Abbildungen für Riffvorlesung 27.05.2004

Weitere Rifforganismen

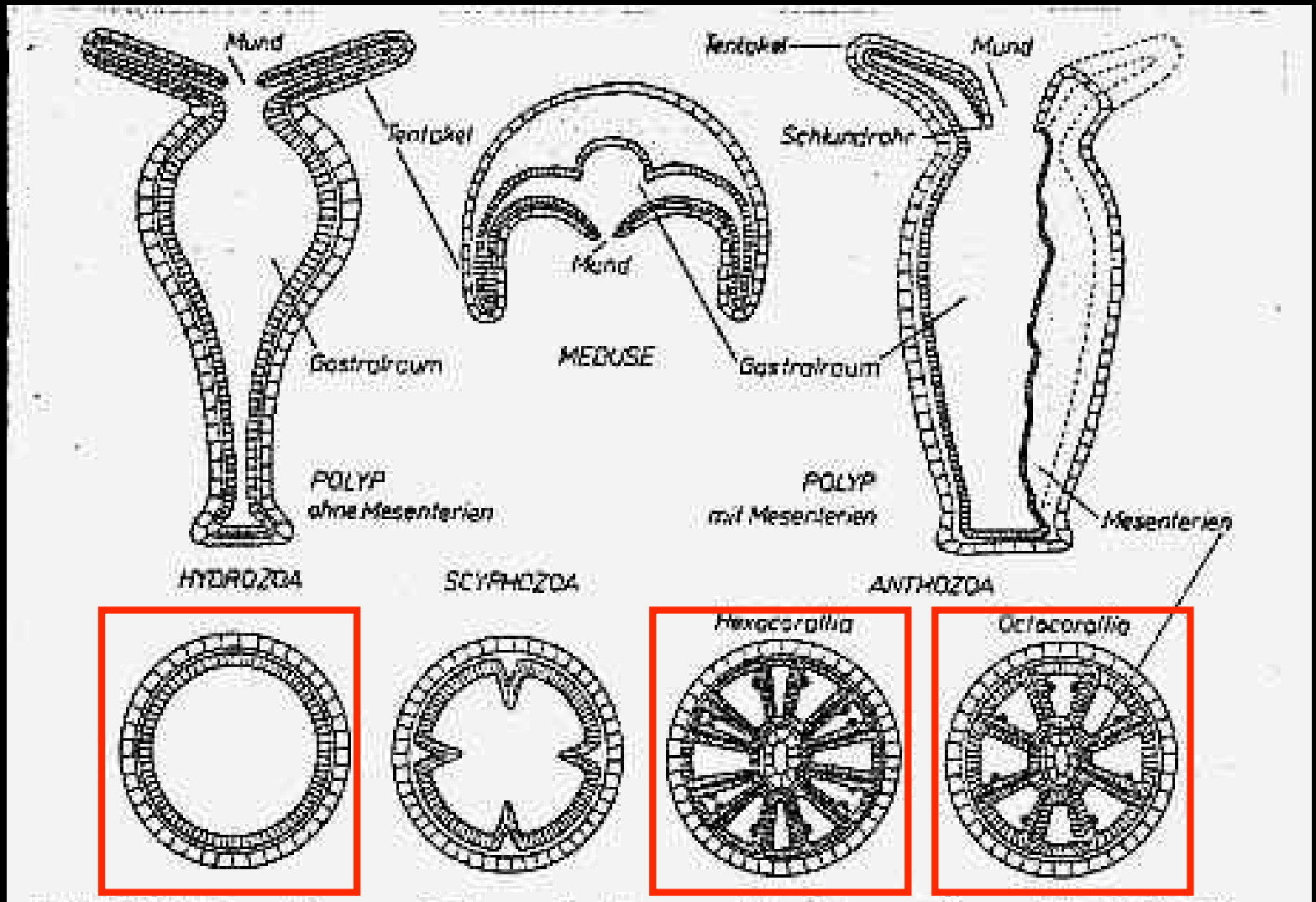


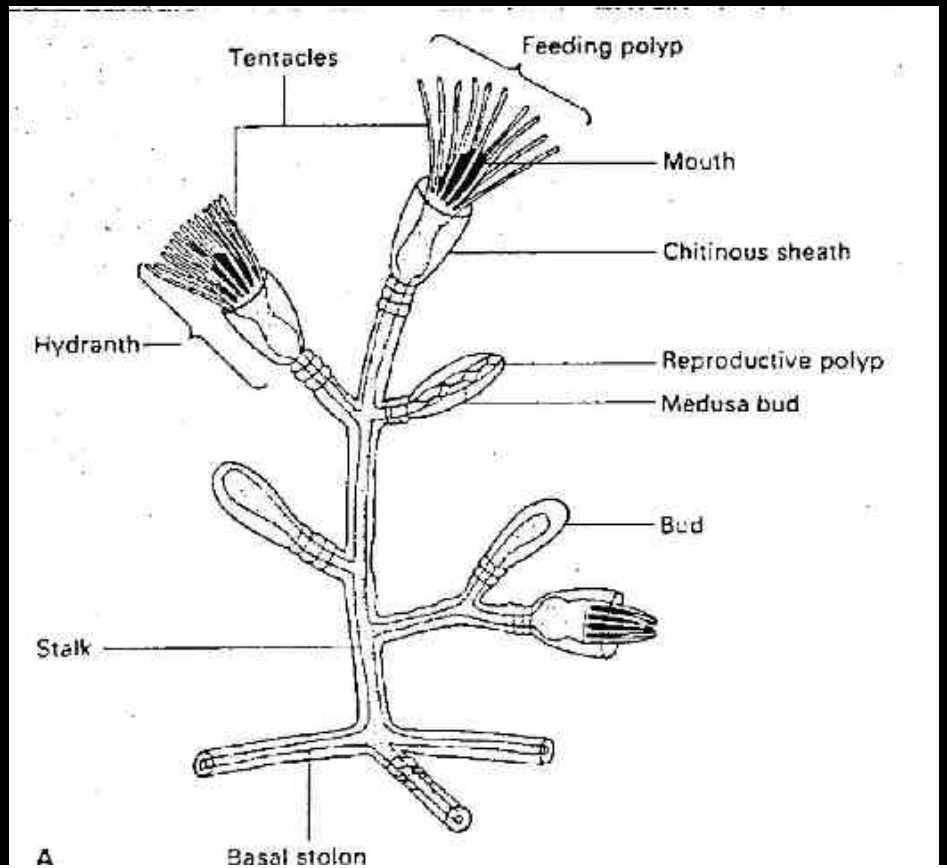
Abb. 38. Die Unterscheidung von Hydrozoen, Scyphozoen und den Anthozoen-Gruppen Hexacorallia und Octocorallia nach der Gliederung des Gastralraumes durch Mesenterien.

Klasse: Hydrozoa
(ausgehendes Präkambrium? – rez.)

Life Cycle Animation

- Zum Teil kompletter Generationswechsel, z.T. aber Medusengeneration unterdrückt
- Keine Mesenterien, keine Septen, z.T. Kalkskelett
- Meist verschiedene Typen von Polypen in einem Individuum

Fresspolyp
(= Hydranth
= Gastrozooid)



Nemato-cysten

Reproduktionspolyp
(daraus Medusen)

Auch taktile und Verteidigungs-Polypen:
Dactylozooid

Feuerkoralle Millepora

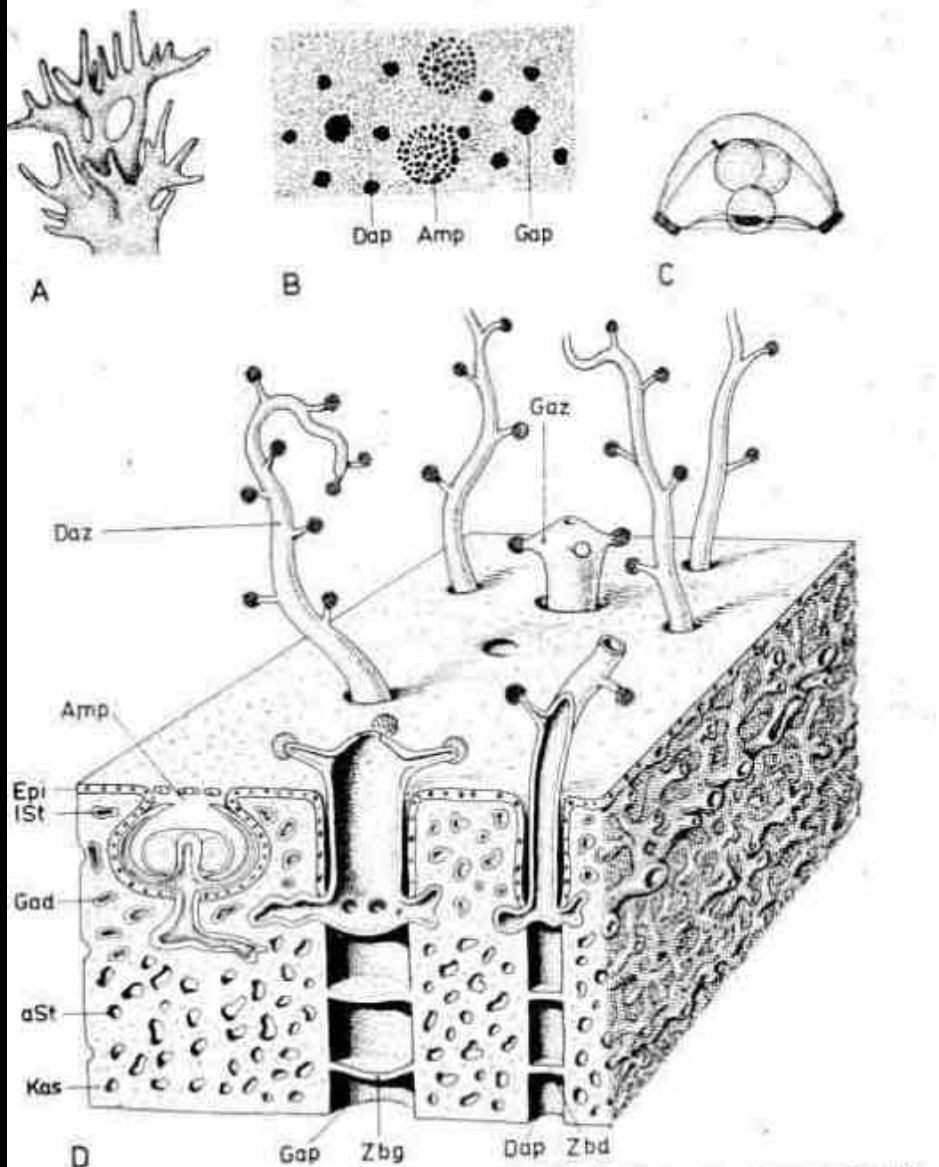


Abb. 108. *Millepora*, Hydroida Athecata. **A**. Habitusbild, Teil eines Stockes von *M. alcicornis*. **B**. Teilstück, Oberflächenansicht des Kalkskeletts. **C**. Freischwimmendes Medusoid mit Eizellen. **D**. Blockdiagramm. Der Übersichtlichkeit wegen sind die Körperwände der Zooide und der Medusenanlagen einschichtig, also nicht als Epi- und Gastrodermis gezeichnet. — **Amp** Ampulle, in D mit Medusenanlage, **aSt** abgestorbene Stolonenröhre, **Dap** Dactyloporus, **Daz** Dactylozooid, **Epi** Epidermis, durch Zellkerne markiert, **Gad** Gastrodermis, weiß, **Gap** Gastroporus, **Gaz** Gastrozooid, **Kas** Kalkskelett, **lSt** lebende Stolonenröhre, **Zbd** Zwischenboden (Tabula) eines Dactyloporus, **Zbg** Zwischenboden eines Gastroporus. — A und B aus Moore 1956, D nach Kaestner 1969, verändert.

Feuerkoralle Millepora, (Riffexkursion 2001)

Dia 1201: Hydrokoralle Stylasterina, (Foto ?)

Weichkorallen-Hydrozoen-Ensemble (Foto Lehnert)

Octokorallen

darunter:
Stolonifera (Orgelkorallen)
Coenothecalia (Heliopora, blaue Koralle)
Alcyonaria und **Gorgonacea**: Weich- und Lederkorallen
Pennatularia: Seefedern

Seeanemonen

(gehören mit Scleractinia zu Zoantharia bzw. Hexakorallen)
Actinaria, **Corallimorpharia**, **Zoanthinaria**

Anthozoa: „Weichkorallen s.l."

Unterklasse: Ceriantipatharia (Miozän – rez.): zwanzig Gattungen, davon nur eine auch fossilUnterklasse:

Octocorallia (?Silur, Perm – rez.)

- Ordnung: **Stolonifera** (Kreide – rez.): ***Tubipora*** („Orgelkoralle") (rez.)
- Ordnung: **Coenothecalia** (Kreide – rez.): ***Heliopora*** („Blaue Koralle") (rez.)
  Ordnung: **Gorgonacea** (Weich- und Lederkorallen) (Kreide – rez.)
  z.B. *Corallium* (rez.), ***Eunicella*** (rez.), ***Isis*** (rez.)
  Weitere Ordnungen: Alcyonaria (Weich- und Lederkorallen), Pennatularia (Seefedern)

Wichtig: **Seeanemonen** (verschiedene Ordnungen: Actinaria, Corallimorpharia, Zoanthinaria) gehören mit den Scleractinia zu den Zoantharia (= „Hexakorallen").

Tubipora (Orgelkoralle) u.a.

Dia 1111: Gorgone

Dia 1231: „Des toten Mannes Hand“

Dia 1193: Oktokoralle Dendronephthyra mit Spiculae

Dia 1118: Spiculae von Alcyonaris (stachelige Lederkoralle)
mit Crustacee Stenopus

Seefächer, Bahamas (Foto Leinfelder)

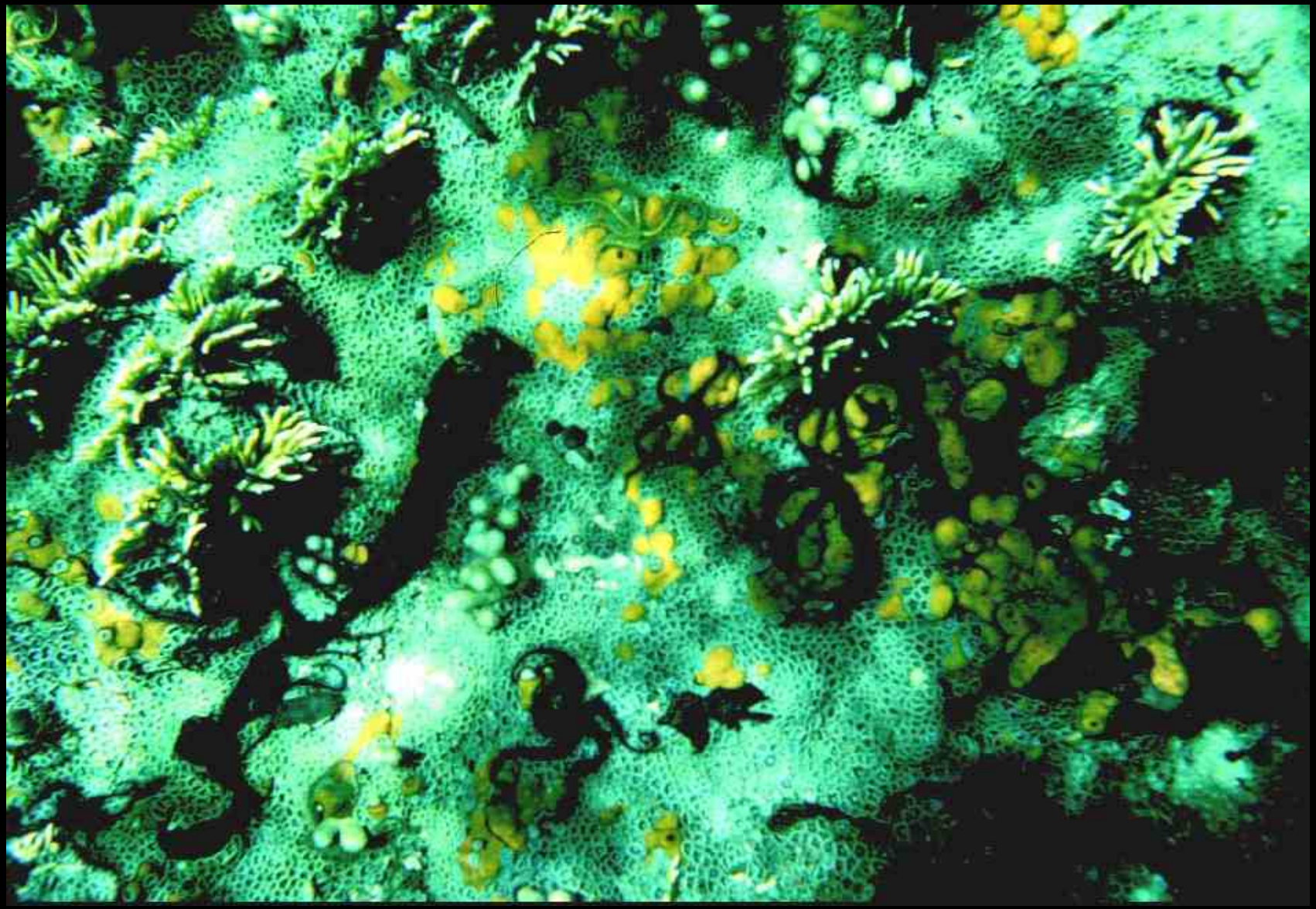
„Peitschenkorallen“, Kolumbien (Foto Leinfelder)

Weichkorallen (Foto ?)

