



DEEP SEA NEWSLETTER

No. 13, September 1987

Fifth Deep-Sea Biology Symposium:

BIOLOGY AND ECOLOGY OF THE DEEP SEA

(Bathyal to hadal environments, including hydrothermal and cold-seep communities)

SECOND ANNOUNCEMENT

Time: 26 June (Sunday evening) until 1 July, 1988.

Place: IFREMER, Centre de Brest, Brest Finistère, France. - For all mail: Dr. Myriam Sibuet, Département Environnement Profond, Centre de Brest de l'IFREMER, B.P. 337, F-29273 Brest Cédex, France.

NB! This place is the former COB of the late CNEXO. It is situated in the westernmost part of French Brittany.

Symposium fees: We hope, at this time, that no symposium fee will be due.

Organizing board: M. Sibuet, L. Laubier, A. Guille, D. Desbruyères, C. Emig, A. Dinet, A. Khripounoff, D. Prieur, A. Fiala-Medioni.

Language: English.

Participants in the symposium: Following the first announcement in Deep-Sea Newsletter No. 12, so far 73 scientists from eight different countries indicated their interest. And we do expect more participants to the symposium.

Canada

Kenneth J. Sulak
Verena Tunnicliffe

Denmark

Jørgen B. Kirkegaard
Jørgen Knudsen
Ole S. Tendal
Torben Wolff

France

A.M. Alayse
D. Bellan-Santini
P. Bouchet
G. Cahet
Daniel Desbruyères
A. Dinet
Christian Emig

France (cont.)

J.P. Feral
Françoise Gaill
P. Geistdoerfer
N. Gourbalt
Laurence Guidi
C. Lambert
M. Le Pennec
C. Monniot
F. Monniot
D. Prieur
J. Renaud Mornant
Michel Roux
Michel Segonzac
Myriam Sibuet
Annick Vangriesheim
M. Van Praet

F. R. G.

A.V. Altenbach
G. Graf
Gerd Liebezheit
K. Linke
Karin Lochte
Olaf Pfannkuche
Hjalmar Thiel
Michael Türkay

Ireland

John W. Patching

Japan

Masuoki Horikoshi

U. K.

John A. Allen
D.S.M. Billett

U. K. (cont.)

G.A. Boxhall
Gareth Davies
P.J.D. Lamshead
Richard Lampitt
Gordon L.J. Paterson
I.G. Priede
Anthony L. Rice
H.S.J. Roe
Michael H. Thurston
P.A. Tyler

U. S. A.

Josephine Aller
Joshua S. Baker
Andrew G. Carey Jr.
J.J. Childress
Rita R. Colwell (cont.)

| | | | |
|------------------|--------------------|------------------|--------------------|
| U. S. A. (cont.) | Fred Grassle | Ian Rosman | E. Willis |
| Jody W. Deming | Robert R. Hessler | Gilbert T. Rowe | George D.F. Wilson |
| Horst Felbeck | Peter Jumars | Graig R. Smith | R.R. Wilson |
| Amatzia Genin | Lisa A. Levin | Kenneth L. Smith | |
| Robert Y. George | Linda H. Pequegnat | David Thistle | |

Topics: Papers (20 + 10 min.), short communications (10 + 5 min.) and posters may concern all questions on deep-sea biology, ecology, evolution, and environmental problems. All contributions will be evaluated by a screening procedure based on the abstracts delivered. Several unformal workshops will be held after presentations given as "invited papers".

Abstracts: We hope to receive all abstracts by 1 March, 1988. We wish hard data papers and will reject abstracts based only on philosophy.

Publications: We offer the opportunity to interested participants to publish their contribution in a special issue of Oceanologica Acta. Those of you interested must indicate this in the final application form and must deliver their manuscript during the symposium.

Application: During the autumn we shall send the final application form (with accommodation possibilities, tentative schedule, etc.) to all of you from whom we already have received or will receive the preliminary form (below).

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IFREMER - CENTRE DE BREST
 c/o Dr. Myriam Sibuet
 BP 337, F-29273 BREST CEDEX
 F r a n c e

| |
|---------------------------|
| Return to address at left |
|---------------------------|

Symposium on Deep-Sea Biology

Preliminary form

1. The Symposium will be held at Brest, 26 June - 1 July, 1988.
2. I am planning to attend the Symposium yes no with persons
3. I wish to present a paper on _____
 _____ subject not decided
4. I wish to present a short communication on _____
 _____ subject not decided
5. I wish to present a poster on _____
 _____ subject not decided
6. Name and title:
 Institution:
 Address:
7. Suggestions:

DIRECTORY OF DEEP-SEA BIOLOGISTS

One tangible outcome of the deliberations of SCOR Working Group 76 (see Deep-Sea Newsletter nos. 8 & 11) is the intention to produce a simple directory of biologists (both benthic and mid-water) interested in, and involved with, deep sea problems. Such a directory might be of value to scientists, governmental and intergovernmental agencies, industry and so on. If you would like to be included in this directory, please complete the questionnaire and return it to Tony Rice, Institute of Oceanographic Sciences Deacon Laboratory, Wormley, Godalming, Surrey GU8 5UB, U.K.

PLEASE ALSO BRING THE QUESTIONNAIRE TO THE NOTICE OF ANY COLLEAGUES WHO MIGHT OTHERWISE NOT SEE IT.

FORENAME(S) OR GIVEN NAME(S)

FAMILY NAME

TITLE (Dr, Mr, Mrs, Miss, etc)

WORK ADDRESS (including any post code)

.....

