hydroid was always found on small mollusk shells, usually *Rissoa* sp., in the Posidonia beds 20 to 40 m deep. It may be collected throughout the year.



TEXT-FIG. 53. - Coryne epizoica; *section through a gonophore;* a - *ectoderm;* b - *endoderm;* c - *gastrodermis.*

Systematic discussion

STECHOW (1921) described this species without gonophores. There was never any dispute about the identity of this species, because it has this specialized biotop on *Rissoa* shells, the annulated perisarc and no ramification of the stems. RIEDL (1958) reported the species from the entrance of a cave living amongst algae. As his specimen was without gonophores and not from the environment which is typical for *C. epizoica,* I suppose that RIEDL's specimen was not *C. epizoica* but rather *C. pusilla.*

Coryne muscoides (LINNÉ 1761)
Text-figs. 54-56

Synonymy

Coryne vaginata HINCKS 1861, p. 295 (hydroid).
Coryne muscoides BEDOT (1918, p. 110) (hydroid) listing synonymy from 1800 to 1900.
Coryne muscoides STECHOW (1919, p. 4).

Specific characters

Corynidae with upright colonies dichotomously branching. Perisarc always annulated extending up to the aboral tentacles. Below the aboral tentacles the perisarc enlarges and forms a calyx-like opening in which the hydranth is partly retractile. All tentacles capitate, arranged in three or four whorls. Fixed gonophores born in the axils of the tentacles of the two aboral whorls.

Material seen: Naples, Villefranche, Banyuls (Mediterranean).

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Outside Mediterranean: Devonshire, England (HINCKS, 1861).
Mediterranean: Naples, Italy (STECHOW, 1919; and author); Villefranche and Banyuls, France (author).

Methods of collection and cultivation

Hydroids of *C. muscoides* can be collected in the rocky littoral 1 to 2 m deep often among *Corallina* sp. algae. It is very common in all outer parts of the gulf of Naples. The species is easy to grow in the laboratory, but it develops fewer branches there than in nature.

Description of the species

The colonies measure 1 to 5 cm in height. Usually there is one main stem which grows into two or three large side branches shortly above the hydrorhiza. These large side branches give off short side branches in a manner that was described by KÜHN (1913) as « racemöse Verzweigung ». However the length of the colony and the regularity of the branching depends much on the environment.

Colonies which are found among large *Corallina* sp. algae display the most regular branching. It seems that they are best protected in the vicinity of these algae. Colonies which are more exposed are much smaller and without a regular branching pattern.

One of the most significant characters of the species is the calyx-like enlargement of the perisarc below the hydranths. A second layer of perisarc develops inside the calyx in older hydranths (text-fig. 55). This « inner » layer of perisarc is not dilated at its opening. The perisarc is annulated throughout. The tentacles are arranged in three to four whorls.

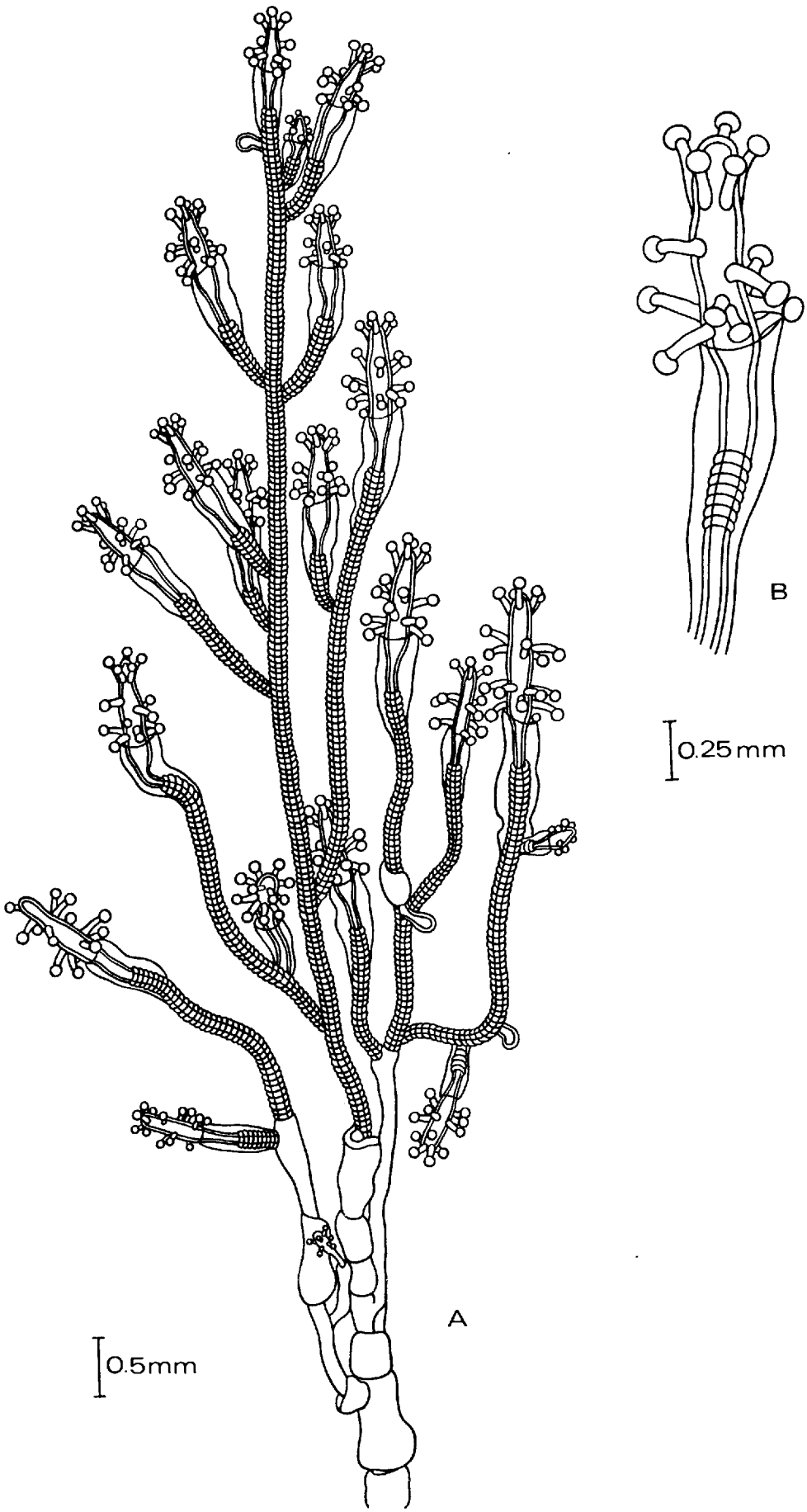
The single tentacles of successive whorls alternate in their position. The distance between successive tentacle whorls decreases from the oral to the aboral end of the hydranth. In young immature sterile colonies, the hydranths usually have but three tentacle whorls. The fourth tentacle whorl will appear during the development of the gonophores. The gonophores are situated in the axils of the 3rd and 4th tentacle whorl, those of the 3rd whorl being the older ones. The colour of the hydranths is pink. The perisarc is brown in old colonies but rather transparent in young branches. The cnidocysts are stenotheles ad desmonemes.

Developmental stages

Nothing is known about the development of the embryo and the primary polyp. I observed the development of the tentacles in different growth stages of hydranths in the same colony. Numbering the tentacle whorls as they are present in adult hydranths in an oral to aboral direction with numbers 1 to 4, we see the following appearance of tentacle whorls in young hydranths: 1 and 2 are the first to appear. Sometimes 2 appears before 1. Thereafter the whorl 3 is developed,

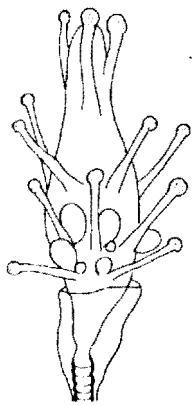
and very often gonophores occur in the axils of whorl 3 before whorl 4 appears. The tentacles of the fourth whorl are always the last ones to grow (text-fig. 56).

I have not observed this interesting sequence in tentacle growth in sufficient detail in other species of *Coryne*. The matter is worth some study. If the same pat-



TEXT-FIG. 54. - Coryne muscoides; *colony without gonophores;* a - *entire colony,* b - *enlarged hydranth, drawn by* ILONA RICHTER.

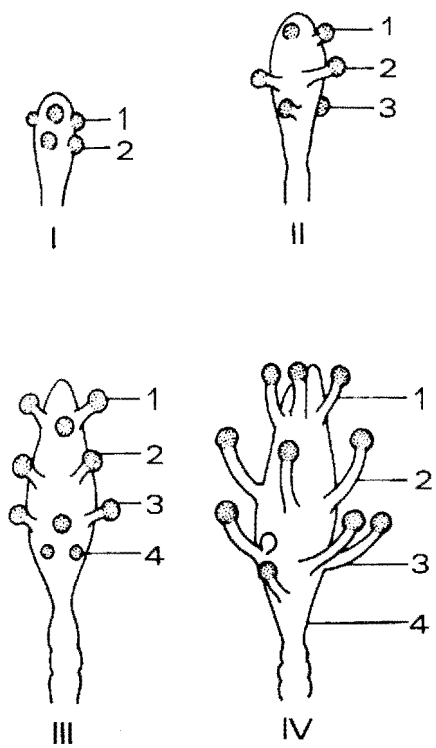
tern of development occurs in the other species of *Coryne*, it would constitute a difference between the genus *Coryne* and the « lower » capitate hydroids (*Tubularia*), where the aboral tentacle whorl is the first one to appear.



TEXT-FIG. 55. - Coryne muscoides; *hydranth with gonophors.*

Ecology

Colonies were collected by the author in February, April, May and August. These colonies carried gonophores only in May, both in Naples and in Banyuls. STECHOW (1919, 1921) reported *C. muscoides* with gonophores from Naples in March, from other localities of the Mediterranean in October, April and February.



TEXT-FIG. 56. - Coryne muscoides; *appearance of tentacle whorls in developing hydranths from the same colony;* 1-4 - *number of tentacle whorls according to their appearance.* I - *young hydranth with buds of tentacle whorl* 1 *and* 2; II - *tentacle whorl* 1 *and* 2 *developed,* 3 *appears in form of buds;* III - 1 *to* 3 *developed,* 4 *appears with small buds;* IV - *begin of gonophore development at the level of whorl* 3; *whorl* 4 *develops.*

Coryne muscoides is one of the rare athecate hydroids living in a region which may sometimes be exposed to the air. Usually it grows amongst the tufts of *Corallina* sp. algae which live in exposed areas only one or two feet below sea-level, which may be left uncovered by sea-water during low tide. I suppose that *C. muscoides* is able withstand these conditions thanks to its perisarcal sheath.

Systematic discussion

The species was described by LINNÉ (1761). HINCKS (1861) described it under the name *C. vaginata*, but BEDOT (1910, 1912) pointed out that LINNÉ's name and description have priority.

Coryne pusilla GAERTNER 1774
Text-fig. 57

« I believe it to be quite impossible to settle with any approach to certainty what the *C. pusilla* of GAERTNER was. The name has been applied to many different forms, has almost been used as a general appelation for anything corynid, and it is a serious question whether it would not be wise to discard it altogether ». So far HINCKS (1868, p. 38), a hundred years ago and the confusion about *C. pusilla* has not decreased since.

The species which is here described from Naples does agree with the *C. pusilla* found by STECHOW in various places in the Mediterranean (STECHOW, 1919, p. 5) but nobody can be sure if this is actually the *Coryne pusilla* of GAERTNER. The only possibility for identification of forms resembling *Coryne pusilla* is, to mention by which author's description and illustration the identification was made. (For instance: *Coryne pusilla* identified after JÄDERHOLM, 1909, pl. I, figs. 1-3).

Synonymy

Coryne pusilla GAERTNER 1774, fasc. X, 40, b, tab. 4, fig. 8.
Coryne glandulosa LAMARCK 1816, Vol. 2, p. 62.
Syncoryne pusilla EHRENBERG 1834, p. 294.
Hermia glandulosa JOHNSTON (1838, p. 111, fig. 2, pl. 4, figg. 1, 2).
Coryne pusilla STECHOW (1919, p. 5, fig. A).

As mentioned above it is nearly impossible to give a synonymy of *C. pusilla*. See BEDOT I-VI (1901-1918).

Specific characters

« Stem rather stout, irregularly and sparingly branched; polypary of a dark horn-colour, closely and distinctly annulated throughout; polypite long, linear, very slender, scarcely tapering towards the lower extremity, reddish; tentacles very numerous (30 or more), (less for Mediterranean species, author) rather long and slender, and not expanded at the base, subverticillate; gonophores scattered over the body ». (HINCKS, 1868, p. 39).

Material seen: Gulf of Naples; material from Norway (collection from Harvard).

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Outside Mediterranean: all European coasts (JÄDERHOLM, 1909).

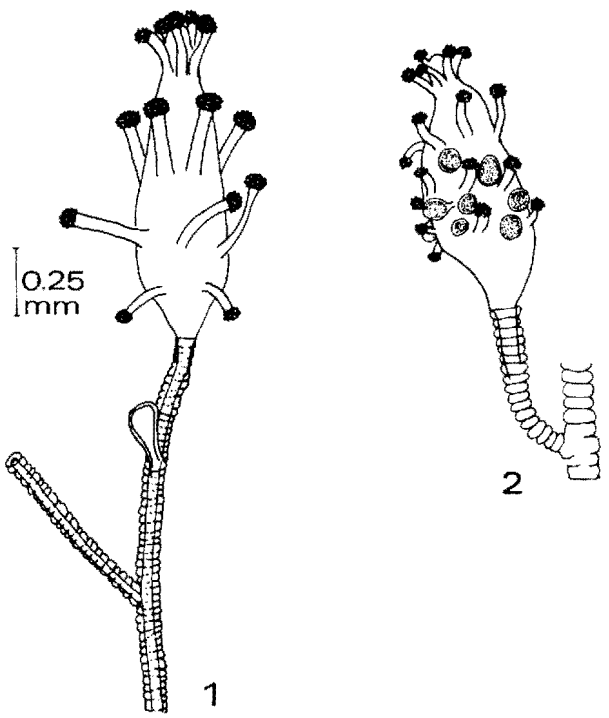
Mediterranean: (see discussion of the species). Adriatic sea (HELLER, 1868; BABIC, 1904); Rovigno, Yugoslavia; Corsica, Marseille, Villefranche, France; Genova, Naples, Italy (DU PLESSIS, 1881 *a, b*; STECHOW, 1919; LO BIANCO, 1909); Athens, Greece (YAMADA, 1965). However only STECHOW's specimens from Genova agree with the one described in this Monograph for Naples. All other Mediterranean records of *C. pusilla* are doubtful, because they are lacking a description or illustration.

Methods of collection and cultivation

C. pusilla was found 2 m deep in the cave of Capo Miseno. It was not kept in the laboratory.

Description of the species

Once again I want to point out that the following description is a dubious *C. pusilla* GAERTNER, just as are all the other references in literature to this « species ». My observations are based on living material I found in Naples and agree with the animal described by STECHOW (1919, p. 5) for various Mediterranean localities as *C. pusilla.*



TEXT-FIG. 57. - Coryne pusilla; 1 *from Naples;* 2 *after* STECHOW 1919, fig. A.

The colonies of *Coryne pusilla* attain a height of 10 mm; the hydranth (preserved in 10 % form) is 1.0 to 1.2 mm high. The colonies are slightly branched with 3 to 4 side branches. The perisarc is annulated throughout the stem and branches, however not as strongly as in *C. muscoides* (p. 50). There is no widening of the perisarc below the hydranth. The hydranth is spindle-shaped, with a conical proboscis, in some specimens with a slight constriction above the oral tentacle whorl. Tentacles are arranged in three to four whorls carrying usually five tentacles each. In living specimens the perisarc is light to medium brown, the hydranths are red brown with white dots, this being a good distinguishing character from *Coryne pintneri* which is always flesh-coloured.

Developmental stages

Not seen.

Ecology

Colonies of *C. pusilla* were found around Naples only in shaded places of the cave of Capo Miseno among *Peysonellia* sp. algae. Gonophores were observed in May.

Habits

Not observed.

Discussion of the species

Our specimens agree with the illustration given by STECHOW (1919, p. 5, fig. A). It is doubtful, whether LO BIANCO's *C. pusilla* and WEISSMAN'S *C. pusilla* var. *neapolitana* are *C. pusilla* or rather *Coryne pintneri;* the latter species is much more common and occurs very often without filiform tentacles and is then very similar to *C. pusilla* (see p. 51). Unfortunately neither LO BIANCO nor WEISSMAN (1883) give any sketch of the whole hydranth or the colony of *C. pusilla.*

Coryne vanBenedeni HINCKS 1868

Synonymy

Coryne vanBenedeni HINCKS 1868, p. 45-47, pl. 9, fig. 1.
Syncoryne pusilla VAN BENEDEN 1844, p. 52, pl. III, figs. 1-10.
Actinogonium pusillum ALLMAN 1871-72, p. 272.

Coryne vanBenedeni HINCKS 1868 is mentioned by SCHNEIDER (1897) from Rovigno with one colony. However SCHNEIDER does not remark on the typical gonophores of *Coryne* VAN BENEDEN at all. His description of the trophosome is so general, that it can be any corynid. This record of *C. vanBenedeni* for the Mediterranean is therefore extremely doubtful. ALLMAN (1871-72) discusses the status of *C. vanBenedeni* of HINCKS and points out that this species is not a *Coryne* because of its *Tubularia*-like type of reproduction. He therefore established a new genus, *Actinogonium,* and retained the old species name *pusillum* of VAN BENEDEN.

Coryne fucicola DE FILIPPI 1866
Text-fig. 58

Synonymy

Halobotrys fucicola DE FILIPPI 1866, p. 383, pl. 2 (hydroid).
Coryne fucicola CARUS (1884, p. 2) (hydroid).
Halobotrys fucicola DU PLESSIS (1888, p. 533) (hydroid).
Coryne vermicularis DU PLESSIS (1888, p. 533) (hydroid).

Specific characters

Upright, simply branched colonies; each branch quite distant from the other; hydranths clubshaped, situated at the tip of the branches; capitate tentacles, which are numerous, scattered and distant from each other.

Gonophores simple, not medusiform, between the tentacles (after DE FILIPPI, 1866, p. 383).

Material seen: None.

Material deposited: None.

Distribution

Outside Mediterranean: None
Mediterranean: Torin (in an aquarium), Italy (DE FILIPPI, 1866); Villefranche, Balaguir, France (DU PLESSIS, 1888).

TEXT-FIG. 58. - Coryne fucicola *after* DE FILIPPI 1866, pl. 2.

Methods of collection and cultivation

C. fucicola was found by DE FILIPPI between *Corallina* algae in the aquarium. Apparently this species was easy to keep because DE FILIPPI describes the quick development of new hydranths and gonophores in the acquarium.

Description of the species

The colonies of *C. fucicola* attain a height of 40 mm.

The stem and the hydrorhiza are enclosed in a thin perisarc which does not widen below the hydranth. The hydranth measures 5-6 mm from the end of the perisarc to the mouth of the hydranth. There are numerous scattered tentacles. The gonophores which develop between the tentacles are simple, styloid.

The hydranth body is pink, its tentacles white, seen in reflected light (after DE FILIPPI, 1866, p. 384).

Discussion of the species

DU PLESSIS (1888) united *C. fucicola* DE FILIPPI with *C. vermicularis* HINCKS. I checked original descriptions of both species and found that, apart from the length of the hydranth, these two species are quite different: *C. vermicularis* is much more branched and has fewer tentacles than *C. fucicola.* It may be very well that the *C. fucicola* of DU PLESSIS was the above described *C. pusilla* (p. 51).

PICARD (1958 *a*) united *Coryne pintneri* with *C. fucicola* without giving a reason for it. I maintain that *C. pintneri* can not be united with *C. fucicola,* because the hydranths of *C. pintneri* are much smaller and have fewer tentacles than *C. fucicola.* In addition to this, *C. pintneri* always has filiform tentacles under aquarium conditions but *C. fucicola* has not.

It will be very difficult to identify *C. fucicola* in the future because it was not described from its natural environment but from an aquarium and DE FILIPPI's specimens show the typical slender hydranths which corynid hydroids develop under aquarium conditions.

Coryne pintneri SCHNEIDER 1897
Pl. 3, fig. 5; text-figs. 59-64

Synonymy

Coryne pintneri SCHNEIDER 1897, p. 476, 493.
Coryne pintneri BEDOT 1918, p. 110.
Stauridia pintneri STECHOW (1923, p. 47).
Staurocoryne pintneri REES (1936, p. 140).

Specific characters

Small colonies not exceeding 2 cm in height and irregularly branched; perisarc feebly annulated. The annulation is never as marked as in *Coryne epizoica* or *Coryne muscoides. Hydranths* (adult) with 4 to 5 whorls of capitate tentacles. Below them a whorl of 2 to 6 short filiform tentacles which are often absent however always present in regenerating hydranths. Fixed gonophores borne in the axils of the 3rd to 5th tentacle whorl.

Material seen by the author: Naples, different regions of the Gulf, common.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

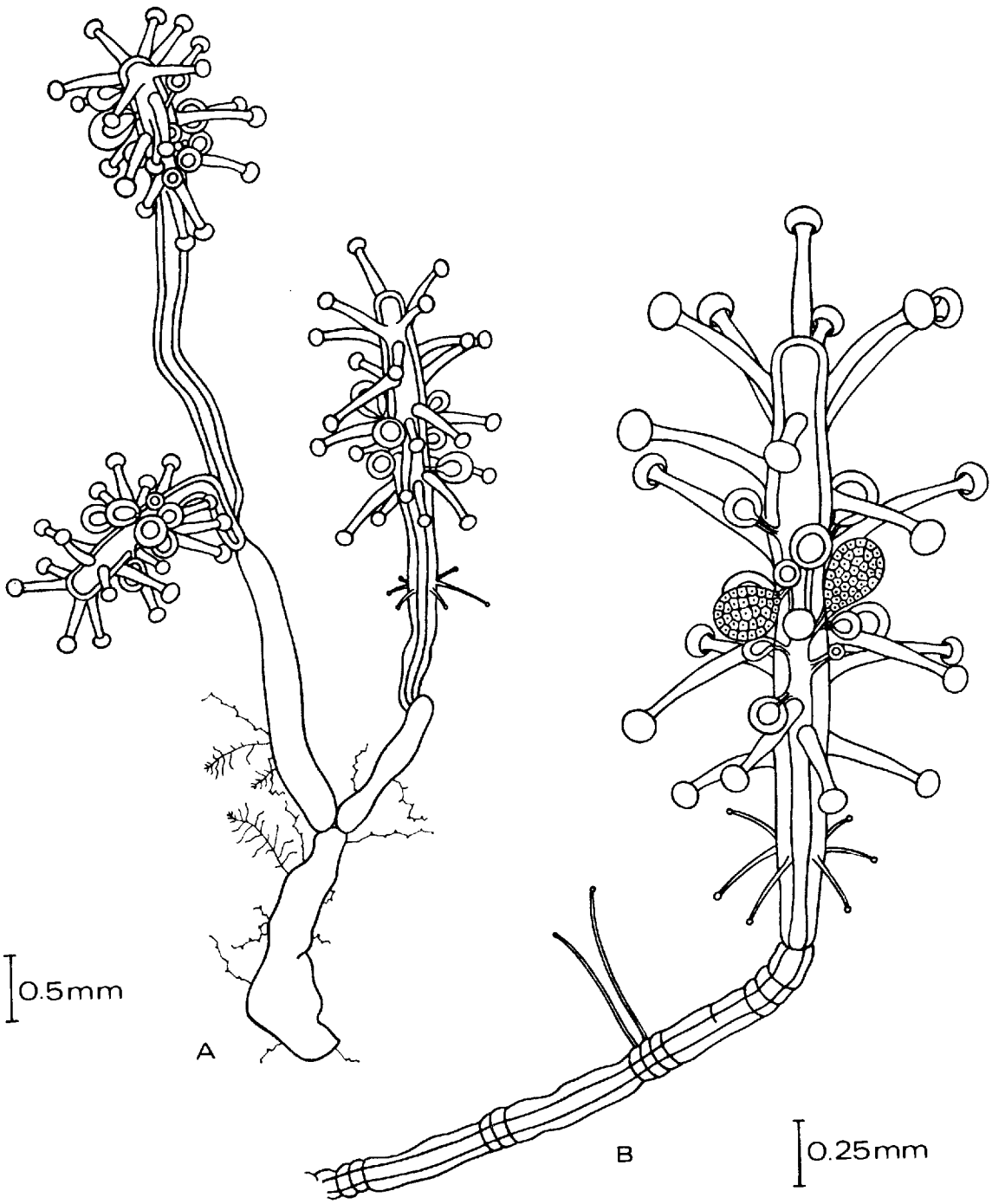
Outside Mediterranean: none.
Mediterranean: Adriatic Sea (SCHNEIDER, 1897); Naples, Italy (author).

Methods of collection and cultivation

The colonies living in the *Posidonia* beds were dredged together with the whole *Posidonia* plants; colonies which live in shady places of the littoral (see ecology, p. 57) were scraped off together with the algae on which they lived. The hydroids were then isolated in the laboratory and kept in large boveri dishes at 18 to 20° C. They were fed three times a week with *Artemia*. Hydroids coming from the sea usually degenerate after a few days, but regenerate quickly and then produce gonophores.

Description of the species

The colonies of *C. pintneri* are sparsely branched (text-figs. 59, 60). They seldom have more than five side branches. The height of the colony does not exceed 2 cm. Colonies from cave material 2 m below surface often show no branching at all and do not exceed 1 cm in height. The perisarc is not very thick, rather smooth, yellowish and extends up to the filiform tentacle whorl of the hydranth. Frequently it has 2 or 3 annulations separated by smooth intervals (text-figs. 59, 60). In colonies from *Posidonia* roots the perisarc can be covered with calcareous algae (text-fig. 59). The length of the living hydranths (mouth to aboral capitate tentacle whorl) measures 1.2 to 1.6 mm. The tentacles from specimens coming directly from the sea are usually arranged in



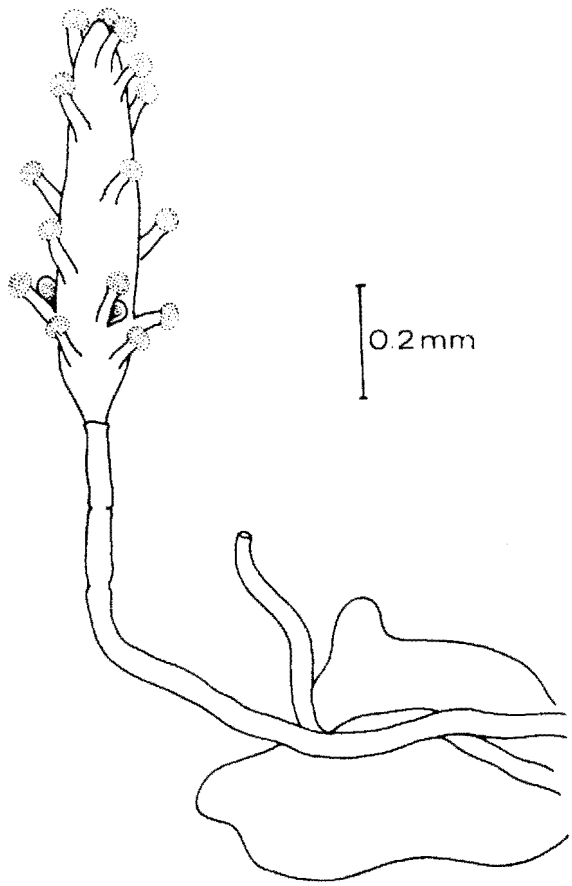
TEXT-FIG. 59. - Coryne pintneri, *hydroid from* Posidonia *roots, 20 m deep.* A - *male colony;* B - *female hydranth. Note that filiform tentacles are present in one hydranth and not in the two others of the same colony; drawn by* ILONA RICHTER.

whorls of four tentacles each and successive whorls are arranged crosswise. However often a tentacle whorl consists only of two tentacles and consequently the arrangement of tentacles becomes less regular. Text-fig. 63 shows the tentacle position from different hydranths of one colony. Below the capitate tentacle whorls there is a whorl of 2 to 6 filiform tentacles. Very often these filiform tentacles are missing either in some hydranths of the colony or throughout a colony. In material taken from rocks 1 to 2 m below the water surface the filiform tentacles appear very seldom, whereas in colonies from the *Posidonia* regions 20 to 30 m deep the filiform tentacles occur regularly. Regenerating colonies from both locations always develop filiform tentacles in the aquarium.

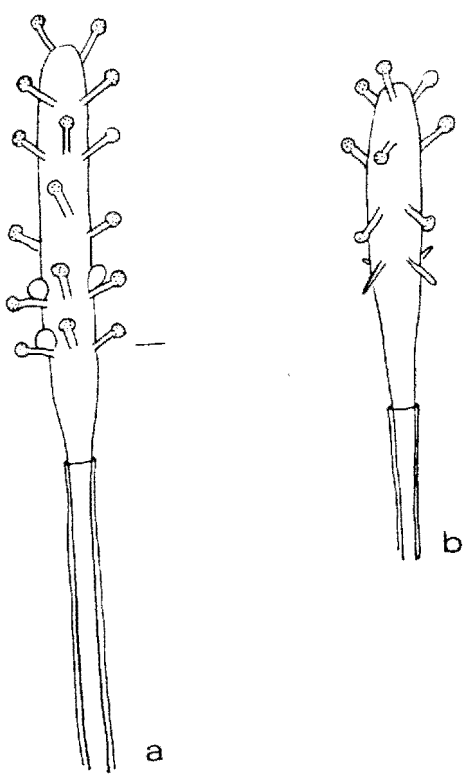
TEXT-FIG. 60. - Coryne pintneri; *male colony growing on* Peysonellia *sp. from cave material 2 m deep. Note that filiform tentacles are only present in a few hydranths. Drawn by* ILONA RICHTER.

(Colonies of other species of *Coryne* do not develop filiform tentacles in regenerating cultures).

Regenerating hydroids of *C. pintneri* have only three tentacles a whorl. This was mentioned also for *Staurocoryne filiformis* by REES (1936). A similar observation has been made by DRZEWINA & BOHN (1916) for a *Stauridium* species.

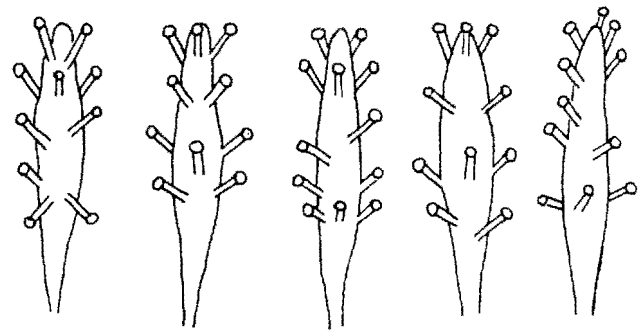


TEXT-FIG. 61. - Coryne pintneri; *hydranth without filiform tentacles from cave material.*



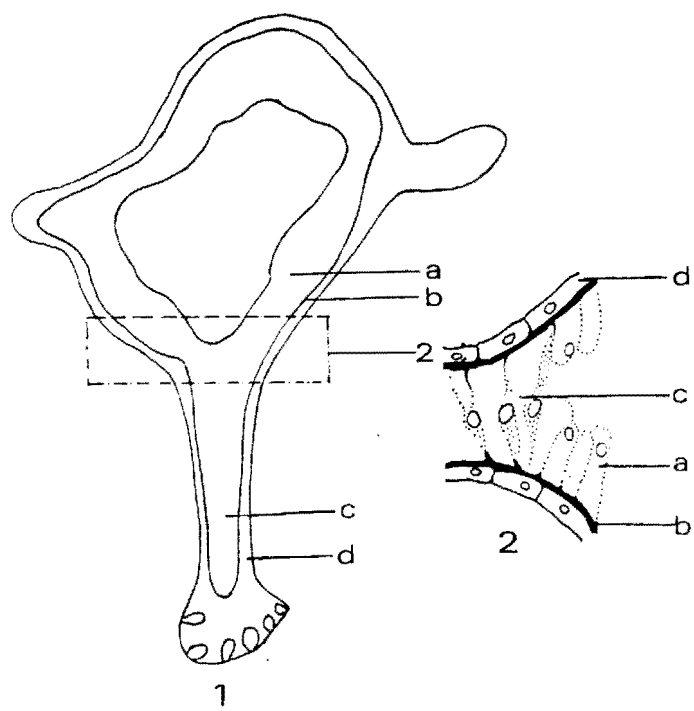
TEXT-FIG. 62. - Coryne pintneri; a - *hydranth without filiform tentacles directly from the sea;* b - *regenerating hydranth with filiform tentacles from the same colony.*

Cross-sections through the hydranth show that in the oral tentacles the mesoglea of the body wall is continuous and separates the endoderm of the tentacle from the endoderm of the body wall. However in all tentacles which lie aboral to the oral tentacles the mesogloea is not continuous and thus the endoderm of the tentacles is not separated from the endoderm of the body wall (text-fig. 64).