Weichkorallen (Foto ?)

Seefeder
(Foto Grüter)

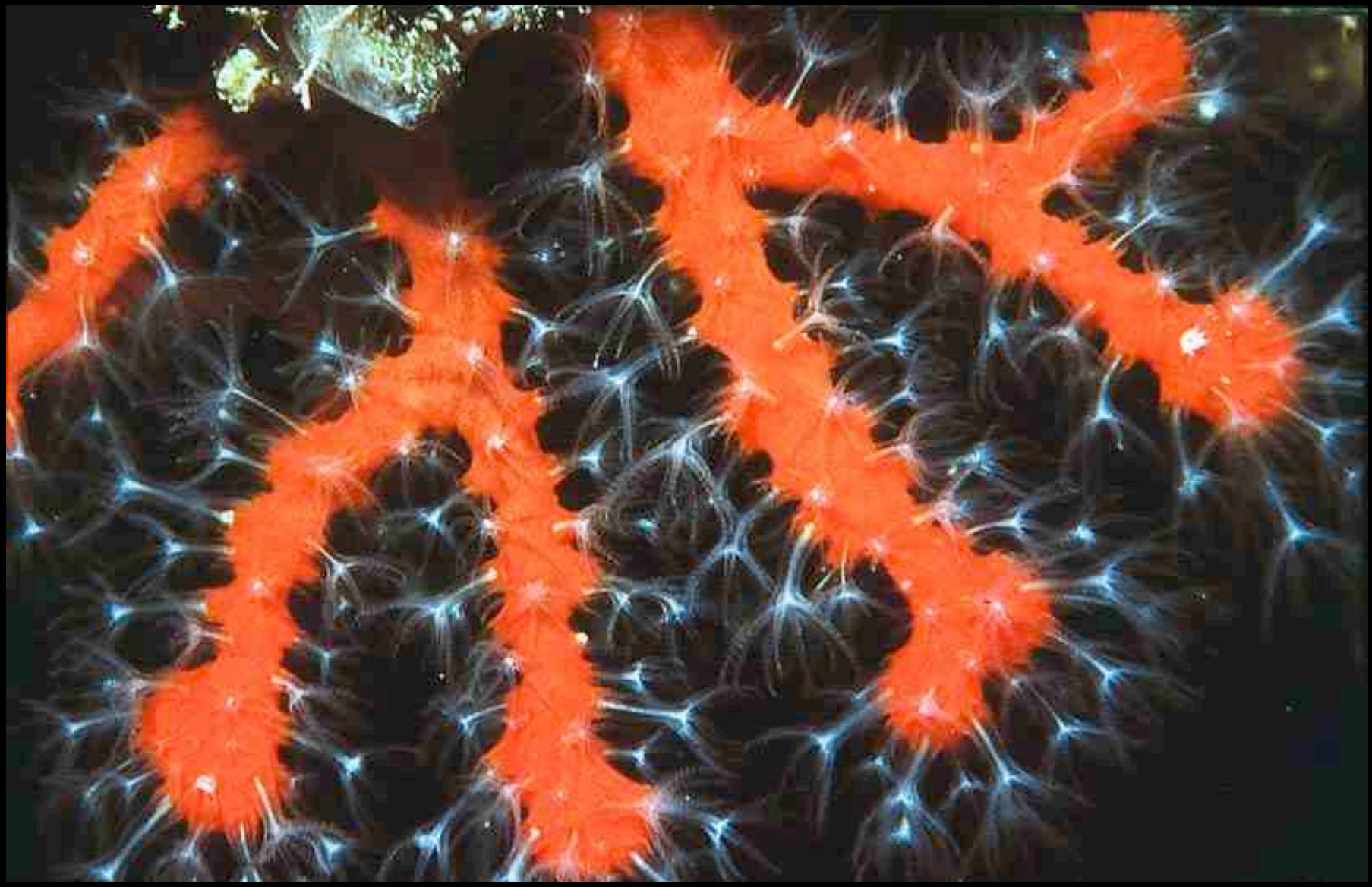
Krustenanemone Zoanthus, Panamá (Foto AG Leinfelder)



Krustenanemone Palythoa (Kolumbien) Foto Leinfelder

Seeanemonen (Foto ?)

Dia 1182: Edelkoralle, Mittelmeer



Bauplan von Oktokorallen

- **8 Mesenterien** + 8 Tentakeln (bzw. Vielfaches davon)
- Polypen über **Coenosark** verbunden, dieses kann Stolonen, Zentralstab oder Coenostheum umkleiden.
- Keine Septen
- Skelett:
  - Nur **hydrostatisch** oder **hornig-chitinös**
  - Oft kalkige **Sklerite** in Mesogloea (z.B. Gorgonien)
  - Sklerite können in manchen Formen zu **festen Skeletten** verwachsen sein; z.B.:
    - ***Tubipora***: hornig+Cc
    - ***Helipora***: aragonitisch. Blaue Koralle, wichtiger indopazifischer Riffbildner

Bauplan von Oktokorallen

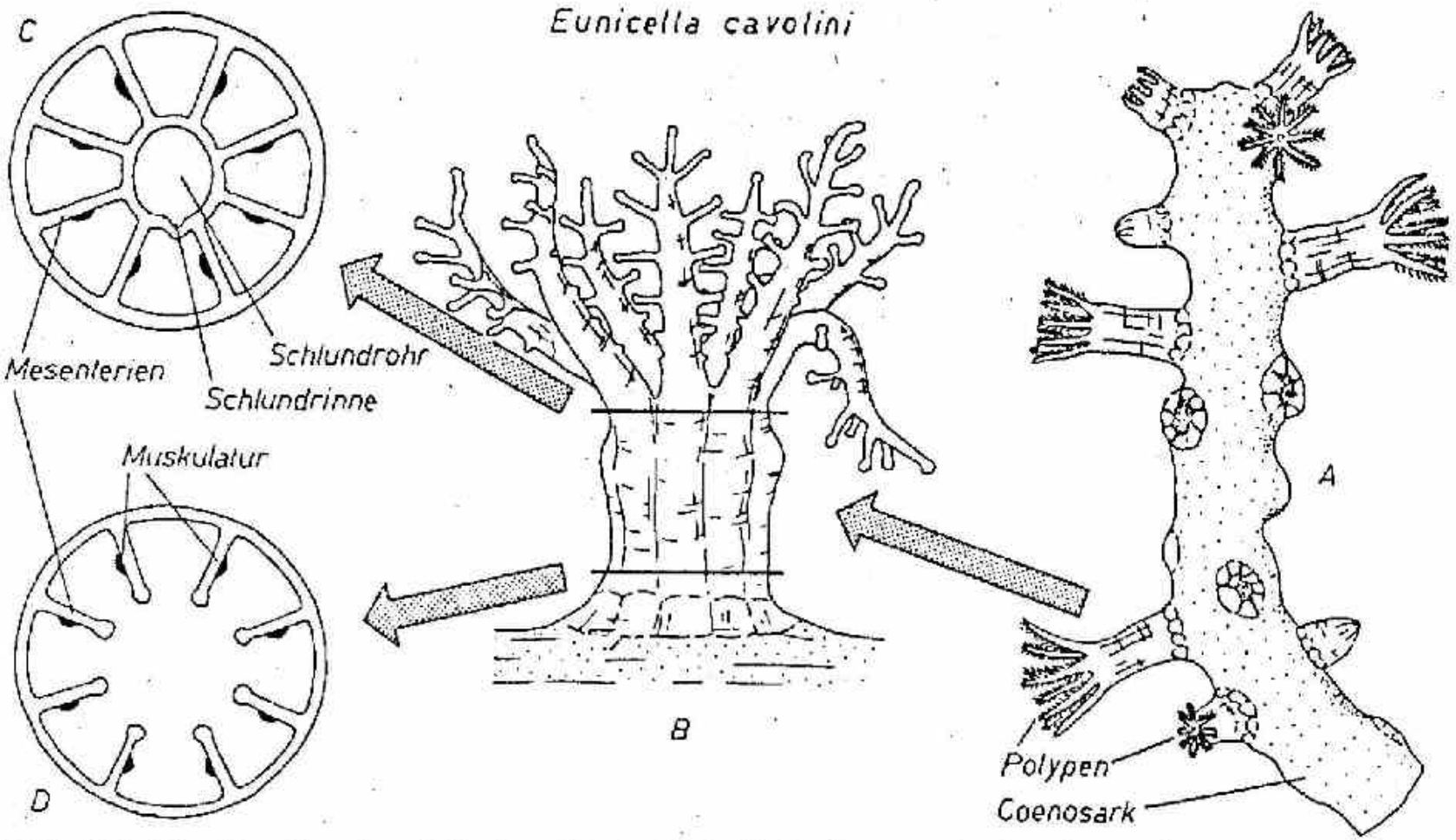


Abb. 184. Der Bauplan einer Oktokoralle. A: Kolonie (rez.), × 5; B: einzelner Polyp, × 15; C, D: Schnitte durch Polypen in unterschiedlicher Höhe. Nach G. VON KOCH.

Bauplan von Oktokorallen

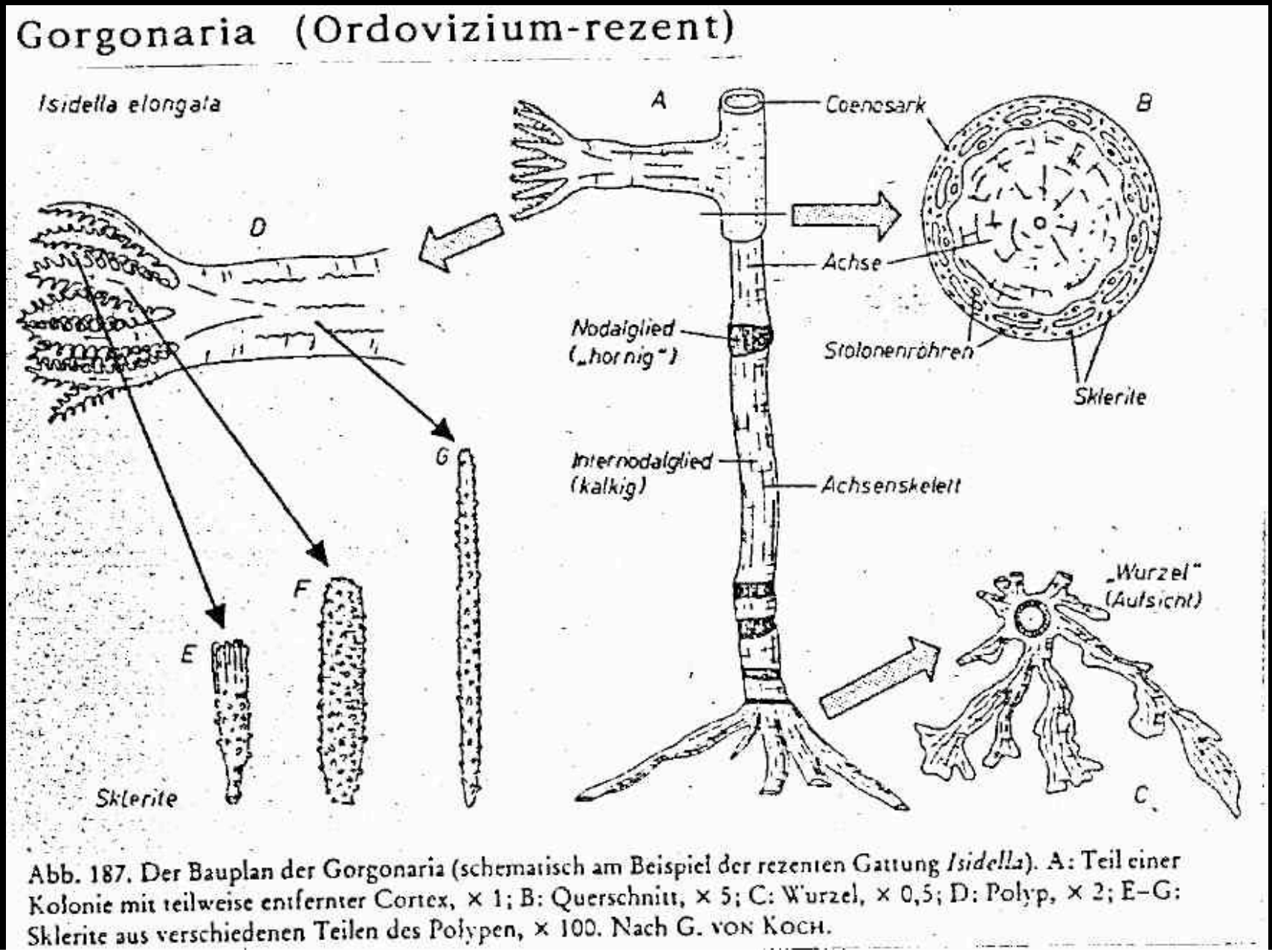


Abb. 187. Der Bauplan der Gorgonaria (schematisch am Beispiel der rezenten Gattung *Isidella*). A: Teil einer Kolonie mit teilweise entfernter Cortex, × 1; B: Querschnitt, × 5; C: Wurzel, × 0,5; D: Polyp, × 2; E–G: Sklerite aus verschiedenen Teilen des Polypen, × 100. Nach G. von Koch.