.....

.....

TELEPHONE NO.

AREAS OF INTEREST/EXPERTISE (including taxonomic group(s))

.....

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.....

.....



**THE INSTITUTE OF OCEANOGRAPHIC SCIENCES
DEACON LABORATORY**

is holding a series of Open Days on
Wednesday 14 October (Press Day)
Thursday 15 October
and Saturday 17 October 1987
at
Wormley, Godalming, Surrey

The Institute of Oceanographic Sciences is one of the foremost of the world's laboratories specialising in the study of the deep oceans. The Open Days will provide opportunities to see at first hand the work of the laboratory and to meet its scientists and engineers.

The Institute's work is based on the fundamental studies of the physics, chemistry, biology and geology of the oceans and has resulted in the development of worldleading technologies. The basic science has produced expertise which has been vital in providing insights into the solutions of very practical problems including those concerned with the design and deployment of offshore hydrocarbon and mineral deposits, and with the environmental impact of the deep ocean disposal of waste materials of various types.

Scientific knowledge has been made available to government departments and to industry, and in recent years this collaborative approach has been expanded to include the basis of a number of commercial enterprises.

The Open Day exhibits will show examples of a wide range of scientific discoveries, technological developments and of the instruments used to study the oceans. In addition, the Institute's increasing collaboration with the private sector will be illustrated by a group of companies affiliated to IOS through membership of the Institute's 'MetOcean Club'.

We invite you to come and see the Institute, to meet its scientists and engineers and to see how its work is being applied by IOS and by industry to resolve some very practical problems of the deep ocean and the more general environment.

Equipment featured will include:

- GLORIA - A long-range side-scan sonar survey system
- TOBI - Deep towed sonar vehicle for resource studies
- PUPPI - Pop-up Pore-Pressure Instrument
- DOBS - Digital Ocean Bottom Seismograph
- FIDO - Deep ocean particle sampler and counter
- Bathysnap - A sea-floor time lapse camera system
- A range of acoustic telemetry and command systems
- Biological samplers for both midwater and bottom-living organisms

**A contribution by the Natural Environment Research Council to the
EUROPEAN YEAR of the ENVIRONMENT**



Further Information from:
The Open Day Office
Institute of Oceanographic Sciences
Deacon Laboratory
Brook Road, Wormley, Godalming
Surrey GU8 5UB
Telephone: Wormley (042 879) 4141

The Hanging Gardens hydrothermal vent site

Hanging Gardens is located on the East Pacific Rise west of Clam Acres at 21°N. The site was first discovered in 1981 (Francheteau & Ballard 1983) and was visited again in 1985. A single black smoker sits at the base of a steep escarpment, with diffusive warm-water vents extending from the base of the smoker up the escarpment (photos in Rona et al. 1983: 3,4). The site was revisited in September 1985.

The vent community at Hanging Gardens is spectacular, dominated by two species of tube worms: the familiar Riftia pachyptila and the less common Oasisia alvinae. O. alvinae, a smaller form than Riftia, grows on Riftia tubes in entangled masses resembling Medusa's head of serpents (Fig. 1). The relative positions of the two species with respect to each other is very distinctive, with Oasisia growing at the base of Riftia. The result is something like a forest in miniature, with Riftia for trees and Oasisia for understory. We suggest that this is classic resource partitioning, with the two species of tubeworms using the same feeding strategy - translocation of organic carbon produced by endosymbiotic chemoautotrophs - but requiring different concentrations of primary nutrients. In addition to tubeworms, other conspicuous megafauna include the crab Bythograea thermydron, the squat lobster Munidopsis subsquamosa, and the clam Calyptogena magnifica.

Another feature that distinguishes Hanging Gardens is the encroachment of typical deep-sea hard bottom fauna (Freyella sp. and other sponges, actinarians, antipatharians) onto the peripheral serpulid and anemone beds of the vent site. We speculate the Hanging Gardens, located as it is in a narrow graben, has a hydrodynamic regime that channels ambient seawater over the peripheral region, allowing sulfide-sensitive species to exist in unusual abundance near the venting water. This contrasts with the situation at more "classical" vent areas such as Clam Acres or Rose Gardens, where the vent fields lie mostly on open plains of pillow or sheet lava. We suggest that flushing of peripheral serpulid beds in these areas is not as great as at Hanging Gardens.

On Alvin dive 1645, a single piece of massive sulfide deposit from the base of the black smoker was recovered from Hanging Gardens. Animals associated with the "rock" were picked off, identified and counted (Table 1). This collection of animals is one of very few from hydrothermal vents where the precise co-occurrence of hard-substrate macrofaunal species is known.

Fifteen species lived on this single piece of sulfide deposit; the maximum dimension of the "rock" was about 60 cm. The diversity of forms is impressive (Fig. 2) and includes symbiotic chemoautotrophs, carnivores, scavengers, filter-feeders and grazers. Juxtaposition of juvenile vestimentifera with species more usually thought of as "peripheral species" (especially the stalked barnacle Neolepas zevinae) is notable. It is possible that juvenile tubeworms do not require as rich a sulfide environment as adults and so inhabit a broader range of habitats, extending into the "peripheral" areas.