TEXT-FIG. 63. - Coryne pintneri; *position of tentacles of five different hydranths from the same colony.*

The gonophores develop in the axils of the 3rd to 5th tentacle whorl. Very often there are two gonophores of different ages in the axil of one tentacle. Sexual products are freed through rupture at the tip of the gonophore. Sexual products are shed in one burst or on two consecutive evenings. Usually the spadix of the gonophore may remain for one day to be resorbed into the body wall of the hydranth afterwards.



TEXT-FIG. 64. - Coryne pintneri; 1 - *cross-section through the middle region of a hydranth;* 2 - *detail of tentacle base.* a - *endoderm;* b - *mesogloea;* c - *endoderm;* d - *ectoderm.*

Developmental stages

The diameter of the liberated egg is 0.1 mm. As in many other hydroids the 8 cell stage is equal, but already irregular.

A morula is formed after a few hours. Free swimming planulae were seen after two days but the settlement of the planula and the development of the primary hydranth was not observed.

Ecology

C. pintneri is found in shaded places in caves 1 to 3 m deep usually associated with the red algae *Peysonellia* sp., and at the bases of *Posidonia* leaves 10 to 30 m deep, or in the same *Posidonia* region on *Balanus* shells. It is very typical for *C. pintneri* that it lives on the borders of leaves and roots of the *Posidonia* plants, very often on the old dead leaves which enclose the young ones.

Gonophores are found from March to end of May.

Discussion of the species

Studying the colonies of *C. pintneri* from the cave material (2 m) and the *Posidonia* beds (30 m), I was convinced for a while that colonies from the rocks in the caves represent *Coryne pusilla* and the colonies from the *Posidonia* beds *C. pintneri,* because filiform tentacles were usually present only in the latter. However, during more intense collecting I found that sometimes the colonies of the 2 m region from the caves have filiform tentacles too. On the other hand colonies from the *Posidonia* region were often without filiform tentacles. Specimens from both regions however, regenerated with filiform tentacles. So it may be that *C. pusilla* as reported for Naples by earlier authors is in fact *C. pintneri,* because *C. pusilla* (p. 51) is much rarer around Naples.

Genus *Sarsia* Lesson 1843

Generic characters

Corynid hydroids with free medusae.

Type species: *Sarsia tubulosa* (M. Sars) 1835.

The genus *Sarsia* in the Mediterranean includes the following former genera and species:

Dipurena Mc Crady with the species *D. dolichogaster, D. ophiogaster, D. reesi, D. halterata.*

Sarsia Lesson with the species *S. gemmifera, S. eximia, S. tubulosa; Sarsia* sp.

Stauridiosarsia Mayer with the species *S. producta.*

Sarsiella Busch with the species *S. ocellata,* doubtful.

Sarsia dolichogaster (Haeckel) 1864

Synonymy

Dipurena dolichogaster Haeckel 1864, p. 337 (medusa).
Dipurena dolichogaster Kramp (1961, p. 22) (medusa) listing synonyms.

Specific characters

Hydroid not known; « medusa similar to *D. ophiogaster,* but tentacles with numerous rings of nematocysts » (Kramp 1961, p. 22).

Material seen: None.

Material deposited: None.

Distribution of the Medusa

Outside Mediterranean: none.
Mediterranean: Nice, France (Haeckel, 1879 1880).

Description of the species

See « Specific characters ».

Discussion of the species

This is a doubtful species which is only kept as a separate species on account of the nematocyst rings. Otherwise it is most similar to *Dipurena ophiogaster* or *Dipurena reesi.* As Haeckel did not deposit any type-specimens it is very difficult to decide whether his species is not a synonym to *D. ophiogaster.*

Sarsia halterata (Forbes) 1846
Text-fig. 65

Synonymy

Slabberia halterata Forbes 1846, p. 286 (medusa).
Dipurena halterata Rees 1939a, p. 343, figs. 1-3 hydroid and young medusa).
Sarsia halterata Babnik 1948, p. 14 (medusa).

Specific characters.

Hydroid « simple unbranched colonies reaching a height of 2.5 mm. Perisarc smooth. Seventeen to 24 irregularly distributed capitate tentacles. Hydranth reddish. Medusa buds born on lower half of hydranth or on blastostyles » (Rees, 1939 *a*).

Medusa « 8 mm high, 6 mm wide, bell shaped. Manubrium very long; gonads with two or more segments surrounding manubrium leaving upper half free. Distinct globular apical chamber. Radial canals with a small swelling. Tentacle bulbs each with large abaxial ocellus, tentacles with large terminal knobs and 3 to 6 rings immediately above » (Kramp, 1961).

Material seen: None.

Material deposited: None.

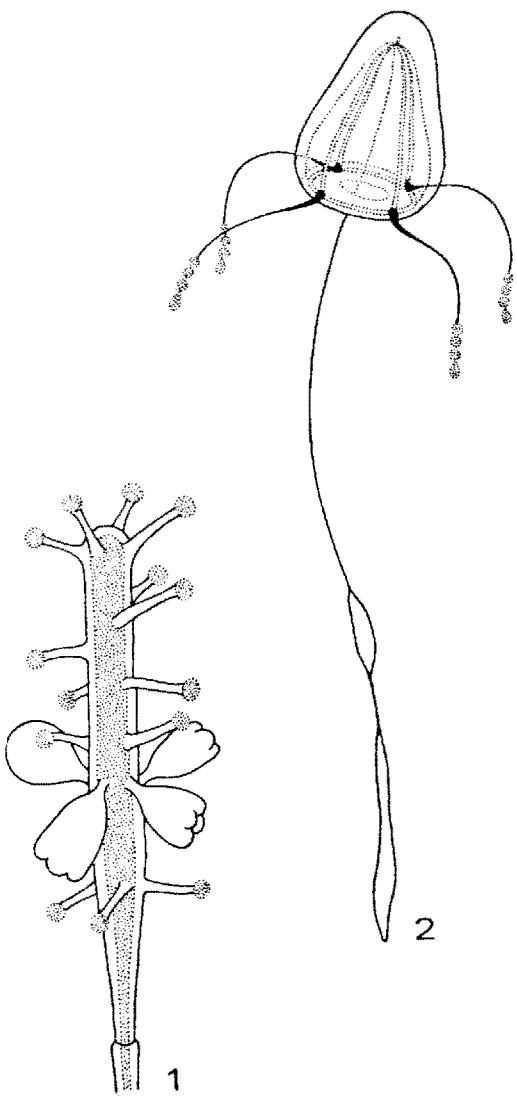
Distribution

Hydroid, outside Mediterranean: Plymouth, England (Rees, 1939).
Mediterranean: none

Medusa, outside Mediterranean: English Channel; Valencia, Ireland; North Sea (RUSSELL, 1953). Mediterranean: Adriatic sea (BABNIC, 1948); HADZI, 1911 *b, c*; Naples, Italy (author), probably young specimen.

Description of the species

Hydroid: REES found the hydroids of *S. halterata* only once, on a sponge. The hydrorhiza is imbedded in the sponge from which the unbranched hydroids arise.



TEXT-FIG. 65. - Sarsia halterata; 1 - *hydroid* (*after* RUSSELL 1953, text-fig. 29 A); 2 - *medusa* (*after* RUSSELL 1953, text-fig. 28).

The stems are usually halfway enclosed in a thin perisarc. The hydranths carry an oral whorl of 4 to 5 tentacles. Below this whorl the tentacles are scattered. The medusa buds are to be found in the lower half of the hydranth. They develop directly on the body wall and not from blastostyles. (For a detailed description, see REES, 1939).

Medusa, adult: « Umbrella bell-shaped, higher than wide; jelly thick. Velum moderately broad. Stomach cylindrical, enlarging into bulbous mass at its oral extremity, in full extension reaching two to three times the length of the umbrella. Mouth simple, tube-like. Four radial canals and ring canal narrow; linear swellings on radial canals. Apical knob present. Gonad with two or more segments surrounding stomach, leaving upper half free. Four perradial marginal tentacles, each with large terminal knob of nematocysts, with three to six nematocyst rings immediately above. Marginal tentacle bulbs moderately large, each with large ocellus. Height about 8 mm when fully grown. Colour of marginal tentacle bulbs, orange, red, reddish brown or brown below, with bright green tinge above; terminal knobs of marginal tentacles red or brownish; ocelli black or deep crimson; apical knob reddish or green » (RUSSELL, 1953, p. 68).

Medusa, young: « The medusa *Dipurena halterata* (here called *Sarsia halterata,* author), when newly liberated from its hydroid, has been described by REES (1939). The umbrella is bell-shaped, a little higher than wide, being 1.5 to 1.6 mm high and 1.3 to 1.4 mm wide. The jelly is fairly thin and there are few scattered nematocysts on the exumbrella. The velum is broad. The stomach is cylindrical and its length is about two-thirds the height of the subumbrellar cavity. There is a slight apical knob. The four radial canals and ring canal are narrow, and there are no signs of the linear swellings on the radial canals. The four marginal tentacles each have a large terminal cluster of nematocysts, and on the distal halves of each tentacle there are a few irregularly scattered small batteries of nematocysts. The colour of the stomach is pale green; the basal bulbs of the marginal tentacles and their terminal endoderm are brick red. The ocelli are black. Later the green colour appears in the marginal tentacle bulbs. REES reared a specimen until it was 2.8 mm high and 2.5 mm wide. At this size the linear swellings on the radial canals had developed. The terminal knobs on the marginal tentacles were now larger and were 0.16-0.22 mm in diameter. The irregularly scattered batteries of nematocysts on the marginal tentacles were now developing into complete rings of nematocysts. In the most fully developed marginal tentacle there were three complete rings and one incomplete ring as well as the terminal cluster. In older individuals these rings may vary from one to six in number, the uppermost one of the series being the youngest » (RUSSELL, 1953, pp. 69, 70).

One specimen of a medusa was found in Naples in June 1960, which was probably *S. halterata;* it had the terminal cnidocyst thickenings typical for this species, but the gonads were not developed and there was no thickening along the radial canals.

Discussion of the species

The hydroids of *S. halterata* may be distinguished from other *Sarsia* hydroids in being unbranched, lacking filiform tentacles, and having their capitate tentacles scattered.

The medusa of *S. halterata* is distinguished from other *Sarsia* medusae by the thickening of the radial canals and the terminal cnidocyst cluster of the tentacles. (For detailed discussion see RUSSELL, 1953, p. 71).

Sarsia ophiogaster (HAECKEL) 1879-1880

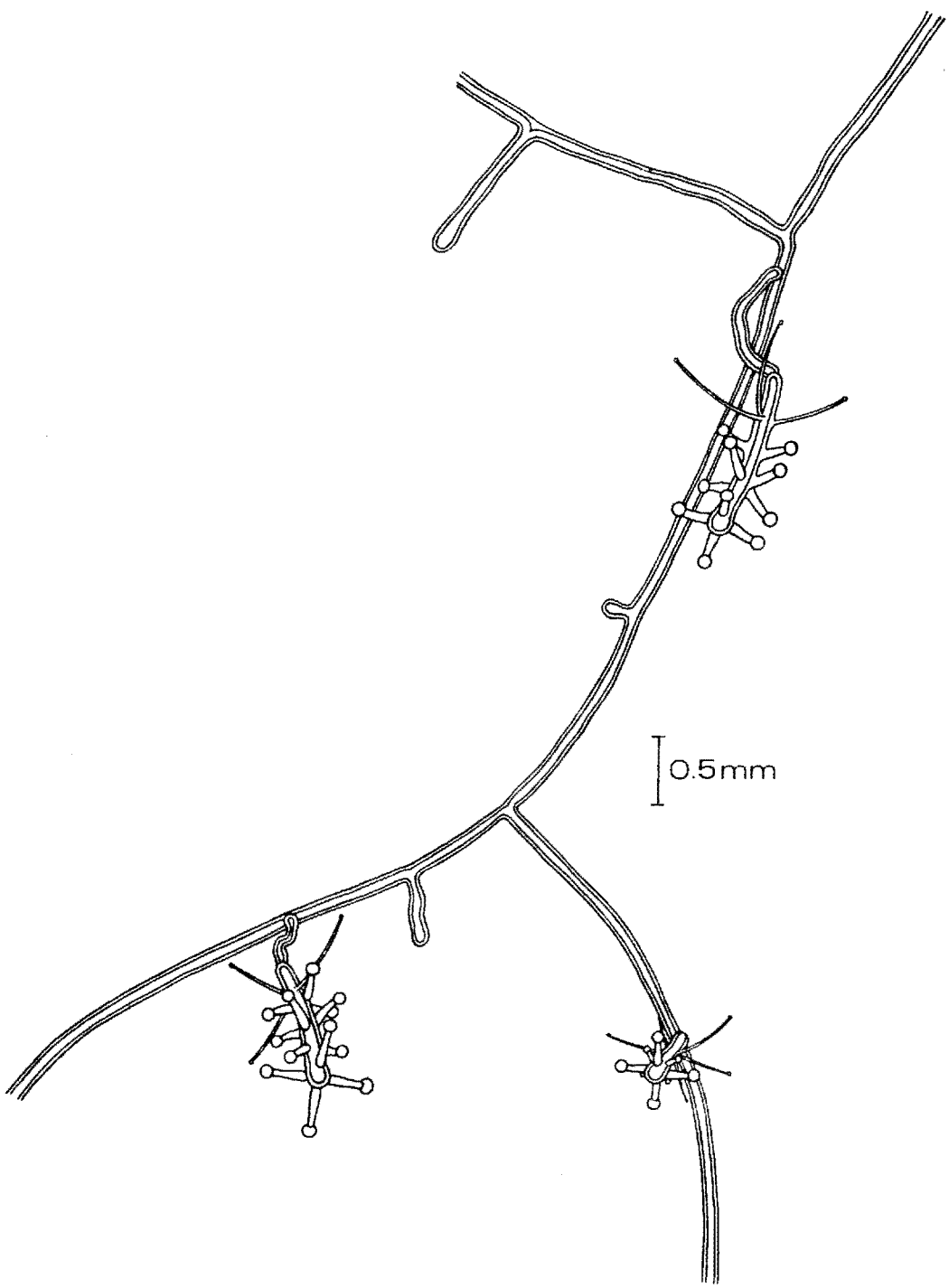
Plate III, fig. 4; text-figs. 66-71

Synonymy

Sarsia strangulata ALLMAN 1871-1872, p. 46, fig. 17 (medusa).
Sarsia dolichogaster SPAGNOLINI 1876, p. 18, Pl. II, fig. 3 (medusa).
Tetrapurena ophiogaster HAECKEL 1877, no. 19 (medusa).
Dipurena ophiogaster HAECKEL 1879-1880, p. 25 (medusa).
Dipurena ophiogaster REES (1941, p. 131, fig. 2) (hydroid).
Dipurena ophiogaster RUSSELL (1953, p. 71) (medusa and hydroid).
Dipurena ophiogaster KRAMP (1961, p. 23) (medusa), listing synonyms.

Specific characters

Hydroid with generally unbranched colonies with three or four whorls of capitate tentacles which may show a scattered appearance. With reduced filiform tentacles which may be absent. Medusa buds in groups of 1 to 3 in the region of the aboral capitate tentacle whorl. Free medusae when liberated with 8 longitudinal rows of nematocysts on the exumbrella. Adult medusa



TEXT-FIG. 66. - Sarsia ophiogaster; *sterile colony which has been kept in culture for some months; note the long, filiform tentacles; drawn by* ILONA RICHTER.

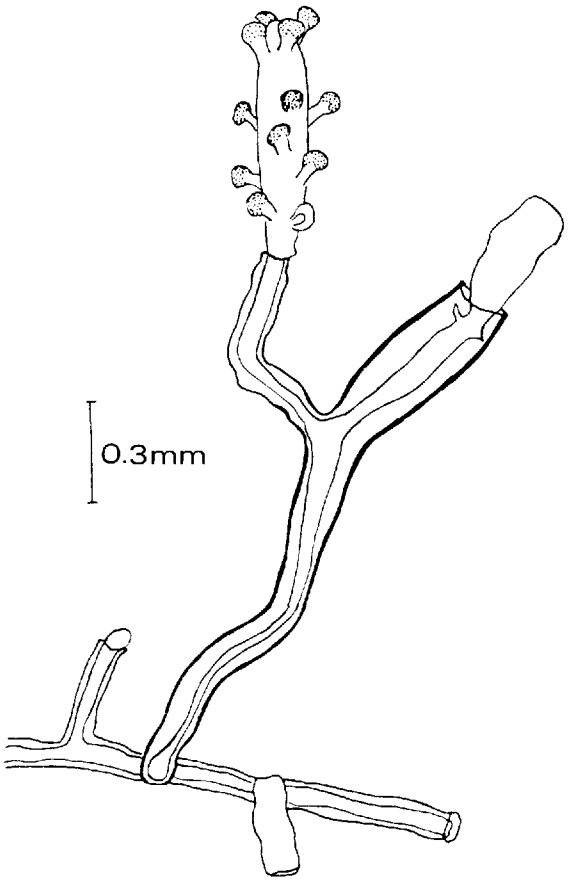
with manubrium much longer than the umbrella. Gonads with 2 to 8 (rarely) segments surrounding stomach. Apical chamber distinct. Tentacles with irregularly distributed clusters of nematocysts.

Material seen: Naples, Italy.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: Valencia, Ireland (RUSSELL, 1953).
Mediterranean: Naples, Italy (author).
Medusa, outside Mediterranean: Southern parts of the British coast; Skagerak; Ceylon; southern Japan; Pelew Island in central Pacific; west coast of Mexico (KRAMP, 1959).
Mediterranean: Naples, Italy (SPAGNOLINI, 1876; author).

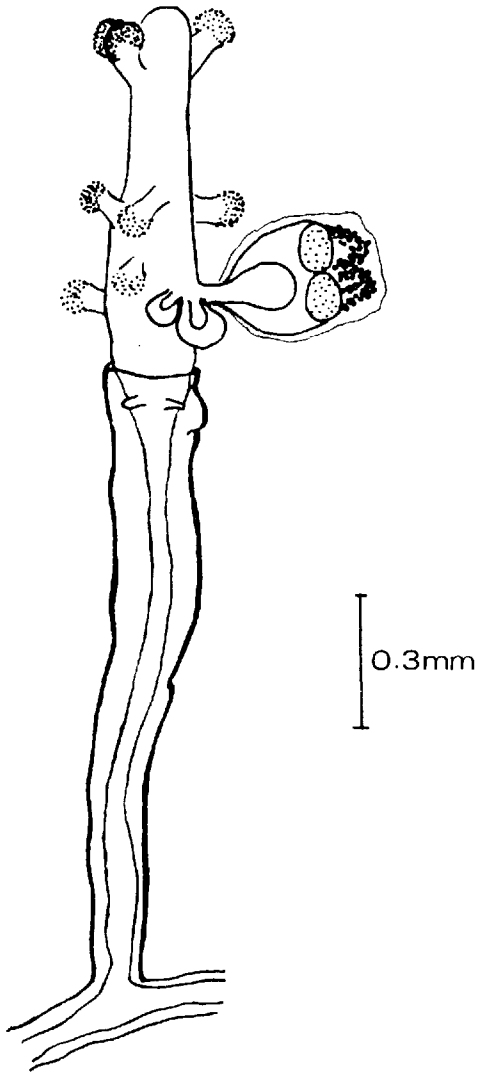


TEXT-FIG. 67. - Sarsia ophiogaster; *part of a colony drawn after arrival from the sea.*

Methods of collection and cultivation

The hydroids live in shaded places of the rocky littoral 1 to 3 m deep. In the laboratory the colonies are easily detected on small rock or *Balanus* pieces under the dissecting microscope. Colonies can be cultured easily in boveri dishes, either on their natural substrate or detached. Detached hydroids will soon grow a stolon and new hydranth, and before long the new colony starts to develop medusae.

The medusae were collected from the sea with a zooplankton net at 1 to 3 m depth. They keep well at 18-20° C on a rocking table fed with *Artemia salina*.



TEXT-FIG. 68. - Sarsia ophiogaster; *hydranth with medusa buds; drawn after arrival from the sea.*

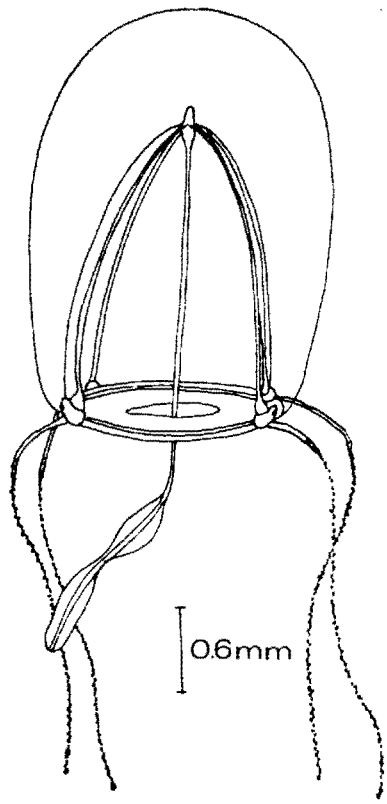
Description of the species

Hydroids: The hydranths of *S. ophiogaster* (text-fig. 66) rise on stems from a creeping stolon. The stems are usually twice as long as the hydranth. In the majority of colonies stems are not branched, but sometimes small side branches occur as it is shown in text-fig. 67. The stems are enclosed in a wide, soft perisarc, into which the basal part of the hydranths may retract. Although the width of the perisarc varies a lot even in one colony it is a very striking character and seems to have a good diagnostic value (text-fig. 68). Regenerating colonies which are kept in the laboratory do not develop this wide perisarc.

The hydranth measures 0.5 to 1.0 mm from its oral capitate tentacle whorl to the aboral filiform tentacle whorl. In most specimens the capitate tentacles of the oral region of the hydranth are arranged in whorls. The arrangement of capitate tentacles becomes more scattered in the aboral part. Filiform tentacles are often absent or reduced. In preserved specimens they are

difficult to detect because they may be retracted into the perisarc. Filiform tentacles are always present in regenerated hydroids kept in culture. They are to be found below the capitate tentacles and usually in a whorl of 2 to 6. The medusa buds develop in the basal part of the hydranth; but always distal from the filiform tentacles. Usually they are arranged in groups of three or four on short blastostyles. There may be 2 to 3 blastostyles carrying medusae on each hydranth. The medusa buds are enclosed in a thin covering which can be observed shortly before the liberation of the medusa (text-fig. 68). The eight cnidocyst rows on the exumbrella which are typical for the young medusae of *S. ophiogaster* can already be detected in older buds.

Adult medusa (text-fig. 69): The adult medusa has a height of 3 to 4 mm and a diameter of 2 to 3 mm (preserved).



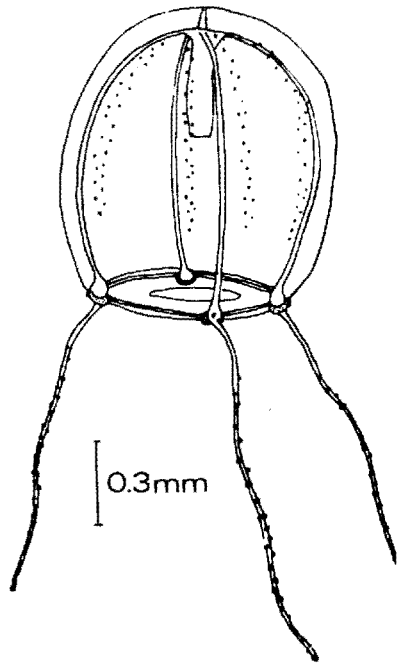
TEXT-FIG. 69. - Sarsia ophiogaster; *adult medusa.*

The umbrella is very thick at the apex and gets gradually thinner towards the margin of the medusa. The manubrium is two to three times longer than the umbrella.

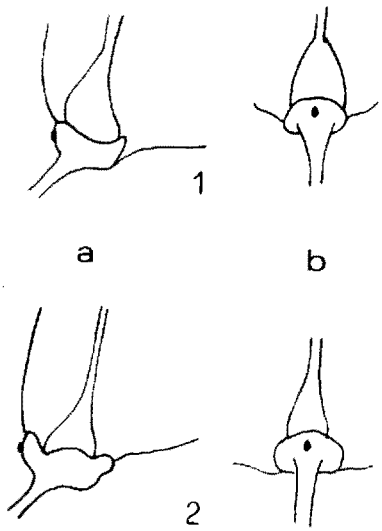
A small apical chamber is always present. Usually the gonads appear in 2 or 3 rings around the distal end of the manubrium. HAECKEL (1879-1880) describes up to eight gonads, however RUSSELL (1953, p. 73) illustrates *S. ophiogaster* with not more than 4 gonads.

The expanded tentacles measure more than three times the height of the umbrella carrying more than 100 cnidocyst clusters which are distributed irregularly along the tentacles.

There is one ocellus on each of the four marginal parradial bulbs. The four radial canals enter the marginal bulbs adaxially. The ectodermal cnidocyst pad of the marginal bulb is larger than the endodermal swelling of the radial canals at their entrance into the marginal bulbs. I found that this is a good and significant distinguishing character between *S. ophiogaster* and *S. reesi* (text-fig. 71).



TEXT-FIG. 70. - Sarsia ophiogaster; *one day old medusa.*



TEXT-FIG. 71. - *Marginal tentacle bulbs of* 1 - Sarsia reesi, 2 - Sarsia ophiogaster; a - *lateral view;* b - *frontal view.*

Developmental stages

The eggs, development of the embryo, planulae and primary hydranths were not observed. The medusae have 8 longitudinal nematocyst rows at the time of liberation (text-fig. 70). These cnidocysts can already be detected in buds on the hydroids. They disappear one or two days after liberation. Each of the four tentacles carries 20 to 24 cnidocyst clusters.

The manubrium grows rapidly: at liberation it is one-third of the subumbrella; within four days it is as long as the subumbrella, at 15 days twice the length of the umbrella and at 25 days after liberation the manubrium measures three times the length of the umbrella.

Gonads appear between the 10th and the 15th day after liberation. As is often the case with other hydromedusae, *S. ophiogaster* medusae grow slightly larger in the Atlantic than in the Mediterranean. RUSSELL (1953) gives an umbrella height of 5 mm for adult specimens whereas the specimens from Naples grew to a height of usually 3 mm, never more than 4 mm.

Ecology

The colonies of *S. ophiogaster* occur on shaded, steep rocks either on *Balanus* sp. which is living on the rocks or on the surface of the rocks directly. The hydroids are often hidden between *Gelidium* sp. and *Peysonellia* algae which grow in the same biotop.

S. ophiogaster hydroids are common around the Peninsula of Nisida and the Islands of Ischia and Capri (Naples, Italy).

The occurrence of the hydroids of *S. ophiogaster* around Naples is seasonal: they can be found in small colonies in February (personal note of Dr. YAMADA), cover large areas and carry medusa buds until the end of May, become scarcer in June and are rarely found from July to January.

The medusae were taken from the end of April to the beginning of May. Despite the abundance of the hydroid only four medusa specimens were found from 1958 to 1963.

Systematic discussion

The hydroids of *S. ophiogaster* are similar to those of *S. producta*. Hydroids of *S. ophiogaster* in an advanced stage of medusa budding can be identified by the exumbrellar cnidocyst rows on the medusa buds. Besides, hydroids of *S. ophiogaster* are also identified by their wide perisarc.

The adult medusa of *D. ophiogaster* is nearly indistinguishable from *D. reesi*. The differences in the medusa stage between these two species is discussed on p. 64.

Sarsia reesi (VANNUCCI) 1956
Plate 3, fig. 2; text-figs. 72-74

Synonymy

Dipurena reesi VANNUCCI 1956, p. 479 (medusa and hydroid).
Dipurena reesi BRINCKMANN & PETERSEN (1960, p. 1) (medusa and hydroid).
Dipurena reesi KRAMP (1961, p. 24) (medusa).

Specific characters

VANNUCCI (1956, p. 485): « A corynid with long stolons and short unbranched hydrocauli, with smooth non-annulated perisarc.

Hydranths fusiform with short conical proboscis and oral whorl of from three to seven capitate tentacles and an aboral whorl of four to six, rarely more filiform tentacles. Medusa buds borne on the body of the hydranth, between the two whorls of tentacles. Newly liberated medusae: *Sarsia* like. Umbrella with scattered exumbrellar nematocysts. Tentacles with scattered groups of nematocysts. Adult medusa of *Dipurena* with long tubular manubrium with gonads arranged in at least two separated gonads on the distal half of the manubrium. Tentacles with numerous irregularly distributed groups of nematocysts not arranged in distinct rings and without a large terminal cluster ».

Material seen: Gulf of Naples.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: Brazil (VANNUCCI, 1956).
Mediterranean: Naples, Italy (BRINCKMANN & PETERSEN, 1960).
Medusa, outside Mediterranean: Brazil (VANNUCCI, 1956).
Mediterranean: Naples, Italy (BRINCKMANN & PETERSEN, 1960).

Methods of collection and cultivation

The hydroids of *S. reesi* are found on shells — often *Ostrea* sp. — at a depth of 20 to 50 m. In the Gulf of Naples they were collected from « Donn'Anna » to the « secca di Gaiola ». As the hydroid is quite small and the colonies consist of a linear stolon with only a few hydranths, the colonies have to be carefully searched for under the dissecting microscope. Once a hydroid is found and brought into a clean boveri dish at about 20° C it will immediately start to grow. It is interesting that it does not develop one linear stolon only but several new stolons with new hydrocauli and hydranths, and after some time the hydranths will start to bud medusae. Medusa budding takes place in the laboratory throughout the year and the medusae are easy to rear. Both medusa and hydroid do very well on a diet of *Artemia salina* and occasionally plankton copepods. *D. reesi* would therefore be an « ideal » animal for experimental work in the laboratory.

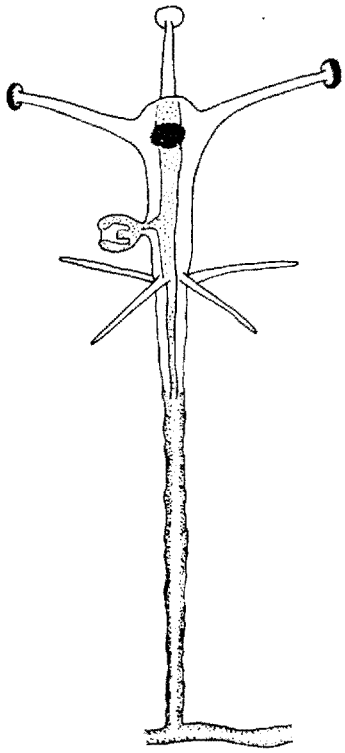
Description of the species

In colonies taken from the sea the stolons form a very wide network and I never found more than four or five hydranths for colony. The hydranths are about 1.0 to 1.5 mm long, club-shaped. The capitate oral tentacles are placed in one whorl consisting of 4, often 5 solid tentacles with a row of about 18 endodermal cells. The terminal knobs of these tentacles are button shaped. The aboral tentacle whorl consists of 4 to 5 filiform tentacles. It is situated midway between the oral whorl and the beginning of the perisarc (text-fig. 72). The filiform tentacles of this species are always present, in specimens taken from the sea and in regenerating cultures as well. The filiform tentacles have a tendency to elongate and enlarge slightly at their tips if kept in

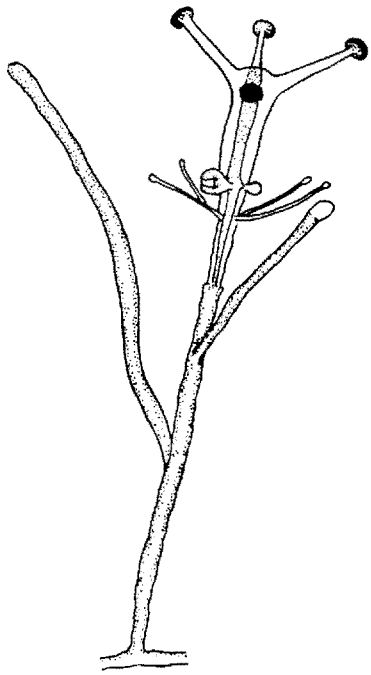
the laboratory for a long period (Plate 3, fig. 5). In laboratory specimens the hydrocauli may reach two to three times their original length.

One to 3 medusa buds are developed above the aboral tentacle whorl.

Cnidocysts of the hydroids are stenotheles.