Bauplan von Oktokorallen

Pennatularia (Trias-rezent)

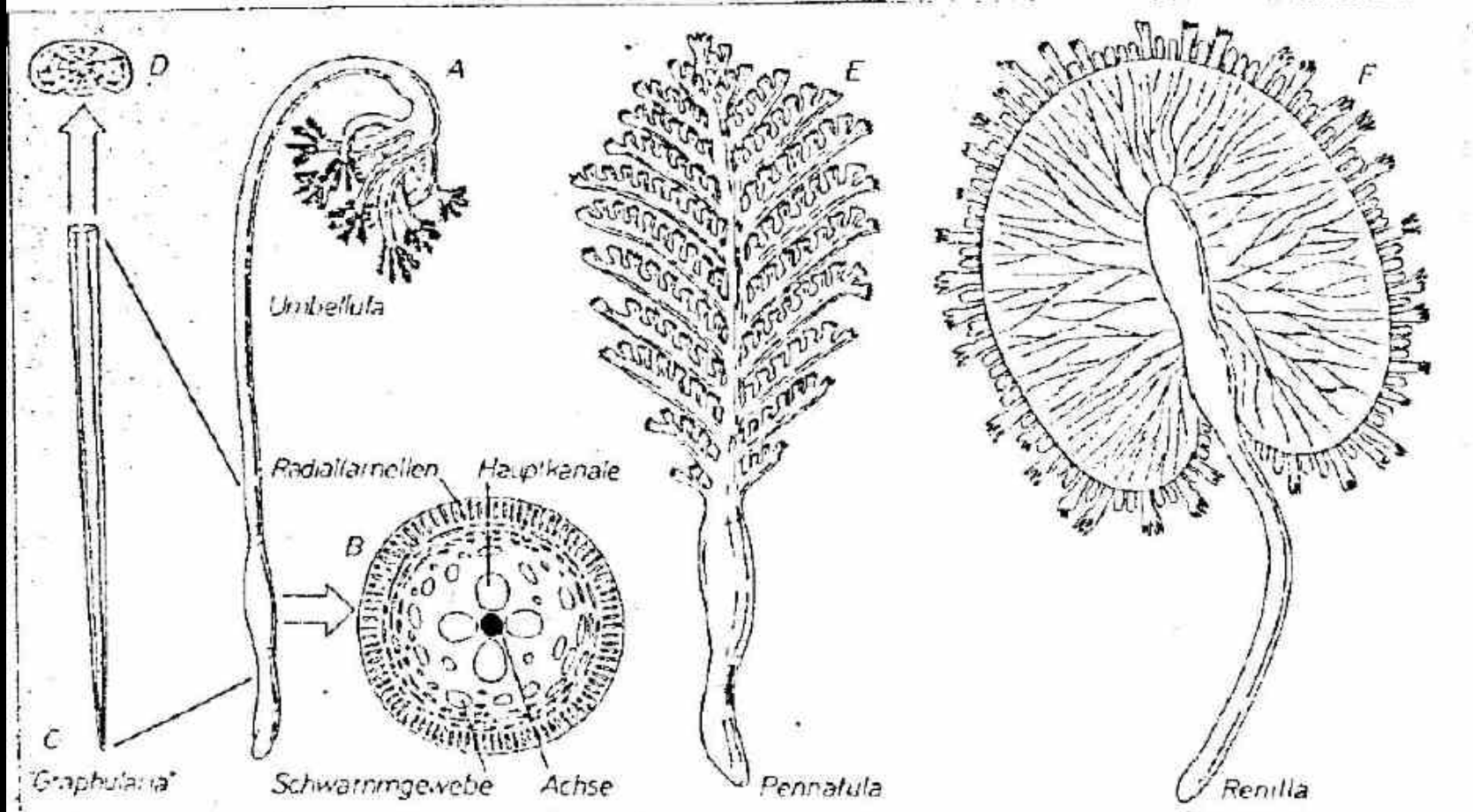
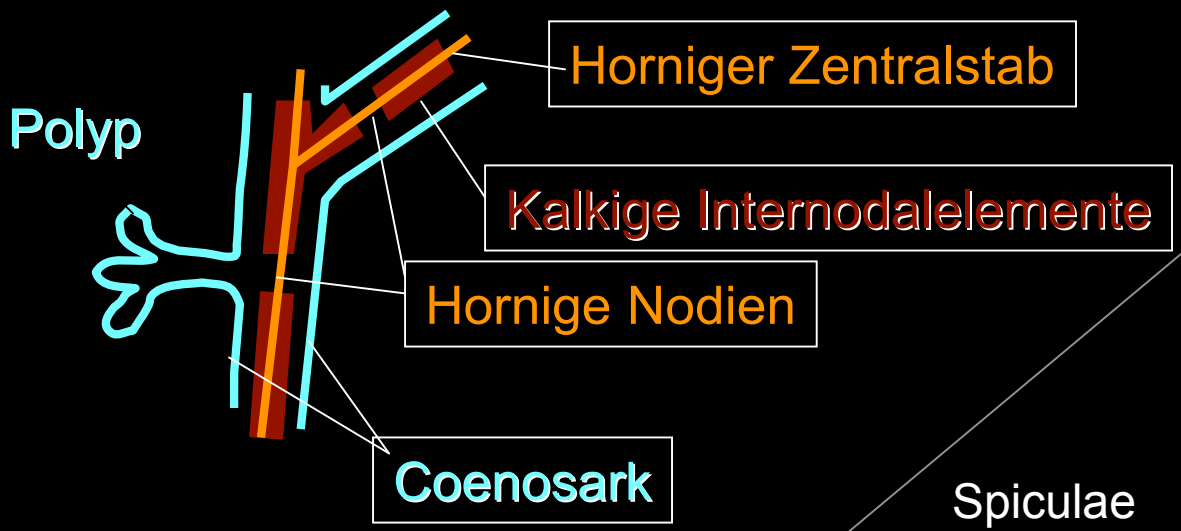


Abb. 190. Pennatularien. A: rezente Gattung mit Knospen im oberen Teil des Gründungspolypen, × 0,3; B: Schnitt durch den tieferen Teil eines Gründungspolypen von *Pteroeides* (rez.), schematisch; die Hauptkanäle entsprechen dem Magenraum, sie werden durch die verwachsenen Mesenterien getrennt; C, D: Achsenskelett einer triassischen Gattung, × 1, × 3; E: rezente Gattung mit fiederförmigen Zweigpolypen, × 0,3; F: rezente Gattung mit blattförmig verwachsenen Zweigpolypen, von der Unterseite, × 1. Überwiegend nach W. KÜKENTHAL.

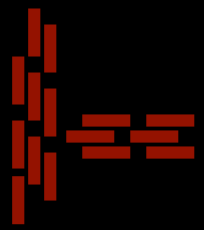
Bauplan von Oktokorallen

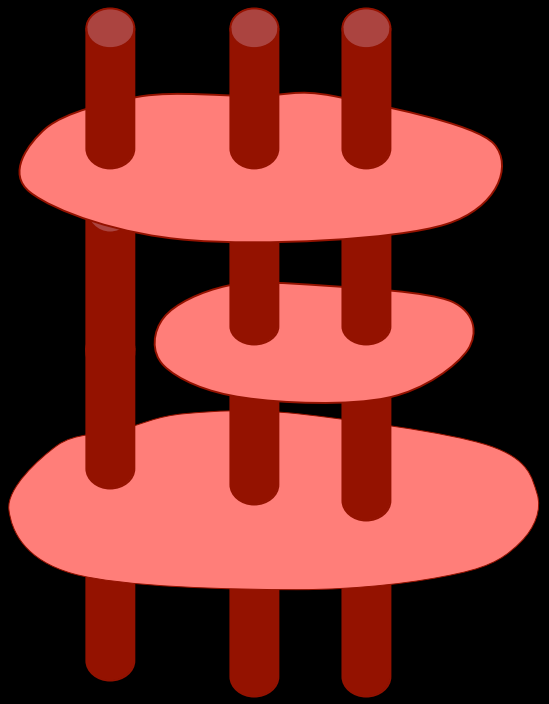
Gorgone ***Isis***



Orgelkoralle ***Tubipora***

Spiculae zu Röhren verbunden





Schwämme im Korallenriff

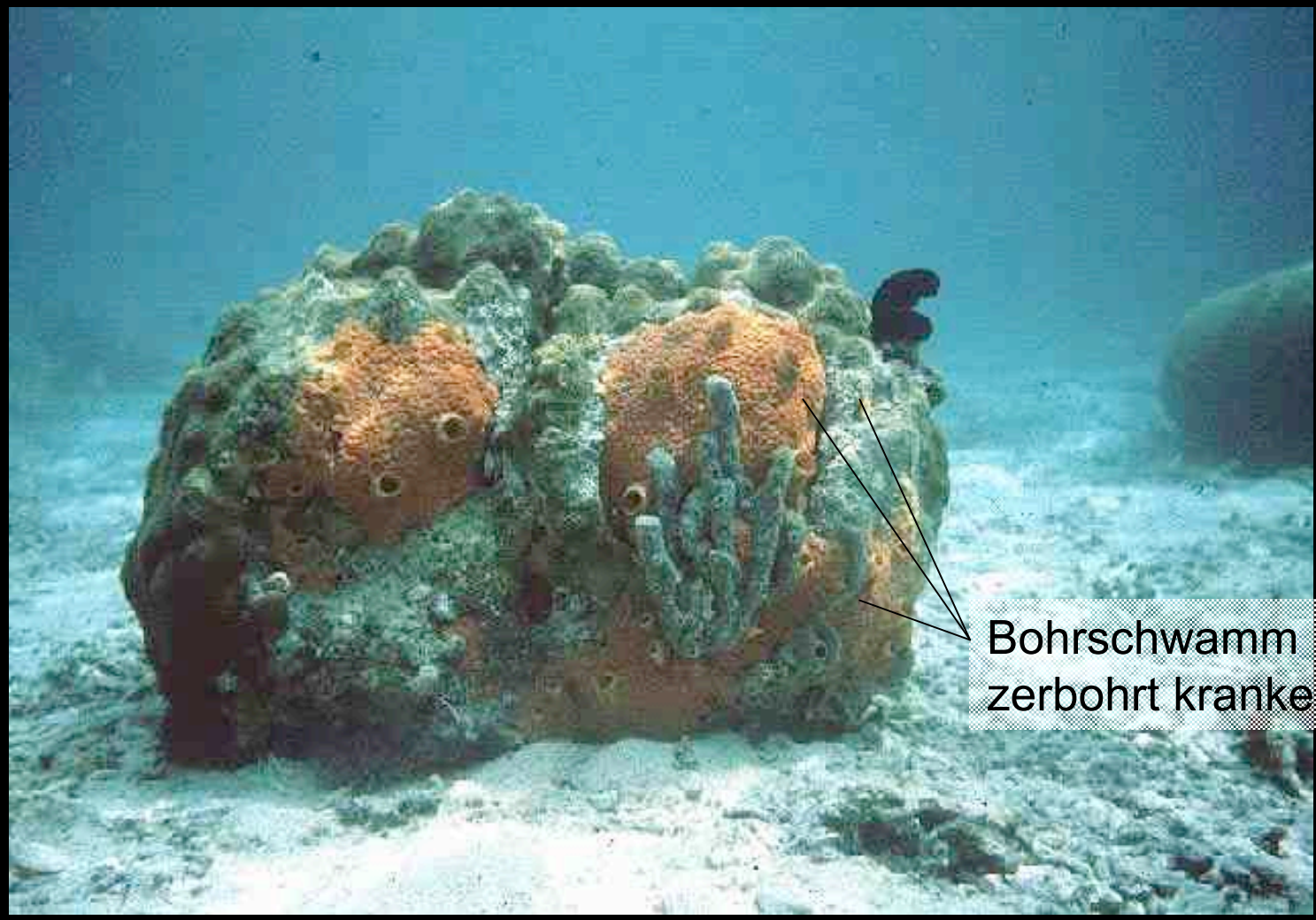
Dia 1197/98: Röhrenschwämme (Rotes Meer)

Riesenschwämme, Bocas, Panamá (Foto AG Leinfelder)

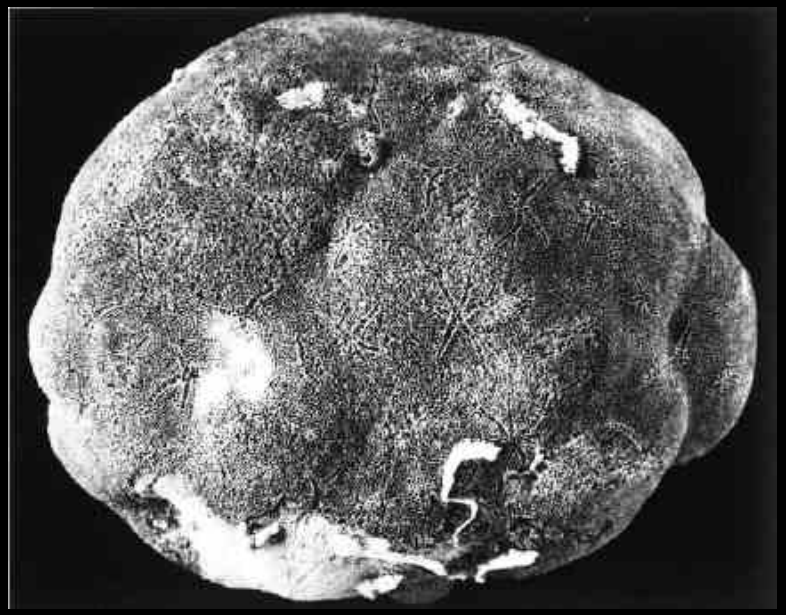
Riesenschwamm, Bocas, Panamá (Foto AG Leinfelder)

Demospongia-Ensemble, Bocas, Panamá (Foto Saric)

Cliona-Bohrschwamm, Panamá (Foto AG Leinfelder)



Rezente Stromatoporen

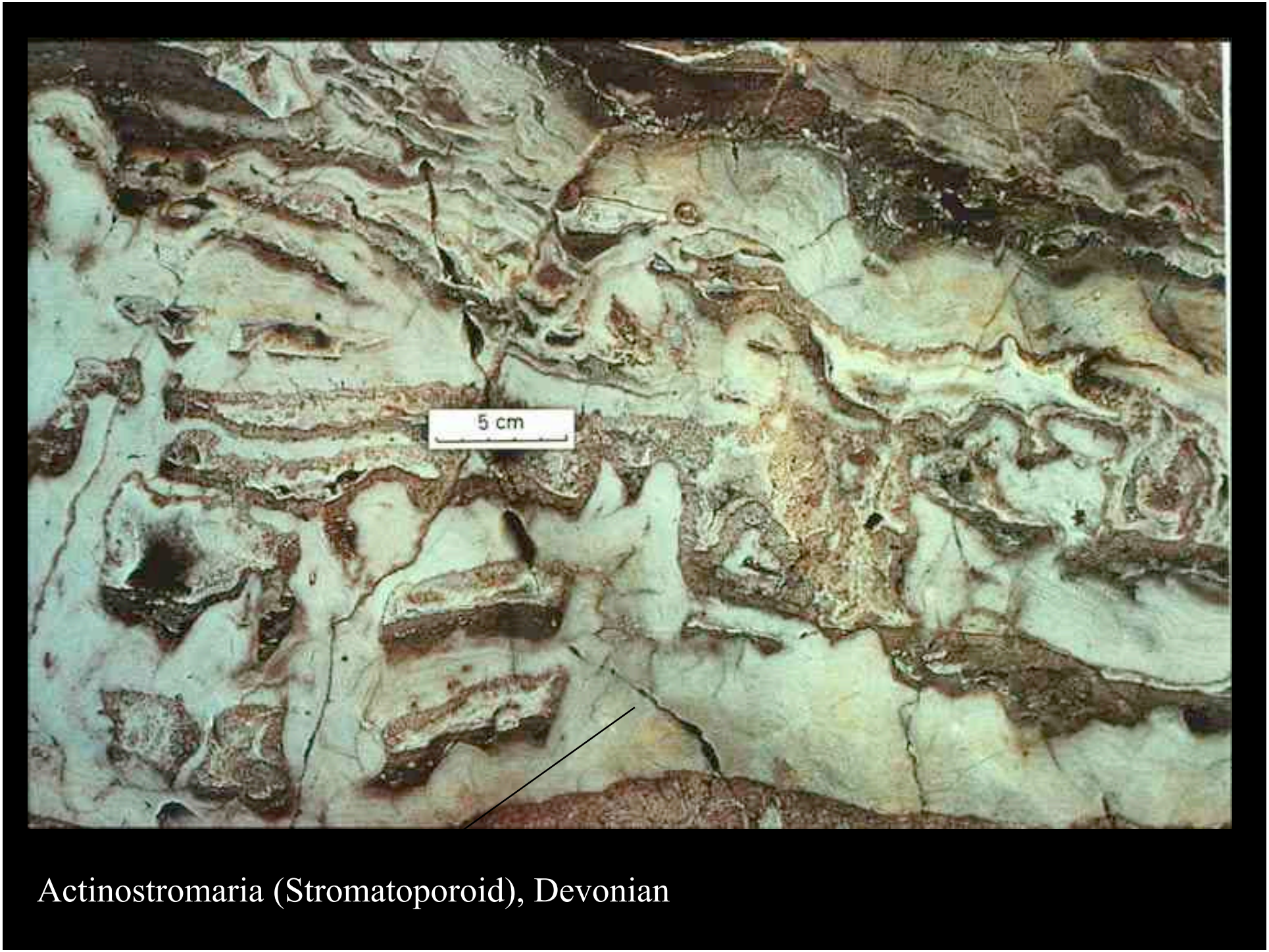


Heute „coelobitisch“: in Riffhöhlen

Ceratoporella (Jamaica)

Exkurs: Stromatoporoids in Earth History

- (Cambrian?-) Ordovician - Recent
- widespread from Ordovician to Devonian *(till Frasnian/Famennian boundary),* Chaetetids frequent during Late Paleozoic
  - Major reef builders together with tabulate corals
  - Stromatoporoid zonations
  - Important reservoir rocks (e.g. Golden Spike and equiv.)
  - Also in calm-water settings (lagoons)