Fig. 1. Representatives of the vent community at Hanging Gardens

References

Francheteau, J. & R.D. Ballard, 1983: The East Pacific Rise near 21°N, 13°N and 20°S: Inferences for along strike variability of axial processes of the Mid-Ocean Ridge. - Earth and Planetary Science Letters 64: 93-116.
 Rona, P., K. Bostrom, L. Laubier & K.L. Smith, Jr. (editors), 1983: Hydrothermal Processes at Seafloor Spreading Centers. - NATO Conference Series, Series IV: Marine Science. Plenum Press, NY, xiv+796 pp.

Table 1. Hard substrate fauna from Hanging Gardens

| TAXON | NUMBER OF SPECIMENS | SPECIES | FIGURE |
|----------------|---------------------|-----------------------------------|--------|
| Vestimentifera | 8 | <i>Oasisia alvinae</i> , juvenile | a |
| | 2 | <i>Riftia pachyptila</i> , juv. | b |
| Polychaeta | 8 | <i>Amphisamytha galapagensis</i> | c |
| | 5 | <i>Nereis sandersi</i> | d |
| | 3 | <i>Nicomache arwidssoni</i> | e |
| | 1 | serpulid | f |
| Gastropoda | 4 | globose operculate | g |
| | 3 | <i>Neomphalus fretterae</i> | h |
| | 1 | dimorphic highsmooth | i |
| | 1 | transparent | j |
| | 1 | <i>Melanodrymia auriantica</i> | k |
| Crustacea | 63 | <i>Neolepas zevinae</i> | l |
| | 1 | verrucomorph cirriped | m |
| | 2 | lysianassid amphipods | - |

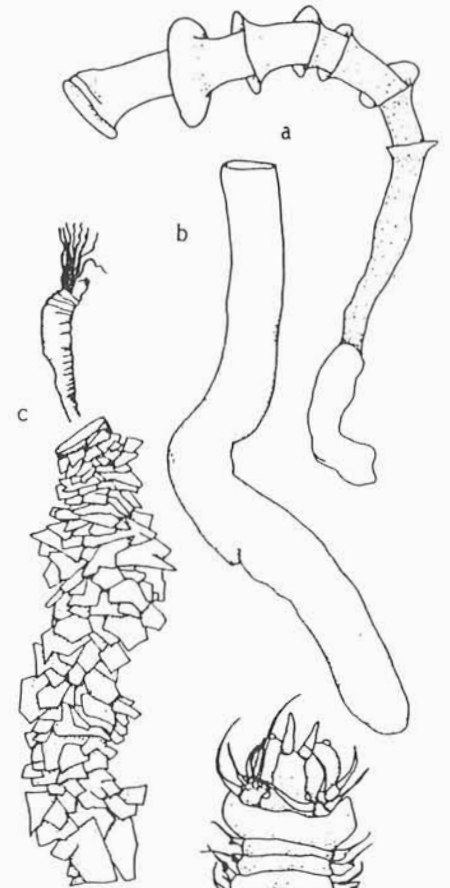
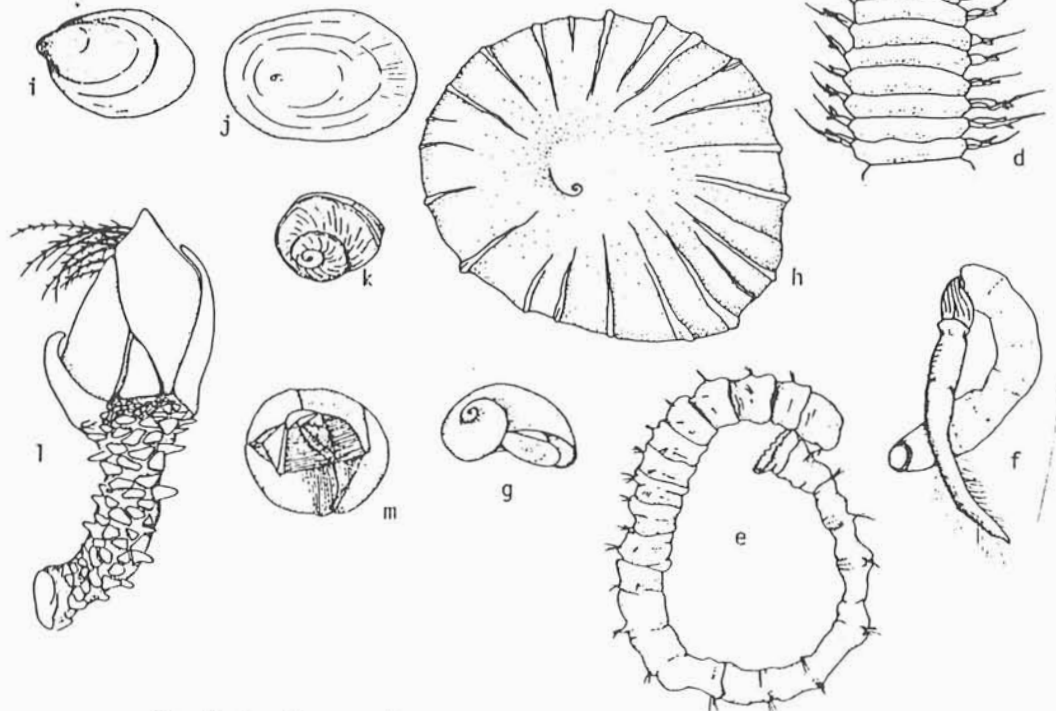


Fig. 2. All specimens drawn to same scale (approx. x3)



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Hydrothermal processes at the Mid-Atlantic Ridge: Recent developments

The present year 1987 is a time of consolidation and planning after the first submersible investigation of black smoker-type vents, massive sulfide deposits and vent biota at the Mid-Atlantic Ridge made with Alvin in 1986, as reported in Deep-Sea Newsletter 12. Below is included a partial bibliography of the numerous reports resulting from the three dives made at the TAG site at 26°N and the one dive made at the Snake Pit site at 23°N which were presented at the December 1986 Annual Meeting of the American Geophysical Union and are in various stages of publication.