TEXT-FIG. 72. - Sarsia reesi, *hydroid, (partly after* BRINCKMANN & PETERSEN, 1961).



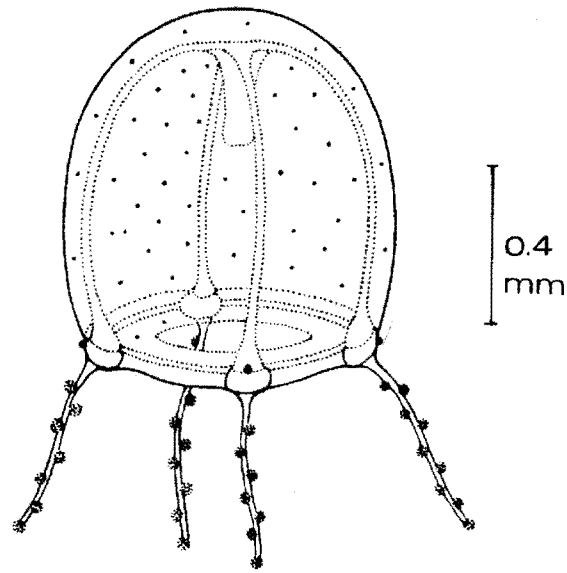
TEXT-FIG. 73. - Sarsia reesi; *hydroid; colony which has been kept several months in the laboratory.*

The adult medusa (Pl. 3, fig. 2) has a nearly triangular shaped umbrella. The height of the medusa is 4-5 mm (preserved in 10 % formalin) and its diameter 4 mm. The manubrium is two to three times longer than the umbrella. VANNUCCI (1956) mentions only two gonads, in her original description of the species but older specimens of *S. reesi* can have three gonads (BRINCKMANN & PETERSEN, 1960, fig. 5). The tentacles in adult specimens have up to 100 cnidocyst clusters. The cnidocysts of the medusa are stenotheles and desmonemes.

Developmental stages

The eggs and early development of the hydroid have not been observed until now.

The newly liberated medusa (text-fig. 74) is 0.7 to 0.9 mm high and has a diameter of 0.6 to 0.8 mm. The umbrella is bell-shaped with irregularly scattered nematocysts on the exumbrella.



TEXT-FIG. 74. - Sarsia reesi; *one day old medusa.*

The manubrium measures about half the length of the bell-cavity. Each of the four perradial tentacle bulbs carries a tentacle with 5 to 10 cnidocyst clusters.

Four day old specimens are 1 mm high and 1 mm in diameter with a length of the manubrium of 0.8 mm. They no longer have exumbrellar cnidocysts. There are 12 to 13 cnidocyst clusters on the tentacles. After seven days the medusa attains a height of 1.5 mm and a diameter of 1.7 mm with a manubrium length of 1.1 mm. Each tentacle carries 20 to 22 cnidocyst clusters. At 16-18 days the bell is 3 to 4 mm high and 2.5 to 3.5 mm wide. The manubrium is twice as long as the bell cavity and there are gonads, although not yet ripe. Mature gonads and more than 100 cnidocyst clusters per tentacle were observed in specimens 30 days old.

Ecology

The hydroid was found throughout the year on slightly muddy bottoms. It was quite common from

Donn'Anna to Capo Posillipo (Gulf of Naples). The colonies live mainly on mollusk shells and tunicates at a depth of 20 to 70 m. Medusa buds were very seldom seen on specimens collected from the sea. The medusa is only known from its hydroid. It was never found in the plankton.

Systematic discussion

The hydroid of *Sarsia reesi* and the hydroid of *Cladonema radiatum* (Cladonematidae, p. 75) are very similar. Hydroids of the two species can be distinguished by the following characteristics:

a) The number of endodermal cells in the capitate tentacles is ca. 18 in *S. reesi*, but 7 to 8 in *C. radiatum*.

b) The knob of the capitate tentacles is button shaped in *S. reesi*, cone shaped in *C. radiatum*.

c) The swelling of the distal part of the filiform tentacles is absent in specimens of *S. reesi* directly from the sea, but present in laboratory specimens of *S. reesi*, and always present in *C. radiatum*.

d) *S. reesi* has two spines in its stenotheles, *C. radiatum* three.

e) Macrobasic eurithetes are not found in *S. reesi*, but are present in *C. radiatum* (BRINCKMANN & PETERSEN, 1960).

The adult medusae of *S. reesi* and *S. ophiogaster* (p. 61) are difficult to distinguish. The following characters may help in the identification: The umbrella of *S. reesi* measures 4 to 5 mm, that of *S. ophiogaster* 3 to 4 mm. The shape of the exumbrella of *S. reesi* is more triangular whereas the exumbrella of *S. ophiogaster* is more dome-shaped (compare Pl. III, fig. 2 with text-fig. 69). The difference in the shape of the marginal tentacle bulbs is best illustrated in text-fig. 71.

The young medusae of both species can be distinguished much more easily: *S. reesi* has scattered exumbrellar cnidocysts, *S. ophiogaster* has eight rows of exumbrellar cnidocysts for the first two days after liberation. *S. reesi* has about 10 cnidocyst clusters on the tentacles when 1 or 2 days old, whilst *S. ophiogaster* has 20 or more cnidocyst clusters on tentacles at that young age.

Sarsia gemmifera FORBES 1848

Pl. III, fig. 1; text-fig. 75-76

Synonymy

Sarsia gemmifera FORBES 1848, p. 57, Pl. 7, fig. 2 (medusa).
Purena gemmifera HARTLAUB (1907-1917, p. 391) (medusa).
Coryne gemmifera PICARD (1958 *b*, no page) (hydroid, doubtful, see p. 66).
Sarsia gemmifera KRAMP (1961, p. 27) (medusa) listing synonyms.

Specific characters

Hydroid not known; free medusae with stomach in full extension reaching far beyond umbrella margin with dilatation at oral extremity. One circular gonad at the oral end of the manubrium. Asexual reproduction by budding from stomach.

Material seen: Naples, Italy.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Medusa, outside Mediterranean: European coasts (for detailed distribution see KRAMP, 1961, p. 27, 28).
Mediterranean: Adriatic Sea (NEPPI & STIASNY, 1913); Naples, Italy (author).

Methods of collection and cultivation

Medusae of *Sarsia gemmifera* are caught at a depth of ca. 50 m during the night or early morning. The specimens keep well in large Boveri dishes on a rocking table in water at 13° C or 18° C. Fed with *Artemia* naupli daily or every second day, the medusae may live for 4 to 6 weeks. As the occurrence of this species is strictly seasonal (p. 66), the life span in the laboratory may reflect the life span of the medusae in the sea.

Description of the species

Hydroid not known. Medusa (partly after RUSSELL, 1953, p. 62): « Umbrella bell shaped, higher than wide; jelly moderately thick. Velum narrow. Stomach cylindrical, enlarging into a bulbous mass at its oral extremity, in full extension reaching three or more times the length of the umbrella. Mouth simple, tube-like, beset with nematocysts. Sometimes a short umbilical canal and always an apical knob present. Four radial canals and ring canal very narrow. Gonad completely surrounding oral, dilated portion of stomach. Asexual reproduction by budding at intervals along stomach above oral dilatation. Four perradial marginal tentacles, with irregularly scattered clusters of nematocysts. Marginal tentacle bulbs of moderate size, each with one ocellus. Height when full grown usually 2 to 3 mm, may reach 5 mm. Colour of mouth, apical knob and marginal tentacle bulbs pale orange-red or straw. Terminal knob of marginal tentacles faint orange-red. Ocelli black. »

HARTLAUB (1907-1917) pointed out that the medusae of the Mediterranean may have more than one gonad, however neither NEPPI & STIASNY (1913) nor I have found any *Sarsia gemmifera* with more than one gonad. The nematocysts are stenotheles and desmonemes.

Developmental stages

The eggs of *S. gemmifera* are shed during the early morning hours. The diameter of the egg is 125 µ. The first 3 to 4 divisions are total, equal and regular, a case which is quite rare in the Anthomedusae. The 16 cell stage will show 4 cell layers, each layer consisting of four cells. A free swimming planula is developed after 24 hours. After a few days the planulae settle on the bottom and cover themselves with a thin, transparent perisarc. Although I kept these cysts at different and changing temperatures from 13° to 22° C, the

primary polyps did not hatch in the laboratory out of the cysts. Cysts like those which were observed here seem also to be present in other species of *Sarsia:* HARTLAUB (1907, p. 32, fig. 21) drew hydroids of *S. decipiens* growing out of a cystlike structure. However he does not mention whether the embryos rested inside the cyst for a longer time. NAUMOV (1960, p. 234, fig. 122) pictures primary polyps of *S. tubulosa* liberating from a cyst-like structure. The hydroid of *S. gemmifera* is mentioned as *Coryne gemmifera* by PICARD (1958 *b*), but he gives neither a description nor a picture of the hydranth.

The development of the young medusa is not known.

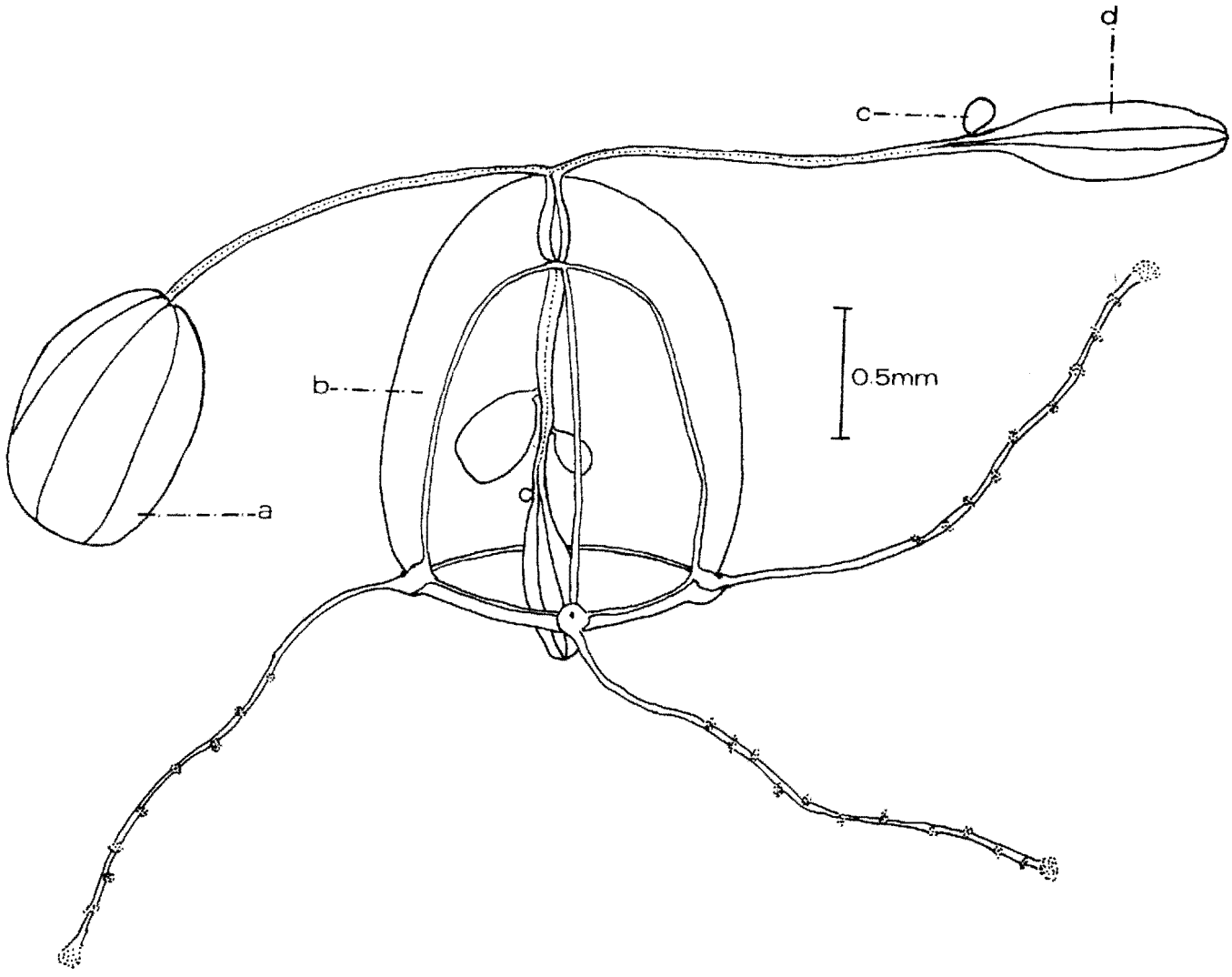
The budding of medusae from medusae takes place at 13° C in the laboratory, development of gonads of the medusae at 18° C.

The distal apical succession of medusa buds on the manubrium has been a subject of discussion (see RUSSELL, 1953, p. 62, 63).

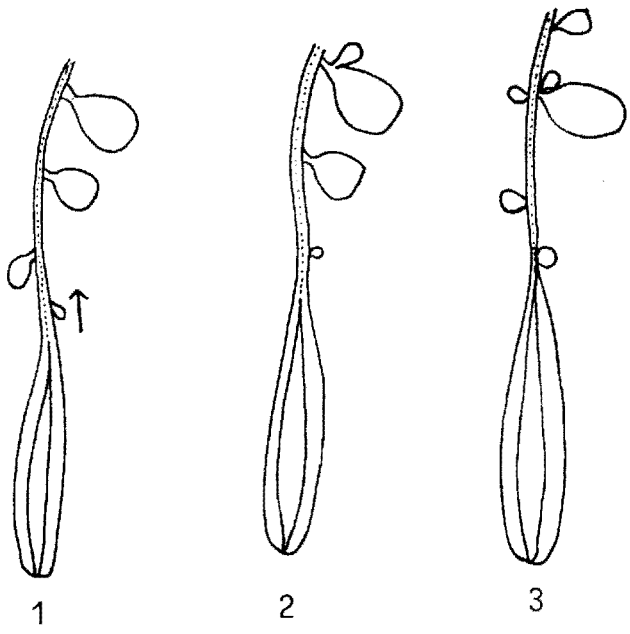
Observations on numerous specimens showed me that the young buds originate directly apical to the ripening gonad (text-fig. 76). Then that part of the manubrium between the gonad and the bud stretches and the bud is « carried » away in a proximal direction. One or two days after the formation of the first bud, a second bud is developed at the same place where the first one originated, directly proximally from the gonad. This second bud « moves » in a proximal direction in the same manner as the first one. This leads to the succession of older proximal and younger distal buds. However very often a second or third bud is developed at the pedicel of the first bud (text-fig. 76/2). After the primary medusa is liberated this secondary medusa starts to grow. Thereby the original succession of older apical medusae and younger distal medusae is upset and we may get smaller medusa buds situated apically above larger distal ones. Very often specimens obtained directly from the sea have the umbrella of the mother medusa turned inside out, slightly shrunk and the oldest medusa bud, still attached to the manubrium of the dying mother medusa has taken over the locomotion of the animal and swims around (text-fig. 75).

Ecology

S. gemmifera has a very short period of seasonal occurrence.



TEXT-FIG. 75. - Sarsia gemmifera; *« reduced mother » medusa with young bud which has taken over the locomotion of mother medusa and buds;* a - *umbrella of mother medusa;* b - *young medusa derived through budding from a;* c - *young bud;* d - *gonad of mother medusa.*



TEXT-FIG. 76. - Sarsia gemmifera; *different stages of medusa bud formation;* 1 - *medusa with 4 primary buds, the proximal being the oldest one; the arrow indicates the direction in which the buds move during their development;* 2 - *medusa pedicel of the oldest primary bud;* 3 - *older medusa; several of the primary buds are already liberated. Secondary buds are developed on the pedicels of the primary ones.*

During five years of observation it was never seen before the middle of April and after the end of May. During this period the occurrence of the medusa is fairly regular, sometimes one may find it in great abundance.

The species is very seldom found in the surface plankton. All my specimens came from 50 to 70 m depth.

Discussion of the species

HARTLAUB (1907-1917) named *S. gemmifera Purena gemmifera* because he thought that *S. gemmifera* of the Mediterranean had more than one gonad.

PICARD (1958) links the medusae of *S. gemmifera* with a polyp *Coryne gemmifera;* this is only published in the form of an abstract without a description. The proper name for the animal is *Sarsia gemmifera,* as supported by RUSSELL (1953) and KRAMP (1961).

Sarsia prolifera FORBES 1848

Synonymy

Sarsia prolifera FORBES 1848, p. 59, Pl. 7, fig. 3 (medusa).
Codonium codonophorum HAECKEL 1879-1880, p. 14, Pl. I, fig. 3 (medusa).
Sarsia prolifera KRAMP (1961, p. 30) (medusa) listing synonyms.

Specific characters

Hydroid not known. Medusa with stomach not extending beyond umbrella margin. Asexual reproduction by budding from marginal tentacle bulbs.

Material seen: None.

Material deposited: None.

Distribution

Outside Mediterranean: British coasts (KRAMP, 1961); Black Sea (THIEL, 1935).
Mediterranean: Channel of Corfu (HAECKEL, 1879), only one specimen.

Methods of collection and cultivation

None known.

Description of the species

« Umbrella bell-shaped, slightly higher than wide; jelly moderately thick. Margin quadrangular. Velum broad. Stomach small, cylindrical, about one to two-thirds the length of the subumbrellar cavity, never reaching beyond margin in full extension. Mouth simple, tubelike. Four radial canals and ring canal narrow. Apical knob may be present. Gonads completely surrounding stomach, leaving upper end and mouth free. Asexual reproduction by budding from the marginal tentacle bulbs. Four perradial marginal tentacles, very extensile, with irregularly scattered clusters of nematocysts. Marginal tentacle bulbs large and tapering, each with one ocellus. Colour of marginal tentacle bulbs and stomach sage green, yellowish brown or reddish brown; marginal tentacle tips may be light reddish brown; ocelli black or brownish. Height 2 to 3 mm when fully grown, usually less than 2 mm » (RUSSELL, 1953, p. 53).

Discussion of the species

MAYER (1910) pointed out that the species *Codonium codonophorum* HAECKEL is identical with *Sarsia prolifera* FORBES.

This species was never reported from the Western Mediterranean or the Adriatic Sea.

Sarsia tubulosa (M. SARS) 1835

Synonymy

Oceania tubulosa M. SARS 1835, p. 25, pl. V, fig. 11 *a, b* (medusa).
Syncoryna sarsii LOVEN 1836, pl. VIII, figs. 7-10 (hydroid).
Syncoryna sarsii SARS (1846, p. 2, pl. I, figs. 1-6) (hydroid and medusa).
Sarsia tubulosa RUSSELL (1953, p. 556, text-figs. 21-23) (hydroid and medusa).
(RUSSELL discusses the difficult synonymy for the hydroid and medusa of this species).
Coryne tubulosa WERNER (1963, p. 160, fig. 7) (hydroid).

Specific characters

Hydroid. RUSSELL (1953, p. 60): « Delicate, simple or slightly branched colonies reaching a height of about 20 mm. Perisarc smooth or slightly wrinkled, especially towards the base. Ten to twenty-five capitate tentacles irregularly distributed over the body of hydranth. Medusae borne on short peduncles chiefly, but not exclusively, at the base of the lowest tentacles. »

Free *medusae.* « Stomach very extensile, extending

far beyond umbrella margin in full extension. Radial canals smooth. Without asexual reproduction by budding. Gonad surrounding stomach continuous » (RUSSELL, 1953, p. 56).

Distribution

Outside the Mediterranean see KRAMP (1961), RUSSELL (1953).

The medusa of *S. tubulosa* has never been reported from the Mediterranean. There are several records of the hydroid of *S. tubulosa* from the Mediterranean. Upon checking these records it becomes apparent that the identifications were made neither with hydroids with medusa buds nor with hydroids with liberating medusae. As pointed out earlier for Corynidae, the hydroid unless it is liberating medusae, has insufficient distinctive characters for certain identification. These are the « records » for the hydroids of *S. tubulosa* for the Mediterranean:

DU PLESSIS (1881 *a, b*) as *Syncoryne pulchella* ALLMAN. Doubtful record because he described only the hydroid without medusa buds.

STECHOW (1923, p. 35) as *Sarsia pulchella* (ALLMAN). This record is also doubtful, because STECHOW's species had many more tentacles than are described for *S. tubulosa* and free medusae were not observed. KÜHN (1913, p. 52) mentions that he got *Syncoryne sarsii* LOVEN and *Sarsia pulchella* GAERTNER [syn. to *S. pulchella* (ALLMAN)] for his embryological studies from Naples. KÜHN gives neither a description nor a picture of the whole hydroids; therefore I am not sure, if he actually worked with *S. pulchella* GAERTNER (synonym to *S. tubulosa* M. SARS). This species is most unlikely to occur in the Mediterranean, because its distribution is circumpolar-boreal (RUSSELL, 1953, p. 56).

Description of the species

Hydroid: see specific characters. Adult medusa: « Umbrella bell-shaped, slightly higher than broad; jelly moderately thick. Velum broad. Stomach cylindrical, slightly more than half the height of the subumbrellar cavity when completely contracted, in full extension reaching three or more times the length of umbrella. Mouth simple, tube-like. Four simple radial canals and ring canal narrow. Radial canals enter marginal tentacle bulbs on abaxial side.

Apical knob or chamber usually present. Gonads completely surrounding stomach leaving short proximal region and mouth free. Four perradial marginal tentacles with many clusters of nematocysts. Marginal tentacle bulbs large and oval, each with large circular ocellus. Height up to 18 mm. Colour of stomach, apical knob and marginal tentacle bulbs yellow, orange, yellowish-brown, brown, green, scarlet or blue; ocelli black or crimson » (RUSSELL, 1953, p. 56).

Developmental stages

See RUSSELL (1953, p. 56).

Discussion of the species

See RUSSELL (1953, p. 60).

Sarsia producta (WRIGHT) 1858
Text-figs. 77-78

Synonymy

Oceania thelostyla GEGENBAUR 1856, p. 202-73 (medusa).
Stauridia producta WRIGHT 1858, p. 285, pl. VII, figs. 6-8 (hydroid).
Stauridium productum HINCKS (1862, p. 459, pl. IX) (hydroid and medusa).
Stauridium productum HARTLAUB (1907-1917, p. 53-54, figs. 47-50) (hydroid and medusa).
Sarsia producta MAYER (1910, vol. I, p. 65, figs. 28-30) (medusa).
Sarsia producta VANNUCCI (1949) (hydroid and medusa).
Stauridiosarsia producta RUSSELL (1953, p. 64) (hydroid and medusa).
Stauridiosarsia producta KRAMP (1961, p. 33) (medusa).

Material seen: None.

Material deposited: None.

Specific characters

Hydroid: « Hydrocaulus simple or slightly and irregularly branched. Perisarc pale yellowish brown, smooth. Hydranths elongate, reddish, with oral extremity opaque white. Medusae borne at the base of the lower capitate tentacles. Three or four whorls of capitate tentacles with four to six tentacles in a whorl; one proximal whorl of four to six reduced filiform tentacles. » (RUSSELL, 1953, p. 66).

Medusa: Gonads forming single continuous ring surrounding stomach; Stomach short, extending at most for about one-third its length beyond umbrella margin in full extension. Similar to *Sarsia eximia.*

Distribution

Hydroid, outside Mediterranean: Ilfracombe, England (HINCKS, 1862). Helgoland, North Sea (HARTLAUB, 1895). Brazil (VANNUCCI, 1949). Villefranche (author).
Mediterranean: Naples, Italy (DU PLESSIS, 1881 *a, b*).
Medusa, outside Mediterranean: see KRAMP (1961, p. 33).
Mediterranean: Messina, Italy (GEGENBAUR, 1856). Trieste, Yugoslavia (NEPPI & STIASNY, 1911, 1913).

Discussion of the occurrence of this species in the Mediterranean

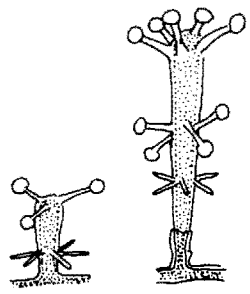
DU PLESSIS (1881) describes a hydroid from Naples which he provisionally refers to *Stauridium productum,* which is synonymous with *Sarsia producta.* However DU PLESSIS had neither the medusa liberated from its hydroid nor did he raise the medusa from it. He writes that he found the « medusa correspondante » — appa-

rently in the plankton — but does not describe this medusa nor does he give any reasons why he connects the medusa with the hydroid *Stauridium productum*. DU PLESSIS' hydroid may have been *producta*, but this is not certain. It is possible that DU PLESSIS had two different species of hydroids because he reports them from very different biotops, some colonies on the crab *Maia squinado*, the other ones on rocks in shallow water (1881 *a, b*, p. 112). I found a corynid hydroid colony with *Sarsia* type medusa buds 20 m deep in Villefranche in 1953. The hydroids had the arrangement of tentacles in 3 to 4 whorls which is typical for *S. producta*, they did not however possess the filiform tentacles. NEPPI & STIASNY (1912, 1913) found the medusa of *S. producta* several times, but only once with gonads. They point out themselves, that they are not absolutely certain of their identification. Therefore it seems to me that the occurrence of *S. producta* in the Mediterranean would be assured only when medusae are reared from their hydroid to maturity.

Description of the species

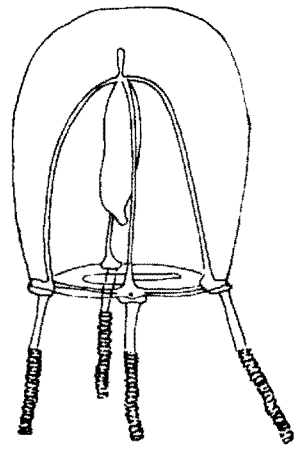
Hydroid: « Stem smooth, simple or slightly and irregularly branched; polypites elongate, reddish, the oral extremity opaque white, with 12 tentacles (in the adult state) disposed in three whorls of four (furnished with numerous palpocils), the capitula (capitate cnidocyst cluster, author) of the uppermost row larger than the rest; false tentacles (reduced filiform tentacles, author) 4-6, usually suberect; gonophores borne at the base of the lower tentacles, pyriform, slightly pedunculate, of a pinkish colour, not more than one or two on a polypite. » (After HINCKS, 1868, pl. 68).

Medusa: « Umbrella bell-shaped, higher than wide; jelly thick.



TEXT-FIG. 77. - Sarsia producta; *young and adult hydroid; (after* RUSSELL 1953, text-fig. 27).

Velum moderately broad. Stomach short, cylindrical, extending at most for about one-third of its length beyond umbrella margin in full extension. Mouth simple, tube-like. Four radial canals and ring canal narrow. Apical knob present, with vestiges of umbilical canal. Gonad completely surrounding stomach from its base to mouth. Four perradial marginal tentacles with irregularly scattered nematocyst clusters and a terminal nematocyst cluster. Marginal tentacle bulbs well developed, each with one ocellus. Height when fully grown 10 mm. Colour of apical knob and marginal tentacle bulbs reddish; ocelli black or deep-brown. » (After RUSSELL, 1953, p. 64, 65).



TEXT-FIG. 78. - Sarsia producta; *adult medusa (after* RUSSELL 1953, text-fig. 26 c).

Discussion of the species

The hydroid of *S. producta* can be distinguished from that of *S. ophiogaster* (p. 59) by the following details: *S. producta* has tentacles strictly arranged in whorls, its perisarc is short and narrow. *S. ophiogaster* has tentacles not strictly arranged in whorls, its perisarc is higher, the perisarcal opening wide and thick. The medusae of *S. producta* can hardly be distinguished from the medusae of *S. eximia*.

Sarsia eximia ALLMAN 1859

Synonymy

Coryne eximia ALLMAN 1859 (hydroid).
Sarsia eximia RUSSELL 1953, p. 50 (medusa and hydroid, listing all synonyms).

The medusa of *Sarsia eximia* has been recorded by KRAMP (1957 *c*) from Villefranche. The hydroid has not been reported for the Mediterranean. For the description of the medusa and hydroid see RUSSELL (1953) and KRAMP (1957 *c*).

Incerta sedis
Sarsia ocellata BUSCH 1851

Synonymy

Sarsia ocellata BUSCH 1851, p. 16, pl. II, figs. 1-3 (medusa).
Dinema ocellatum HAECKEL 1879-1880, p. 29 (medusa).
Syndictiyon ocellatum AGASSIZ, L. 1860-1862, vol. 4, p. 340 (medusa).
Sarsia ocellata DU PLESSIS 1888, p. 532 (medusa).
Sarsiella dinema HARTLAUB 1907-1917, p. 67 (medusa).

Specific characters

Hydroid not known; medusa with spherical or bell-shaped umbrella, 5 mm high, 4 to 5 mm wide. Exumbrella besprinkled with nematocysts. Manubrium club-shaped, 2 to 3 times longer than the umbrella. Gonads encircling the manubrium in its whole length.

Two perradial tentacles with small bulbs and abaxial ocelli. (Partly translated from HAECKEL, 1879-1880, p. 29).

Distribution

Outside Mediterranean: none.

Mediterranean: Triest, Yugoslavia (BUSCH, 1851); Villefranche, France (DU PLESSIS, 1888).

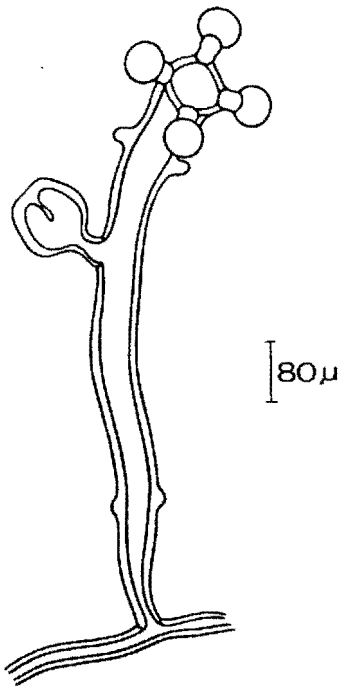
Description of the species

See specific characters. This species still lacks a proper description, therefore its systematic position remains doubtful.

DU PLESSIS claims that *Sarsia ocellata* is the medusa stage of the hydroid *Campaniclava cleodora*, but the connection between the two stages is not proven, because the medusa was not raised from its hydroid.

Sarsia sp.
Text-fig. 79

Two specimens of a tiny colonial corynid hydroid were found in a small cave at Nisida (Gulf of Naples) 2 m deep, on May 14, 1962. The hydranths have no stem and arise directly from a linear stolon. The hydranths are less than 1 mm high and are equipped with four capitate oral tentacles. Below these are two stump-like filiform tentacles and two other stump-like filiform tentacles near the base of the hydranth. Medusa buds develop between the two sets of filiform tentacles. Of the two hydranths collected both had two medusa buds each, one of them nearing liberation had the typical corynid marginal bulbs provided with black ocelli.



TEXT-FIG. 79. - Sarsia sp.; *hydroid with young medusa buds; drawn by* ILONA RICHTER.

There was no trace of gonads around the manubrium. Therefore supposing that the medusa would be freed I place the species provisionally in the genus *Sarsia*. The specimen with the most advanced medusa buds died before it could be drawn; text-fig. 79 belongs to the specimen with less advanced medusa buds.

I do not name this species, because I do not have a type specimen to deposit and it may turn out that this polyp is the hydroid stage of one of the sarsiid medusae of which the hydroid is not known as yet.

FAMILY CLADOCORYNIDAE ALLMAN 1871-1872

The Cladocorynidae with one genus *Cladocoryne* are very easy to distinguish from other hydroids on account of their ramified or « coryniform » tentacles. Although *Cladocoryne* is quite common, nothing is known about the development of the embryo, planula and primary hydranth. Therefore no one can reliably place this aberrant form, at the present time.

Definition of the family

Hydroids colonial covered with perisarc up to the base of the hydranth. Stems of hydranths rising usually directly from the creeping stolon, sometimes with one or two side branches. Hydranths with one oral whorl of capitate tentacles with coryniform tentacles below, either in whorls or scattered. Gonophores, where known, fixed, borne on the hydranth.

Genus *Cladocoryne* ROTCH 1871

Generic characters

Cladocorynidae with characters of the family.

The genus *Cladocoryne* comprises three species, *Cladocoryne floccosa* ROTCH 1871, *Cladocoryne pelagica* ALLMAN 1874, and *Cladocoryne haddoni* KIRKPATRICK 1890. The latter two species are poorly described and the gonophores of them are not known. Only *Cladocoryne floccosa* is reported for the Mediterranean.

Cladocoryne floccosa ROTCH 1871
Text-figs. 80-82

Synonymy

Cladocoryne floccosa ROTCH 1871, p. 227-228 (hydroid).
Polycoryne helleri GRAEFFE 1883, p. 202 (hydroid).