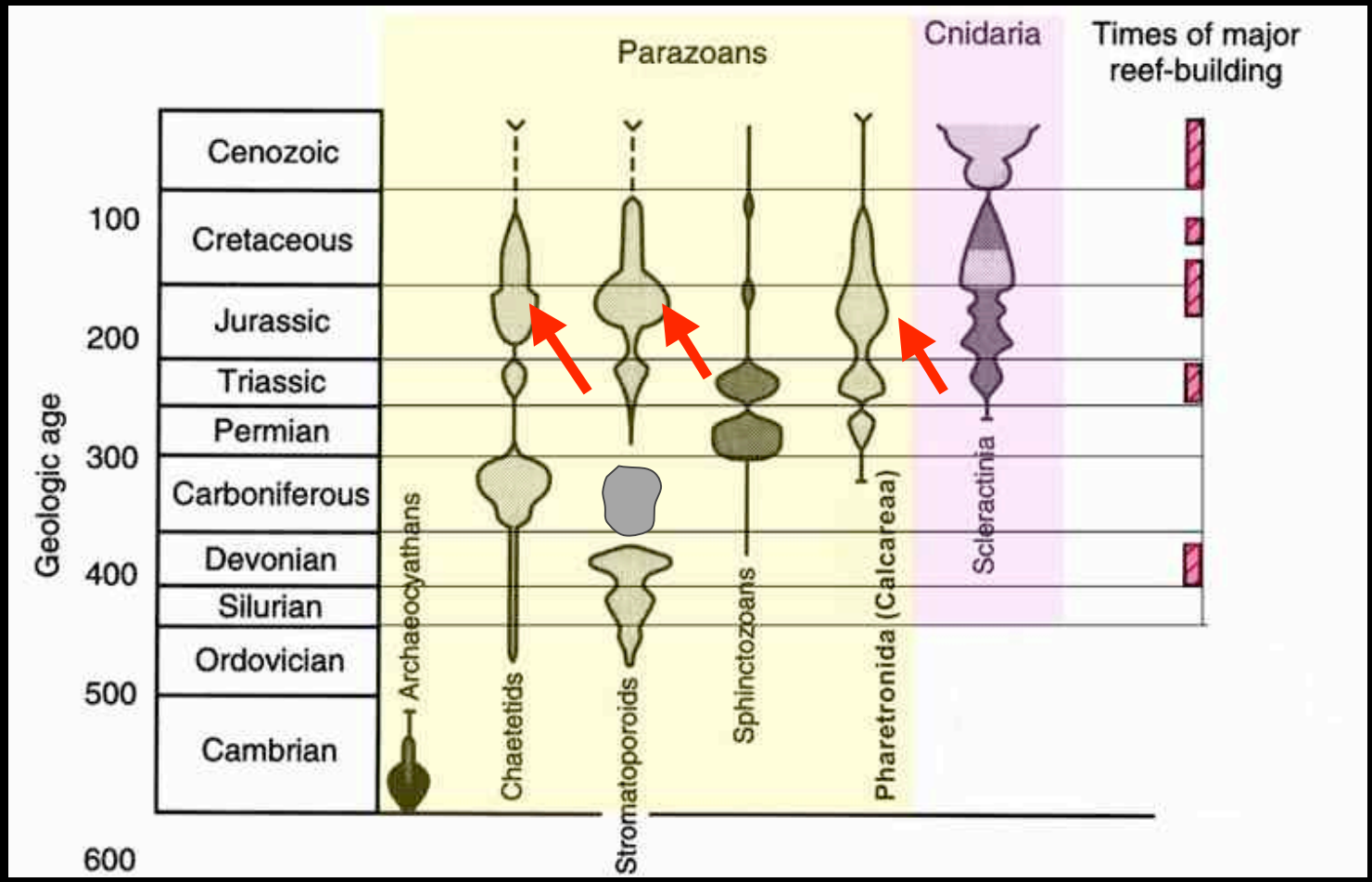
Actinostromaria (Stromatoporoid), Devonian

1162: Stachyoides (Stromatoporoid) and Renalcis (Calcimicrobe), Devonian

Amphipora and Actinostromaria, Devonian

Stromatoporoids through Earth History

Incl. Chaetetids



from Benton & Harper (1997)

Synonyms

(...possibly...)

Tabulozoans = Chaetetids

Stromatoporoids: sometimes includes Chaetetids, sometimes not (we include them or otherwise use stromatoporoids s.str.)

Dysjectoporoids, Spongiomorphids, Ellipsactiniids: all (probably) Stromatoporoids s.l.

Hydrozoans (or Hydrocorals): most are now considered stromatoporoids, but there are also ‚real ones'.

Sclerosponges: normally including stromatoporoids together with other calcifying sponges. Often, either not used any longer or restricted to modern representatives.

Coralline sponges: an informal name for all (or most) calcifying sponges. By some used only for calcifying demosponges (contrasting the Class Calcarea). Some use the name coralline demosponges.

History of Interpreting Stromatoporoids

- **1820-33: Individual group** between milleporid hydrozoans and scleractinian corals (*Goldfuß*)
- **1834: Sponges** (*Steininger*)
- **1850s**: **bryozoans, tabulate corals** (*Römer*); some reconsidered them as sponges
- **1877**: **Hydrozoans** (*Carter, Nicholson*);
- **view persisted** (e.g. *Lecompte* 1956, *Galloway* 1957, *Flügel* 1958 ff)
- **Late 1960s, early 70s** *(Hartman):* discovery of **extant sclerosponges**; similarities to stroms were noted; view was rejected by most others.
- **Hydrozoan interpretation persisted**, additional interpretations: **foraminifera**, **cyanobacteria**, **tabulate corals, scleractinian corals**)
- **1975** (*Hartman & Goreau*): Extant Acantochaetetes described and spicules in fossil chaetetids detected: sponge interpretation.
- **Since then**: at least spiculate fossil **stromatoporoids considered as sponges.** (Important: Wood 1987)

A bit on systematics and morphology

Class Demospongea

Order Lithistida
Order Stromatoporida
Order Sclerospongea
Order Chaetetida
Order Sphinctozoa

or

Class Demospongea

Order Lithistida
Order Stromatoporida
(incl.chaetetids and modern sclerosponges)
Order Sphinctozoa

Nowadays: most fossil Stromatoporoids, chaetetids considered to have calcite skeleton, Sclerospongea are now Extant ‚stromatoporoids' with aragonite skeleton and spongine fibres.

*Recap: Calcareous sponges also in the **Class Calcarea!***
Sphinctozoa might also partially belong to the Calcarea

The ‚modern' view (e.g. Wood 1987)

Phylum Porifera
- Class Demospongiae
  - Subclass Ceractinomorpha
    - Order Haplosclerida
      (e.g. Calcifibrospongia, rec.; Aka, Jurassic
      ?Order/?Fam.Burgundidae
      (Burgundia only)
      Inc. Sed. *Vaceletia* (rec.)
  - Subclass Tetractinomorpha
    - Order Axinellida: Merlia (rec).
    - Order Axinellida
      - Fam. Ceratoporellidae
      - Fam. Milleporellidae
        (e.g. Dehornella, Shuqraia, Promillepora, Steineria, Parastromatopora)
      - Fam Actinostromariidae
        (e.g. Actinostromaria, Actostroma)
      - ?Fam.Actinostromarianinidae
        (Actinostromarianina)

Not considered by Wood are stromatoporoids which do not have spicules or at least the characteristic microstructures

Most demosponge groups include soft sponges, siliceous sponges and ‚stromatoporoids'. Hence, stromatoporoids are not a natural group, but rather a ‚state of organisation'

Some systematics and morphology

Stromatoporoids s.str.

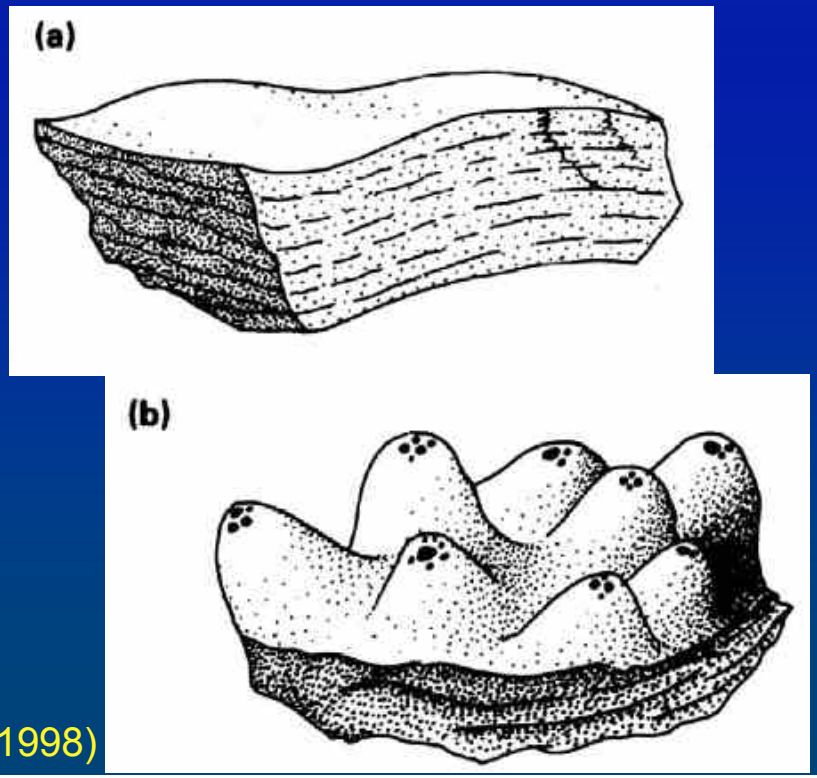
Hard parts: Calcite or Aragonite Layers)

SiO_2 - Sklerites *(if visible; some possibly without)*

Spongin fibres (not all)

Elements:

- Laminae
- Astrorhizae
- Mamelons
- Pilae

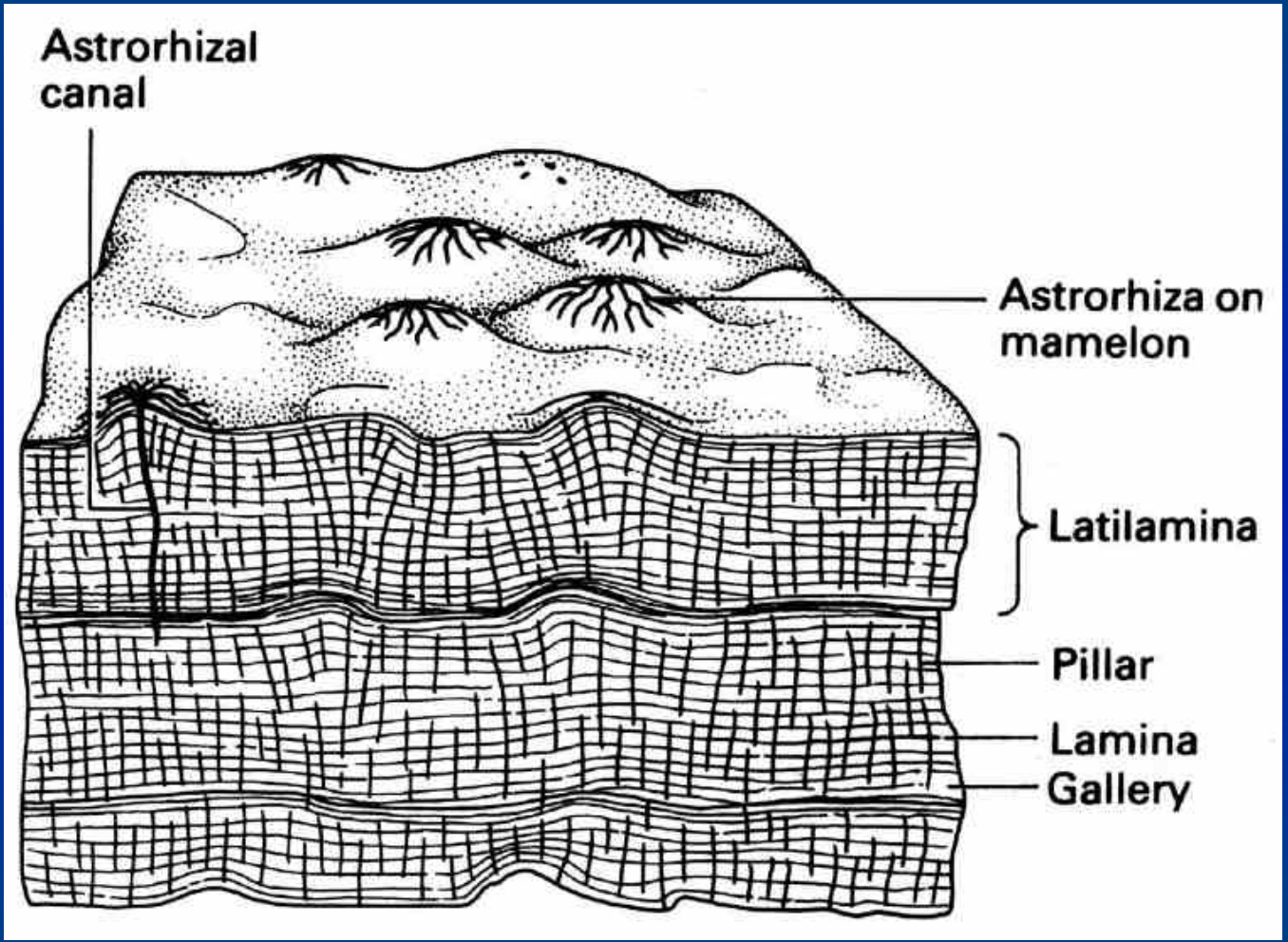


from Clarkson (1998)

Some systematics and morphology

Stromatoporoids s.str.

Elements:
- Laminae
- Astrorhizae
- Mamelons
- Pilae (pillars)



from Boardman et al. (1987)

„ Chaetetida gr. *chaeta* = Helmet bush, hair bush

Outer shape: similar with stromatoporoids s. str.,
- no mamelons / no astrorhizae (but transitional forms)
- mostly polygonal tubes in cross section

skeleton: calcite layers
SiO_2 - spicules (if visible)