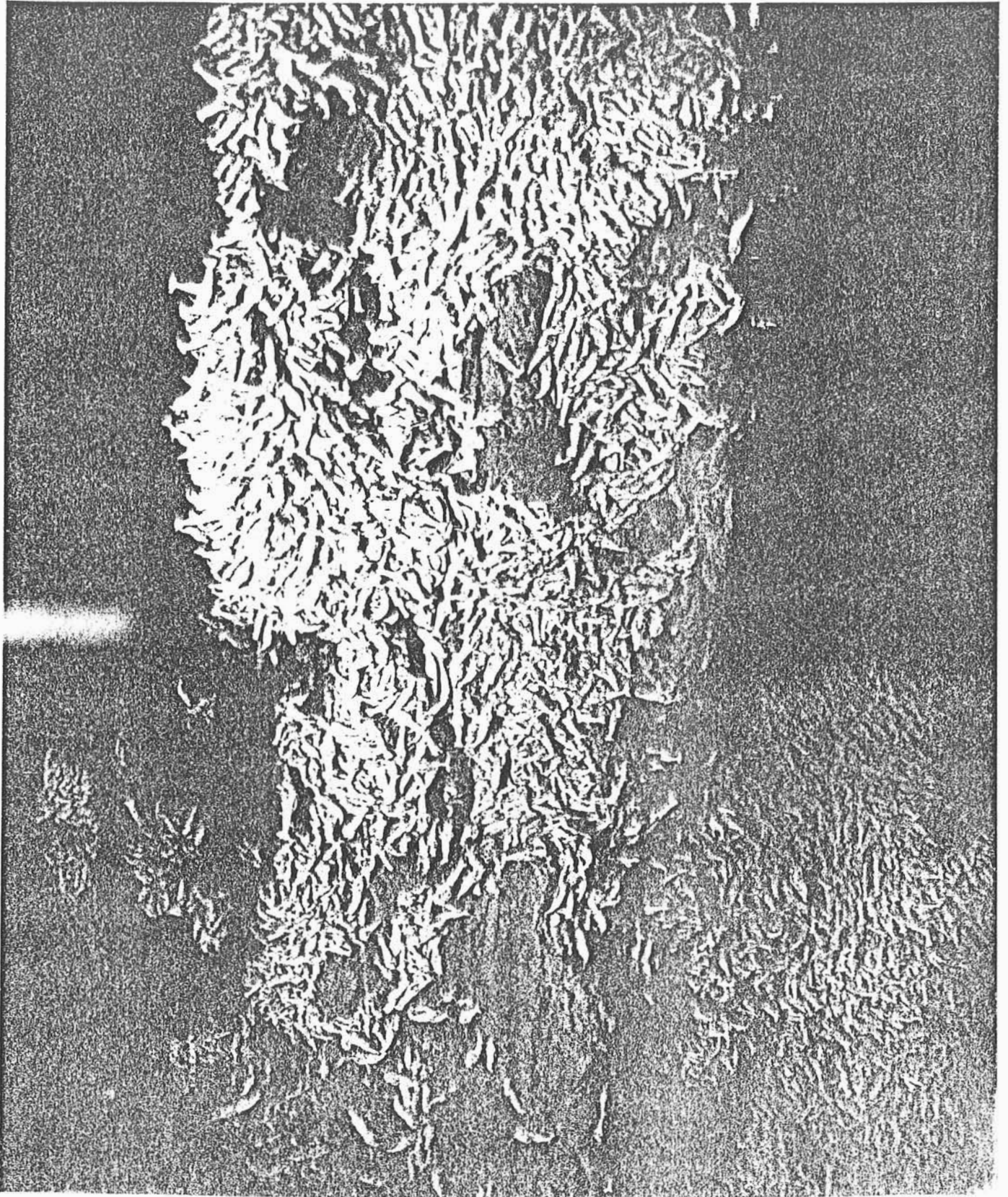
Work on hydrothermal processes at the Mid-Atlantic Ridge planned for 1988 include submersible dives in March at the Snake Pit site by a French group with the submersible Nautile (Dr. Catherine Mevel, Pétrologie Metamorphique, Université Pierre & Marie Curie, 4 Place Jussieu, F-75252 Paris Cedex 5, France); a surface ship cruise in September to the TAG site by a British group with the Research Vessel Discovery (Dr. Henry Elderfield, Dept. of Earth Sciences, University of Cambridge, Cambridge CB3 0EZ, England); and a surface ship cruise to the TAG site and other potential sites by American and French groups with the NOAA Ship Oceanographer (Dr. Peter Rona, NOAA, 4301 Rickenbacker Causeway, Miami, Florida 33149, USA).