Specific characters

Cladocoryne with 4 to 6 oral tentacles and 3 to 4 circlets of ramified (coryniform) tentacles. Gonophores borne in the middle of the hydranth; the hydranths which develop gonophores are reduced to blastostyles during the development of the gonophore.

Material seen: Naples, Italy; Villefranche, Banyuls, France.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: English coasts (ROTCH, 1871; ALLMAN, 1871, 1872); Australia (SPENCER, 1892); Atlantic coast of France (PRUVOT, 1897).

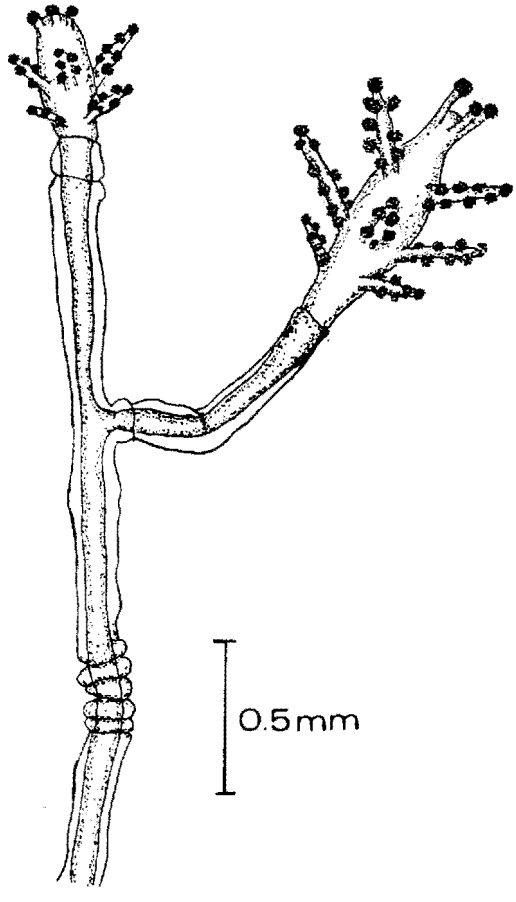
Mediterranean: Adriatic Sea (SCHNEIDER, 1897); Villefranche, Banyuls, France (author); Naples, Italy (DU PLESSIS, 1883; LO BIANCO, 1899).

Methods of collection and cultivation

C. floccosa may be found in the littoral on steep rocks 1 to 2 m below surface. Here it grows on *Fucus* or other brown algae. Besides the rock litoral it is found on the basal pieces of *Posidonia* leaves 10 to 30 m deep. It is easy to keep in the laboratory at 18-20° C fed with *Artemia*. But it was not possible to induce the gonophore production in the laboratory, even under changing temperatures.

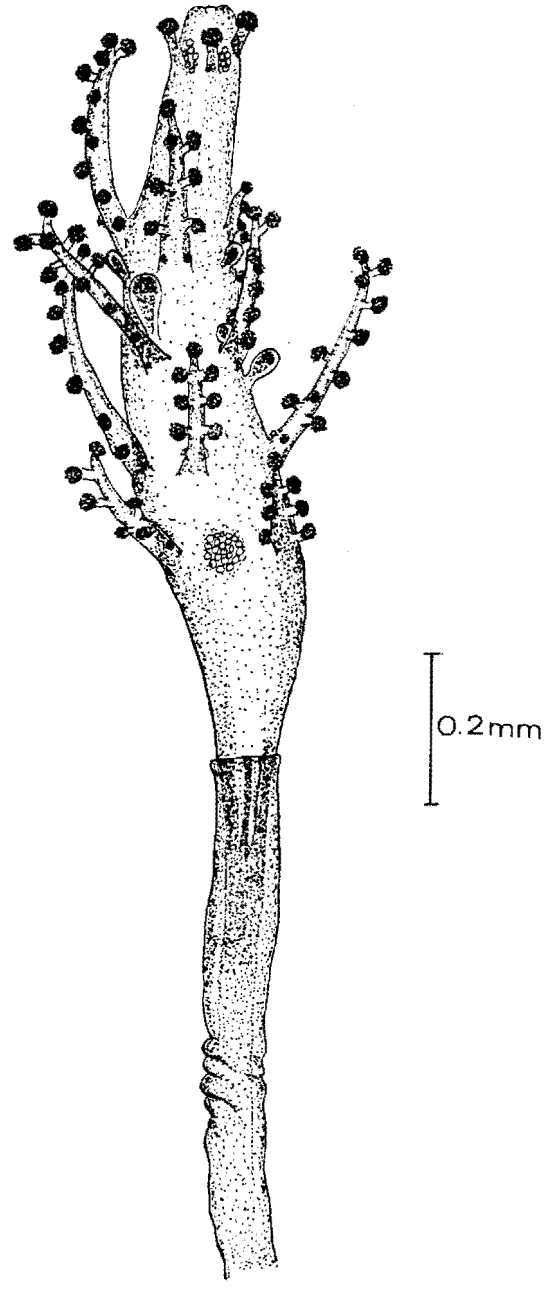
Description of the species

Colonies of *C. floccosa usually* do not have more than 20 hydranths in the Mediterranean. The height of the stem and hydranths varies from 0.5 to 1.0 cm. In well developed colonies (see discussion of the species on p. 71) about two-thirds of the stems are unbranched, about one-third have one, rarely two side-branches.



TEXT-FIG. 80. - Cladocoryne floccosa; *stem and hydranths with one side branch.*

REES (1957 *a*, p. 511) states that *Cladocoryne floccosa* is not branched. However, the original description of ROTCH says « stems simple or branched » (ROTCH, 1871, p. 227). The perisarc is brown and somewhat annulated in older parts of the colony, transparent and smooth in parts where new hydranths have grown (text-fig. 80). The hydranths are large, clubshaped; they measure 0.8-1.0 mm in preserved and 1.2 mm in unpreserved specimens from the tip of the hydranth to the base of the aboral tentacle whorl.

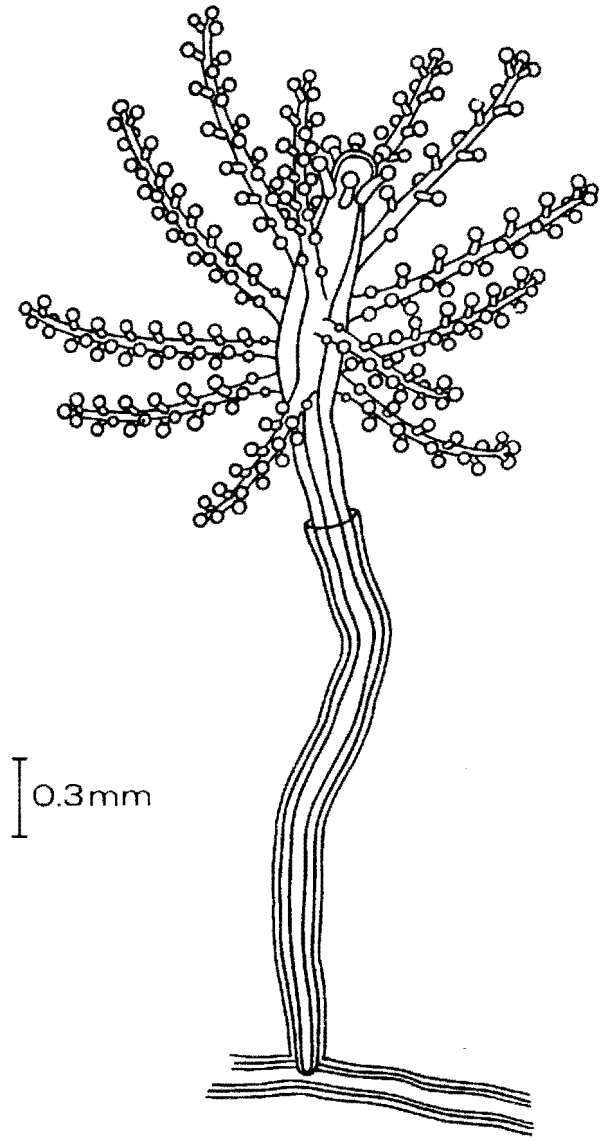


TEXT-FIG. 81. - Cladocoryne floccosa; *hydranth with young gonophores.*

There are 6 capitate oral tentacles and 3 to 4 circlets of coryniform tentacles. Usually there are 4 tentacles in each row, the tentacles of two subsequent rows standing in an alternate position. Each tentacle is provided with a terminal cnidocyst cluster and two to three longitudinal rows of small capitate tentacles. The position of these rows is mainly on the abaxial or outer side of each tentacle; there are very few on the adaxial or inner side of each tentacle. Seldom mentioned are the round cnidocyst patches between the tentacles of the oral and aboral whorls. These patches are as cha-

racteristic for *Cladocoryne* as the coryniform tentacles. The cnidocyst patches can be seen only in strong reflected light. The oral cnidocyst patches are a little bit smaller and more elongated than the aboral ones. The gonophores appear between the two middle circles of tentacles. DU PLESSIS (1880) mentions that the gonophores are on reduced hydranths which have lost their tentacles. KÜHN (1913) reports that he has found ripe gonophores on fully developed hydranths. I have seen ripe gonophores occasionally on fully developed hydranths which do not differ from sterile ones, but in most cases one finds young gonophores on fully developed hydranths with tentacles and the ripe gonophores on reduced blastostyle-like hydranths. BEHNER (1914) stages of the development of young hydranths. I have states that gonophore development may start at all never found gonophores on developing young hydranths but repeatedly a degeneration of the hydranth and its tentacles during the development of the gonophores.

Similar cases of hydranth reduction during the development of the gonophore are known from a *Hydractinia* species (REES, 1956 *b*) and in *Rhysia autumnalis* (BRINCKMANN, 1965 *b*).



TEXT-FIG. 82. - Cladocoryne floccosa; *sketch of living hydroid; perisarc which is always present in this species, is not drawn here; drawn by* ILONA RICHTER.

Developmental stages

The development of the gonophores has been studied by DU PLESSIS (1880), the histology of the gonophore by KÜHN (1910) and the development of the egg by WEISSMANN (1883). However many details on the egg development, fertilization, development of the embryo, planulae and primary hydranths remain to be learned.

Ecology

Cladocoryne lives mainly on *Fucus* sp. and other brownalgae on steep rocks 2 to 3 m deep. It is also to be found at the base of *Posidonia* leaves from a depth of 10 to 30 m. On the rocks it grows together with *Coryne muscoides* and *Haleciella microtheca* (BRINCKMANN, 1958) and *Zanclea costata* GEGENBAUR. In the *Posidonia* region it was found together with *Coryne pintneri*. From September to February, *Cladocoryne* would be very rare in either region. From March on I found small colonies consisting of 1 to 2 hydranths especially in the *Posidonia* region. By the end of April and beginning of May the colonies were much larger with more hydranths and from the end of April to the end of May gonophore production was observed. From the end of June on gonophores were no longer seen. This covers only the region of Naples and Villefranche.

Specimens from Roscoff (English Channel) showed gonophores in August.

Discussion of the species

Cladocoryne floccosa has been described by ROTCH (1871).

GRAEFFE (1883) published a similar species under the name of *Polycoryne helleri*, which seems to be identical with *Cladocoryne floccosa*. GRAEFFE studied the cnidocysts. According to his figure, the species has macrobasic mastigophores.

FAMILY ZANCLEIDAE RUSSELL 1953

The family Zancleidae is a rather divergent group with only one character in common, the stalked nematocysts on the tentacles of the medusa. Quite a number of genera are poorly described, the description being based on only one specimen, as for instance *Oonautes*. As our knowledge of these species, especially of their hydroid stages improves, the Zancleidae may prove to represent more than one family.

Definition of the family

Hydroids colonial with perisarc either enclosing only the hydrorhiza or hydrorhiza and hydrocauli. Tentacles scattered, either capitate or slightly club-shaped (REES, 1957 *a*, p. 526). Where known, free medusae. « With or without exumbrellar nematocysts confined to specialized tissue in form of oval or club-shaped patches or elongated tracks; with simple circular mouth; with four radial canals; with interradial gonads; with two or four hollow marginal tentacles, each with abaxial stalked

capsules (or cnidophores) containing nematocysts, or without marginal tentacles, without ocelli. » (After RUSSELL, 1953, p. 98).

The Zancleidae are represented in the Mediterranean by one genus, *Zanclea* GEGENBAUR 1854. This includes *Mnestra* KROHN (see MARTIN & BRINCKMANN, 1963; MARTIN, 1966).

Zanclea GEGENBAUR 1856

Generic characters

Hydroids with well or feebly developed perisarc. Capitate, scattered tentacles. Medusa buds borne either between or below the tentacles.

Type species: *Zanclea costata* GEGENBAUR 1856.

There are two varieties of *Zanclea costata* in the Mediterranean (BRÜCKNER, 1914; MARTIN & BRINCKMANN, 1963).

Zanclea costata GEGENBAUR 1856 and *Zanclea costata* var. *neapolitana* BRÜCKNER 1914.

Zanclea costata var. *neapolitana* BRÜCKNER 1914

Plate 4, fig. 1; text-figs. 83-84

Synonymy

Gemmaria implexa varietas *neapolitana* BRÜCKNER 1914, p. 460, text-figs. 7-24; pl. VIII, figs. 3-14 (hydroid and young medusa).

Specific characters

Hydroid with perisarc extending on the hydrocaulus up to the base of the hydranth. Up to 100 tentacles per hydranth; medusa buds borne between the tentacles. Medusa with two tentacles when young, increasing to four. The medusa is not distinguishable from the *Zanclea costata* of GEGENBAUR.

Material seen: Gulf of Naples.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

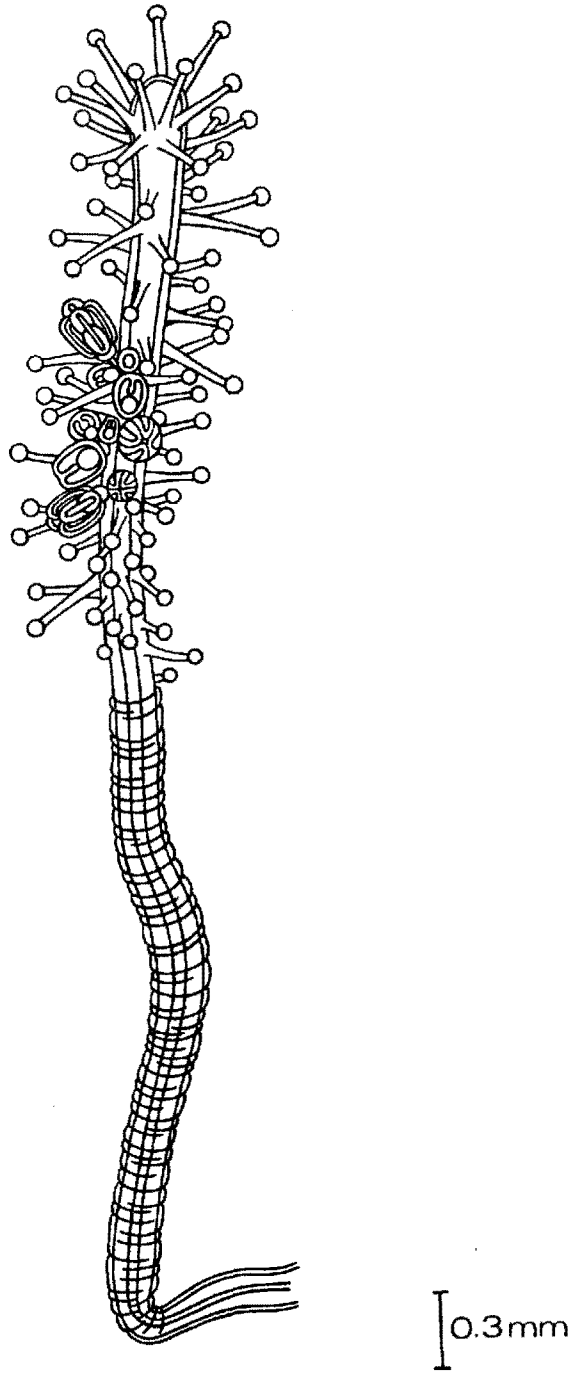
Hydroid, outside Mediterranean: none.
Mediterranean: Naples, Italy (BRÜCKNER, 1914).
Medusa, outside Mediterranean: none.
Mediterranean: see p. 73.

Methods of collection and cultivation

The hydroid can be found only on lamellibranch shells, mostly *Cardium* sp. It thrives under laboratory conditions and develops medusa buds from March to June.

Description of the species

Hydroid: The hydroid lives exclusively on the margin of lamellibranch shells. In specimens from the sea the hydrorhiza and stems are covered with a brownish, annulated perisarc which extends up to the lowest tentacles of the hydranth. The perisarc-covered stem measures about 2 mm in length. The hydranth is of about the same length. In specimens with medusa buds there are no less than 70 capitate tentacles, this being one of the characteristics of the *neapolitana* variety of *Z. costata*. Clusters of medusa buds are situated between the tentacles. The colour of the hydranth is faintly pink, that of the perisarc more brown. If kept in culture the hydranth may grow to 1 cm in length or even longer and the tentacles increase in number. In regenerating hydranths the perisarc looks whitish-hyaline, and its annulation is less marked. However the perisarc covers always the larger part of the stem even in colonies which are kept in the laboratory for several months.

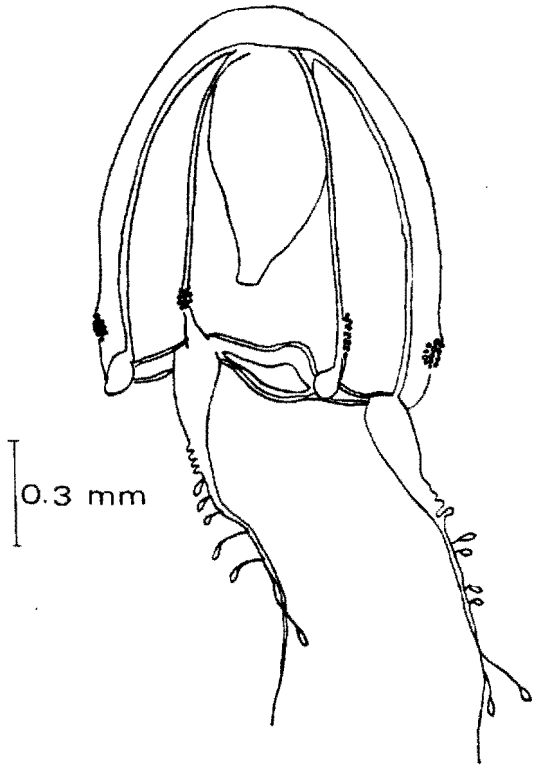


TEXT-FIG. 83 - Zanclea costata *var.* neapolitana; *hydroid; drawn after living specimen by* ILONA RICHTER.

The liberated medusa measures 0.5 mm in diameter and 0.4 mm in height (measurements from preserved specimens). It carries 2 perradial tentacles and 2 perradial marginal bulbs. There are four exumbrellar cnidocyst patches each containing 15 to 20 cnidocysts. In a 10 day old specimen three of the exumbrellar cnidocyst patches were still concentrated in oval discs, but in one of the cnidocyst patches the cnidocysts were arranged more linearly (text-fig. 84). This observation supports RUSSELL's (1953) statement that the arrangement of exumbrellar cnidocysts in rows or in discs does not help to differentiate species but to determine age.

The second pair of tentacles develops between the second week and one month of age, together with the ripening of the gonads.

BRÜCKNER (1914) made a careful study of the histological structure of the medusa.



TEXT-FIG. 84. - Zanclea costata, *var.* neapolitana; *meausa, 10 days old; preserved, slightly damaged specimen.*

Habits

The medusa swims vigorously and is extremely sensitive to light.

Ecology

The hydroids of *Z. costata* var. *neapolitana* were found by BRÜCKNER (1914) on the margin of *Venus gallina* especially around the siphons. Our specimen, with medusa buds on, was found on the margin of *Cardium* sp. in June.

Discussion of the species

The hydroid stage of this variety can easily be distinguished from *Zanclea costata* by its stronger perisarc, the numerous tentacles, the medusa buds between the tentacles and its habitat on the margin of Lamellibranchia. The medusa stage does not show significant differences from the medusae of *Z. costata.* Therefore it is not possible to identify the variety in the medusa stage.

It seemed to me that the medusae of the variety *neapolitana* were developing quicker and were easier to rear than *Z. costata.* But our material was not abundant enough to clear this question. It would be desirable to raise numerous *Zanclea* medusae from the variety *neapolitana* BRÜCKNER and *costata* GEGENBAUR, on a comparative basis.

Zanclea costata GEGENBAUR 1856
Pl. 4, fig. 1; text-figs. 85-87

Synonymy

Zanclea costata GEGENBAUR 1856, p. 229, pl. VIII, figs. 4-7 (medusa).
Tubularia implexa ALDER 1857, p. 108, pl. IX, figs. 3-6 (hydroid).
Gemmaria implexa ALLMAN (1871-1872, p. 223, 290, pl. VII, figs. 1-10) (hydroid).
Zanclea gemmosa RUSSELL & REES (1936, p. 107, figs. 1-12) (medusa and hydroid) listing synonyms for the hydroid stage.
Zanclea costata RUSSELL (1953, p. 99) (medusa and hydroid) listing synonyms for the hydroid.

Specific characters

Hydroid with whitish, feebly developed perisarc, not annulated, with up to 50 tentacles, often less; medusa buds borne below tentacle whorls or on reduced hydranths, seldom among tentacles. Free medusa with two tentacles when young, four when adult; with stalked capsules of cnidocysts. The medusa cannot be distinguished from *Z. costata* var. *neapolitana.*

Material seen: Naples.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: All European coasts (RUSSELL, 1953); North America (Mc CRADY, 1858; A. AGASSIZ, 1865).
Mediterranean: Naples, Italy (author).
Medusa, outside Mediterranean: See KRAMP (1961).
Mediterranean: Dalmatia (NEPPI, 1912); Triest, Yugoslavia (NEPPI & STIASNY, 1913); Adriatic sea (BABNIK, 1948; PELL, 1938); Villefranche, France, (KRAMP, 1957 *c*); Naples, Italy (MARTIN & BRINCKMANN, 1963).

As the medusa stage of *Zanclea costata* GEGENBAUR and *Zanclea costata* var. *neapolitana* BRÜCKNER can only be distinguished after being raised from their hydroids, one does not know to which of the two varieties all the above mentioned findings of the medusa refer.

Methods of collection and cultivation

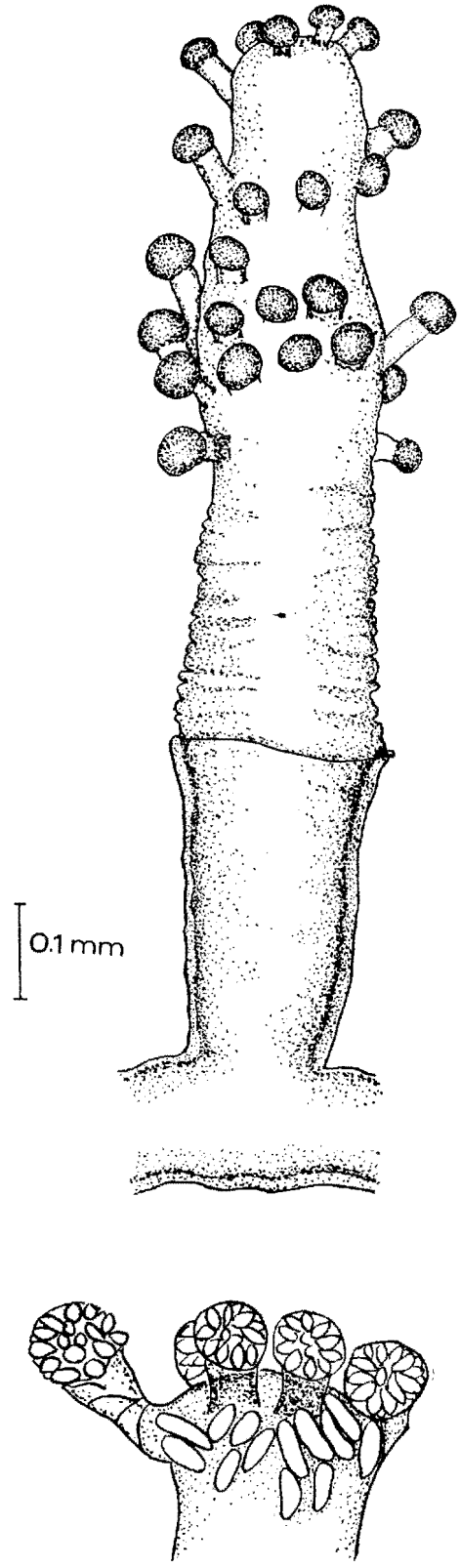
The hydroids of *Z. costata* GEGENBAUR may usually be found on *Cellopora* sp. (Bryozoa) in shady, rocky littoral 2 to 3 m below surface. If the Bryozoa are living on *Balanus* colonies, the *Zanclea* colonies may spread onto the *Balanus*, too. *Z. costata* hydroids can also be found on the stems of large corals such as *Muricaea* sp. (Gorgonidae) if these are encrusted with Bryozoa 20 to 30 m below surface. The hydroid is easy to rear in glass cultures fed with *Artemia* every second day. The medusae are produced from March to May if the hydroids are kept at 18° or 20° C. The medusa is difficult to rear; but if food is brought directly to its mouth every day, it will grow and reach maturity.

Description of the species

Hydroid: Colonies of unbranched hydranths from 2 to 10 mm in height. Perisarc surrounding base of each hydranth irregularly corrugated, sometimes ringed at base. No visible perisarc in young colonies. Twenty to 50 capitate tentacles irregularly distributed over body of hydranth with a tendency sometimes toward verticillate arrangement and always an apical whorl of four to six tentacles. Medusa buds borne usually on medusiferous hydranths often reduced to mere blastostyles on or at the base of hydranth or below tentacles but may seldom occur among tentacles (RUSSELL, 1953). While the colour of the hydranth is described there as reddish, specimens from Naples are commonly whitish, this being a good distinguishing character against other corynid hydroids. The hydroids have a white proboscis, resulting from the concentration of large cnidocysts there (text-fig. 85). As mentioned by RUSSELL & REES (1936, p. 108) the length of hydranths in different colonies varies considerably and the length of the hydranths may reach 10 mm in cultures. This can also be verified for cultures of *Z. costata* from Naples. However *Z. costata* hydroids remain much shorter than *Z. costata* var. *neapolitana* under the same culture conditions.

Medusa: « Umbrella bell-shaped, about as high as wide; jelly moderately thick, sometimes thicker in apical region and at sides near margin; exumbrellar nematocysts confined to specialized tissue in form of oval or club-shaped patches immediately above marginal bulbs or elongated meridional tracks runing for varying lengths towards summit of umbrella. Velum fairly broad. Stomach cylindrical, in full extension reaching nearly to, but not beyond, umbrella margin. Mouth simple, circular, with nematocysts along margin. Four straight radial canals and ring canal of moderate breadth; linear thickenings along middle regions of radial canals. Gonads interradial, covering most of the length of the stomach, leaving mouth end free. Two opposite perradial marginal tentacles and two opposite perradial nontentacular marginal bulbs, or four perradial marginal tentacles.

Marginal tentacles with elongated conical bases and stalked capsules or cnidophores along their abaxial surface; each cnidophore oval in shape, 0.02 to 0.03 mm in length and containing two to five nematocysts.



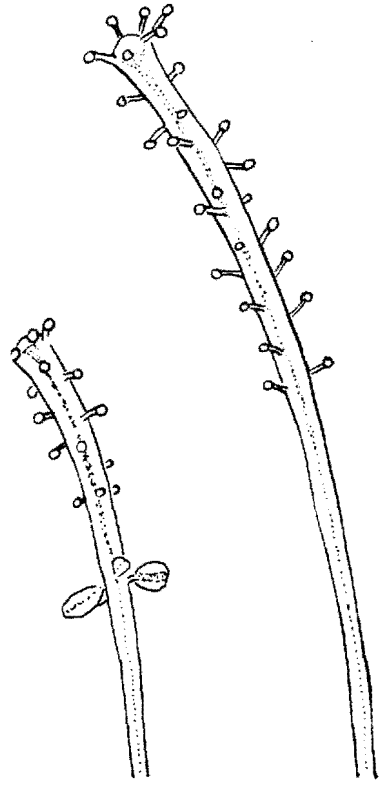
TEXT-FIG. 85. - Zanclea costata GEGENBAUR; *hydroid without medusa buds; preserved directly after taken from the sea, oral region enlarged.*

Height of umbrella usually 1.5 to 3.0 mm. Colour of stomach pale yellow, radial canals and ring canal pink; marginal tentacle bulbs reddish or orange. » (After RUSSELL, 1953, p. 99).

Developmental stages

The newly liberated medusa is 0.7 to 0.9 mm high in living specimens from Naples. RUSSELL gives a height

of 0.6 to 0.7 mm for the Plymouth region and 1.8 mm for American waters (RUSSELL, 1953, p. 100). The development of the medusa and the variation of the hydroid have been described in full detail by RUSSELL (1953) and RUSSELL & REES (1936).



TEXT-FIG. 86. - Zanclea costata GEGENBAUR; *hydroid with medusa buds (after* RUSSELL *and* REES 1936).

Ecological observations

Hydroids of *Z. costata* may be found in two different regions.

Firstly on steep rocks in shady places 1 to 3 m below surface.

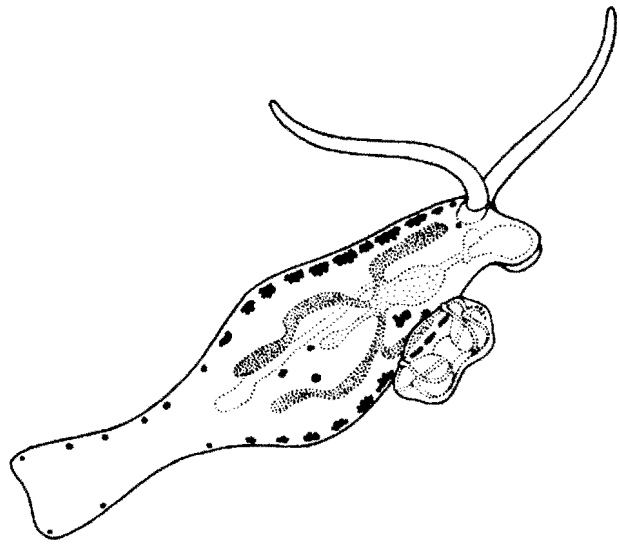
Secondly on Gorgonacea 20 to 60 m deep. In both places *Z. costata* hydroids live on encrusting Bryozoa. In the first place it could be found only from February to November with medusa buds from the middle to the end of May. The absence of the hydroid from December to January is shared by numerous other athecate hydroids from the same biotop which are reduced to their hydrorhiza in certain months of the year.

In the deeper regions medusa buds were observed in February and March.

The interesting case of parasitism of *Phyllirrhoë bucephala* (Mollusca, Opisthobranchia) is reported in earlier papers (MARTIN & BRINCKMANN, 1963; MARTIN, 1966). Text-fig. 87 shows a *Zanclea costata* with an adult *Phyllirrhoë* taken from the plankton, with rudiments of the characteristic tentacles of *Zanclea* still present.

Discussion of the species

There has been considerable confusion in the past about the different species of *Zanclea* hydroids and their medusae.



TEXT-FIG. 87. - Zanclea costata *with* Phyllirrhoë bucephala; *note that one of the typical* Zanclea *tentacles is still present in spite of the reduction of the medusa. Sketch from a living specimen drawn by* ILONA RICHTER.

Medusa specimens with two tentacles were regarded as a species different from those with four tentacles. However RUSSELL & REES (1936) observed from the Atlantic coast of England and the author from the Mediterranean waters that all *Zanclea* medusae are liberated with two tentacles and get the second pair of tentacles in the course of their development. Often one finds medusae from the plankton with maturing gonads but only two tentacles; these specimens will grow the second pair of tentacles after a few days. Therefore I can only confirm RUSSELL'S (1953) opinion and that of KRAMP (1961) that *Z. costata* has to be united with *Z. implexa* ALDER and *Z. gemmosa* MC CRADY, with *Z. costata* having priority. TREGOUBOFF & ROSE (1957, p. 282) reports two species of *Zanclea* for Villefranche, France: *Zanclea sessilis* GOSSE (synonym of *Z. implexa* which is a synonym of *Z. costata*) and *Z. hargitti* HARTLAUB. He describes both species as indistinguishable except by the size of much larger macrobasic euritheles in the latter species. Unfortunately I was not aware of this distinguishing character when I had numerous specimens of *Zanclea* from the plankton. The hydroid of *Z. costata* has been attributed to different species and even genera. But RUSSELL & REES (1936) concluded that the characters which led to the establishment of different species or genera actually reflect the age of the colony and are very variable; therefore all the different *Zanclea* hydroids belong to *Z. costata* GEGENBAUR.