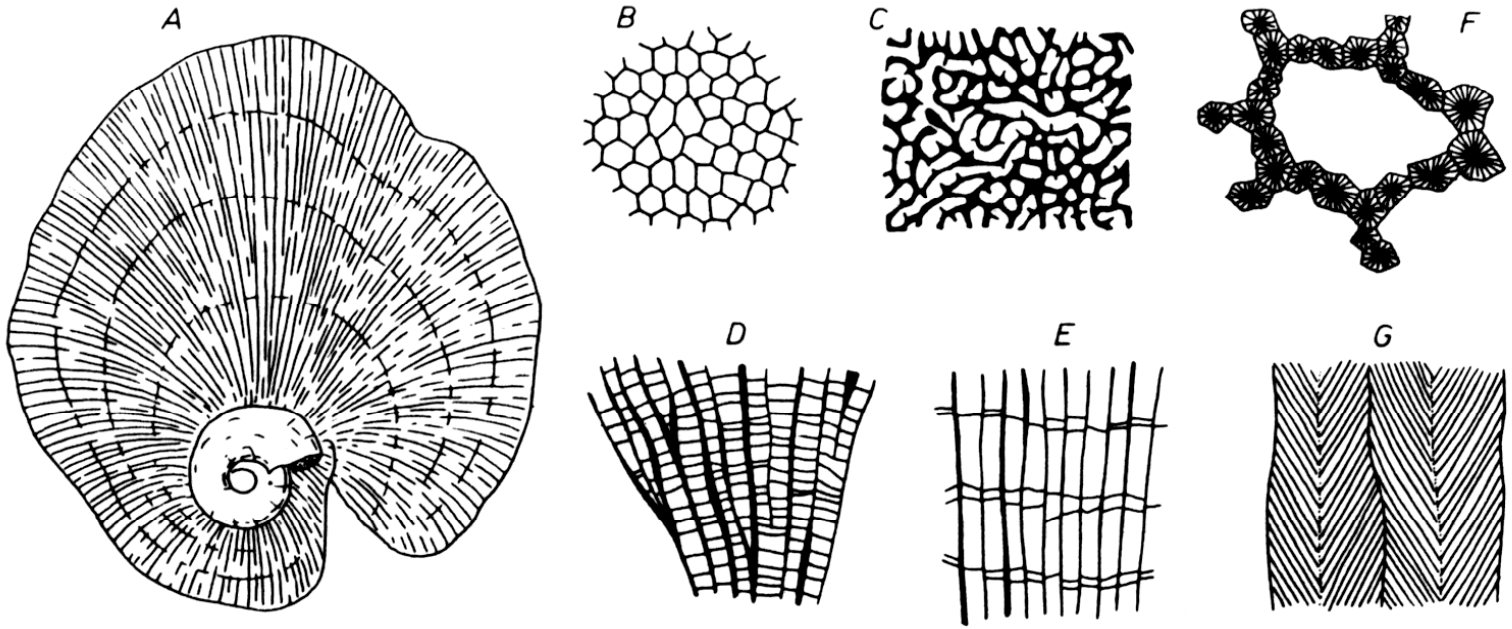
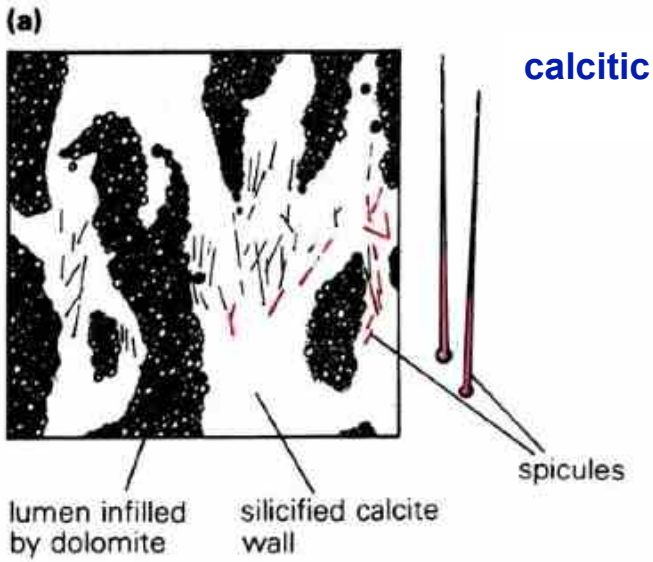
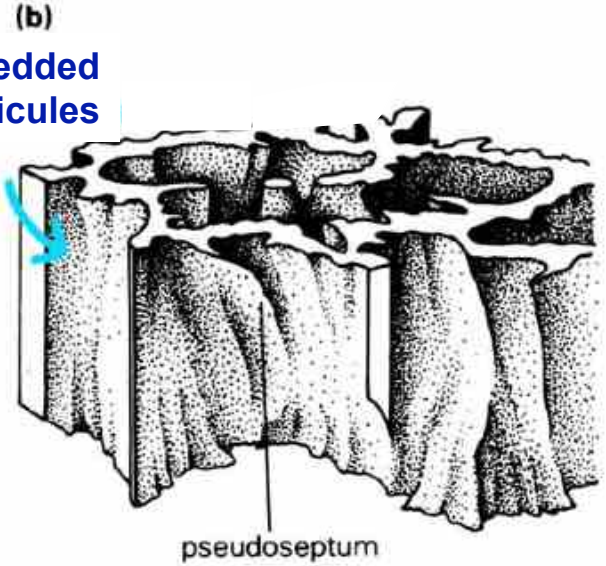


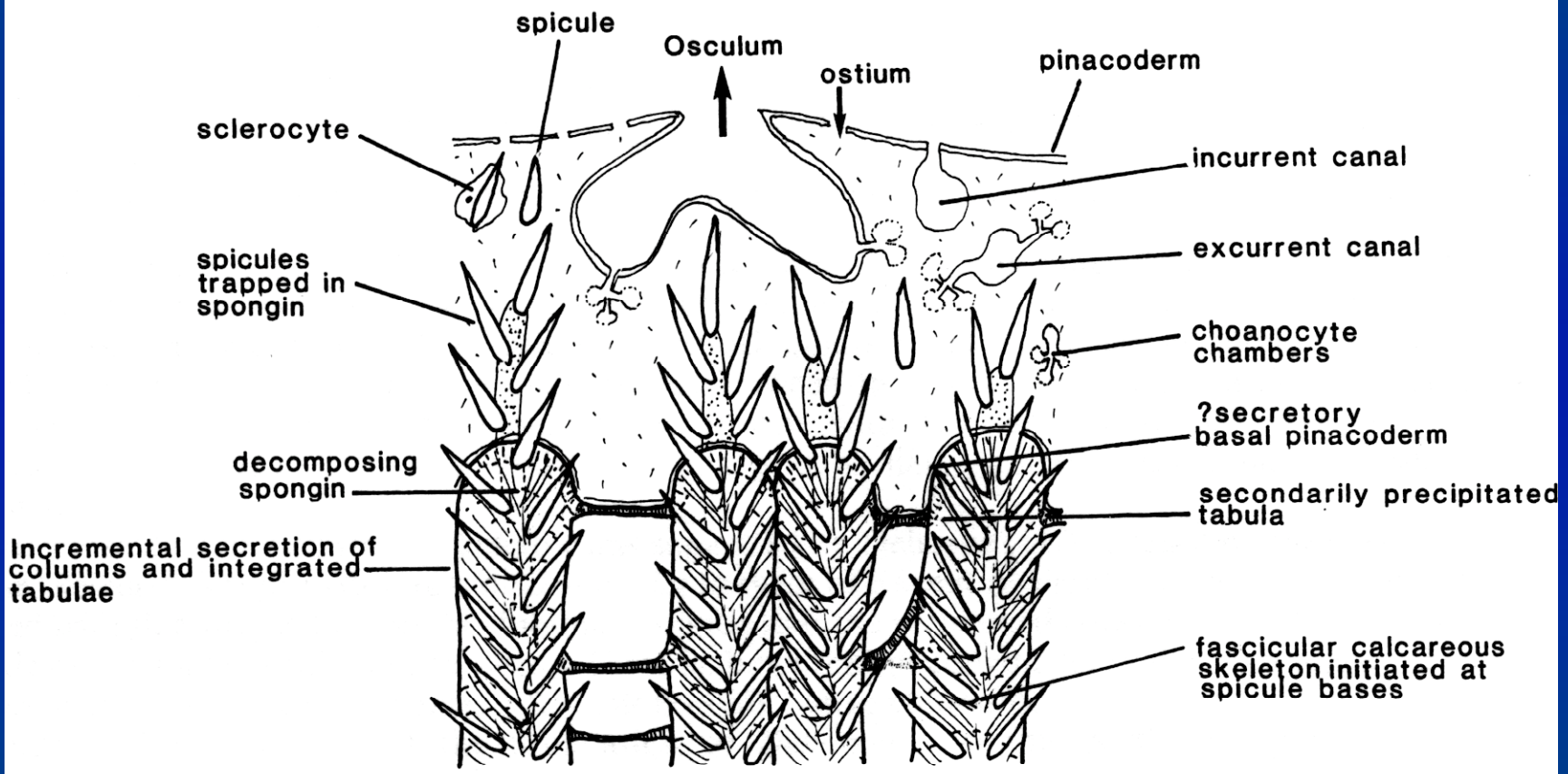
Abb. 126. Tabulozoen (Chaetetiden). A: Querschnitt durch *Chaetetes* (Ord. – Perm, ?Mesozoikum) mit umkrustetem Gastropoden, × 0,5; B: Tangentialschnitt durch *Hattonia* (Silur), × 2; C: Tangentialschnitt durch *Chaetetes*, × 4; D: Schnitt durch *?Chaetetes* (Jura), × 3; E: Schnitt durch *Hattonia*, × 2; F und G: Mikrostrukturen bei *Chaetetes*, vergr. Nach A. FENNINGER und H. HÖTZL, D. HILL & E. C. STUMM und B. S.



calcitic tubes with embedded Siliceous spicules

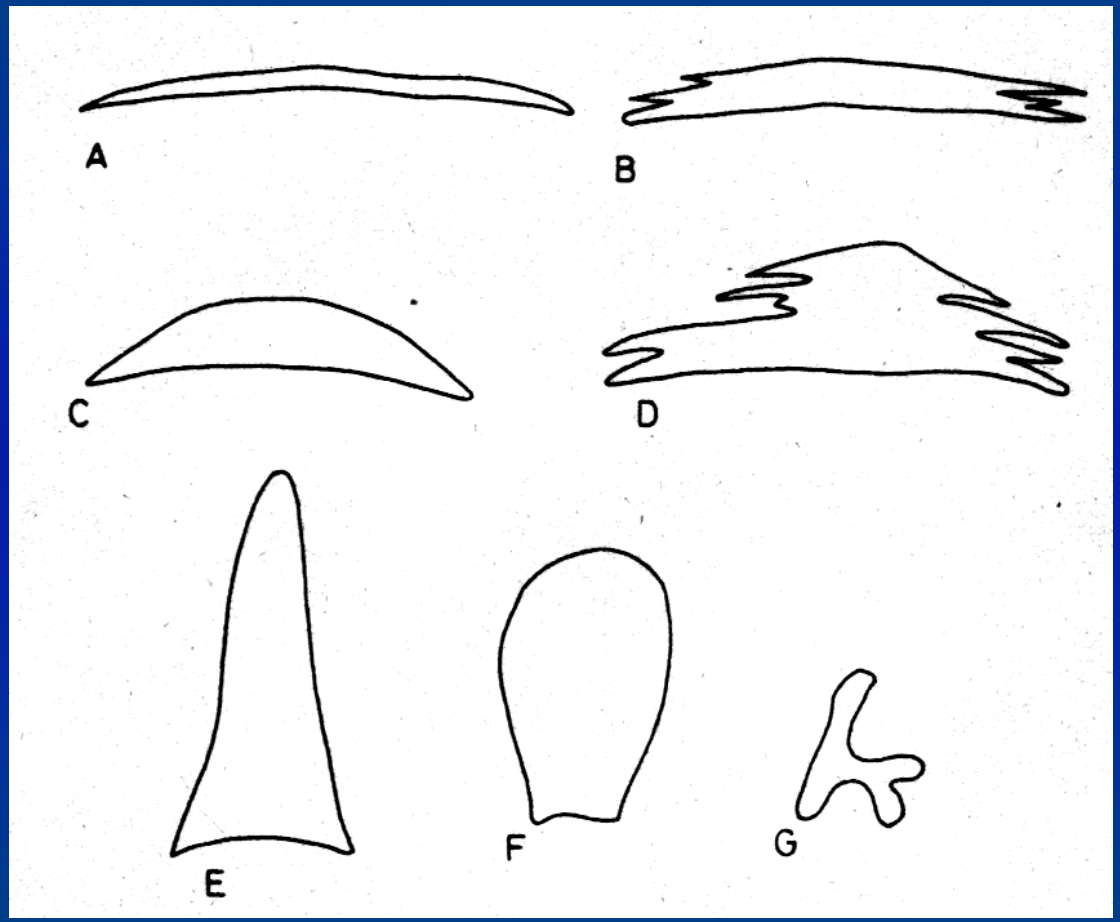


Spiculation in Jurassic taxa



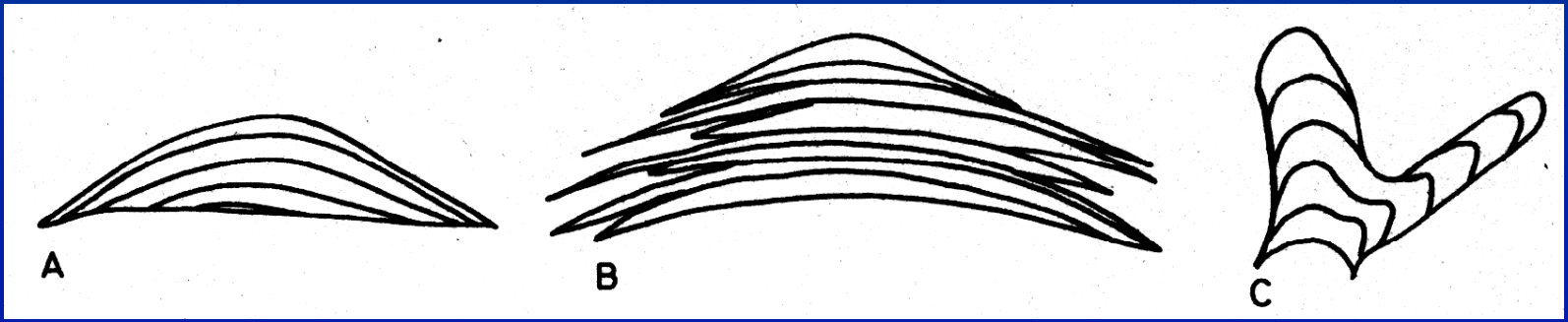
Soft-tissue reconstruction of a member of the Milleporellidae. Spicules are secreted by sclerocytes and transported into position by collenocytes. When arranged in a plumose way, they are bound with spongin to produce an echinating tract. Calcification of the primary calcareous skeleton is initiated in penicilliate tufts at the spicule bases. The tabulae are fibrous; they may be formed by mineralized spongin or secreted by the basal pinacoderm. The excurrent canals inhibit skeletal formation (spicule positioning, spongin secretion and possibly calcitization) below and possibly around them. (Not to scale.)

Strom-Morphologies



Common stromatoporoid morphotypes: A, B, laminar; C, D, low domical; E, extended domical; F, bulbous, G, dendroid. From Kershaw & Riding (1978).

Latilaminae: growth bands



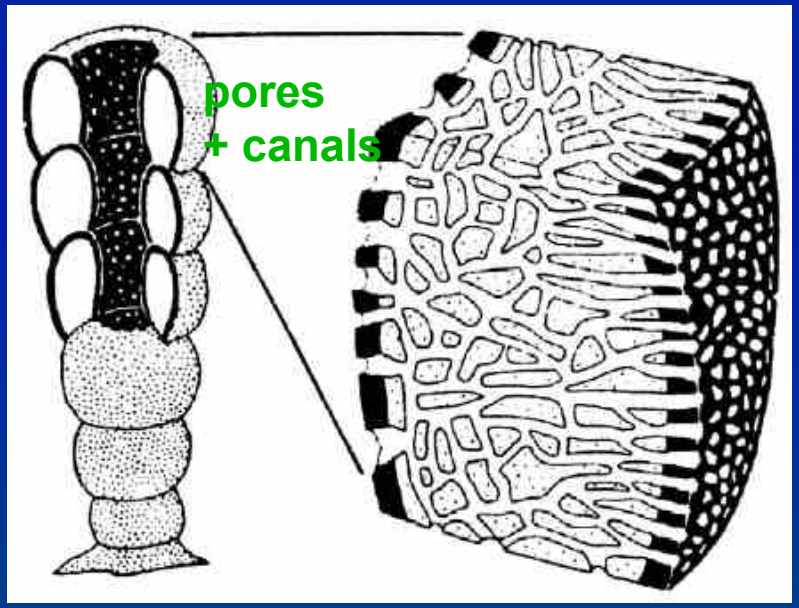
Enveloping (A) and non-enveloping (B, C) latilaminae in domical (A, B) and dendroid stromatoporoids; B is a ragged variety. From Kershaw & Riding (1978).

Class Demospongea: Order Sphinctozoa (= Thalamida)

gr. *sphincto* = string (of pearls)

Outer shape: segmented, bulbous chambers

hard parts: calcite fibres, no sklerites !



from Clarkson (1998)

from Thenius (2000)

Problematic: some sphinctozoans might belong to Cl. Calcarea!

„true calcareous sponges“ = Class Calcispongea

Hard parts

- fibres of $CaCO_3$, no Spongin !