Peter A. Rona

National Oceanic and Atmospheric Administration (NOAA)

Partial Bibliography of Recent Reports on Hydrothermal Processes at the Mid-Atl. Ridge

- Charlou, J.L., P.A. Rona & H. Bougault: Methane anomalies over TAG Hydrothermal Field on Mid-Atlantic Ridge. - *J. Mar. Res.*, submitted.
- Edmond, J.M., A.C. Campbell, M.R. Palmer & G.P. Klinkhammer, 1986: Preliminary report on the chemistry of hydrothermal fluids from the Mid-Atlantic Ridge. - *EOS, Trans. Am. Geophys. Union* 67: 1021.
- Karson, J.A., G. Thompson, S.E. Humphris, J.M. Edmond, W.B. Bryan, J.R. Brown, A.T. Winters, R.A. Pockalny, J.F. Casey, A.C. Campbell, G. Klinkhammer, M.R. Palmer, R.J. Kinzler & M. Sulanowska: Along axis variations in seafloor spreading in the MARK area. - *Nature, Lond.*, in press.
- Klinkhammer, G., H. Elderfield, M. Greaves, P. Rona & T. Nelsen, 1986: Manganese geochemistry near high-temperature vents in the Mid-Atlantic Ridge rift valley. - *Earth Planet. Sci. Lett.* 80: 230-240.
- Lalou, C., G. Thompson, P.A. Rona, E. Bricchet & C. Jehanno, 1986: Chronology of selected hydrothermal Mn oxide deposits from the Trans-Atlantic Geotraverse "TAG" area, Mid-Atlantic Ridge 26°N. - *Geochim. Cosmochim. Acta* 50: 1737-1743.
- Nelsen, T.A., G. Klinkhammer & J. Trefry, 1986/87: Real-time observation and tracking of dispersed hydrothermal plumes using nephelometry: examples from the Mid-Atlantic Ridge. - *Earth Planet. Sci. Lett.* 81: 245-252.
- Ocean Drilling Program Leg 106 Scientific Party (R.S. Detrick, J. Honnorez, A.C. Adamson, G. Brass, K.M. Gillis, S.E. Humphris, C. Mevel, P. Meyer, N. Petersen, M. Rautenschlein, T. Shibata, H. Staudigal, K. Yamamoto and A.L. Wooldridge), 1986: Drilling the Snake Pit hydrothermal sulfide deposit on the Mid-Atlantic Ridge, latitude 23°22'N. - *Geology* 14: 1004-1007.
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- Rona, P.A., G. Klinkhammer, T.A. Nelsen, J.H. Trefry & H. Elderfield, 1986: Black smokers, massive sulfides and vent biota at the Mid-Atlantic Ridge. - *Nature, Lond.* 321, No. 6065: 33-37.
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- Trefry, J.H., S. Metz, R.P. Trocine & T.A. Nelsen, 1986: Geochemistry and history of hydrothermal precipitates in a Mid-Atlantic Ridge vent field. - *EOS, Trans. Am. Geophys. Union* 67: 1022.
- Van Dover, C.L., B. Fry, J.F. Grassle, S. Humphris & P.A. Rona: Feeding biology of the Mid-Atlantic Ridge hydrothermal vent shrimp: functional morphology, gut content analyses, and stable isotope compositions. - *Mar. Biol.*, submitted.
- Williams, A.B. & P.A. Rona, 1986: Two new Caridean shrimps (Bresiliidae) from a hydrothermal field on the Mid-Atlantic Ridge. - *J. Crust. Biol.* 6, 3: 446-462.



This photograph was made from the submersible Alvin in May 1986 during the first dives to observe black smoker hot springs that were initially discovered in the Atlantic Ocean at the TAG (Trans-Atlantic Geotraverse) Hydrothermal Field in 1985 (Rona et al. 1986). Vent shrimps (individual length 3-5 cm) of the new genus Fimicaris are swarming over a active, 2 m high, black smoker chimney composed of massive sulfide minerals, located at 3630 m in the rift valley of the Mid-Atlantic Ridge near 26°N. (Photograph courtesy of the National Oceanic and Atmospheric Administration/Woods Hole Oceanographic Institution, Massachusetts Institute of Technology Vents Research Team).

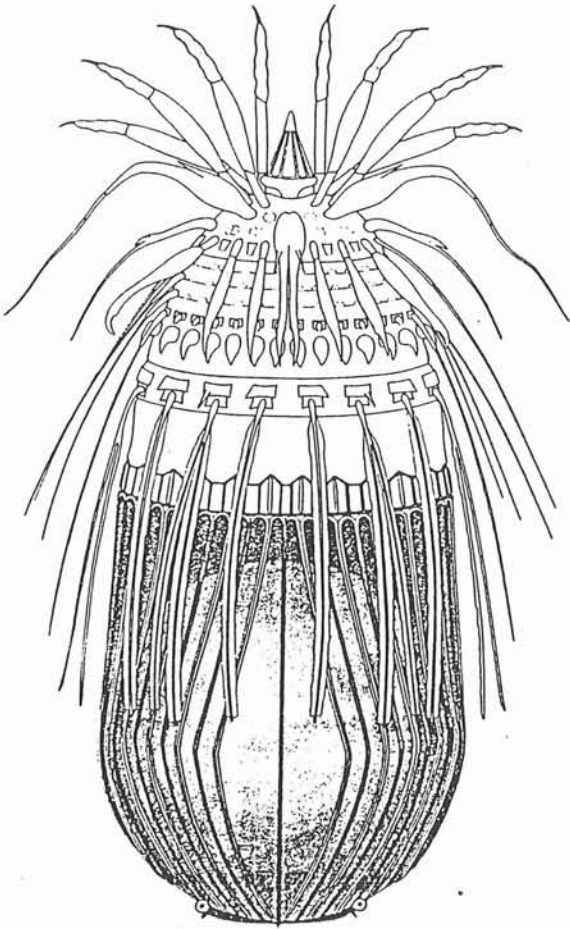
Discovery of a hadal representative of Loricifera

The most recent phylum of the Animal Kingdom is Loricifera Kristensen, 1983. Until now nine species, representing three genera and two families, have been described, all from coarse, subtidal sediments in the Atlantic Ocean.