FAMILY CLADONEMATIDAE GEGENBAUR 1856

The Cladonematidae — in their medusa stage easy to identify by the branched tentacles — are represented by one genus, *Cladonema* and one species, *C. radiatum* DUJARDIN in the Mediterranean. GEGENBAUR defined the family in 1856. Later ALLMAN (1871-1872) established the family Cladonemidae for the same genera. As GEGENBAUR'S definition has priority, his family name Cladonematidae is held to be valid.

Definition of the family

Hydroids colonial with perisarc either extending on the hydrocaulus up to the base of the hydranth or no perisarc at all. With one whorl of capitate oral tentacles; with or without small filiform aboral tentacles. Medusa buds borne above the aboral tentacle whorl when these are present or at the same distance from the oral whorl when the filiform tentacles are absent (NAUMOV, 1960, p. 228).

Free medusae creeping and swimming Anthomedusae with mouth with short lips armed with cnidocyst clusters; with stomach with perradial pouches; with variable number of radial canals, some simple, some bifurcated, final number of canals entering ring canal usually of same number as marginal tentacles; with gonads completely surrounding stomach; with variable number of hollow branching marginal tentacles, each furnished with organs of adhesion; with ocelli. (Definition of the medusa stage after RUSSELL, 1953, p. 105).

Genus *Cladonema* DUJARDIN 1843

Generic characters

With characters of the family.
Type species: *Cladonema radiatum* DUJARDIN 1843.

Cladonema radiatum DUJARDIN 1843
Plate V, figs. 1, 2; text-figs. 88-89

Synonymy

Cladonema radiatum DUJARDIN 1843, p. 1134 (medusa).
Stauridie radiatum DUJARDIN 1843, p. 1133 (hydroid).
Stauridie radiatum DUJARDIN 1845 *b*, p. 271, pl. 14, fig. C (hydroid).
Cladonema radiatum DUJARDIN 1845 *b*, p. 272, pl. 14, fig. C, pl. 15 (medusa).
Coryne stauridia GOSSE 1853, p. 257, pl. XVI, figs. 1-5, fig. C (hydroid).
Eleutheria radiata LENGERICH (1922, p. 210) (hydroid and medusa).
Eleutheria radiata LENGERICH (1923 *b*, p. 313) (hydroid and medusa).
Cladonema radiatum RUSSELL (1953, p. 105-110) (hydroid and medusa).

Specific characters

Hydroids with up to five capitate oral tentacles and up to five (usually four) short filiform aboral tentacles. Medusa with fairly thin walls, rounded apex. Manubrium as long as bell cavity. With four or five simple oral tentacles with terminal knobs. Gonad encircles stomach, with 4 to 5 radial sac-like protrusions. Eight to 10 radial canals reach the ring canal. Eight to 10 tentacles with several branches with clusters of nematocysts. (Definition of the medusa partly after KRAMP, 1961, p. 57).

Material seen: Naples, Italy; Villefranche, France.

Material deposited: B.M.N.H.; S.Z.N.

Methods of collection and cultivation

Strangely enough the hydroid is reported very often to be brought into the laboratories or aquaria « accidentally ». It is then only noticed on account of the sudden presence of its medusa. In nature the hydroid is difficult to find. Around Naples it was never found in large numbers, only in colonies of 2 to 3 hydranths in shaded places of the cave of Capo Miseno. From the end of June to the end of July the medusae can be caught in large numbers by pulling a stramin net over the *Posidonia* beds around Ischia (Italy).

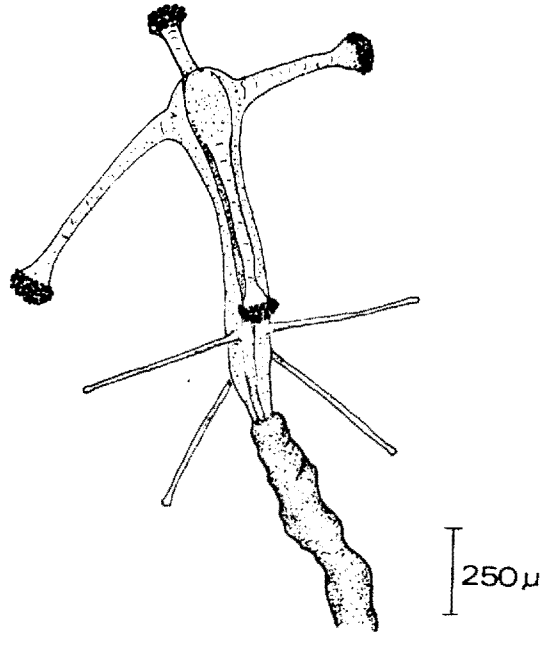
Hydroid and medusa are easy to keep in the laboratory in Boveri dishes at 18° C. They feed well on *Artemia*. Hydroids brought into the laboratory start soon to form large colonies and bud medusae. The hydroid can be raised easily from the medusa. Therefore this species is an ideal tool for embryologists and physiologists.

Distribution

Hydroid, outside the Mediterranean: Devonshire coast, England (GOSSE, 1943); besides this single record from nature all others are from aquarium material.
Mediterranean: Villefranche, France (DU PLESSIS, 1888); Adriatic Sea, one specimen only (SCHNEIDER, 1897); Naples, Italy (DU PLESSIS, 1881 *a, b*, only from the aquarium; author, specimens from the sea).
Medusa, outside Mediterranean: All European coasts (for more details see KRAMP, 1961).
Mediterranean: Adriatic Sea (SCHNEIDER, 1897; HADZI, 1911 *c*; NEPPI & STIASNY, 1913); French Mediterranean coast (PICARD, 1952, 1955 *a*); Naples, Italy (LO BIANCO, 1899; DU PLESSIS, 1881 *a, b*).

Description of the species

Hydroids slender, simple or slightly branched, reaching a height of 12 to 25 mm, the hydranths without stem being about 1 mm high. The perisarc is smooth, light yellowish or brown in colour.



TEXT-FIG. 88. - Cladonema radiatum, *hydroid* (*after* BRINCKMANN & PETERSEN, 1960).

In cultures the perisarc is nearly transparent, therefore it has been overlooked in fig. 2 of plate V. The four or five capitate tentacles in the oral whorl are solid with 7 to 8 endodermal cells in a row. The terminal knobs are cone-shaped with rounded base. The filiform tentacles have a tiny distal swelling; its distance from the base of the hydranth is about half its distance from the oral whorl. (Partly after RUSSELL, 1953, p. 110; BRINCKMANN & PETERSEN, 1960, p. 388). Medusa buds are borne above the filiform tentacles, there are one or two buds developing at the same time. The buds are naked, and in the stages shortly before liberation of the medusa the tentacles of the bud move freely.

The adult medusa is 3 to 4 mm in diameter and about 3 mm high. « Umbrella bell-shaped slightly higher than broad, jelly moderately thin, sometimes with a slight apical projection. Velum very broad. Stomach spindle-shaped, with usually five, sometimes four short protuberances or lobes, each armed with nematocyst clusters. Stomach not extending beyond umbrella margin » (after RUSSELL, 1953, p. 106). Eight or 10 radial canals with corresponding number of marginal tentacles. Two or four of the radial canals may unite before entering the stomach. HARTLAUB (1897), LENGERICH (1923 *a, b*), and BILLARD (1905) place much emphasis on the pattern of branching of the radial canals, stating that this is a developmental process. According to them there are originally only four or five radial canals which branch and thus reach the number of eight or ten. Although I examined about 100 specimens from Naples I could not find any regularity in the « branching » of the radial canals. The term « branching » in the case of the radial canals of *C. radiatum* will be discussed below. Each tentacle carries distally 2 or 3 moniliform side-branches and basally 2 to 3 capitate branches. With the latter branches the medusa stands and adheres itself to the substrate. The gonads surround the stomach completely in its upper part. HARTLAUB (1897) states that there is a successive hermaphroditism.

However neither LENGERICH (1923 *a, b*) nor I could ever find hermaphroditic specimens.

Developmental stages

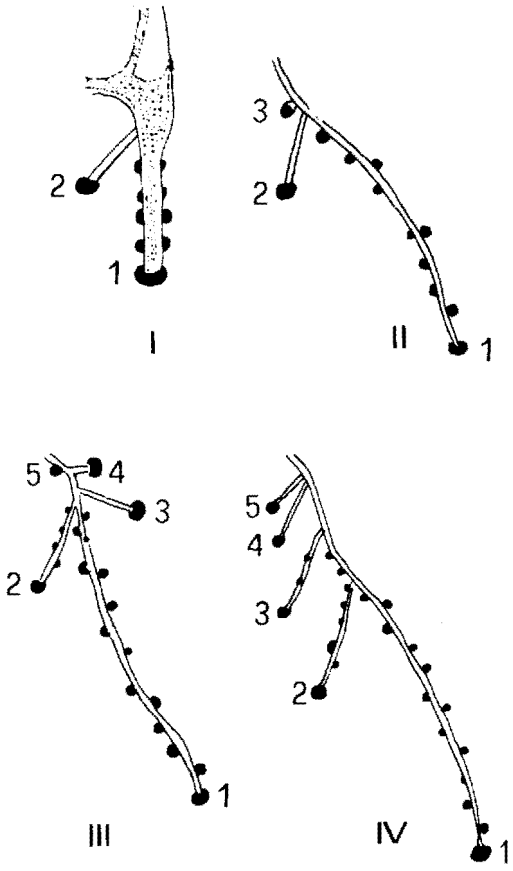
The eggs of *C. radiatum* develop into a free swimming planula, which settles on the bottom in a form of a round disc. The primary hydranth develops without a resting stage. However detailed observation is still required on the development of the embryo and the histology of the development of the primary hydranth.

The histology of medusa bud formation on the hydranth has been studied by BRIEN (1942); the growth of a medusa bud from its first appearance to the liberation is extremely quick, in cultures at 18° C it takes only 6 to 7 days.

Although numerous papers were written on the development and morphology of *C. radiatum* (HADZI, 1911 *a*; HARTLAUB, 1897; BILLARD, 1905; MÜLLER, 1911; BRIEN, 1942; RUSSELL, 1953) there seems to exist some confusion about the « branching » of the radial canals. According to HARTLAUB (1897, 1907-1917) there are « originally » 5 primary radial canals. Some of these primary radial canals branch to form 8 or 10 radial canals. However no one describes whether this branching takes place before or after liberation of the medusa bud and no picture can be found in any of the literature cited about the development of the « secondary » radial canals. All pictures show already 8 radial canals either entering the stomach independently or uniting into pairs slightly distal from their junction with the stomach. Therefore, if the development of the eight or ten radial canals is through branching, it must take place before the liberation of the medusa. However this has not been stated by any of the authors. Since it is unknown how the final number of 10 radial canals is reached, I suggest that one should omit the terms « primary » and « secondary » radial canals as well as « branching ». In *Staurocladia portmanni* (Eleutheriidae) the radial canals often enter the stomach in pairs and not singly (see p. 82).

Very interesting is the development of the tentacles and their branches, which was followed up during the development of one specimen as well as on specimens of different sizes from the plankton. The liberated medusa has 8 or 10 tentacles. Each tentacle carries 1 terminal cnidocyst cluster and 3 abaxial and 3 adaxial cnidocyst bulbs. Basal to the cnidocyst bulbs there is 1 adaxial branch which carries one terminal cnidocyst cluster. This stage is often referred to as the « *Eleutheria* stage » because the tentacles resemble those of *Eleutheria* (text-fig. 89, I). Three days later the cnidocyst clusters on the main branch (branch 1 in text-fig. 89) have increased in number in a basal direction, and basally from the first side branch — numbered as branch 2 — a new cnidocyst bulb can be seen which grows later into a second side branch — numbered as branch 3. This branch « 3 » has at first only one terminal cnidocyst bulb. In the course of development, branch no. 2 develops cnidocyst bulbs along the side of the tentacle and can no longer be distinguished morphologically from branch no. 1. The same happens to the following side branches: First they appear only with a terminal cnidocyst bulb and act as adhesive branches and later when new cnidocyst bulbs are formed along their sides they become more flexible and cannot be distinguished any more from the first branch. At the end of its development the medusa has on each tentacle only the two basal branches « capitate » while all other side branches have become moniliform after having passed through a capitate stage. This is a confirmation of UCHIDA's (1927, p. 200) account of the tentacle development of *Cladonema*: « The shorter branches (of the tentacles, author) which are said to act as sucker, seem to be only young stages of the filamentar (moniliform, author); the nematocyst clusters first appear only on the tip of the shaft and gradually shift to the dorsal side, so that the entire branch comes to be covered with several series of nematocyst

batteries regularly arranged in a row. The tentacle branches make their first appearance in the median line of the tentacle base and gradually shift to the sides ».



TEXT-FIG. 89. - Cladonema radiatum, *medusa, developmental stages of one tentacle:* I - *medusa one day old. Each tentacle carries a moniliform* (1) *and a capitate* (2) *branch;* II - *same specimen, 3 days old; cnidocyst clusters of branch 1 increased; branch 2 unchanged; branch 3 starts to grow proximally to branch 2.* III - *same specimen, 8 days old. Branch 2 has been transformed from capitate to moniliform through the development of lateral cnidocyst clusters; branch 3 elongated, but capitate; new branches 4 and 5 appear.* IV - *same specimen, 13 days old. Branch 3 has been transformed from capitate to moniliform. Branch 4 and 5 capitate. Additional cnidocyst clusters developed between branch 2 and 3.*

Whole mounted tentacles under a 400 times magnification showed no differences between the terminal bulbs of the basal branches (up to now referred to as « adhesive organs » or « Schreitäste ») and those of the distal branches (« defensive organs » or « Wehräste » in German). Terminal bulbs of all branches are fully packed with cnidocyst clusters. Truly adhesive organs of the basal tentacles branches can be found in the genera *Eleutheria* and *Staurocladia* (p. 79). The basal tentacle branches of *Cladonema* are twice the diameter of the distal ones. This larger diameter of the basal branches may cause a typically stiff position while the medusa is attached to the substrate.

Ecological observations

Although *C. radiatum* has been studied often from aquarium material in the laboratory, observations on its ecology are rather scarce. DU PLESSIS (1888) and SCHNEIDER (1897) were the only ones who found *C. radiatum* hydroids in the Mediterranean. DU PLESSIS mentions that he found the hydroid on algae and various objects «sous marine». The medusae were then liberated in the aquarium and it is not clear whether he collected the medusae in nature at all. TREGOUBOFF (1957) mentions that the medusa can be found in Villefranche the year round. An observation period of several years in Naples and Villefranche gave the following interesting results: The medusa occurs regularly in the *Posidonia* beds around the islands of Ischia and Casamicciola in great numbers, further in small numbers in the *Posidonia* beds around Capo Posillipo from the beginning of June to the middle of July. It is abundant in the *Posidonia* beds in Villefranche (France) in May and June. There were no *Cladonema* medusae in other periods of the year and in no other locations.

The hydroid has been found only in shaded parts of the cave of Capo Miseno about 2 m deep and then only in colonies of 1 to 2 individuals. Strangely enough the hydroid was never found on *Posidonia* plants or roots where the medusae live after liberation. As there is such an abundance of medusae in June and July and the medusa is not budding, there must be other localities where the hydroid grows in large colonies.

Discussion of the species

C. radiatum DUJARDIN 1843 was united by KRAMP (1961) with the American species *C. perkinsi* MAYER and *C. mayeri* PERKINS (MAYER, 1910, p. 101; RUSSELL, 1953, p. 110). *C. radiatum* is different from *C. uchidai* HIRAI 1958 on account of the morphology of the polyp (HIRAI, 1958).

FAMILY ELEUTHERIIDAE STECHOW 1923

Definition of the family

Hydroids colonial, unbranched, rising directly from a creeping stolon, with an oral whorl of capitate tentacles, with or without a whorl of short filiform tentacles. Where known, free medusae. Medusae with continuous or broken thickened ring of nematocysts around umbrella margin; with simple circular mouth with or without lip-like cnidocyst patches, with variable number of radial canals which may or may not branch; with gonads on subumbrellar surface or in special brood pouches or surrounding stomach; with variable number of hollow bifurcating marginal tentacles, each furnished with an organ of adhesion; with abaxial ocelli; velum well developed (KRAMP, 1961; BRINCKMANN, 1964 *b*). The Eleutheriidae are represented in the Mediterranean by two genera, *Eleutheria* QUATREFAGES 1842 and *Staurocladia* HARTLAUB 1917.

Genus *Eleutheria* QUATREFAGES 1842

Generic characters

Hydroids where known without filiform tentacles; medusae with or without brood-pouch above stomach; mouth without lips or tentacles; velum well developed; with four or more simple radial canals and several bifurcated tentacles, lower branch with a terminal adhesive disk, upper branch with a terminal cluster of nematocysts.

Type species: *Eleutheria dichotoma* QUATREFAGES 1842.

Two species of this genus, *E. dichotoma* and *E. claparedi* have been reported for the Mediterranean. Unfortunately *E. claparedii* was found in the Mediterranean only once and only one specimen; therefore the description of this species is mainly based on material from Tatihou which MÜLLER found in 1912.

Eleutheria dichotoma QUATREFAGES
Text-figs. 90-92

Synonymy

Eleutheria dichotoma QUATREFAGES 1842, p. 270, pl. VIII (medusa).
Clavatella prolifera HINCKS 1861, p. 73, pl. VII-VIII (hydroid and medusa).
Clavatella prolifera HINCKS 1868, p. 73, 320, pl. XII, figs. 2, 2*a* (hydroid and medusa).
Eleutheria Krohni KRUMBACH 1907*a*, p. 1-47 (medusa).
Eleutheria radiata LENGERICH 1923*a*, p. 61-65 (medusa).
Eleutheria radiata LENGERICH 1923*b*, p. 311-388 (medusa).
Eleutheria dichotoma RUSSELL 1953, p. 110-114, text-figs. 52-53.

Material seen: Naples, Italy.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: Torquay, Ilfracombe, Filey Brigg, Whitby, British Isles (HINCKS, 1868).

Although the hydroid has been raised from the medusa several times (DE FILIPPI, 1866; DRZEWINA & BOHN, 1913; DU PLESSIS, 1909), the above mentioned finding of the hydroid by HINCKS seems to be the only record of the hydroid from the sea.

Mediterranean: Naples (only raised from its medusa).

Medusa, outside Mediterranean: British Isles; Skagerrak, Sweden; France (RUSSELL, 1953).

Mediterranean: Triest, Yugoslavia (NEPPI & STIASNY, 1913); French Mediterranean (DU PLESSIS, 1881*a*, *b*; PICARD, 1952); Rhodos, Greece (HAUENSCHILD, 1956); Naples, Italy (HARTLAUB, 1907-1917).

Methods of collection and cultivation

The medusa is quite rare around Naples. It was found only twice in dredging material from the Gulf of Pozzuoli and from Posillipo about 20 m deep in the spring. It appeared in the aquarium circulation in the spring of 1959 but not in the following years. The medusa is easy to keep in the laboratory when fed with *Artemia*. Medusa budding and planula development were observed at 14° C. Primary hydranths were raised at 17° C.

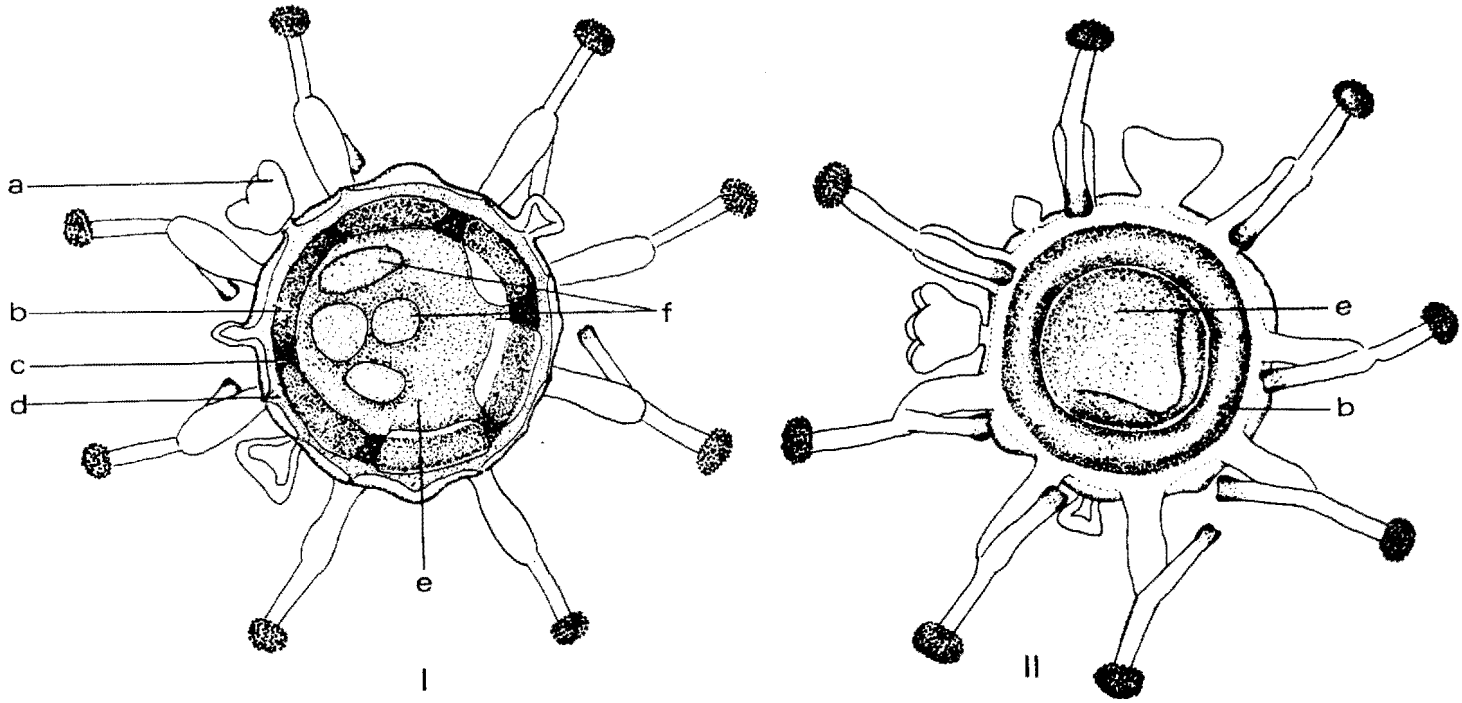
The hydroid was not found in the sea around Naples.

The hydroid consists of unbranched or slightly branched colonies which reach a height of about 9 mm. The perisarc extends to the very base of the hydranth and is of a smooth delicate texture. The hydranth is elongated, cylindrical, very extensile. There is an oral whorl of up to 10 capitate tentacles. The medusa buds are borne in clusters on short gonostyles near the base of the hydranth. (Partly after RUSSELL, 1953, p. 114). RUSSELL mentions that *Eleutheria* hydroids have simple unbranched colonies. HAUENSCHILD (1956, p. 359; 1957*a*, *b*) noticed that in the laboratory the hydroids usually stay solitary and grow seldom to a colony of 3-4 polyps. It seems to be interesting that a species of the related genus *Staurocladia* (see p. 81) has also very small colonies in the laboratory; whereas *Cladonema radiatum* related in its morphology to *Eleutheria*, but found in only small colonies in nature, grows to large colonies in the laboratory (p. 76).

Medusa: The umbrella of *E. dichotoma* is flattened, with a diameter of 0.4 to 0.8 mm. There is a very thick cnidocyst ring which is actually part of the velum and more on the subumbrellar side of the medusa than at the margin (text-fig. 90, I). The stomach is attached to the subumbrella by a very broad base; on account of this broad stomach-base the six radial canals are very short; nearly the entire subumbrellar cavity is occupied by the stomach. The manubrium is conical terminating in a simple and tubular mouth. There are 6 to 11 bifurcated tentacles each terminating in one aboral branch with a terminal cnidocyst cluster and an adaxial branch with an adhesive sucker-like organ at its end. Each tentacle is hollow basal from the branching point, and solid distal from the branching point. There is a dark-red ocellus slightly above the base of the abaxial side of each tentacle. Above the stomach is an ectodermal brood pouch in which planulae develop. The species is hermaphroditic and eggs and planulae in different stages of development can be observed in one animal at the same time (text-fig. 90, I).

Developmental stages

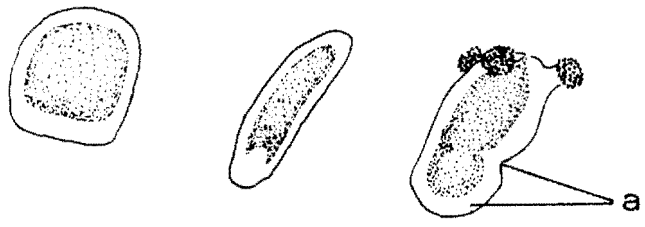
The development of the hydroid and medusa and the asexual reproduction in the medusa has been studied in detail by HAUENSCHILD (1956).



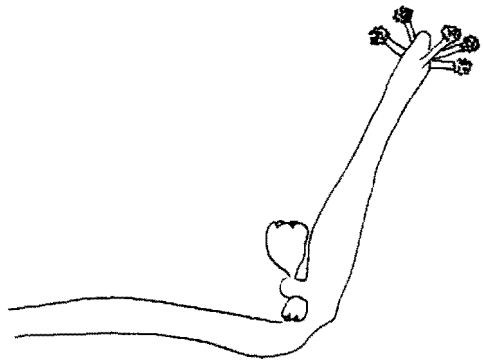
TEXT-FIG. 90. - Eleutheria dichotoma; *medusa with medusa buds, eggs and planulae.* I - *exumbrellar view;* II - *subumbrellar view of the same animal.* a - *medusa buds;* b *cnidocyst ring;* c - *radial canal;* d - *ring canal;* e - *stomach;* f - *planulae;* g - *eggs or developmental stages between the eggs and planulae.*

Ecology

HINCKS (1868, p. 73) mentions that medusa production takes place in summer and autumn (Torquay, England). The medusae occurred in the Naples aquarium circulation at the end of February when the water temperature is usually at its lowest point (13-14 ° C). The medusae were then carrying medusa buds. Two specimens were found in the sea 20 to 30 m deep, also in early spring. This is contrary to the habitat of *E. dichotoma* in colder waters where it is found in small intertidal rock pools (RUSSELL, 1953, p. 112).



TEXT-FIG. 91. - Eleutheria dichotoma; *free planula and primary hydroid raised in the laboratory.* a - *ectoderm.*



TEXT-FIG. 92. - Eleutheria dichotoma; *hydroid with medusa buds (after* HAUENSCHILD 1956, p. 396, fig. 1).

Systematic discussion

E. dichotoma may be mistaken for *E. claparedii* HARTLAUB. However the differences between the two species were clearly stated by MÜLLER (1911): *E. claparedi* lacks the dorsal brood chamber and the thick marginal cnidocyst ring prominently present in *E. dichotoma* (MÜLLER, 1911, p. 162, 163). In *E. dichotoma* the medusa buds develop from the margin or slightly above on the exumbrella. In *E. claparedii* the medusa buds originate from the ring channel inside the subumbrella.

Eleutheria claparedii HARTLAUB 1889
Text-figs. 93-95

Synonymy

Eleutheria dichotoma CLAPARÈDE 1863, p. 4, pl. I (medusa, figs. 4-10).
Eleutheria dichotoma SPAGNOLINI (1877, p. 312) (medusa).
Eleutheria dichotoma SPAGNOLINI cites a letter from PAVESI about an *E. dichotoma* which is different from the *E. dichotoma* of KROHN (1847) and DE FILIPPI (1865) but which looks like the *E.* of CLAPARÈDE (1863).
E. Claparedii HARTLAUB (1889, p. 665).
E. claparedii MÜLLER (1911, p. 159-169).
E. claparedii LENGERICH (1923 *b*, p. 336-345).
E. claparedii HARTLAUB (1907-1917, p. 129).
Stauroclaadia claparedei HARTLAUB (1907-1917, p. 401).
Eleutheria claparedei KRAMP (1961, p. 59).

Specific characters

Hydroid (only primary hydroids raised from the planulae) similar to *E. dichotoma* with 5 capitate oral

tentacles. No perisarc in the primary hydranths. Medusa: « 0.4 mm high, 0.5 mm wide. Four to 6 radial canals; medusa buds from subumbrellar side of ring canal into bell-cavity. 10 tentacles; not corresponding in position to the canals; tentacles bifurcate, one branch with adhesive disk, the other with nematocyst knob. » (KRAMP, 1961, p. 59).

Material seen: none.

Material deposited: none.

Distribution

Hydroid: never found in the sea.

Medusa, outside Mediterranean: Island of Tahitou near St. Vaast la Hogue (CLAPARÈDE, 1863, p. 4; MÜLLER, 1911, p. 159).

Mediterranean: Naples, Italy (only one specimen) (PAVESI in a letter to SPAGNOLINI, published 1877, p. 312).

Description of the species

See specific characters and MÜLLER (1911, p. 159-169), HARTLAUB (1907, p. 129).

Methods of collection and cultivation

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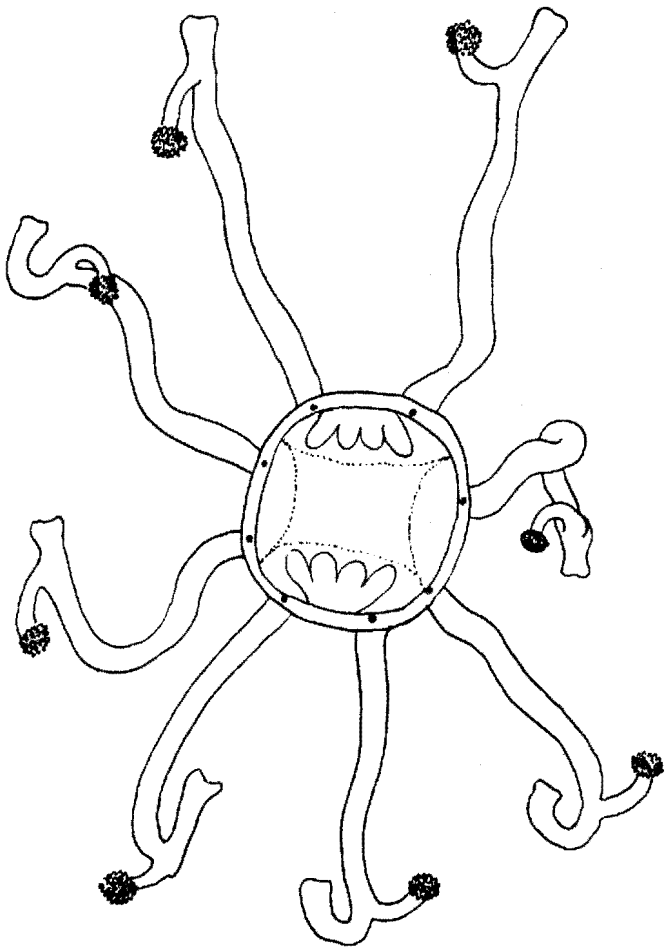


TEXT-FIG. 93. - Eleutheria claparedii; *medusa* (*after* LENGERICH 1923, fig. y, *original from* CLAPARÈDE).

Discussion of the species

See discussion for *E. dichotoma* and table below.

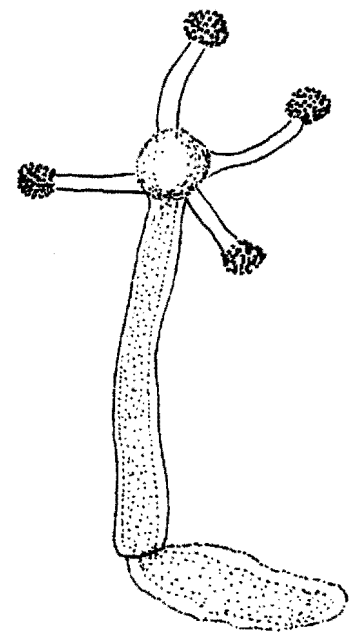
Specific characters of E. dichotoma *and* E. claparedii.

	Tentacles	gonads	medusa buds	cnidocyst ring
E. dichotoma	bifurcation in basal half	brood pouch hermaphroditic	outside	very thick
E. claparedii	bifurcation in distal half	no brood pouch hermaphroditic	inside umbrella	thin

Genus *Staurocladia* HARTLAUB 1917

Generic characters

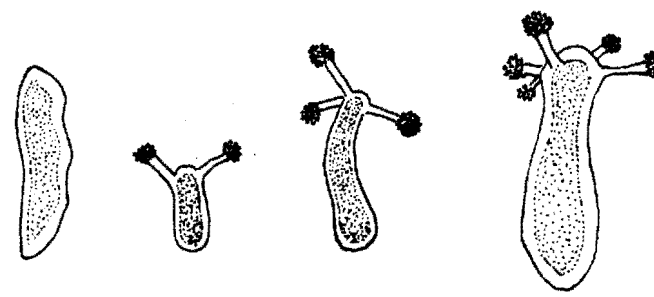
Eleutheriidae without a brood pouch above stomach; gonads well developed; either in ectodermal pockets or completely surrounding the stomach; sexes separate; aboral branch of tentacles with more than one cnidocyst bulb.