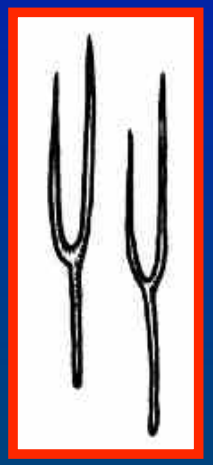
- sklerites of $CaCO_3$, no axial canal

- monaxones

- tetraxones

-frequently
„tuning forc type“

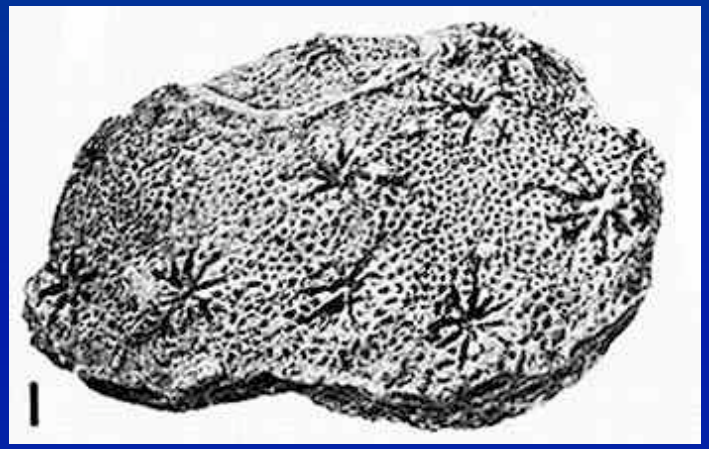
- NO Triaxones



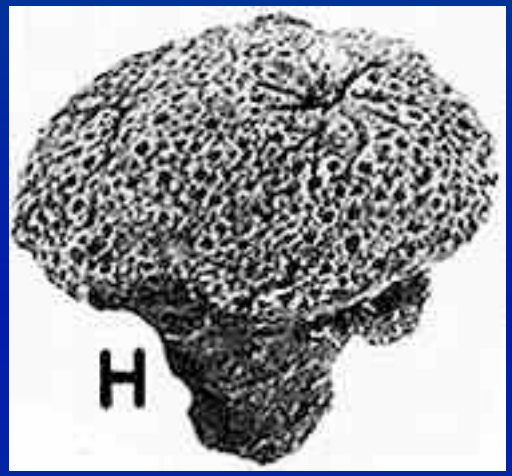
Class Calcispongea

from Boardman et al. 1987, Clarkson 1998

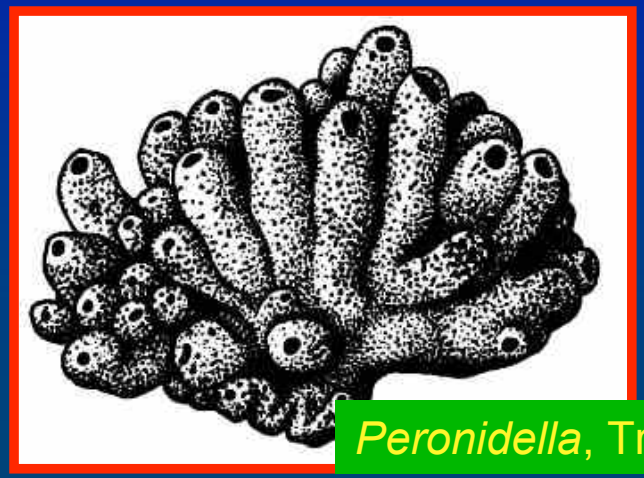
Outer shape: variable



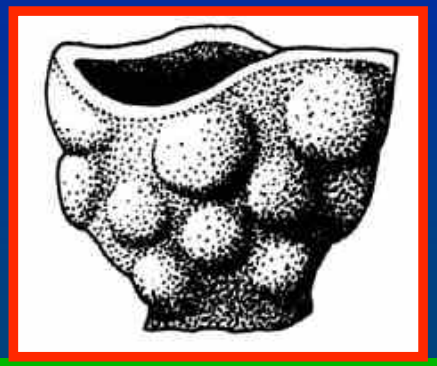
Stellispongia, Permian



Precorynella, Permian

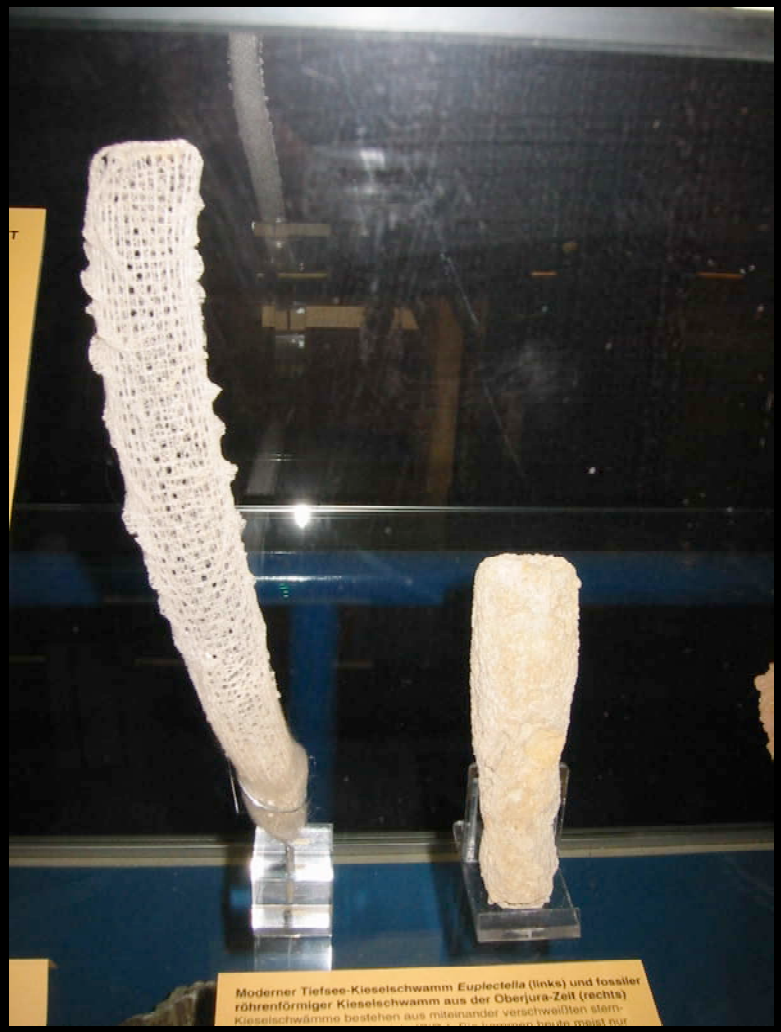


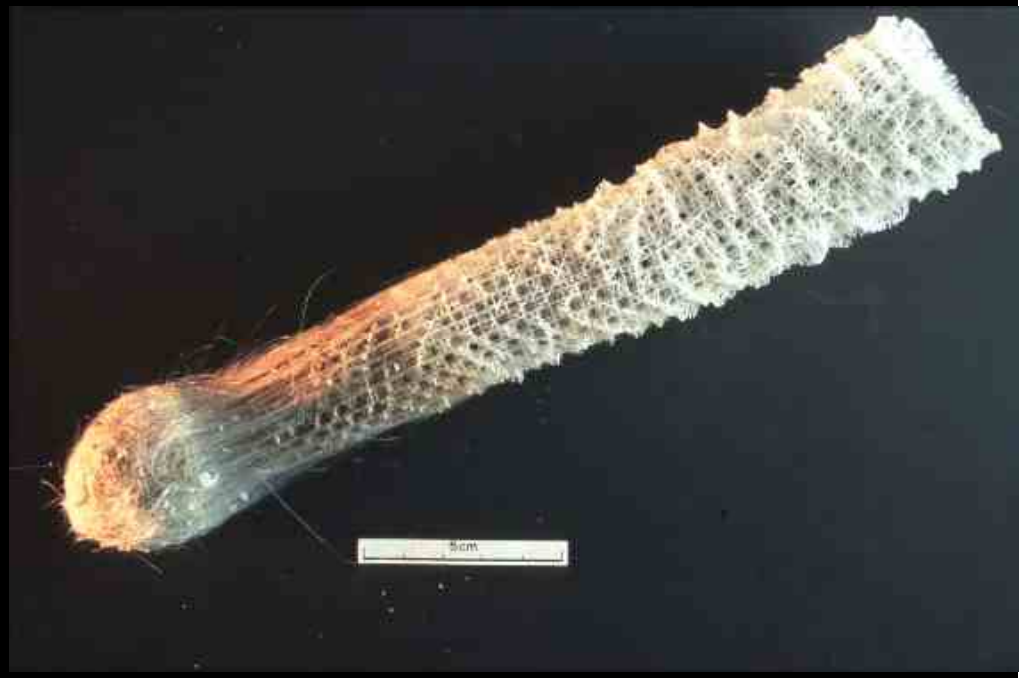
Peronidella, Triassic to Cretaceous



Raphidonema, Low. Cretaceous

Hexactinellide Glasschwämme (heute in Tiefsee)





Riffbinder

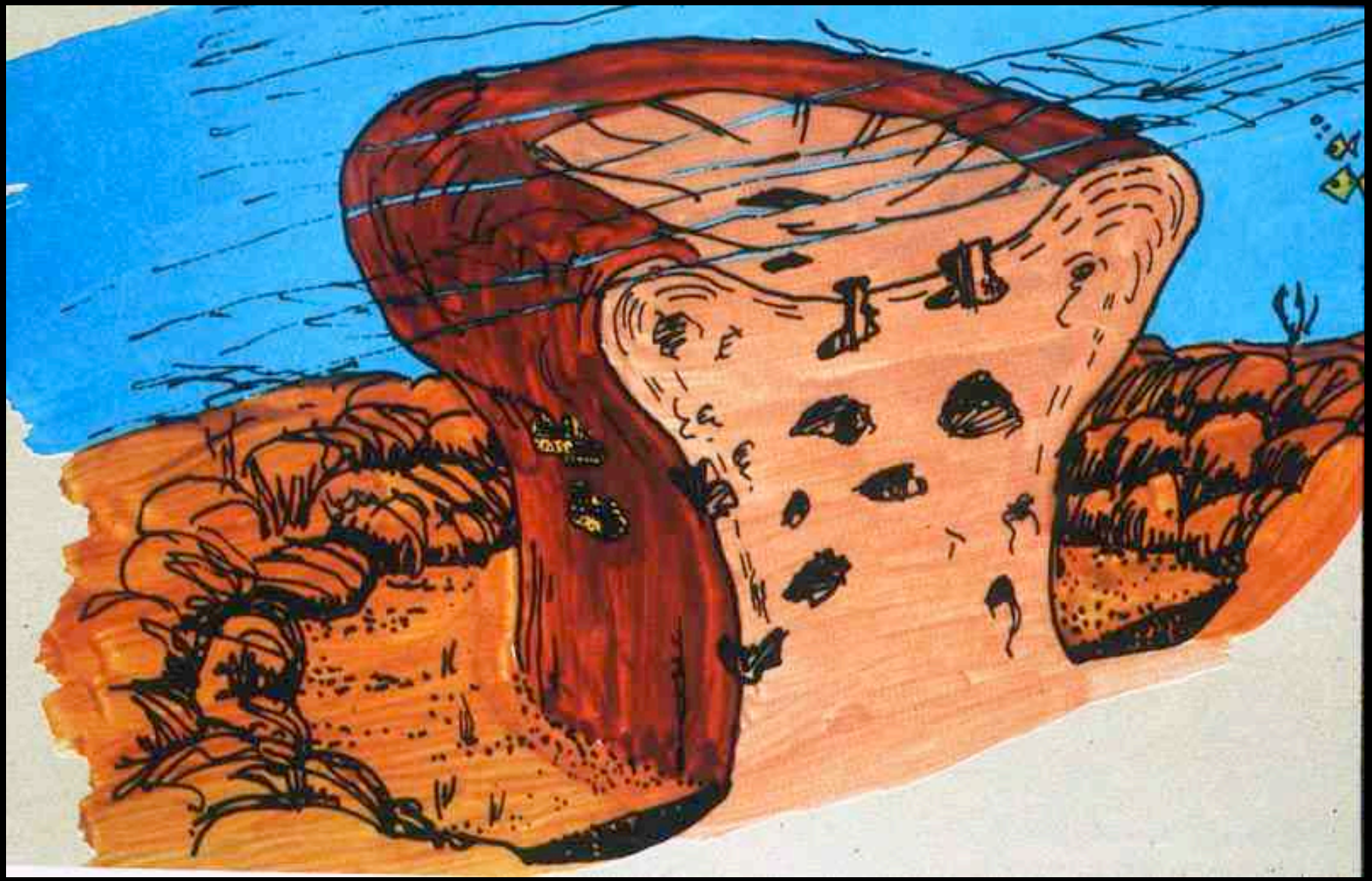
Rotalgen, Mikroben im Riff

Inkrustierende coralline Rotalgen, GBR (Foto RW Müller)

Dia 1235: Rotalgenriffkamm

Inkrustierende coralline Rotalgen, Abrolhos, Brasilien
(Foto Tauchprospekt)

Dia 1152: Algal Cup Reef, Bermudas

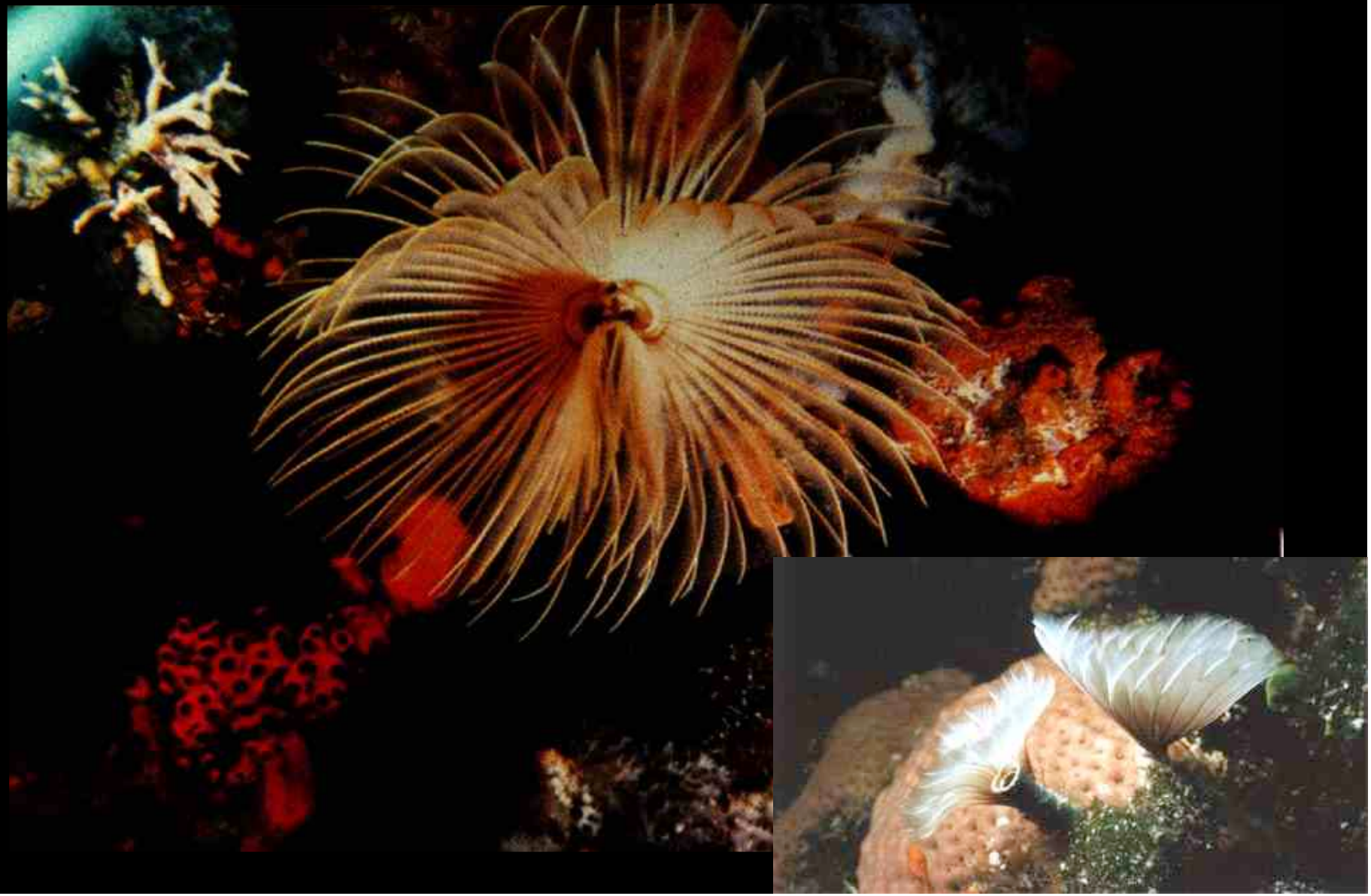


Dia 1102: Riffkamm

Mikrobielle, verkalkende Filme, GBR (Foto RW Müller)

Röhrenwürmer (Foto ?)