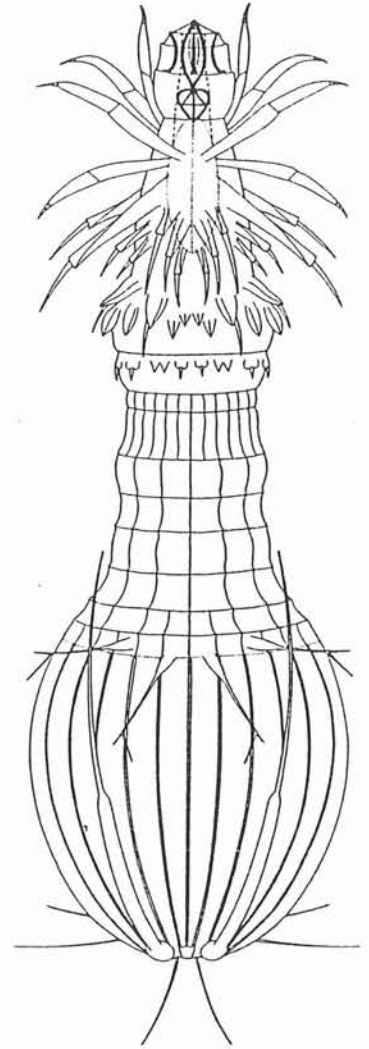
The first loriciferan has now been discovered in a box core sample, collected at Station 9 of the cruise KH-80-1 of the R/V *Hakuho Maru*, Ocean Research Inst. University of Tokyo. The station was situated close to the axis of the Izu-Ogasawara Trench at a depth of 8260 m.

A total of three individuals were collected: a male, a female and a juvenile (Higgins larva). On the basis of morphological studies, the species was found to be new, belonging to the genus *Pliciloricus*, described by Higgins and Kristensen (1986).

This is the first record of the Loricifera from hadal depths as well as from the western Pacific area. Moreover, all the previously described species were collected from a coarse sand habitat, while Loricifera here for the first time have been obtained from a clayey sediment (red clay with silt and sand laminae). Such a wide range



Pliciloricus n.sp., 8260 m.
Female holotype



Pliciloricus n.sp. Larva

of distribution in bathymetry, geography and habitat suggests that *Pliciloricus* has a great ability in dispersion and adaptation to various kinds of environment.

We have three other new species of Loricifera collected on the Shatzky Rise, Central Pacific. One of them belongs to an undescribed family. In addition, we have more information about deep-sea loriciferans and believe that the phylum is distributed ubiquitously throughout the world.

References

Higgins, R.P. & R.M. Kristensen, 1986: New Loricifera from southeastern United States coastal waters. - *Smithson. Contr. Zool.* No. 438: 1-70.
Kristensen, R.M., 1983: Loricifera, a new phylum with aschelminthes characters from the meiobenthos. - *Z. zool. Syst. Evol.forsch.* 21: 163-180.

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Notes on a deep-sea caprellid from Japanese waters

Although I am not a carcinologist but a malacologist, the present report on the occurrence of a bathyal caprellid and comments on the life habits of caprellids in shallow water are in response to Dr. Myriam Sibuet's request (Deep-Sea Newsletter No. 12: 6) for information on deep-sea members of this group.

I collected a bathyal caprellid using a beam trawl at two stations at bathyal depths around 1650 m off the Sanriku Coast on the Pacific coast of northeastern Honshu, the main island of Japan. In this area, an extensive deep-sea terrace with a gentle slope from the depth of 1000-3000 m spreads over about 110 km offshore.

At two stations in this locality (JEDS-4, St. E 1, 1650-1690 m: Suyehiro et al. 1962 and Horikoshi 1971; KH-67-2, St. 5, 1590-1630 m: Horikoshi 1971), a caprellid was collected in large quantities. The body length of this species is about 25-30 mm (Fig. 1), and when its long antennae are included it measures about 40-50 mm in total length. The body is rather translucent and dull straw-coloured with red eyes, and the mouth parts, two pairs of antennae and two pairs of gnathopods are vermilion (coloured parts are stippled in Fig. 1). Also the eggs are reddish.

The benthic community at these two stations is quite peculiar, being dominated by a tubicolous polychaete whose tube is made of sand grains instead of mud (for photograph of these polychaete tubes, see Suyehiro et al. 1962 and Horikoshi 1987). This means two things: that the sediment at these two stations is rather sandy, indicating stronger water movement than at the surrounding muddy bottom, and that polychaete tubes are available as a substratum for caprellids to cling to. That the sediment is sandy further suggests that the caprellid obtains its food from the ample supply of organic matter suspended in the sea water in the bottom boundary layer.