TEXT-FIG. 94. - Eleutheria claparedii; *hydroid* (*after* LENGERICH 1923, p. 337. fig. w; *original from* DRZEWINA & BOHN 1913).

Type species: *Staurocladia vallentini* (BROWNE, 1902).

The genus *Staurocladia* is represented in the Mediterranean by one species, *S. portmanni* BRINCKMANN 1965.



TEXT-FIG. 95. - Eleutheria claparedii; *developmental stages of the hydroid* (*after* LENGERICH 1923, p. 336, fig. V).

Staurocladia portmanni BRINCKMANN 1964
Plate VI, figs. 1, 2, 3; text-figs. 96-98

Synonymy

Staurocladia portmanni BRINCKMANN 1964, p. 693-705, figs. 1-10.

Specific characters

Hydroid with an oral whorl of three to four capitate tentacles and an aboral whorl of six reduced filiform tentacles, slightly enlarged at their outer tips. Perisarc extending to the base of the hydranth body. Medusa buds borne slightly above the aboral tentacle whorl.

Medusa with five to ten radial canals, which give off protuberances to the exumbrella; with 18 to 24 tentacles. Upper branch 3 to 5 aboral and 3 to 4 oral cnidocyst clusters. Two lateral cnidocyst clusters proximal to the ramification of the tentacle. Stomach with five interradial pouches. Mouth with five lip-like protuberances, armed with cnidocysts. Gonads completely surrounding stomach.

Material seen: Naples.

Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: none.
Mediterranean: Sorrentine coast, Naples, Italy (BRINCKMANN, 1964).
Medusa, outside Mdeiterranean: none .
Mediterranean: Island of Ischia, Naples, Italy (BRINCKMANN, 1964).

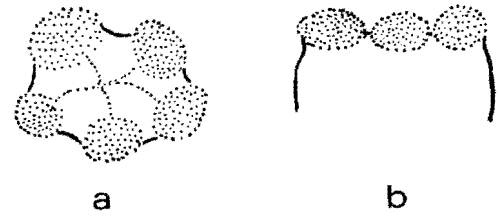
Description of the species

The hydroid forms small colonies. The stolons are surrounded by a perisarc which extends up to the body of the hydranth below the aboral whorl of tentacles. The hydranth body has a height of 1.5 to 2 mm. It has an oral whorl of three to four capitate tentacles and an aboral whorl of always six tentacles. There are usually one, seldom two medusa buds at the same time. The colour of the hydranth is pink-orange. It closely resembles the hydranths of *Cladonema radiatum*. However, there is always this difference that *C. radiatum* has 4 and *S. portmanni* 6 aboral tentacles.

Only stenotheles could be found in the hydroids. However, as I had only very young hydranths for observation of the cnidocysts, it is possible that desmonemes, too, are present in older stages of the polyps.

Adult medusa: The umbrella of the medusa is flat bell-shaped and the exumbrella wider than high. The diameter of the exumbrella is 4 to 6 mm, its height 2.5 to 5 mm (plate VI, fig. 2). The stomach does not extend beyond the subumbrella. It has five stomach-pouches (plate VI, figs. 1, 2). The mouth is not equipped with tentacles, but has five lip-like protuberances, armed with cnidocysts (text-fig. 96).

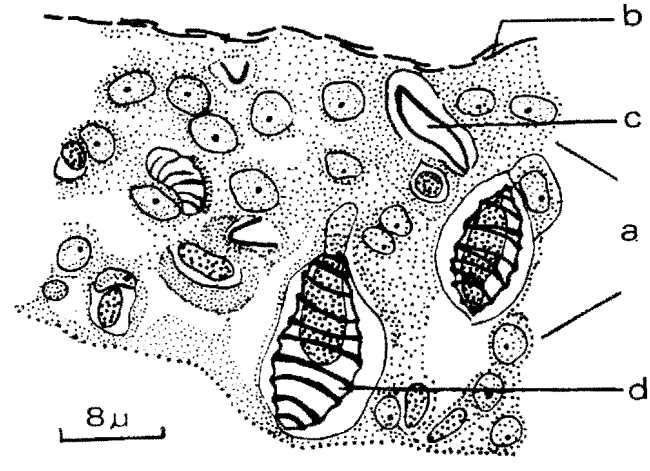
The radial canals originate near the upper centre of the stomach. They are attached both to the subumbrella and to the stomach for a third of the length of the stomach (plate VI, fig. 1, 2). In this upper region they give off finger-like protuberances to the exumbrella. These are continuations of the endoderm of the radial canals and consist of two rows of endodermal cells. At the point of origin from the stomach the radial canals may fork into two branches. The specimens studied had from five to ten radial canals, depending on how many of the five radial canals were forked into two.



TEXT-FIG. 96. - Staurocladia portmanni, *medusa; cnidocyst clusters around the mouth;* a - *oral view,* b - *lateral view (after* BRINCKMANN 1964, fig. 4).

The number of tentacles in adult specimens varies from 16 to 25. The tentacles are hollow and their lumen communicates directly with that of the ring canal. Each tentacle has an oral and aboral branch. The aboral branch ends in a terminal cnidocyst bulb and bears two to five cnidocyst bulbs on its aboral side and, alternating with the aboral ones, two to four on its oral side. The main tentacle stem bears two opposite lateral cnidocyst bulbs immediately proximally to the point of division in two branches (late VI, pl, 2). The oral branch of the tentacles terminates in an adhesive sucker-like organ.

A « Saugpolster » (sucking pad) as described for *Staurocladia vallentini* (LENGERICH, 1923 *b*) was not found (Bouillon 1967).

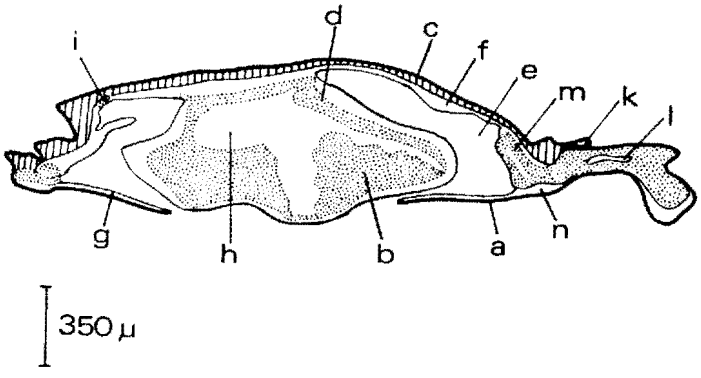


TEXT-FIG. 97. - Staurocladia portmanni, *medusa; section of the marginal cnidocyst ring.* a - *ectodermal cnidocyst ring;* b - *ectodermal muscle fibres;* c - *desmoneme inside its capsule;* d - *cnidocyst present only in the marginal cnidocyst ring, probably a haploneme; (after* BRINCKMANN 1964, fig. 7).

The gonads surround the stomach and stomach pouches in a marginal layer without any perradial or interradial division. Only in the region where the radial canals are « sandwiched » between the subumbrella and the stomach are the gonads divided into five sections by the radial canals. The species is gonochoristic and does not bud off young medusae.

The border between the exumbrella and the velum forms a thickened cnidocyst ring (text-fig. 97).

There is an eye spot on the aboral side of each tentacle basis (plate I, fig. 2; text-fig. 98).



TEXT-FIG. 98. - Staurocladia portmanni, *medusa, adult male; sagittal section, Bouin.* a - *ectoderm;* b - *endoderm;* c - *mesogloea;* d - *gonads;* e - *subumbrellar cavity;* f - *shrunken space between mesogloea and subumbrellar ectoderm;* g - *velum;* h - *stomach with stomach pouches;* i - *portion of radial canal;* k - *eye;* l - *endodermal lumen of tentacle;* m - *thickened basal portion of one radial canal;* n - *marginal cnidocyst ring (after* BRINCKMANN 1964, fig. 3).

The endoderm is red-orange in the stomach, the ring canal and the tentacles. The upper part of the radial canals as well as their finger-like protuberances into the exumbrella show a white pigmentation. This pigmentation also exists in the broadened part of the radial canals distally to their point of junction with the ring canal.

Stenotheles and desmonemes are present in the cnidocyst clusters of the tentacles. The desmonemes are thinner than in other Anthomedusan species.

There is a third, very large kind of cnidocyst in the marginal cnidocyst ring. The tube forms a coil of 9 to 10 loops inside the capsule (text-fig. 97). However, as I could not observe them in the discharged stage, I could not decide whether these cnidocysts are isorhizas, anisorhizas, mastigophores or euritheles.

Developmental stages

For detailed description of development of the embryo, primary hydranths and medusa buds, see BRINCKMANN (1964).

Ecology

The medusae of *S. portmanni* are found in the *Posidonia* beds 15 to 30 m deep from the end of May to the beginning of July. There might be two reasons for *S. portmanni* not being found later in the year: Either the medusae die after having shed their sexual products several times by the end of June, and the species exists in the hydroid stage only from then on; or the medusae cannot be caught after the beginning of July, because the *Posidonia* leaves grow very long and the net can only be pulled over the surface of the upper leaves. It might be that the latter of the two possibilities is more likely because *S. portmanni* lives quite well up to one year in the laboratory.

Cladonema radiatum, Ptychogaster asteroides, and several species of Limnomedusae occur together with *S. portmanni* in the same biotop and during the same season.

The hydroids were found on *Halimeda* sp. and *Udothea* sp. algae material from a depth of 30 m in November. They did not have buds at that time. Although these hydroids and those which were reared in the laboratory from the medusae were kept all the year round at constant temperature (some colonies at 13° C others at 20° C), they produced medusa buds only from November to May, most extensively from the end of January to the end of March.

In this period of the year the colonies grow much better than in other seasons. In the summer and autumn months the hydroid colonies do not form new hydranths; the whole colony resorbs to the stolon material, regenerates to some extent and then degenerates again. A factor or factors may exist apart from temperature, perhaps light or composition of the sea-water, influencing the growth and budding of the colonies in the different periods of the year. (The sea-water used for the cultures was taken from the sea every day).

Habits

The medusae of *S. portmanni* are able to sit, to creep or walk on the tentacles and also to swim. Usually the medusae are attached on glass or plants or they swim vigorously. The creeping movement is very seldom observed. When the medusae are sitting, the aboral branches of the tentacle are free, whereas the oral branches of the tentacles are attached to the substratum by their sucker-like endings. The animal has the same position when it is feeding: As soon as some food particle touches the cnidocyst bulb of the aboral branch of the tentacles, this tentacle moves in an oral direction together with the food particles. The umbrella margin of the medusa is then lifted slightly, the medusa stretches its mouth and picks up the food from the tentacle.

If the medusa is touched on its exumbrella or disturbed in some other way, it quickly pulls the oral branches of the tentacles away from the substratum and swims with rhythmic contractions of the umbrella. In the swimming position the oral branches of the tentacles point in an oral direction with each contraction of the umbrella. The aboral branches always point upwards. The swimming movements of *S. portmanni* are very active, but the medusa likes to return soon to the « sitting » position.

Systematic discussion

See BRINCKMANN (1964).

FAMILY PARACORYNIDAE PICARD 1957

Athecate hydroids with polymorphic colonies consisting of gastrozooids, gonozooids and machozooids (dactylozooids). Gastrozooids with tentacles in irregular circlets, but no oral tentacles. Tentacles with a small cnidocyst concentration at their tip and a ribbon of cnidocysts along the aboral side of the tentacle. Fixed gonophores; no perisarc; hydrorhiza forming an encrusting layer. Cnidocysts are stenotheles, macrobasic euritheles, microbasic euritheles and atrichous.

The family has one genus, *Paracoryne* PICARD 1957.

Genus *Paracoryne* PICARD 1957

Generic characters

Hydrorhiza crusty, forming a round or elongated plate, which consists of endodermal anastomosing channels and is covered by an ectodermal layer without perisarc. A separation from the substrate can be noticed on the edge of the hydrorhiza. The colony is surrounded by a dense circlet of dactylozooids; inside of this circlet are the gastrozooids, gonozooids and a few more dactylozooids.

Type species: *Paracoryne huvei* PICARD 1957.

Paracoryne huvei PICARD 1957

Specific characters

The ectoderm of the different hydroids shows a purple coloration. The endoderm of the hydroids is continuous with the endoderm of the hydrorhiza. Gastrozooids with thick internal longitudinal lines; with 1 to 4 irregular circlets of tentacles. Gonozooids short, without tentacles or mouth, each carrying a group of gonophores. Colonies with separate sexes. Male gonophores with a long, distal collar; female gonophores with three or four large eggs. Gonophores grow in May. Fingerlike large dactylozooids. Found on rocky littoral at the Ilot du Grand Riboud and Cap Taillat Massif de Maures, department du Var). Translated from PICARD's (1957, p. 6) preliminary description.

There is no figure or adequate description of this interesting species, excepting only a drawing of a histological section of a gastrozooid by PREVOST (1959). PICARD placed the species in the superfamily « Pteronematidae » on account of the macrobasic euritheles. However the validity of the Pteronematidae was shattered by REES (1957 *a*) and VERVOORT (1966 *b*). Polymorph character of the colony and the structure of the hydrorhiza plate indicate that this group may be related to the Hydractiniidae of the suborder Filifera.

FAMILY HALOCORYNIDAE PICARD 1957

Corynid Hydroids with colonies consisting of gastrozooids, dactylozooids; gonozooids unknown. Gastrozooids without tentacles but with two lateral opposite cnidocyst clusters below mouth opening; with stenotheles.

The family has one genus *Halocoryne* HADZI 1917.

Genus *Halocoryne* HADZI 1917

Generic characters

Polymorph hydroid colonies living on *Schizoporella sanguinea* NORMAN (Bryozoa). Hydrorhiza net-like, covered with very thin perisarc. Single, upright hydranths without any hydrocaulus, but with a small socket-like thickening of the ectoderm at their base. Hydranths either gastrozooids or dactylozooids (« Machopolypen » in the original description of HADZI). Gastrozooids without tentacles but assuming a bilateral symmetry by the two lateral cnidocyst clusters below the mouth opening. Dactylozooids hollow, without a mouth but with a terminal cnidocyst cluster instead, and up to five additional cnidocyst clusters in a vertical line. Gonozooids not known.

The genus *Halocoryne* has one species *Halocoryne epizoica* HADZI 1917.

Type species *Halocoryne epizoica* HADZI 1917.

Halocoryne epizoica HADZI 1917
Text-fig. 99

Synonymy

Halocoryne epizoica HADZI 1917 *a*, p. 1-27, figs. 1-9 (in Croatian language); 1917 *b*, p. 27-41 (German translation of 1917 *a*, but without figures).

Specific characters

With characters of the genus.

Material seen: None.

Material deposited: None.

Distribution

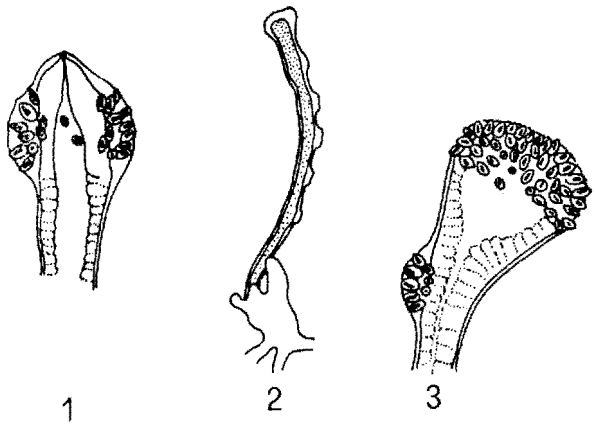
Hydroid, outside Mediterranean: none.
Mediterranean: Triest, Jablanac, Yugoslavia (HADZI, 1917 *a*, *b*).

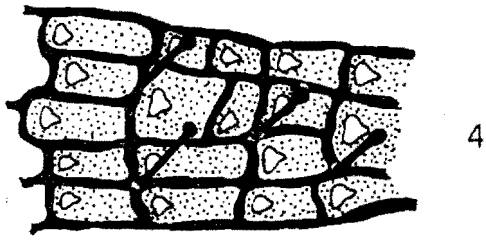
Methods of collection and cultivation

The Bryozoan colony which is the host of *Halocoryne epizoica* was found at a depth of 103 m by dredging. There are no observations on the living specimens, because the colony had to be preserved at once on account of its rarity.

Description of the species

The Bryozoan colony which is the host of *H. epizoica* is provided with box-shaped zooecia. The hydrorhiza of *H. epizoica* forms a frame along the border of each zooecium (text-fig. 99/4). Thus a net-like hydrorhiza is established. The hydrorhiza is enclosed in a very thin perisarc. The hydranths are naked and very slender. The gastrozooids measure up to 7.5 mm in length. Their diameter is 0.02 - 0.03 mm. They do not have tentacles, but have two ectodermal thickenings on either side of the hydranth below the mouth. The ectodermal thickenings are fully packed with stenothele cnidocysts. In some specimens the two cnidocyst clusters are linked by a few cnidocysts in between. In some cases the one cnidocyst cluster is smaller than the other, or one of the two is missing entirely. The dactylozoids have a terminal cnidocyst cluster, no mouth opening (text-fig. 99/2, 3) and up to five additional cnidocyst clusters in a vertical row. The cnidocyst clusters in the dactylozooids increase with age, young ones having only the terminal cnidocyst cluster.





TEXT-FIG. 99. - Halocoryne epizoica (*after* HADZI, 1917 b). 1 - *Gastrozooid (after* HADZI, fig. 5a); 2 - *dactylozooid or machopolyp 5 lateral clusters of cnidocysts (after* HADZI, fig. 8a); 3 - *detail of apical end of dactylozooid with the terminal cnidocyst cluster and one lateral cnidocyst cluster (after* HADZI, fig. 9a); 4 - *colony of* Halocoryne epizoica *on* Schizoporella; *hydroid black, bryozoan colony dotted (after* HADZI, fig. 1).

The colour of the hydranths is red-brown, caused by a red pigmentation of the endodermal cells. (For histological details see HADZI, 1917 *a* and *b*).

The cnidocysts are stenotheles.

Discussion of the species

Although this species has been reported in the literature from only one location, there is no question that it is a good species. The lateral cnidocyst clusters in the gastrozooids are the most distinctive characteristic. PICARD (1957, p. 4) mentions in his definition of the Halocorynidae « gonophores eumedusoides liberables »; however HADZI never described the gonophores and PICARD does not mention whether he found the species himself.

FAMILY PTILOCODIIDAE COWARD 1909

Introduction

The Ptilocodiidae included three genera, *Ptilocodium* COWARD 1909, *Halocoryne* HADZI 1917 (HADZI, 1917 *a* and *b*; STECHOW, 1923) and *Thecocodium* BOUILLON 1967. As there are principally different structures in the cnidocysts and dactylozooids between the two genera, PICARD (1957) established a new family Halocorynidae for the genus *Halocoryne* (see p. 84). The Ptilocodiidae bear a strong resemblence to the Rhysiidae and Hydractiniidae (BRINCKMANN, 1965 *b*). Therefore, I place the Ptilocodiidae provisionally at the end of the suborder Capitata. They were placed in the Capitata by Rees (1957 *a*).

Definition of the family

Colonial Hydroids with hydrorhiza either naked or covered with a thin perisarc. Colonies polymorph provided with dactylozooids, gastrozooids, and gonozooids, gastrozooids without tentacles, dactylozooids with capitate tentacles or cnidocyst patches. No free medusae.

Genus *Thecocodium* BOUILLON 1967

Generic characters

Ptilocodiidae with gastrozooid without pads of cnidocysts, dactylozooids with solid endoderm. Gonozooid similar to gastrozooid. No stenotheles.

Type species: *Thecocodium brieni* BOUILLON 1967.

Thecocodium brieni BOUILLON 1967
Text-figs. 100-106

Synonymy

Thecocodium brieni BOUILLON 1967, p. 1106 (hydroid).

Specific characters

Hydroid colonies with or without perisarcal sheath around the hydrorhiza; dactylozooids with four or five tentacles each. Reproductive hydranths not different from the nutritive hydranth in the young stages of go-

nophore development. In older stages reduction of the female reproductive hydranth. Male reproductive hydranths similar to nutritive ones during all phases of development. Cnidocysts: microbasic euritheles and desmonemes.

Material seen: Naples.

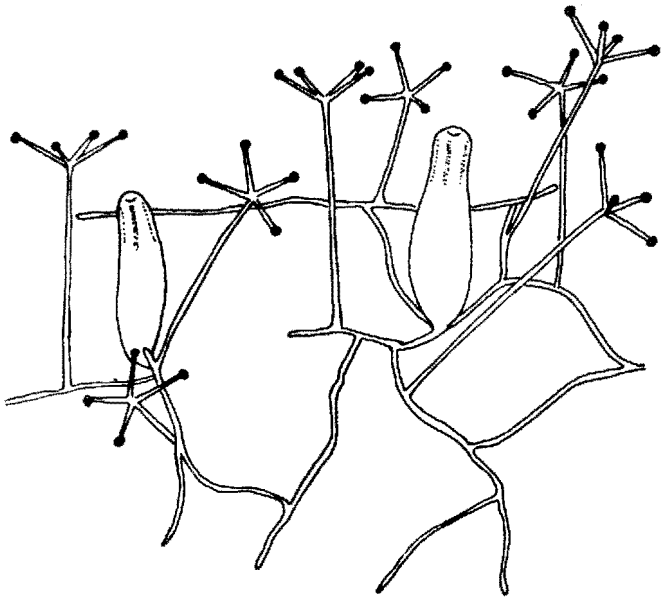
Material deposited: B.M.N.H.; S.Z.N.

Distribution

Hydroid, outside Mediterranean: Roscoff (BOUILLON, 1967).
Mediterranean: Naples, Italy (author, BOUILLON, 1967).

Methods of collection and cultivation

Colonies of *T. brieni* were obtained in scrape material from the rocky littoral zone in caves 2-3 m below sea level and in dredge material from 30 m below sea level. Fed with *Artemia*, the colonies stayed healthy at 20° C over a long period, however they did not produce gonophores in culture.



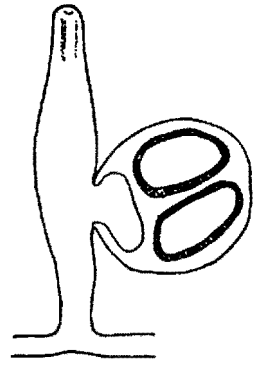
TEXT-FIG. 100. - Thecocodium brieni; *colony with dactylozooids and gastrozooids (after a sketch by* K. PETERSEN).

Description of the species *

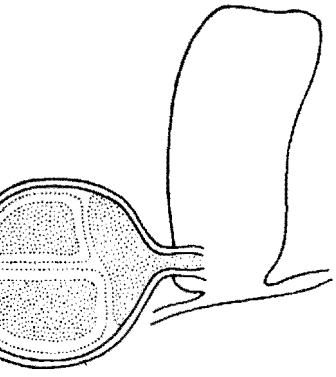
Hydrorhiza: The hydrorhiza consists of a mesh of linear stolons in a nearly geometric pattern (text-fig. 100). The coenosarc-like formation as described for *P. repens* from the Pacific could not be observed in *T. brieni*. The hydrorhiza is enclosed by a very thin perisarc which extends to the very base of the dactylozooids (text-fig. 103).

* BOUILLON (1967) established a new genus and species *Thecocodium Brieni*. Unfortunately I got BOUILLON's excellent paper after I had sent this monograph for printing.

The ectoderm of the part of the hydrorhiza which is attached to the substratum is of a variable thickness, the ectoderm of the upper, non-attached side is more uniform in its thickness and contains numerous cnidocysts (text-fig. 103). Dactylozooids (Machopolyps STECHOW, 1923, p. 23): The dactylozooids measure 0.4 to 0.6 mm. They arise directly from the hydrorhiza and are surrounded by a very thin layer of perisarc at their very base. They consist of a thin solid stem which is divided into 4 or 5 branches at its upper end. The stem consists of long endodermal cells and a very thin ectoderm. Each branch of the dactylozooid carries a cluster of large microbasic eurithele cnidocysts at its tip. There are many more dactylozooids than gastrozooids for colony. The gastrozooids have a length of 0.3 to 1.3 mm depending on their stage of contraction or expansion.. They arise directly from the basal stolon without any perisarc. They have no trace of a stem or hydrocaulus, but appear « sitting » on the stolon with a rather broad base. The mouth is simple, tubular, surrounded by a few nematocysts. There are no tentacles. Cross-sections show that the gastrocoel is cross-shaped in its upper part through four endodermal ridges. In its lower part the gastrocoel is simple and sac-like. The colour of the reproductive hydranths is

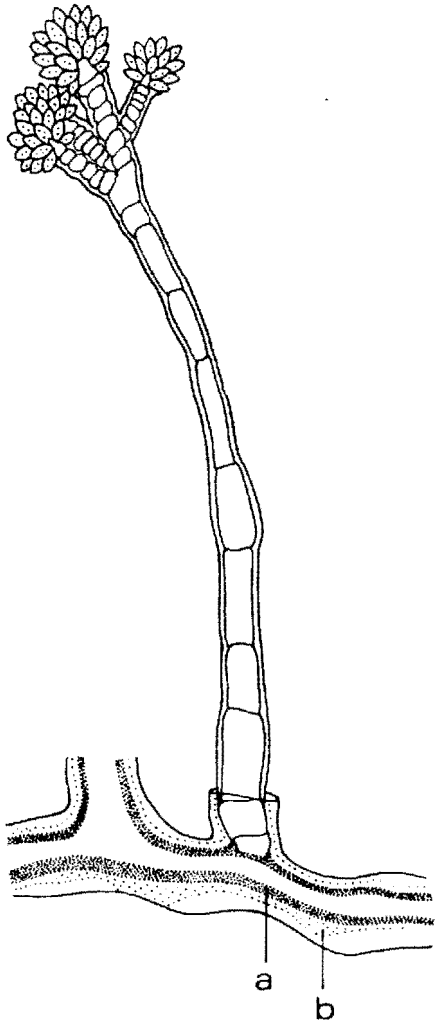


TEXT-FIG. 101. - Thecocodium brieni; *female gonozoid with gonophore carrying two planulae.*



TEXT-FIG. 102. - Thecocodium brieni; *female gonozoid with gonophore carrying two planulae in an advanced stage; gonozoid reduced.*

pink. Four longitudinal lines of red pigment are to be seen in the upper part of the hydranth. They correspond to the position of the endodermal ridges.



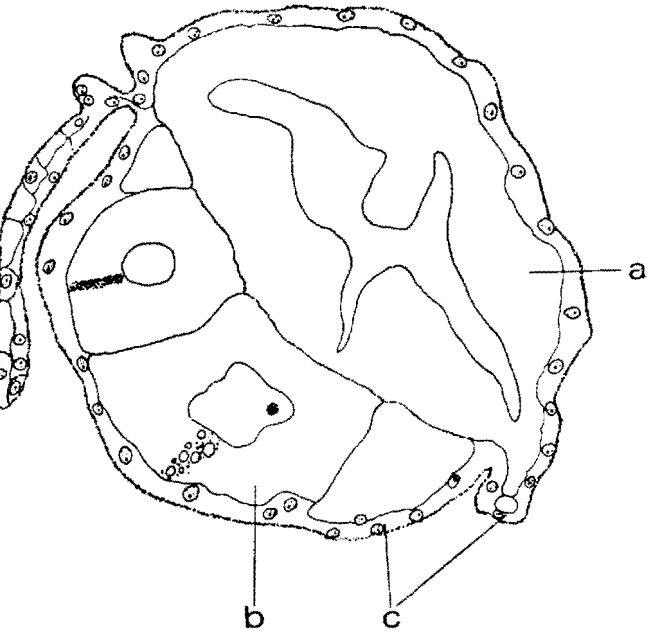
TEXT-FIG. 103. - Thecocodium brieni; *detail of dactylozooid and hydrorhiza with perisarc.* a - *endoderm;* b - *ectoderm.*

Gonozooids, male: The male reproductive hydranths look like the nutritive hydranths. The gonophores develop near the base of the hydranth. The male gonophore is a simple sporosac (fig. 105), the sperm cell being developed between the endodermal spadix and the ectoderm. Judging from the picture of spermatogenesis shown in text-fig. 105/2, the gonophores must be fertile over a longer period of time, because spermatides are found at the periphery and spermatogonia near the centre, with meiotic stages in between.

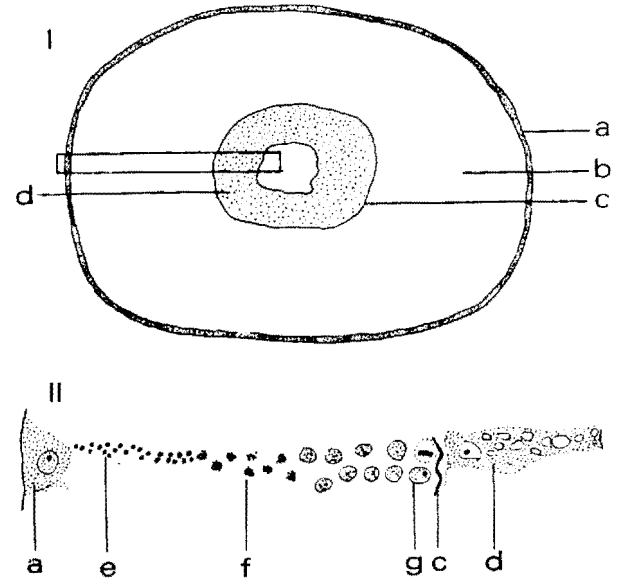
Similar gonads were found in *Acaulis ilonae,* Acaulidae (BRINCKMANN-VOSS, 1965). But, in general, an extended period of spermatogenesis is unusual in athecate hydroids.

Gonozooids, female: The female gonophore also develops near the base of the reproductive hydranth. In young stages of gonophore development the reproductive hydranth looks like a nutritive hydranth.

However, in the final stage of gonophore development the gonophore is reduced to a stump. The female gonophore is an eumedusoid with four radial canals, a ring canal and a subumbrellar cavity. It is somewhat different from the gonophores shown by COWARD for *Ptilocodium repens* (COWARD, 1909, fig. 7). In COWARD's picture the egg cells lie around the endodermal spadix with apparently no ectodermal epithelium. The umbrella in his picture has the structure of a medusa with two layers of ectoderm and an endodermal core between them. In *T. brieni,* the eggs are enclosed in an ectodermal layer and the umbrella has only two cell-layers instead of three. Unfortunately the figure of COWARD is rather « too clear », and the actual position



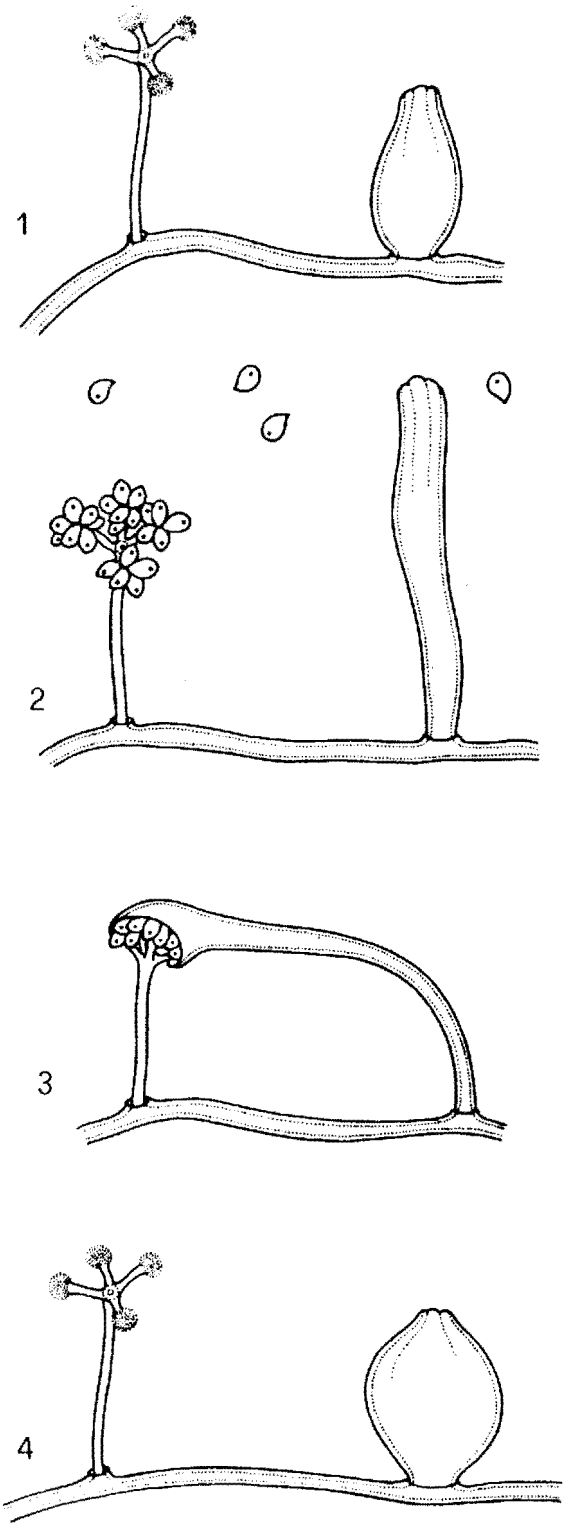
TEXT-FIG. 104. - Thecocodium brieni; *sagittal section through a female gonophore;* a - *spadix;* b - *eggs;* c - *ectoderm.*



TEXT-FIG. 105. - Thecocodium brieni; *cross- section through a male gonophore;* I - *entire gonophore;* II - *detailed section out of* I; a - *ectoderm;* b - *gonad;* c - *mesogloea;* d - *endoderm;* e - *spermatides or sperms;* f - *spermatocytes undergoing meiotic divisions;* g - *spermatogonia.*

of cells is not shown. (Very often authors of 20 to 50 years ago would draw their figures of gonophores according to the model of eumedusoid, cryptomedusoid or styloid (KÜHN, 1913) with the aim of making the type of gonophore conform with one of these models of reduced medusae.) Text-fig. 104 represents an oblique section through a female gonophore. Four egg cells can be seen, the one in the centre is in the most advanced stage of development, as indicated by the amoeboid form of the nucleus and the presence of large yolk-clods. The eggs are fertilized within the gonophore and usually two planulae are developed per gonophore (text-fig. 102).