Dia 1108: Borstenwurm



Feuerwurm (Foto Grüter)

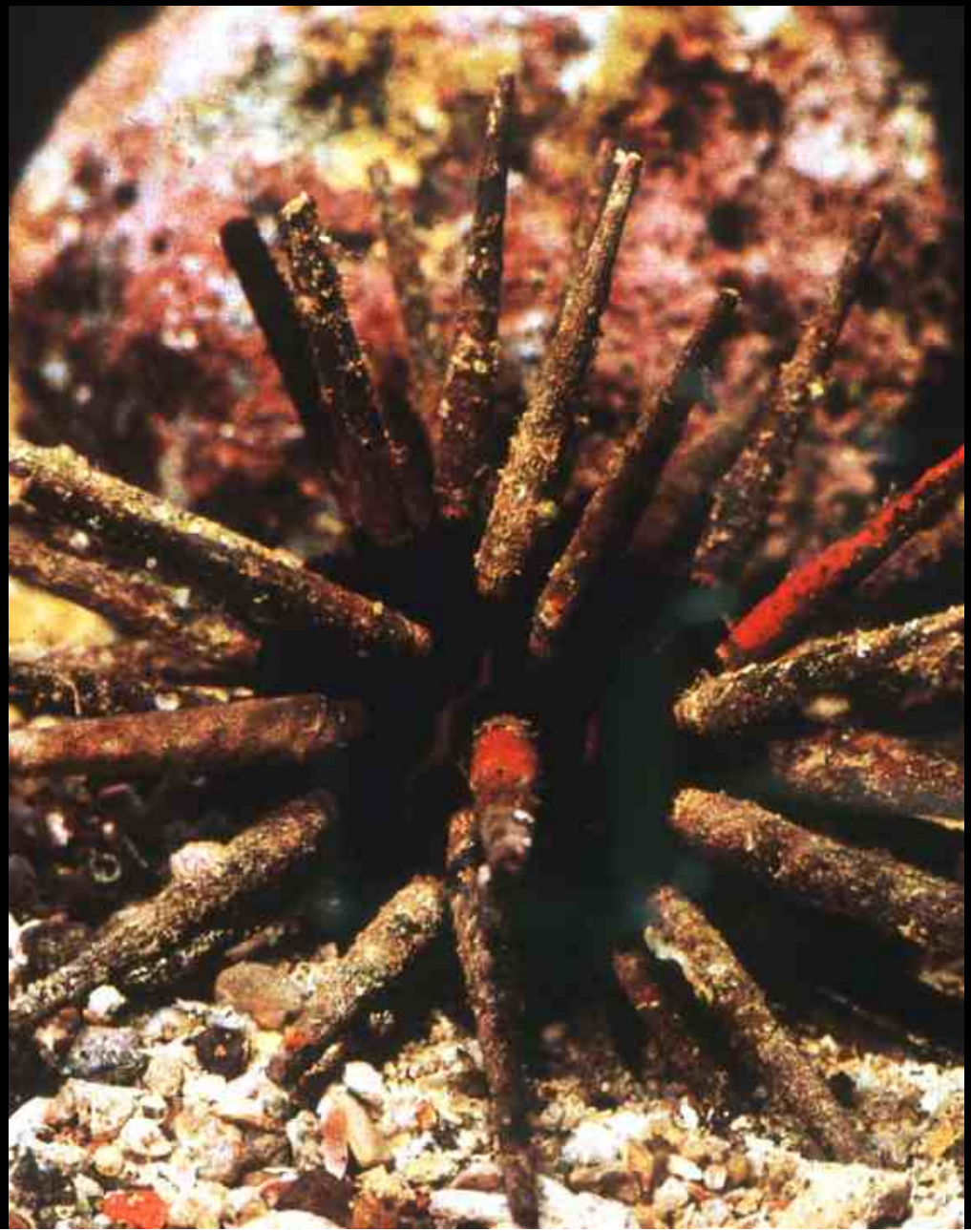
Foraminifere: Homotrema rubrum
(Kolumbien, Foto Leinfelder)

Bryozoen im Riff
(Foto Grüter)

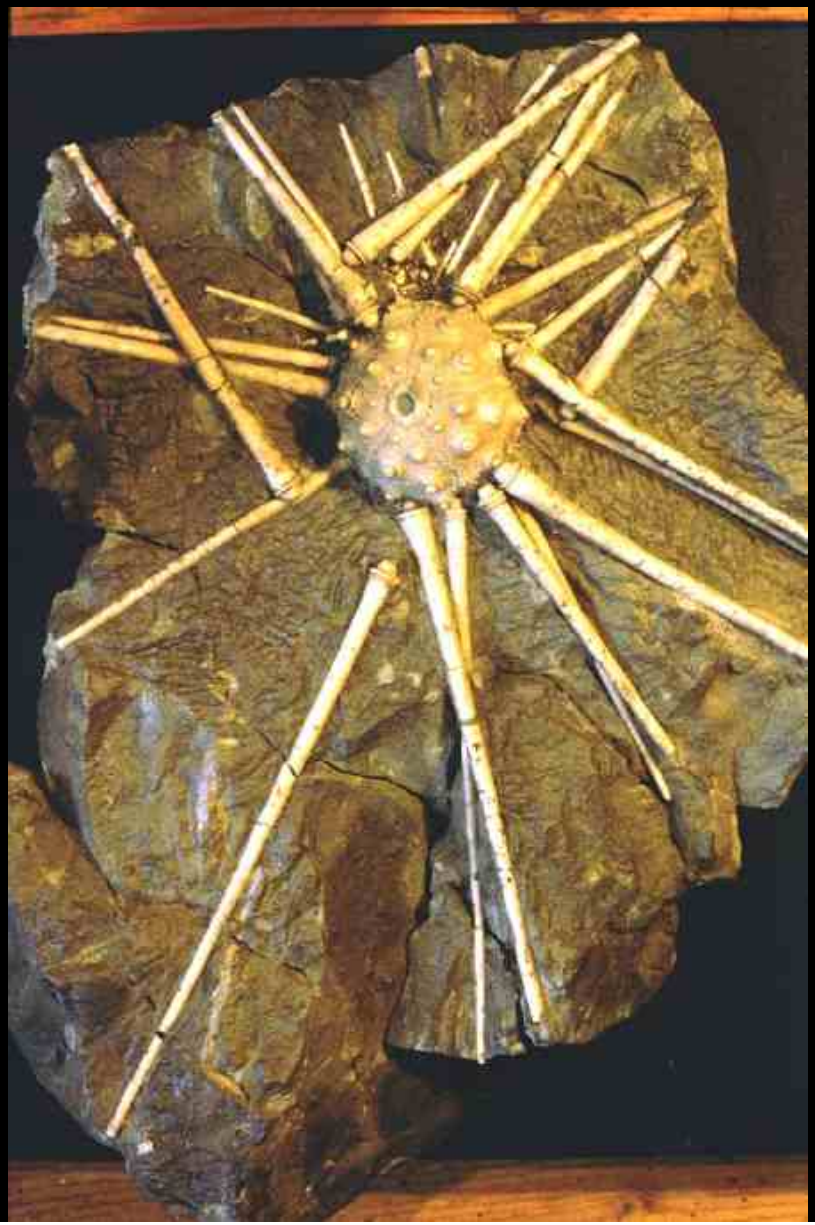
Echinodermen

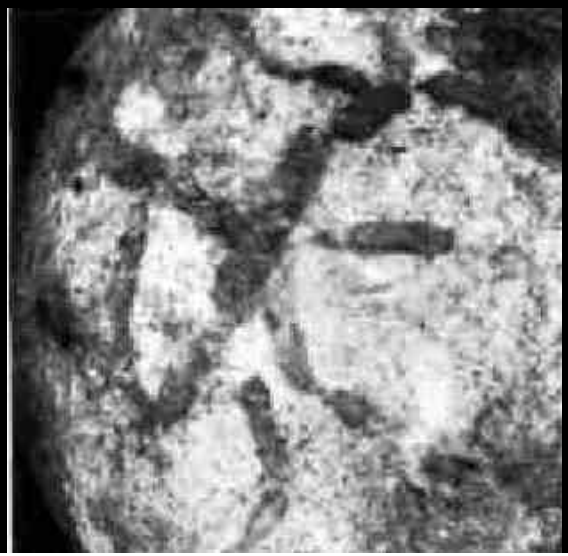
Seeigel Diadema (Foto AG Ginsburg)

Dia 1192: Griffelseeigel mit Bryozoen



Jura-Seeigel und Fraßspuren

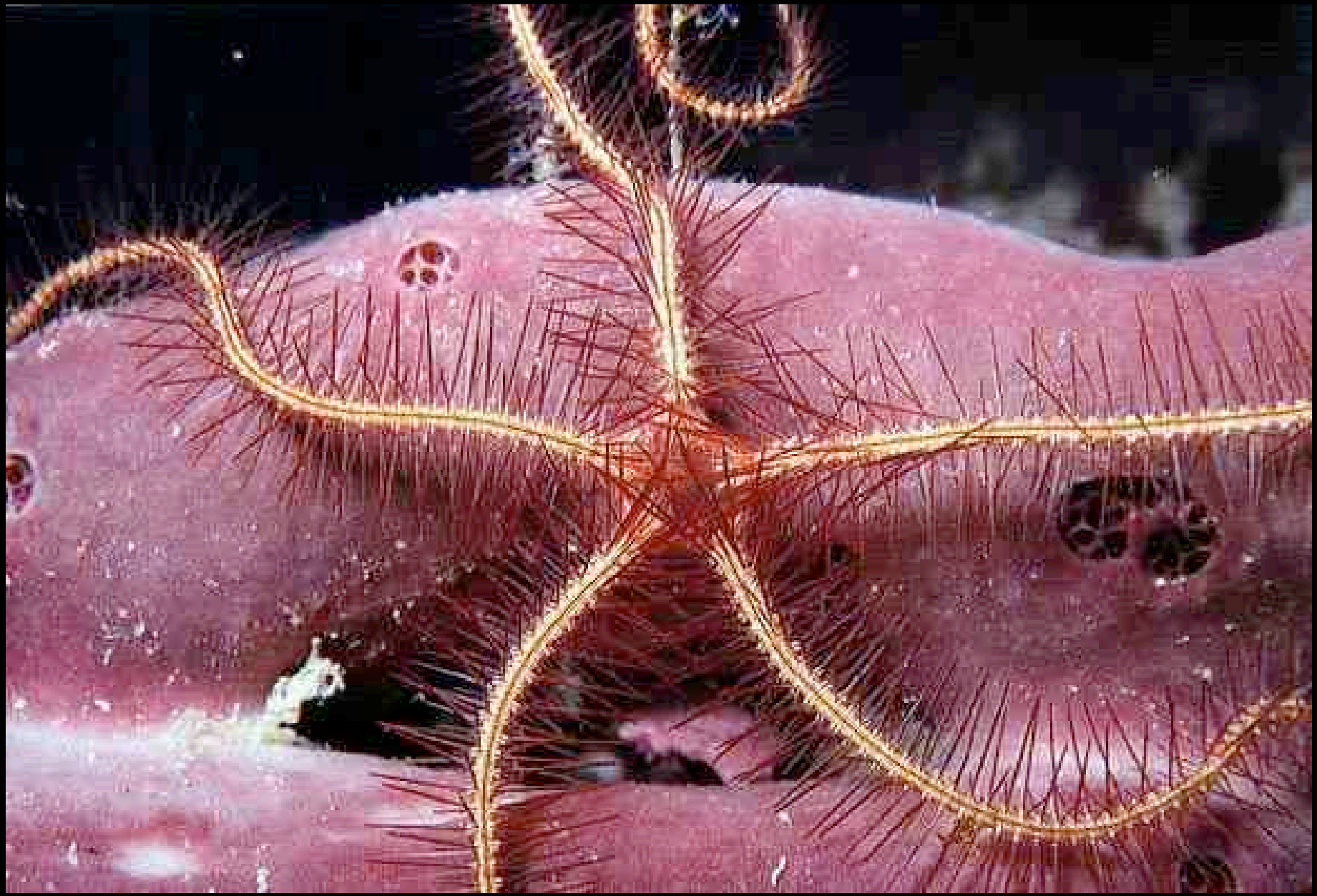




Seestern, Bahamas, (Foto Leinfelder)

Dornenkronenseestern, Acanthaster planci, (Foto ?)

Schlangenstern auf Schwamm, (Foto ?)



Schlangensterne auf Montastrea, Panamá (Foto AG Leinfelder)

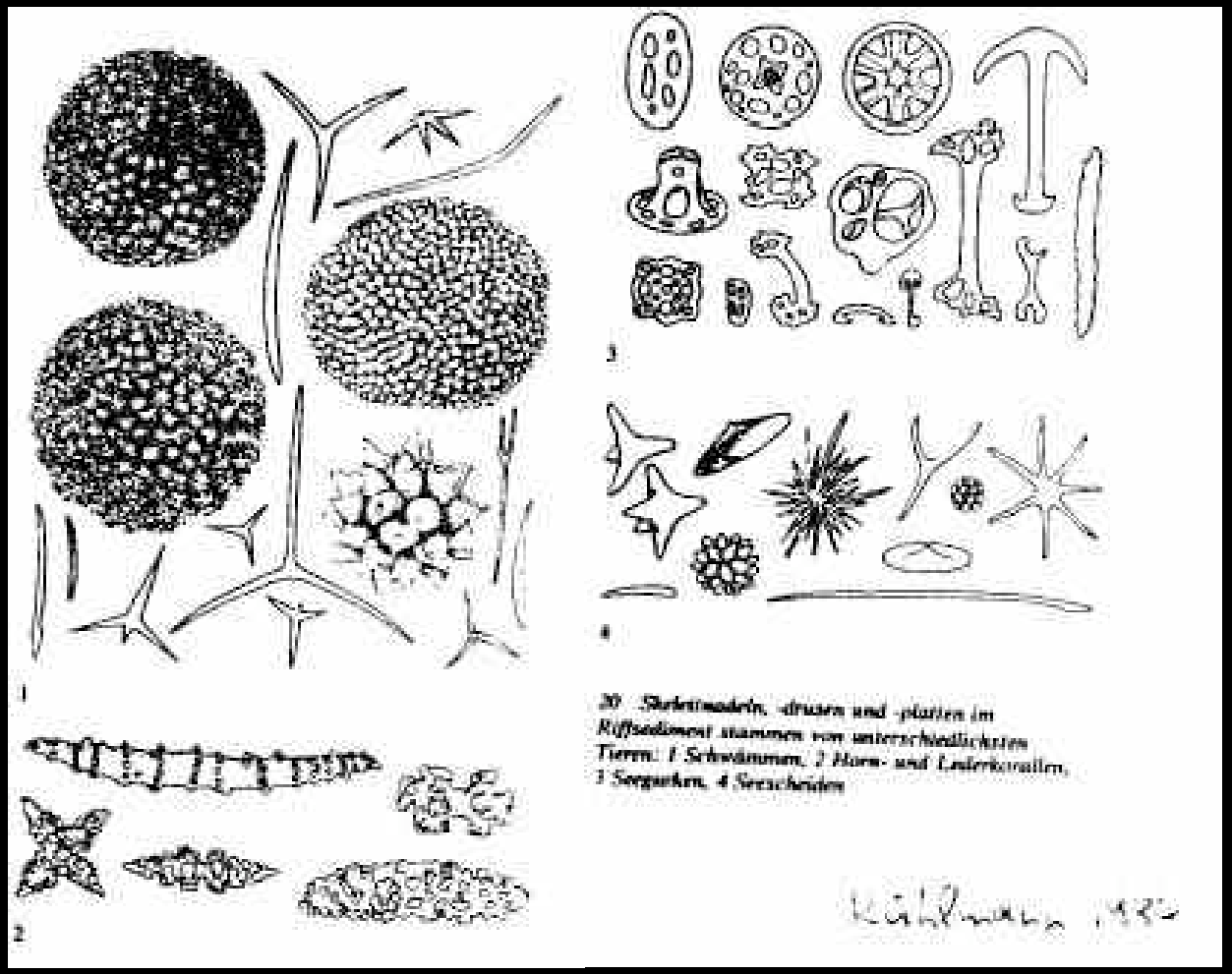
Dia 1237: Haarstern

Haarstern (Foto ?)