Although Dr. Sibuet mentioned that the caprellids are omnivorous browsers, there seem to be at least two types of life habit among them. Actually there are two types

living. In one type, animals are in contact with the frond of seaweed along most of their length, with their ventrum held close to the frond (Takeuchi & Hirano 1987), and in the other type they cling to the substratum, either a tuft of filamentous algae or hydrozoan and/or bryozoan colony, with appendages on their hinder parts (Fig. 2b). Caprellids of the former type and some of the latter may be omnivorous browsers. According to Ricketts & Calvin (1968 p.102), *Metacaprella kennealyi* "seem to be bowing slowly, with ceremonial dignity; clasping their palm-like claws they strike an attitude of prayer. Often they sway from side to side without any apparent reason, attached to the hydroid stem by the clinging hooks that terminate the body, scraping off diatoms and bits of debris, or possibly eating zooids of the host."

On the other hand, at least some of the latter type seem to be agile carnivores. G.E. MacGinitie & Nettie MacGinitie (1949 p. 270) described the feeding habit of such a caprellid very vividly as follows: "When a caprellid is feeding it clings by the posterior feet and stretches out into the water. It remains very still in this attitude until some prey - amphipod, crustacean larva, or other morsel - swims by. Thereupon with a quick downward movement of the body, it grasps its prey by means of the first two pairs of legs, the second pair of which may be shaped somewhat like the pincers of crabs. Then the caprellid methodically eats the captured food piecemeal. One is surprised by the size of the animals it can hold and devour." I also once observed that a shallow-water caprellid species, probably *Caprella kroyeri* de Haan, stood upright on a colony of bryozoans (Fig. 2a), stretching its two pairs of antennae and a pair of the second gnathopod with strong chelae, in the "waiting posture". It would not be unnatural to suppose that our deep-sea caprellid also has a similar life habit.

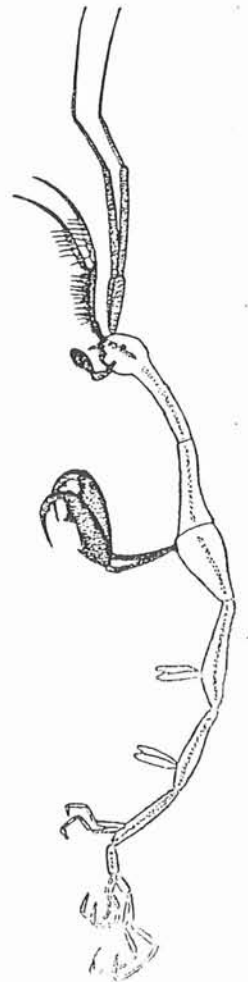


Fig. 1. Deep-sea caprellid collected at JEDS-4, St. E 1, 1650-1690 m, off northeastern Honshu, the main island of Japan (drawn from a coloured sketch made on board the R.V. *Ryofu Maru*)

5 mm

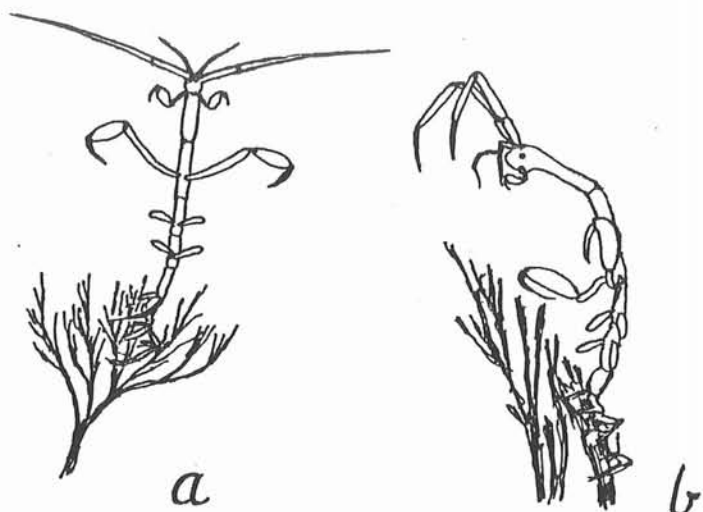


Fig. 2. Life habit of shallow-water caprellids.

a: a caprellid standing erect on a bryozoan colony (Horikoshi, unpublished).

b: *Caprella aequilibra* clinging to a tuft of red weed (drawn after Dr. D.P. Wilson's photograph in Yonge 1949: pl. 7, figure facing p. 76).

References

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- 1987: Deep-sea organisms and their bathymetrical zonation. - Pp. 146-168 *in*: Horikoshi, M., T. Sato & Y. Nagata: Seas around the Japanese Islands (Nature in Japan, Vol. 7), Iwanami Pub. Co., Tokyo, viii+299 pp. (In Japanese).
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- Takeuchi, I. & R. Hirano, 1987: Caprellid fauna in the vicinity of the Kominato Marine Laboratory, Chiba University, Amatsu-Kominato, Chiba Prefecture. - *Ann. Rep. Inst. Mar. Ecosystem, Chiba Univ.* (7): 20-23.
- Yonge, C.M., 1949: The Sea Shore. - Collins, London, xvi+311 pp.

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Current work on the crab *Geryon tridens*

Studies are being undertaken at Port Erin into the major benthic decapod Crustacea of the Porcupine Sea-Bight, namely *Munida* and *Munidopsis* spp. and the red crab *Geryon tridens* (Fig. 1), utilising the *Discovery* collection at the IOS Deacon Laboratory, Surrey.