Although the material was not abundant enough to study the development of the eggs in sufficient detail, it seems that the numerous egg cells which are present in the younger gonophore stage and which do not develop into planulae serve as nutritive cells.



TEXT-FIG. 106. - Thecocodium brieni; *sketch of a colony in successive feeding stages:* 1 - *dactylozooid and gastrozooid in resting position without food;* 2 - *living* Artemia *nauplii have been added to the colony; the dactylozooids « catch » the artemia and the gastrozooids start to elongate;* 3 - *the gastrozooids are very long, bend over to the dactylozooid, stretch the oral region over the dactylozooid and engulf their prey;* 4 - *gastrozooids again in resting position; their middle region filled with* Artemia.

Developmental stages

The freed planulae do not swim, but move around a little on the substrate to settle there after a few days. The development from the planula to the primary hydranth was not observed.

Habits

Some authors called the dactylozooids « protective hydranths » or « defensive hydranths » (KAESTNER, 1967). However observations of the feeding habits of *T. brieni* have shown that the dactylozooids in this species are not there for protection but rather as « fishing hooks » in order to capture food for the colony: if living plankton or *Artemia* is added to a colony of *T. brieni*, both plankton and *Artemia* are caught immediately by the cnidocyst clusters of the dactylozooids. The dactylozooids serve so well that they are often covered with the prey, and nothing can be seen except the stem. The nutritive hydranths then stretch out very long — up to three times of the resting stage — and bend over the dactylozooids picking up the prey with their wide opened mouths (text-fig. 106).

Ecology

T. brieni has been found on sponges and at the base of *Muricaea* sp. (Gorgoniaceae) around Naples.

There were two locations: Firstly the innermost part of the cave of Capo Miseno 2 to 3 m below sea level. This part of the cave is never exposed to the sun. The second locality was the gulf of Pozzuoli about 30 m deep. Colonies with gonophores were found in the cave of Capo Miseno in April and May only. One colony with gonophores with planulae was collected at the Pozzuoli location in the beginning of September.

While sterile cultures of *T. brieni* could be kept flourishing in the laboratory over more than a year, gonophores were not developed.

Systematic discussion

P. repens was described by COWARD (1909) living exclusively on *Ptilosarcus sinosous* (Pennatulidae). LELOUP found *P. repens* living on *Pennatula fimbriata* from Sa-

gami Bay, Japan. *T. brieni* from near Naples differ from COWARD's specimens in some aspects as shown in the table below.

	host	hydrorhiza	mouth of gastrozooid	female gonozooid	male gonozooid
Ptilocodium repens	*Pennatula*	naked	without cnidocysts	eumedusoid	not known
T. brieni	Sponges	with perisarc	with cnidocysts	eumedusoid	sporosac.

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PLATE I

Vannuccia forbesii
Acaulis ilonae

PLATE I, FIG. 1-5.

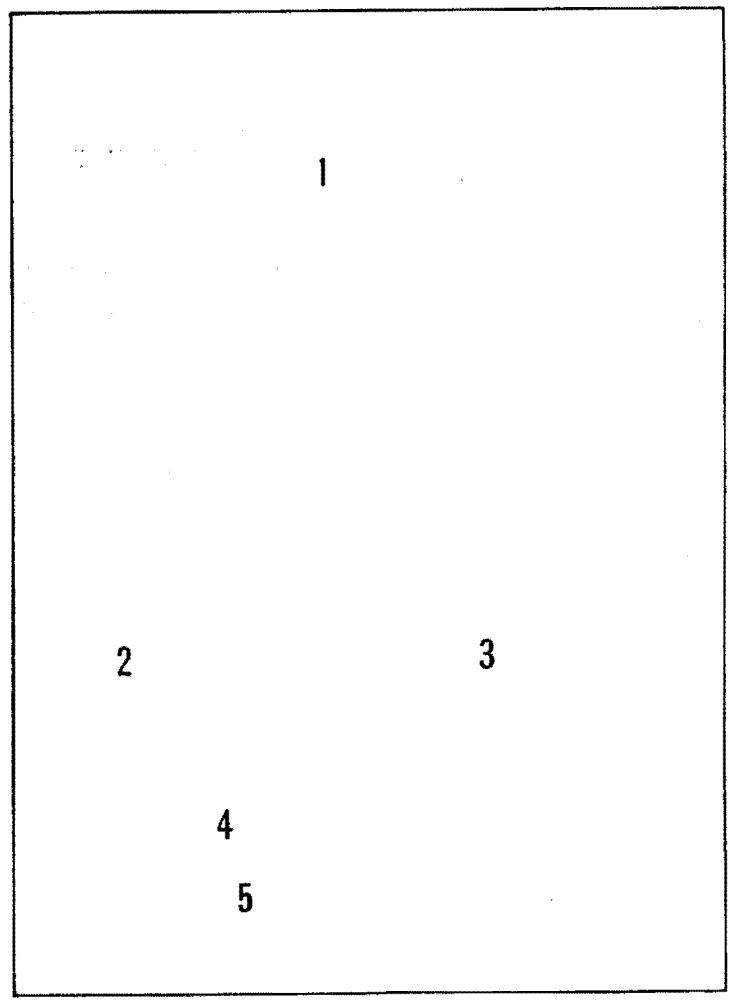


FIG. 1 - Vannuccia forbesii, *hydroid, 10.5 mm high. Gulf of Naples.*
FIG. 2 - Vannuccia forbesii, *medusa grown from its hydroid; height of exumbrella: 1.2 mm; diameter of exumbrella: 1.3 mm.*
FIG. 3 - Acaulis ilonae; *male adult hydroid, 9.5 mm high; Gulf of Naples.*
FIG. 4 - Acaulis ilonae; *aboral part of a divided hydroid one day after the division; height: 2.4 mm.*
FIG. 5 - Acaulis ilonae; *oral part of a divided hydroid one day after the division; diameter: 0.7 mm.*

PLATE II

Ectopleura dumortierii
Ectopleura sacculifera
Corymorpha nutans
Eucodonium brownei

PLATE II, FIG. 1-4.

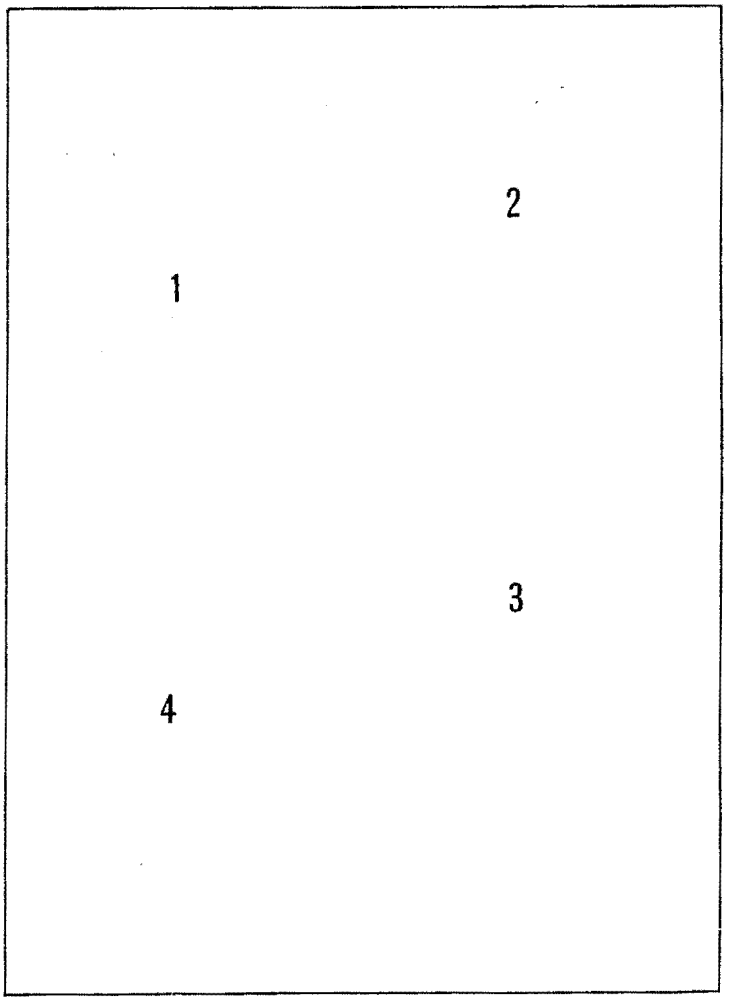


FIG. 1 - Ectopleura dumortierii, *adult male medusa drawn during a resting phase; height of exumbrella: 1.3 mm; diameter of exumbrella: 1.5 mm. (The red spots on the marginal bulbs are no ocelli, only pigment which may be more or less scattered). Gulf of Naples.*

FIG. 2 - Ectopleura sacculifera, *adult male medusa drawn during a swimming phase; height of exumbrella: 3 mm; diameter of exumbrella: 2.7 mm. (The sac-like gonads are actually interradial and not perradial as drawn here). Gulf of Naples, new for the Mediterranean.*

FIG. 3 - Corymorpha nutans, *adult female medusa; height of exumbrella (including apical projection): 4 mm; diameter of exumbrella: 2.5 mm.*

FIG. 4 - Eucodonium brownei, *medusa with buds on its stomach; height of exumbrella: 1 mm; diameter of exumbrella: 0.8 mm.*

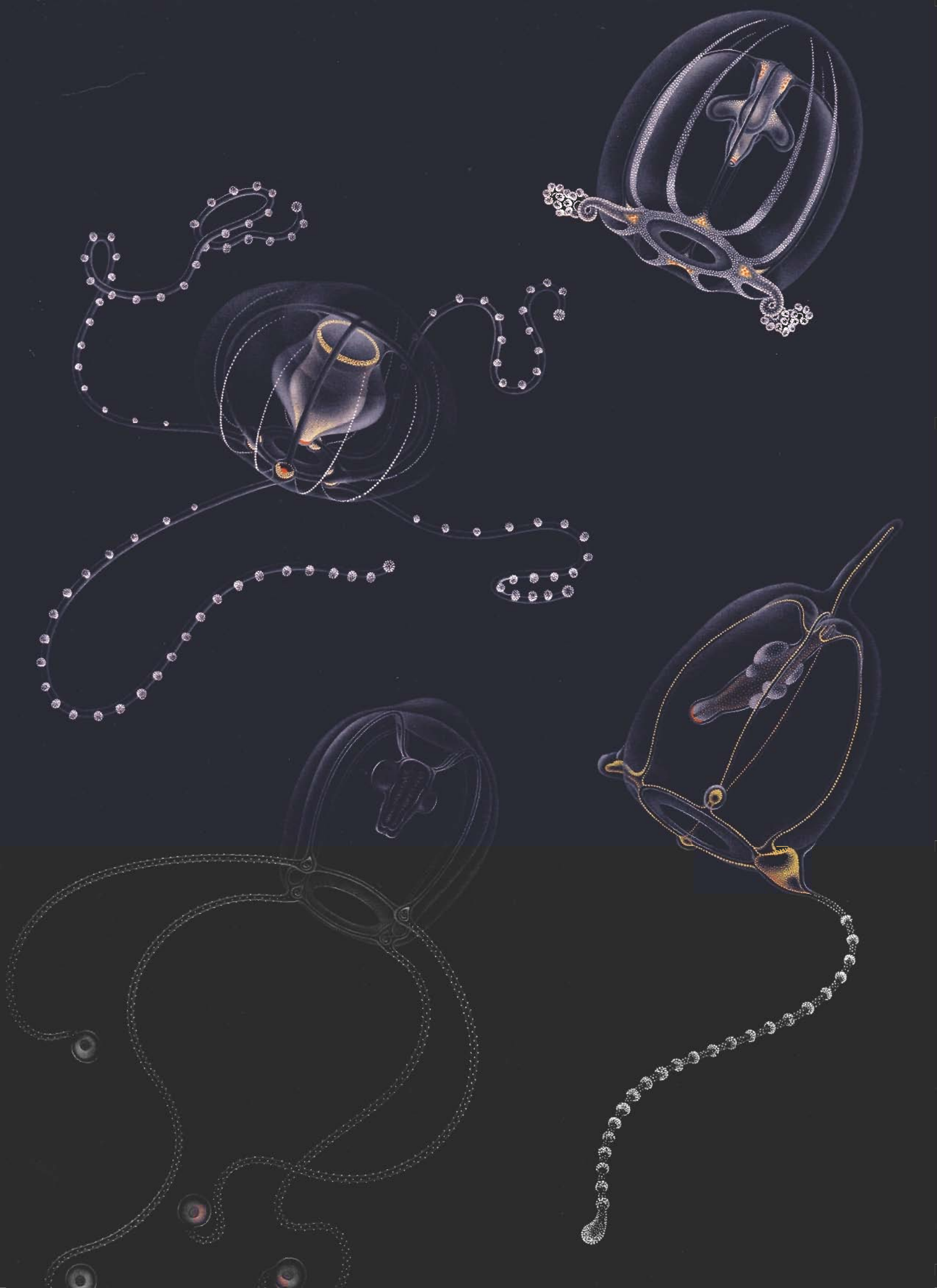


PLATE III

Sarsia gemmifera
Sarsia reesi
Coryne pintneri
Sarsia ophiogaster

PLATE III, FIG. 1-5.

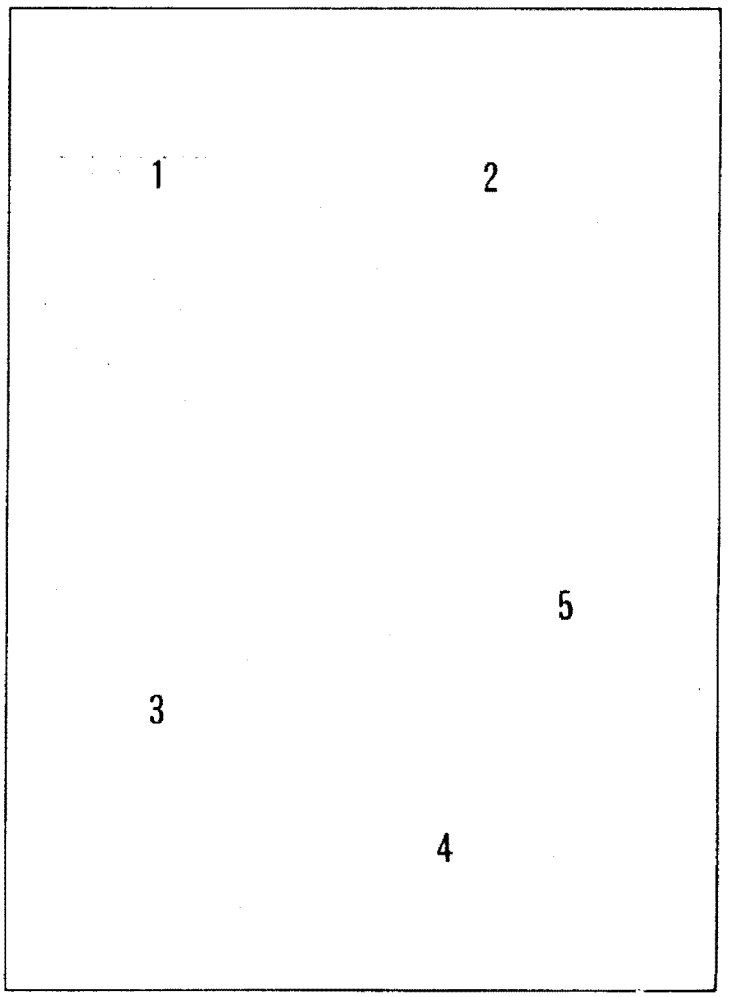


FIG. 1 - Sarsia gemmifera, *young medusa with medusa buds on the manubrium; height of the exumbrella: 3.3 mm; diameter of the exumbrella: 3.1 mm; Gulf of Naples.*

FIG. 2 - Sarsia reesi, *adult male medusa; height of exumbrella: 3.6 mm; diameter of exumbrella: 3.7 mm; grown from its hydroid.*

FIG. 3 - Coryne pintneri, *male hydroid colony; height of the colony: 1.2 mm; Gulf of Naples.*

FIG. 4 - Sarsia reesi, *hydroid colony; height of the colony: 1-2 mm. (The perisarc is not drawn in this figure). Gulf of Naples.*

FIG. 5 - Sarsia ophiogaster, *hydranth with medusa buds. (This specimen had no filiform tentacles, but after the liberation of the medusa these were identified as* Sarsia ophiogaster. *The perisarc is not drawn in this figure). Height of the colony 1.5-2.0 mm.*

PLATE IV

Zanclea costata
Oceania armata

PLATE IV, FIG. 1-2.

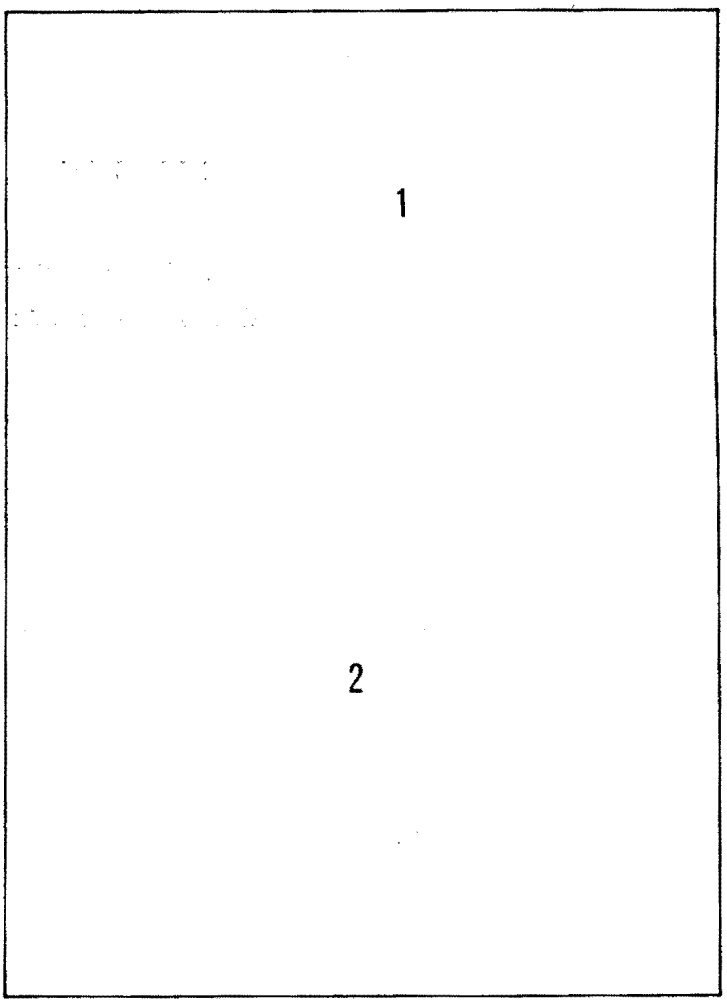


FIG. 1 - Zanclea costata GEGENBAUR *or* Zanclea costata *var.* neapolitana (*see p. 73*), *male medusa; height of the exumbrella: 3.5 mm; diameter of exumbrella: 3.0 mm. (The exumbrellar cnidocyst lines are seldom as long as shown here; the dots in the lines do not represent single cnidocysts). Gulf of Naples.*

FIG. 2 - Oceania armata, *female medusa; height of exumbrella: 6.3 mm; diameter of exumbrella: 8.7 mm. Gulf of Naples. (The text for fig. 2 will appear in a second volume « Filifera »).*

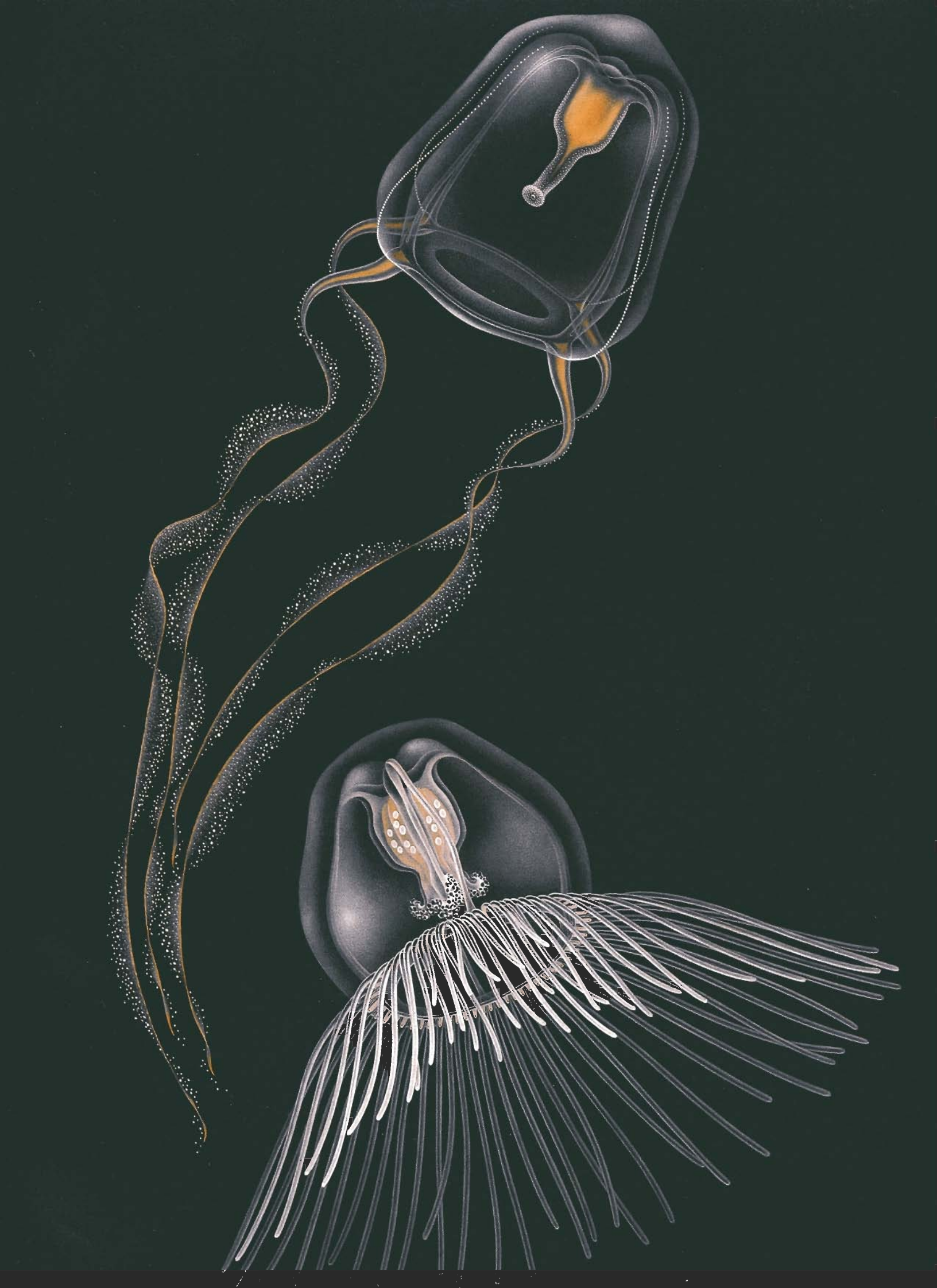


PLATE V

Cladonema radiatum

PLATE V, FIG. 1-2.

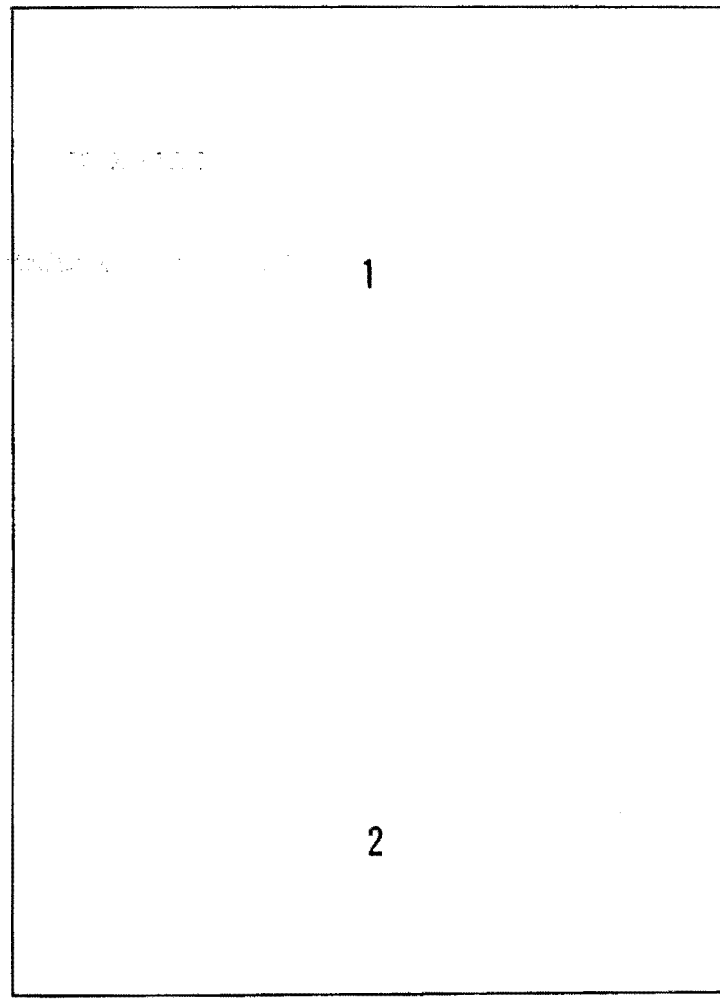


FIG. 1 - Cladonema radiatum, *adult male medusa; diameter of exumbrella: 1.7 mm. Gulf of Naples.*
FIG. 2 - Cladonema radiatum, *hydroid colony; height of the colony: 1.8-2.0 mm. Gulf of Naples.*

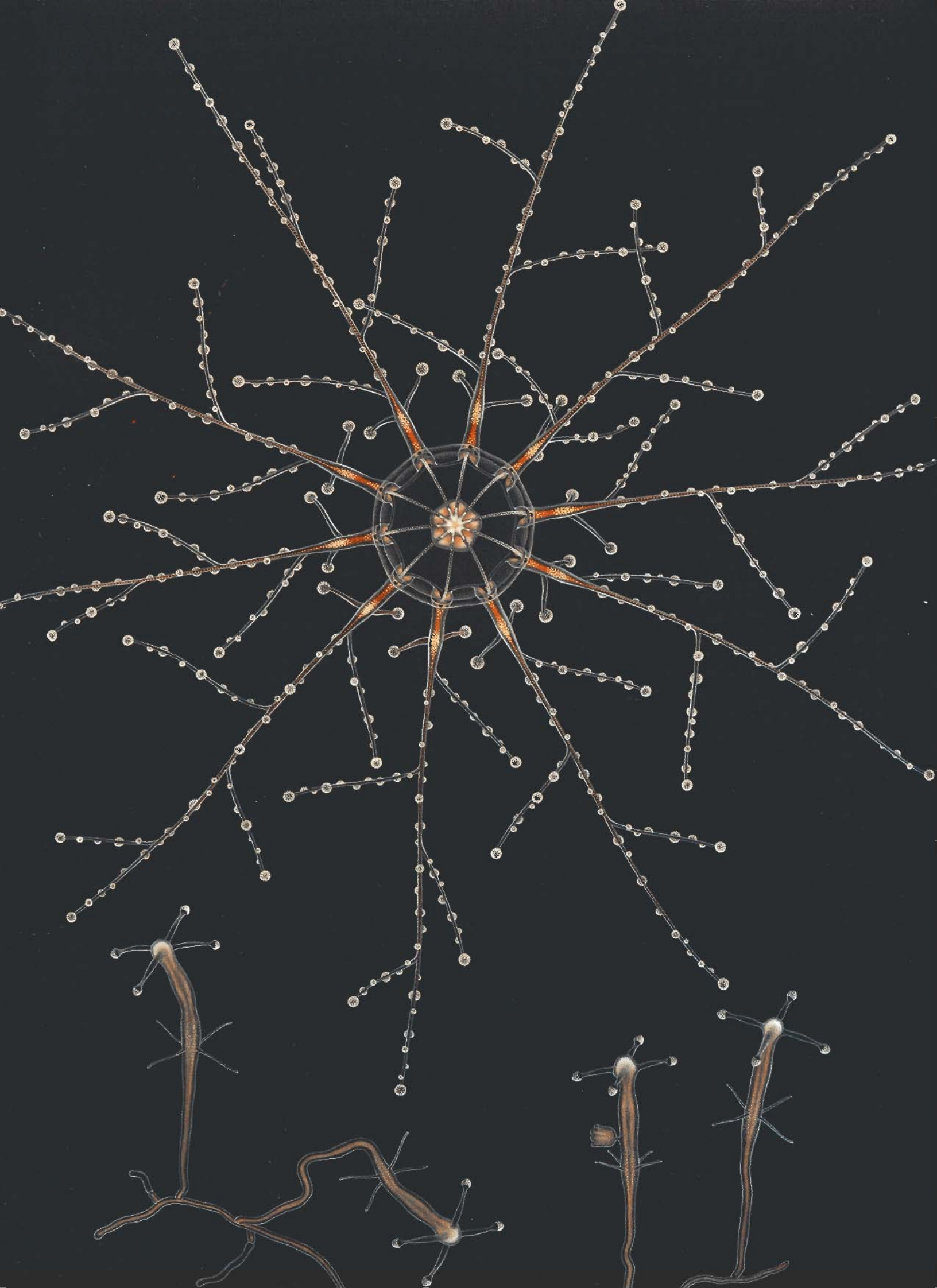


PLATE VI

Staurocladia portmanni

PLATE VI, FIG. 1-3.