Gestielte Crinoiden heute nur in der Tiefsee

Dia 1232: Holothurie: Seemop

Lose Skelettelelemente in Riffsanden



30 Skelettnadeln, -drusen und -platten im Riffsediment stammen von unterschiedlichsten Tieren: 1 Schwämmen, 2 Horn- und Lederkorallen, 3 Seegurken, 4 Seeschnecken

Crustaceen

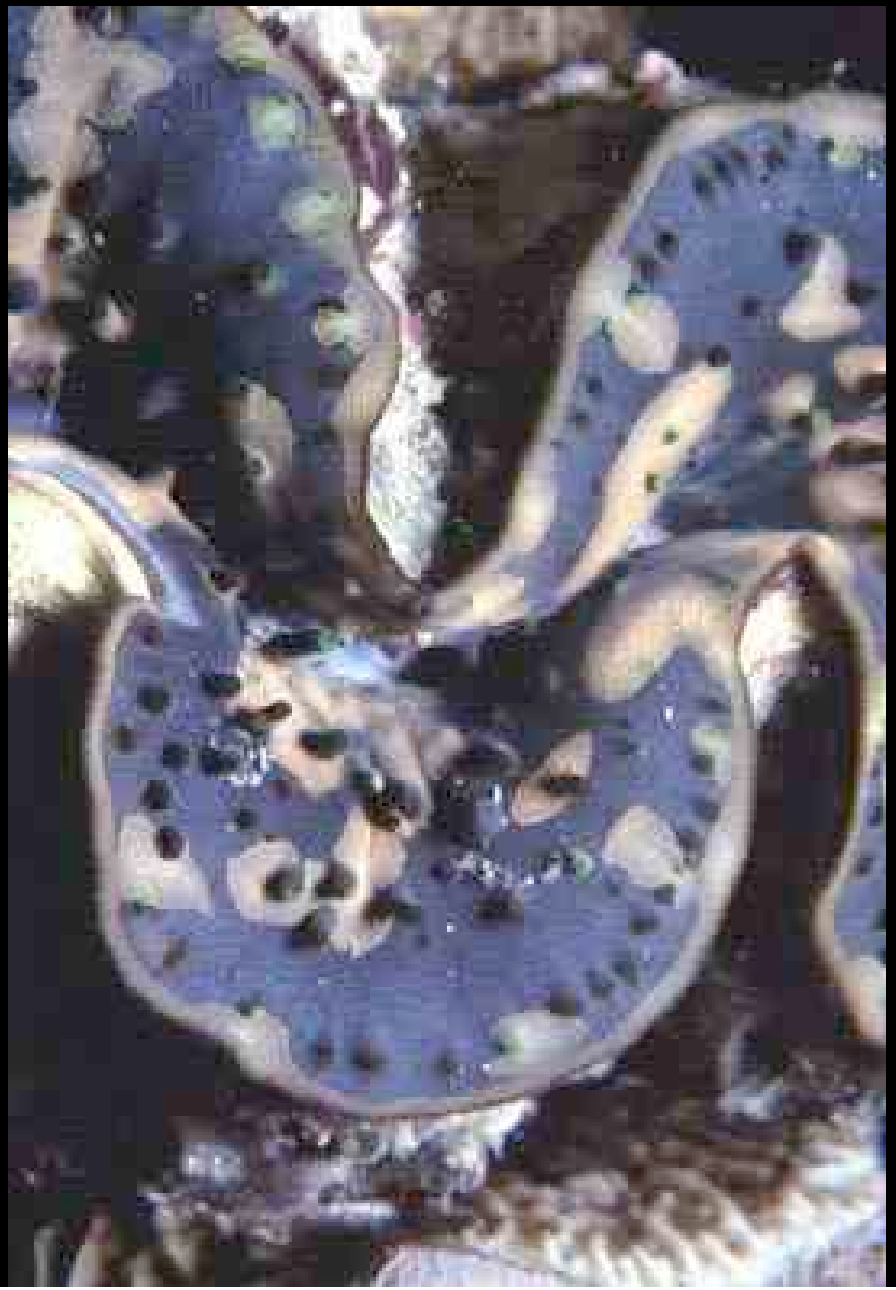
Einsiedlerkrebs (Foto Hanna/Wells / Schellenberger)

Putzergarnelen auf Muräne (Foto ?)

Mollusken und sonstige Invertebraten

Dia 1233: Tridacna - Riesenmuschel

Mantel von Tridacna - Riesenmuschel



Tritonshorn (Foto ?)

Kegelschnecke (Conus)

Nacktschnecke auf Schwamm (Foto ?)

Nacktschnecken

Schneckengelege

Dia 1116: Tunikaten

Ascidien (Foto ?)

Portugiesische Galeere (Foto Leinfelder)

Dia 1196: Bewohner eines Porites-Stockes

Fische und andere Wirbeltiere

Papageifisch (Foto AG Ginsburg)

Papageifisch (Foto Hanna/Wells)

Papageifisch-Fraßspuren (Foto Leinfelder)

Igelfisch (Foto Hanna/Wells)

Damselfische (Foto AG Ginsburg)

Doktorfische, Foto Grüter

Putzerfisch (Foto AG Ginsburg / Schellenberger)

Dia 1230: Clownsfisch in Seeanemone

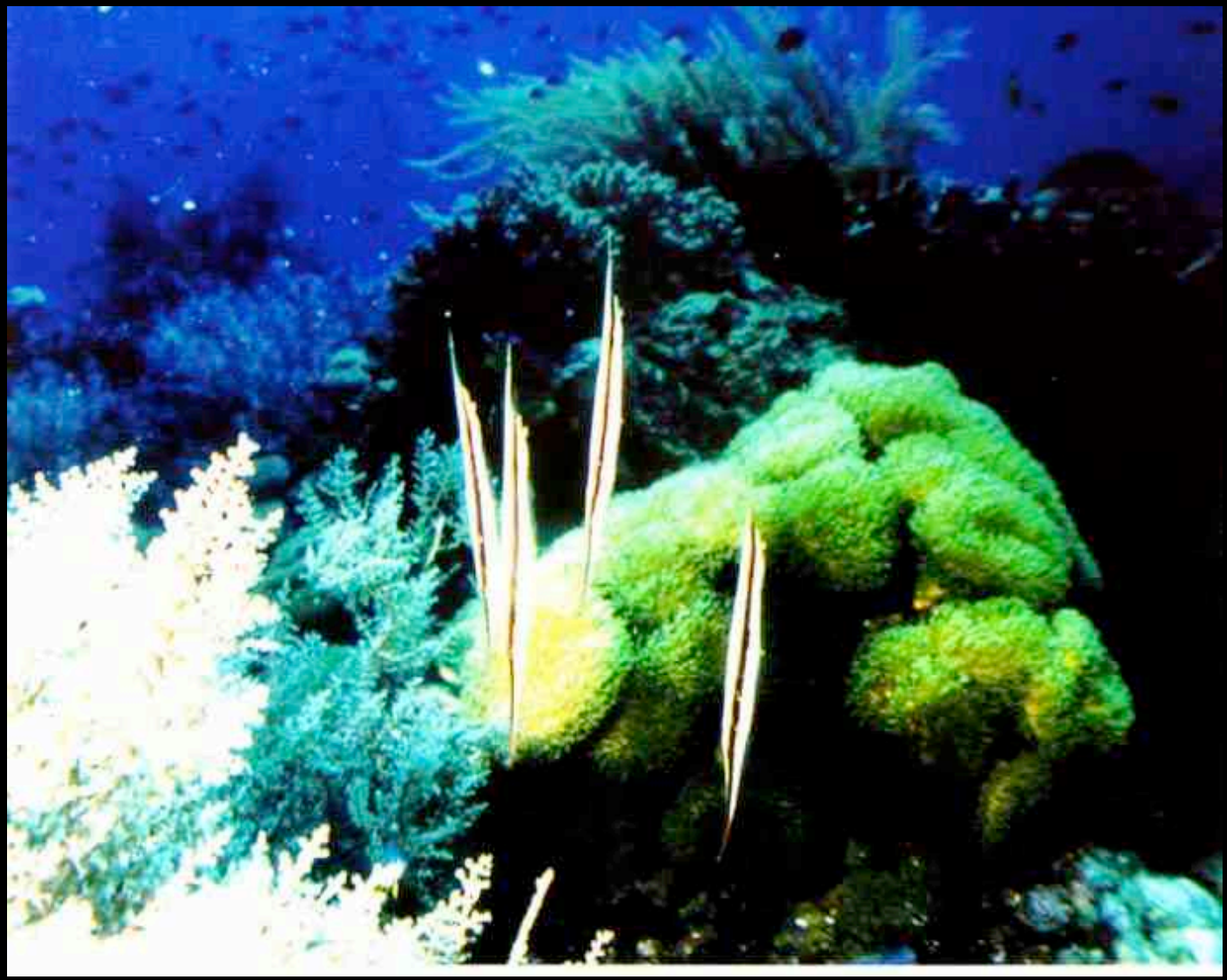
Seeanemone mit Clownsfisch (Foto Brümmer?)

Skorpionsfisch (Foto Grüter)

Steinfische (Fotos Grüter)

Lanzenfisch (Foto Hanna/Wells)

Rasierklingenfische (Foto Grüter)



Rotfeuerfisch (Foto Leinfelder)

Napoleonsfisch (Foto Hanna/Wells)

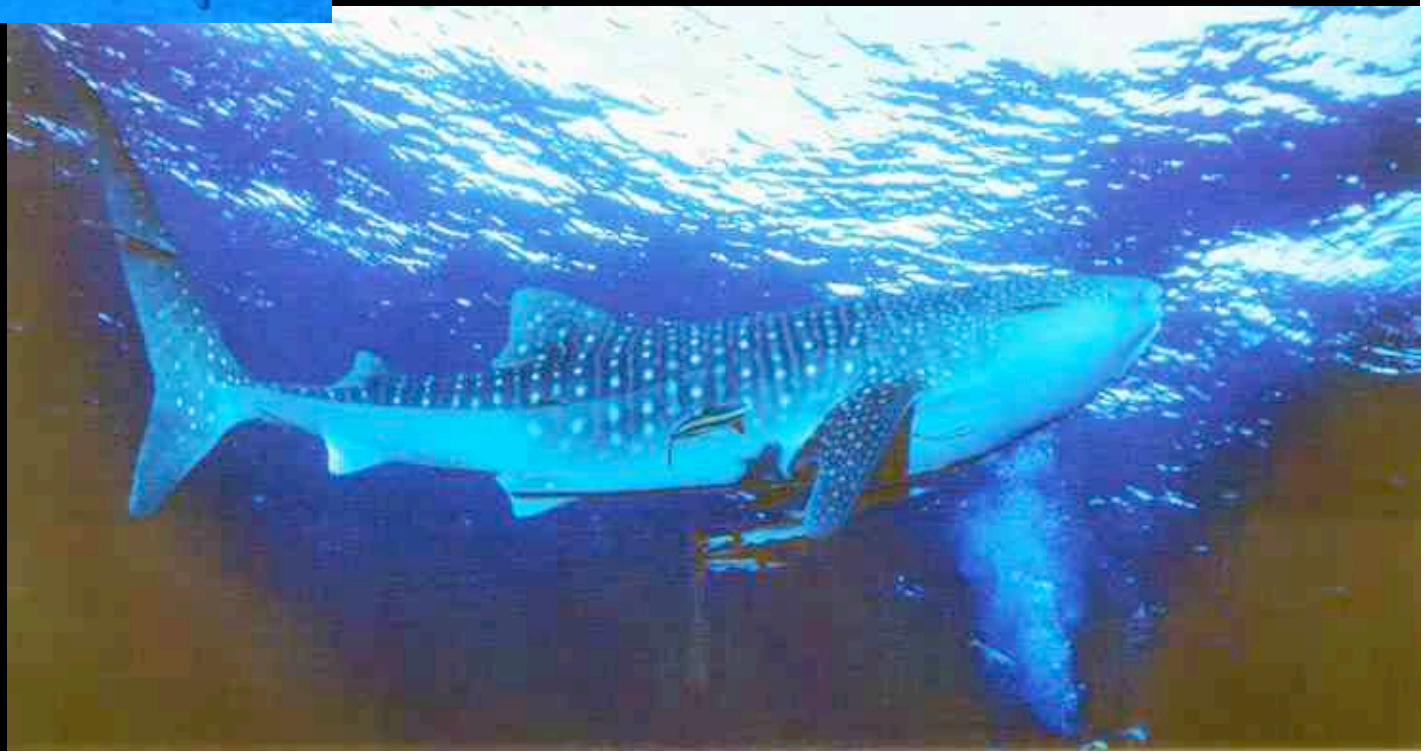
Napoleonsfisch

Moräne

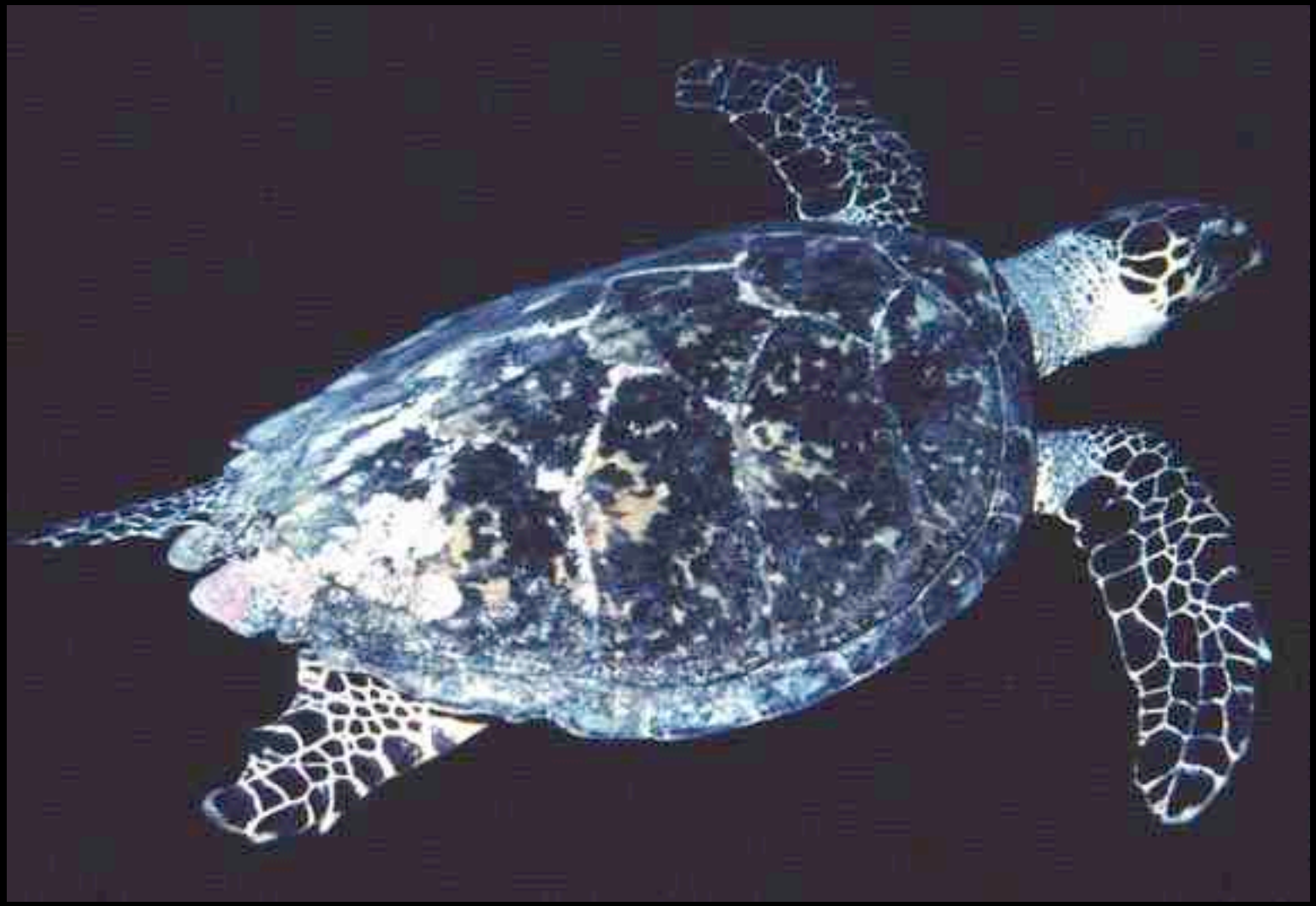
Manta (links)

Walhai (unten)

(Fotos Grüter)



Meeresschildkröte (Foto Hanna/Wells)



Delphin (Foto Hanna/Wells)

Seekuh (Foto Hanna/Wells) (v.a. in Lagunen)