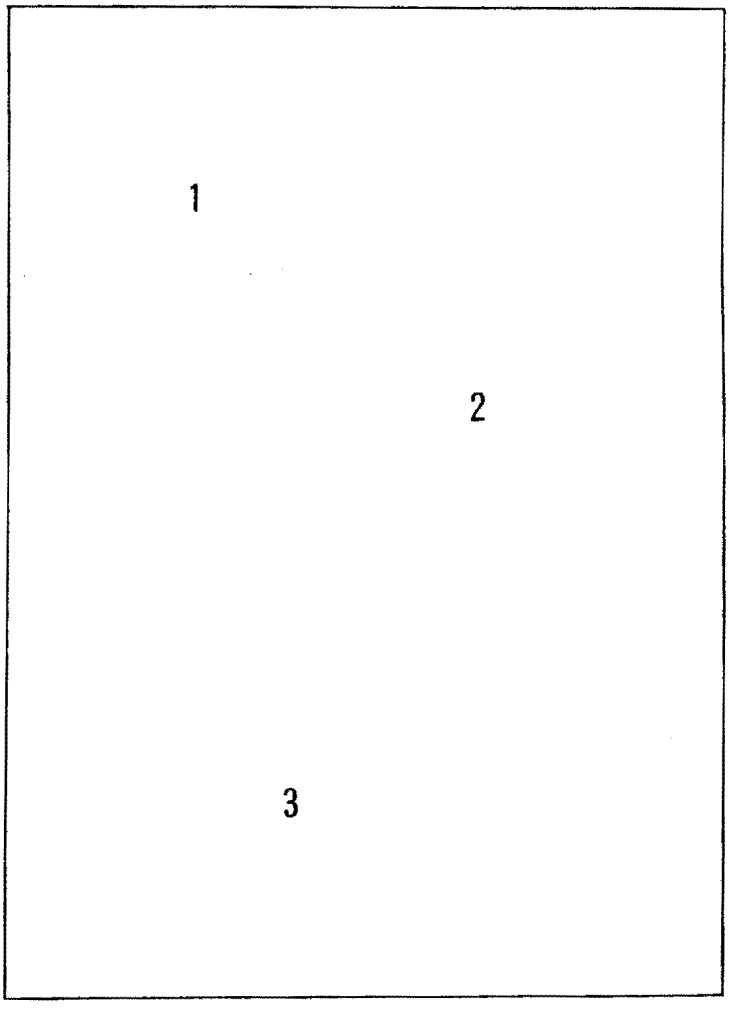


FIG. 1 - Staurocladia portmanni, *young female medusa; height of exumbrella: 1.7 mm; diameter of exumbrella: 1.7 mm; Gulf of Naples.*
FIG. 2 - Staurocladia portmanni, *adult male medusa; diameter of exumbrella: 2.5 mm; height of exumbrella: 2.2 mm. Gulf of Naples.*
FIG. 3 - Staurocladia portmanni, *hydroid colony with medusa buds; height of the colony: 0.5-0.8 mm. Gulf of Naples.*

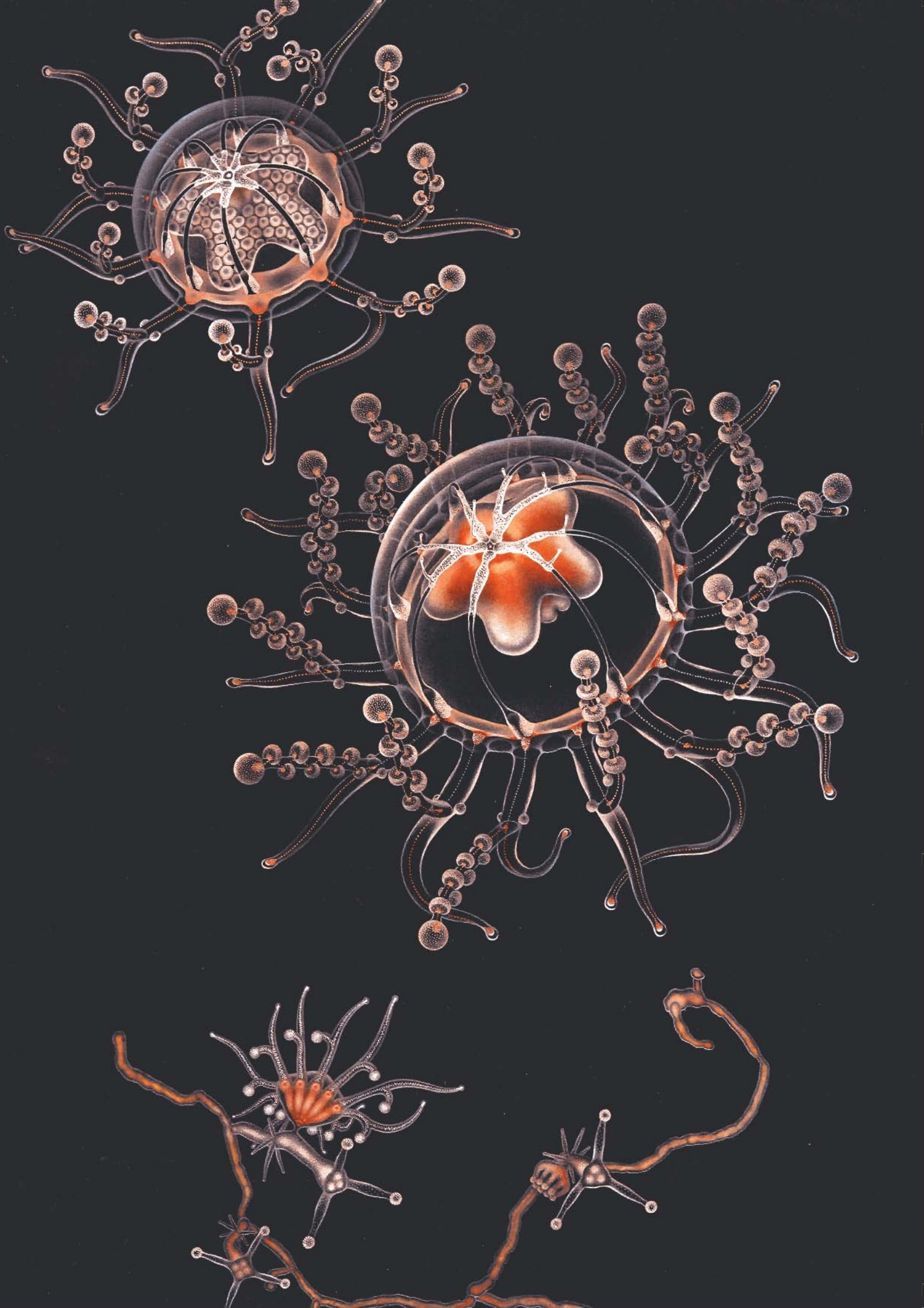
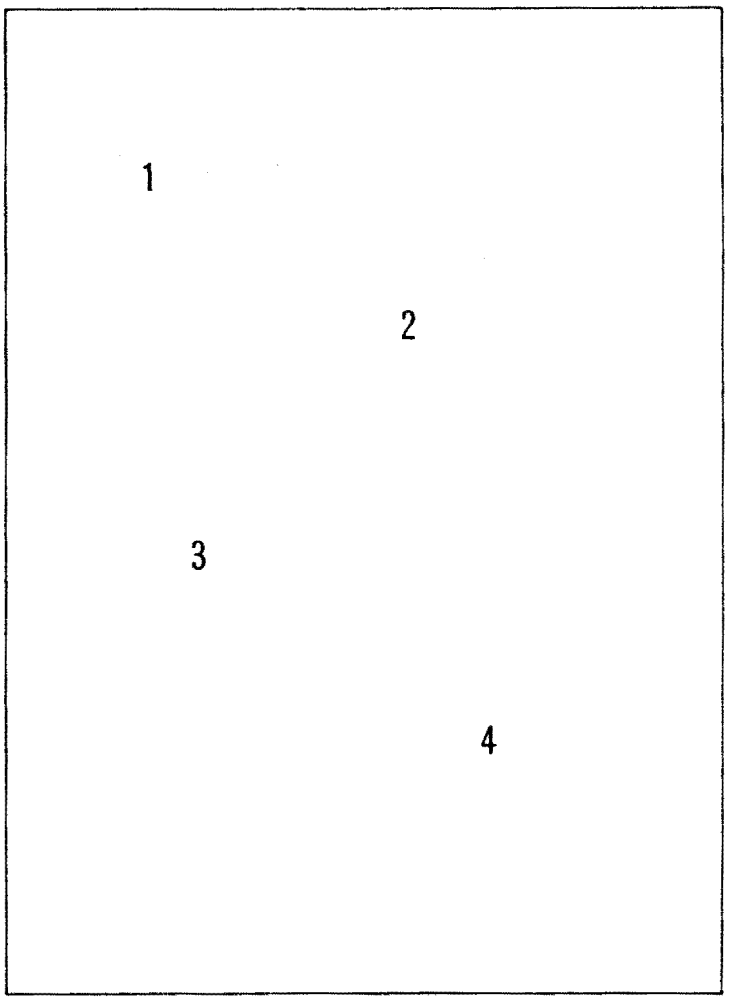


PLATE VII

Podocoryne minima
Podocoryne hartlaubi
Podocoryne carnea
Cytais tetrastyla

PLATE VII, FIG. 1-4.



(The text for this plate will appear in a second volume « Filifera »).

FIG. 1 - Podocoryne minima, *medusa with medusa buds; height of exumbrella: 1 mm; diameter of exumbrella: 1 mm. Gulf of Naples.*

FIG. 2 - Podocoryne hartlaubi, *adult male medusa; height of exumbrella: 2.5 mm; diameter of exumbrella: 2.5 mm. Gulf of Naples.*

FIG. 3 - Podocoryne carnea, *adult male medusa; height of exumbrella: 1.5 mm; diameter of exumbrella: 1.6 mm. Gulf of Naples.*

FIG. 4 - Cytais tetrastyla, *young medusa; height of exumbrella: 2.3 mm; diameter of exumbrella: 2.3 mm. Gulf of Naples.*

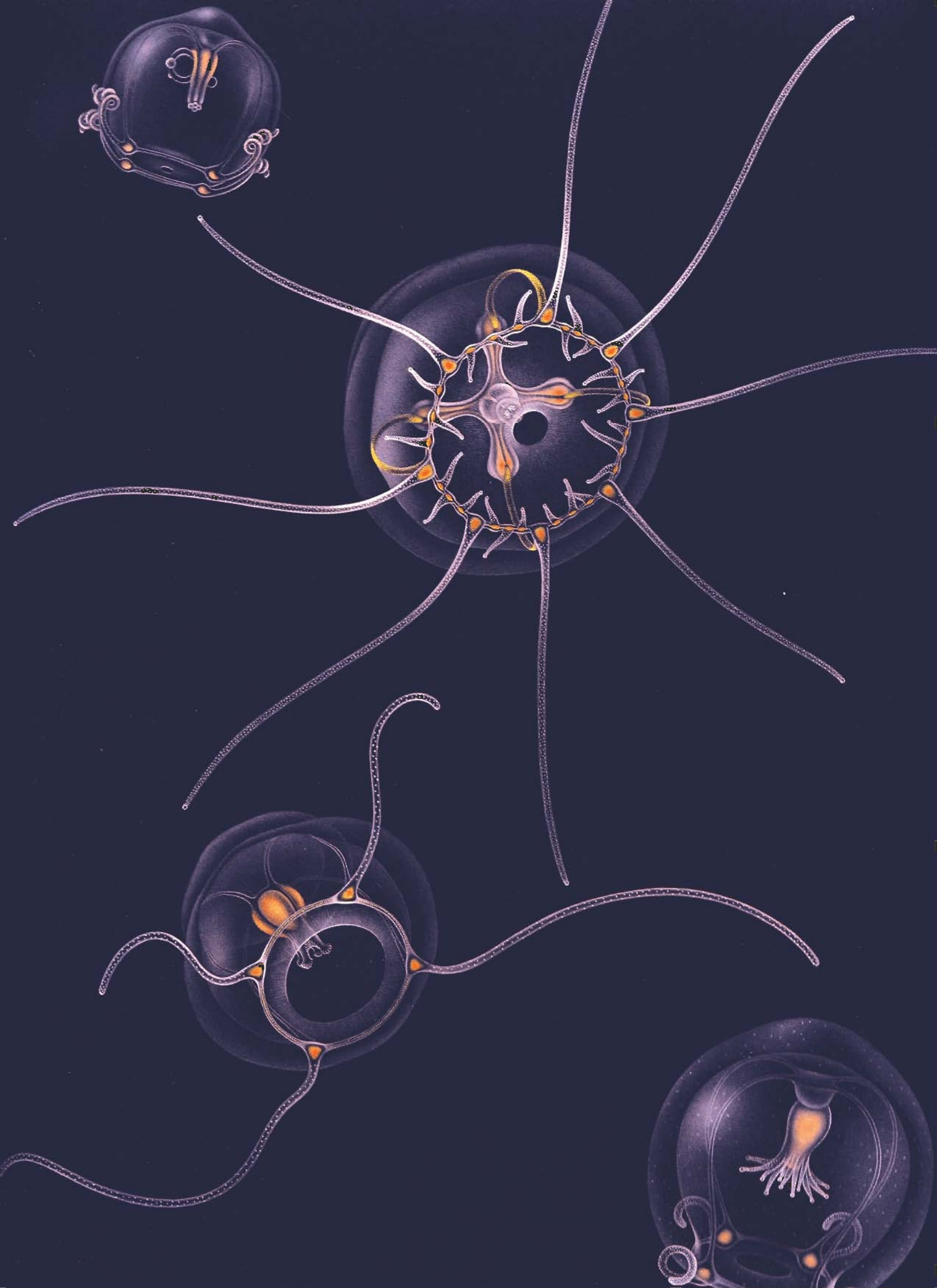
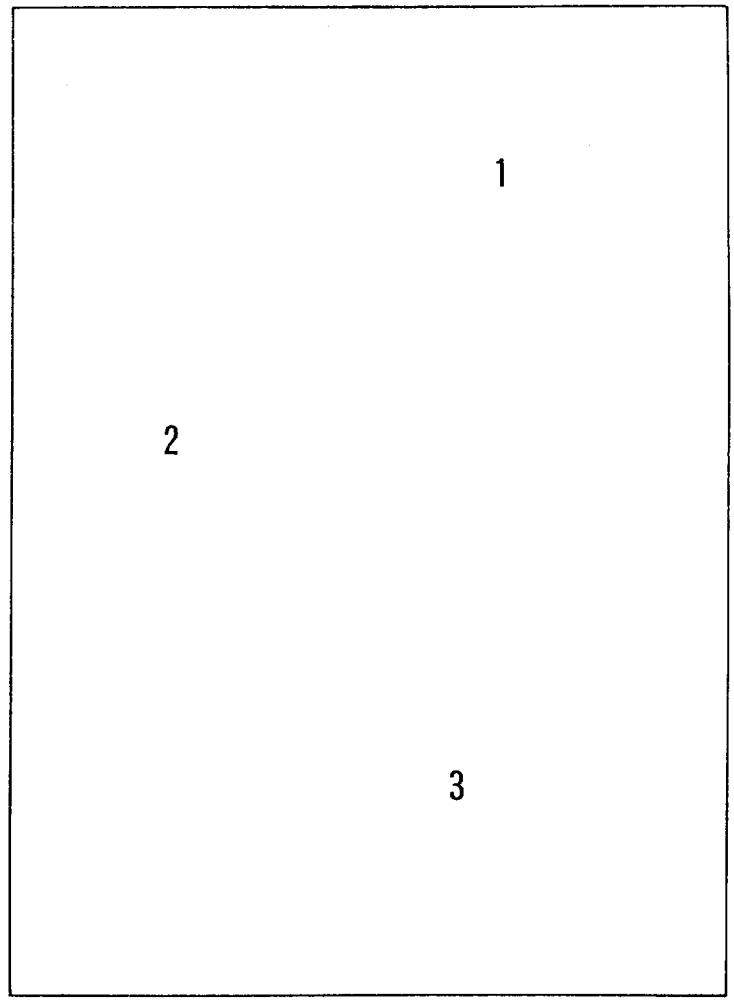


PLATE VIII

Lizzia fulgurans
Lizza blondina
Lizzia octostyla

PLATE VIII, FIG. 1-3.



(The text for this plate will appear in a second volume « Filifera »).

FIG. 1 - Lizzia fulgurans, *adult male medusa; height of exumbrella: 0.9 mm; diameter of exumbrella: 0.8 mm. Gulf of Naples, new for the Mediterranean.*

FIG. 2 - Lizza blondina, *with medusa buds; height of exumbrella: 1.9 mm; diameter of exumbrella: 1.8 mm; Gulf of Naples.*

FIG. 3 - Lizzia octostyla, *with medusa buds; height of the exumbrella: 1.3 mm; diameter of the exumbrella: 1.3 mm. Gulf of Naples.*

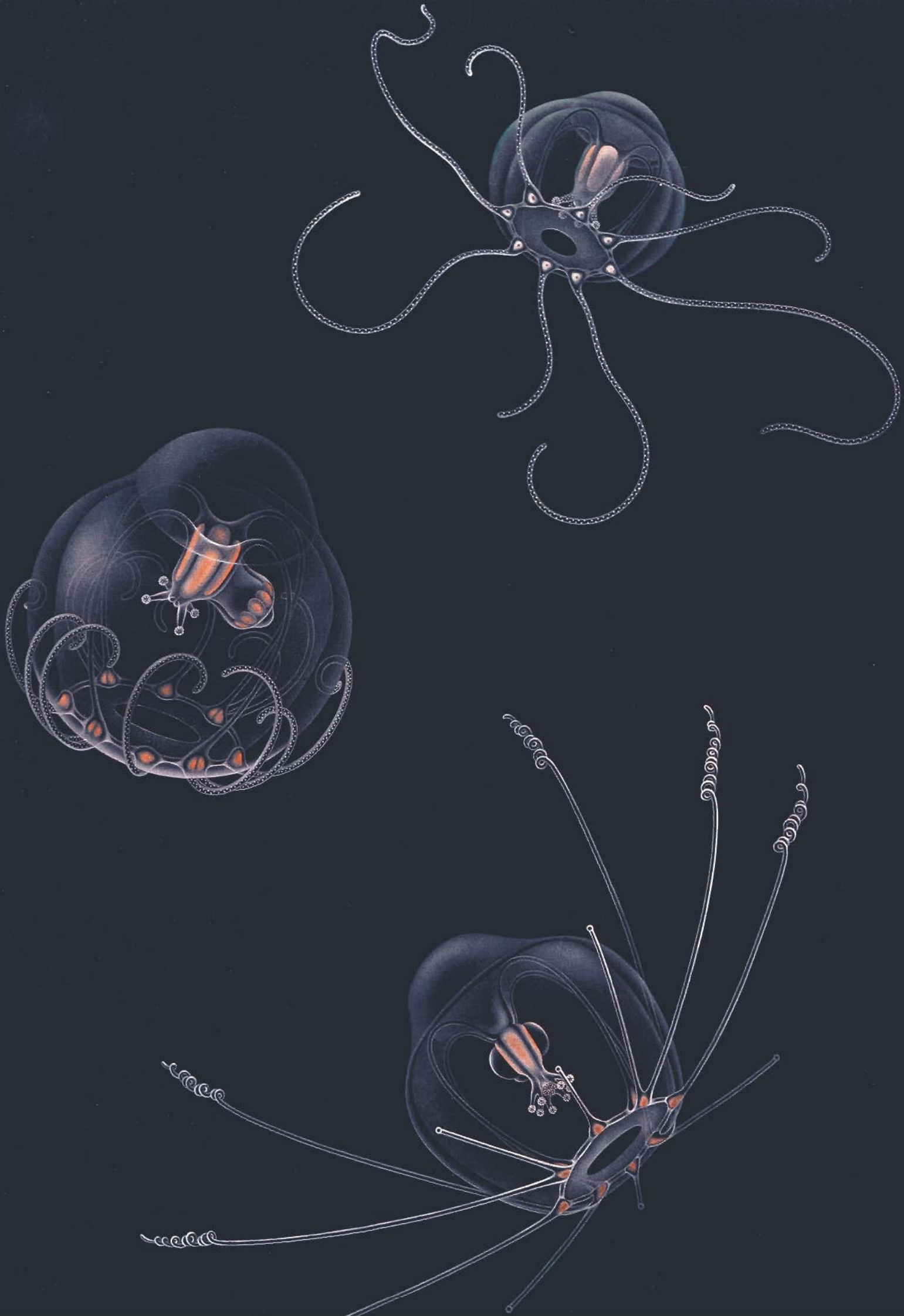
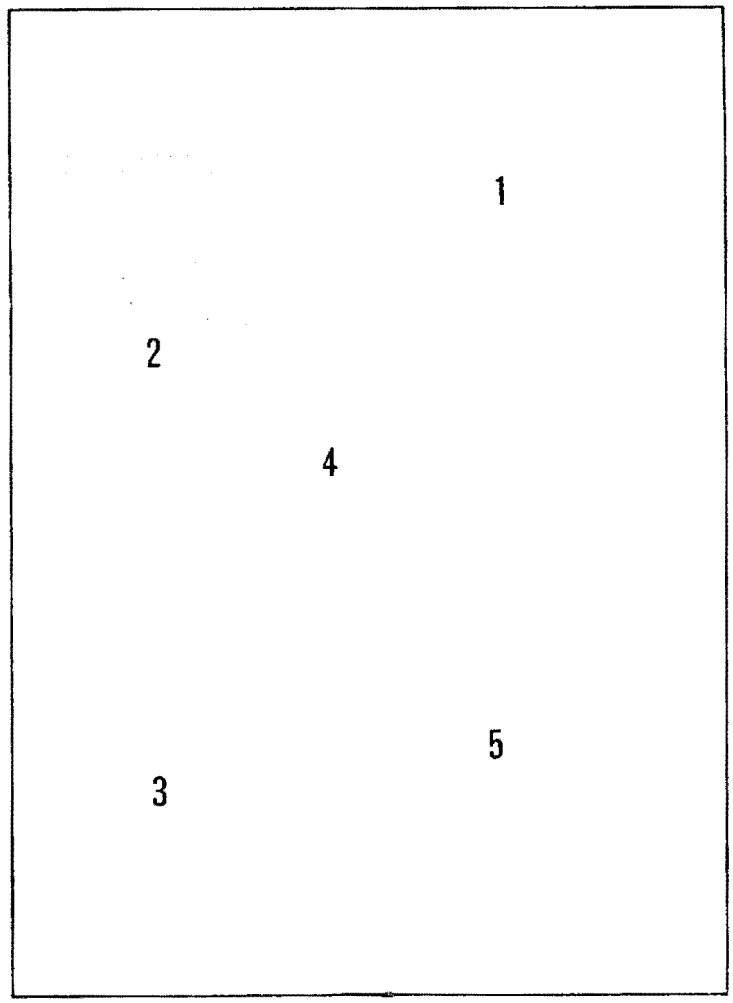


PLATE IX

Köllikerina fasciculata
Bougainvillia ramosa

PLATE IX, FIG. 1-5.



(The text for this plate will appear in a second volume « Filifera »).

FIG. 1 - Köllikerina fasciculata, *adult medusa reared from its hydroid; height of the exumbrella: 6.6 mm; diameter of the exumbrella: 9.1 mm.*

FIG. 2 - Köllikerina fasciculata, *hydroid with medusa buds; height of colony up to 10 mm; Gulf of Naples, on* Stylocidaris *spines.*

FIG. 3 - Köllikerina fasciculata, *enlarged hydranth showing the typical perisarc which encloses the base of the tentacles.*

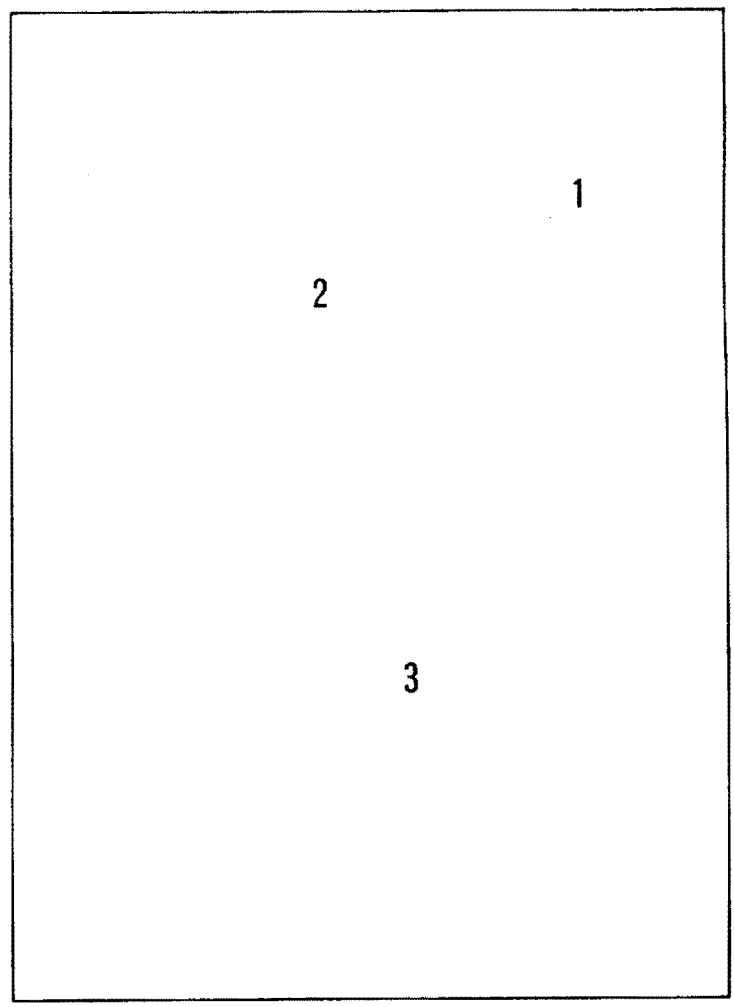
FIG. 4 - Bougainvillia ramosa, *medusa reared from its hydroid; height of the exumbrella: 1.3 mm; diameter of exumbrella: 1.9 mm.*

FIG. 5 - Bougainvillia ramosa, *hydroid colony; height of the colony around Naples: 0.5-2.0 cm.*

PLATE X

Merga tergestina
Leuckartiara nobilis
Merga galleri

PLATE X, FIG. 1-3.



(The text for this plate will appear in a second volume « Filifera »).

FIG. 1 - Merga tergestina, *male medusa; height of the exumbrella: 3.4 mm; diameter of the exumbrella: 3.8 mm. Gulf of Naples.*

FIG. 2 - Leuckartiara nobilis, *male medusa; height of the exumbrella: 6.9 mm; diameter of the exumbrella: 4.7 mm. Gulf of Naples.*

FIG. 3 - Merga galleri, *medusa raised from its hydroid; height of the exumbrella: 8.1 mm; diameter of the exumbrella: 4.7 mm. Gulf of Naples.*

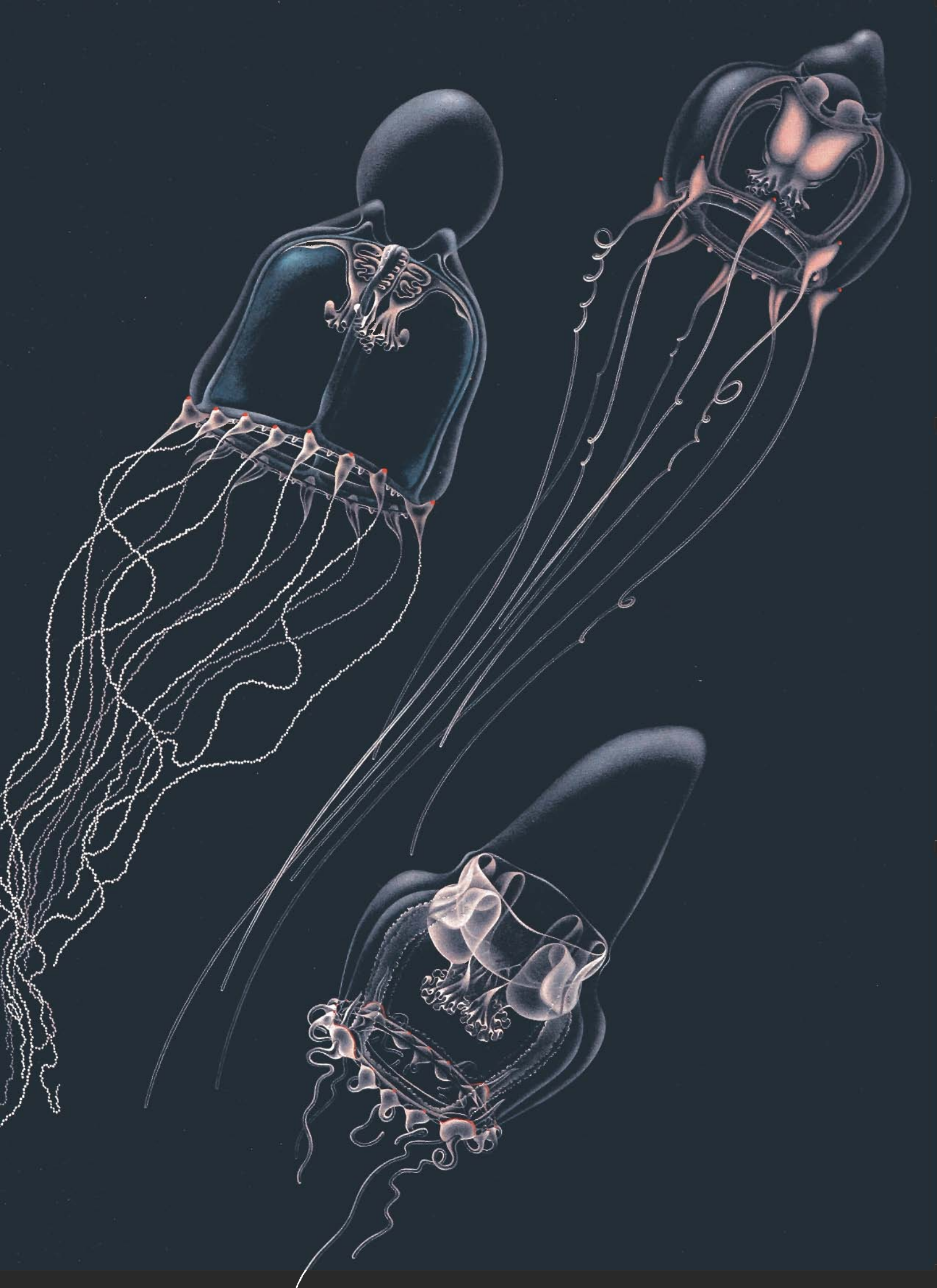
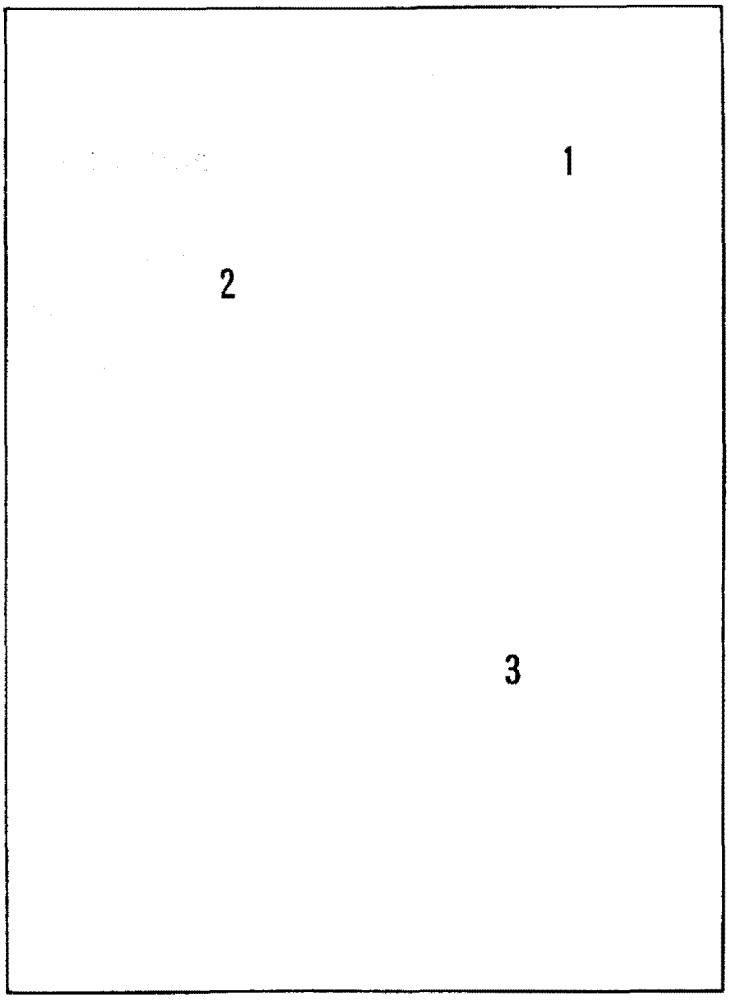


PLATE XI

Halithiara formosa
Pandes conica
Neoturris pileata

PLATE XI, FIG. 1-3.



(The text for this plate will appear in a second volume « Filifera »).

FIG. 1 - Halithiara formosa, *adult medusa; height of the exumbrella: 1.8 mm; diameter of the exumbrella: 1.6 mm. Gulf of Naples, new for the Mediterranean.*

FIG. 2 - Pandes conica, *adult medusa; height of the exumbrella: 14.5 mm; diameter of the exumbrella: 8.0 mm. Gulf of Naples.*

FIG. 3 - Neoturris pileata, *adult medusa; height of the exumbrella: 21 mm; diameter of the exumbrella: 10 mm. Gulf of Naples.*