Geryon tridens, when mature, is one of the largest common decapods in the region. Males reach a carapace length (CL) of more than 70 mm, though females are considerably smaller and rarely exceed 45 mm CL. This sexual dimorphism in respect to size is important in the mating behaviour of the genus, especially the protective stance and the manipulation of the female undertaken by the male (Mori & Relini 1982; Elnor *et al.* 1987). The crab has a bathymetric range from 400 to over 1500 m, where it is succeeded by either *G. gordonae* or *G. affinis*, depending on latitude. It inhabits burrows in the fine silt, as observed on photographs taken by the IOS photosled. The ovigerous females would appear to remain buried throughout the egg development, as there was a surprising

paucity of egg-carrying females in the catches. This behaviour has been observed in other species, most notably *Nephrops norvegicus*, the Norway lobster (Chapman & Rice 1971).

However, what is of particular interest here is the size structure in relation to depth mentioned above. The data obtained from all available specimens, together with some raw size data gathered by Dr. A.L. Rice while on the *Geryon 2* cruise aboard the *Thalassa*, made it apparent that the different sizes of *G. tridens* were not distributed evenly across the whole depth range. The larger individuals were confined to the shallower regions above 700 m, while conversely the smaller young crabs were practically all found in the deeper waters. When the mean CL for each depth interval was calculated, the pattern became clear, especially for males which were caught in greater numbers (Fig. 2). In addition to the data shown in the graph, there were almost 150 post-larval, settling young caught by RMT 20 m from the bottom in 1125 m of water. This pattern of small crabs at depth graduating to large individuals in the shallows is similar to that found by Wigley *et al.* (1975) in *G. quinquedens* off the NE of the USA and suggests a depth related migration during the crabs' early stages from its area of settlement in the deeper water to the region above 700 m where it breeds and is extremely successful.

The migration of these small crabs (of sizes less than 25 mm) covers extensive vertical distances of up to 900 m, but when this is translated into the horizontal distances involved, by plotting the sample sites on a chart and calculating the minimum distance to the 'adult' area, the scale of the movement really becomes apparent. To reach 500 m depth from sites at around 1000 m would involve moving a distance of over 30 km, and as much as 60 km for crabs from the deeper samples, including the sample of settling young. Obviously, the crabs settling far away from the shallow regions may never make it, but even if the adult population is maintained by small crabs from around 1000 m, the distances required to reach 500 m are still impressive.

The question arises of why this pattern should occur. It would seem that the optimum depth for *G. tridens* to breed in is less than 700 m, which is why the younger crabs move up to there. However, there is a distinct lack of the smallest crabs in these shallow regions, the obvious best place to settle. Other work on the *Munida* spp. has shown that *M. sarsi* is by far the most numerous benthic decapod in the Porcupine Sea-Bight above 800 m where certain areas are extremely densely populated (up to 360 individuals/ha.). These munidids are also burrowers, and it is therefore suggested that *M. sarsi*, especially, would out-compete the small *G. tridens* for the same niche and so the young crabs do not survive here. In the deeper water, the *Geryon* would co-habit with *Munidopsis* spp. and particularly *Munida tenuimana*, which are much less common (maximum density 65 ind./ha.), and so the competitive stresses would be lessened. The crabs therefore survive to migrate back to above 700 m, at which time they would have attained such a size that the smaller *M. sarsi* do not pose such a threat.

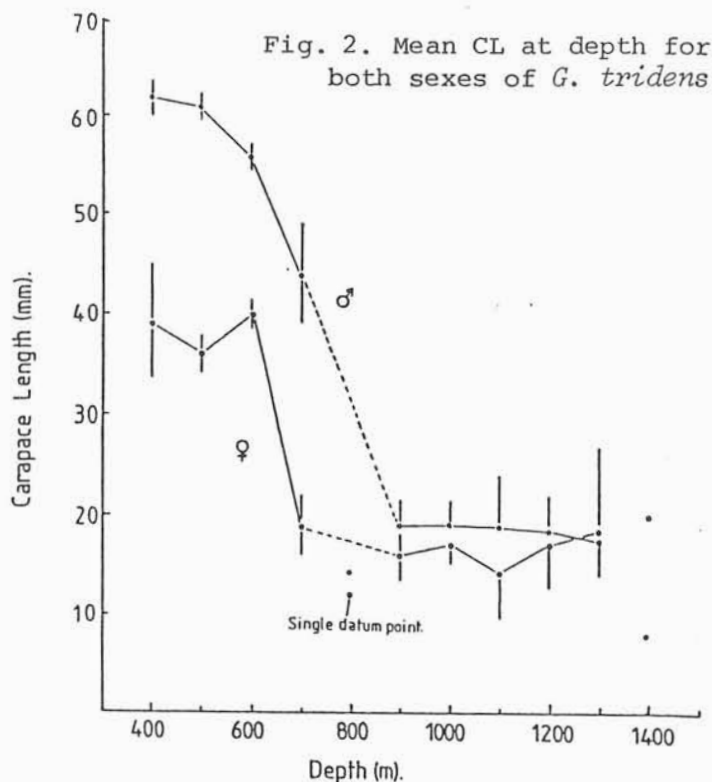
Fig. 1. *Geryon tridens*, female
CL 21.5 mm.



These findings also raise questions about the mechanisms of determining the direction of migration, different to those posed by, for instance, planktonic migrations. Do the crabs respond to changes in pressure, to gradient, or to some other external factor? And if so, how do they detect the changes? Any work or thoughts that can shed light on such mechanisms of migration would be gratefully received.

The Brachyura as a whole are infamous for not having representatives in the more extreme depths of

the deep-sea, and it would appear from its attempts to migrate up the continental slope that *Geryon tridens* is truly a shallow-water species at heart.



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Rhizammina algaeformis - a giant komokiacean foraminifer?

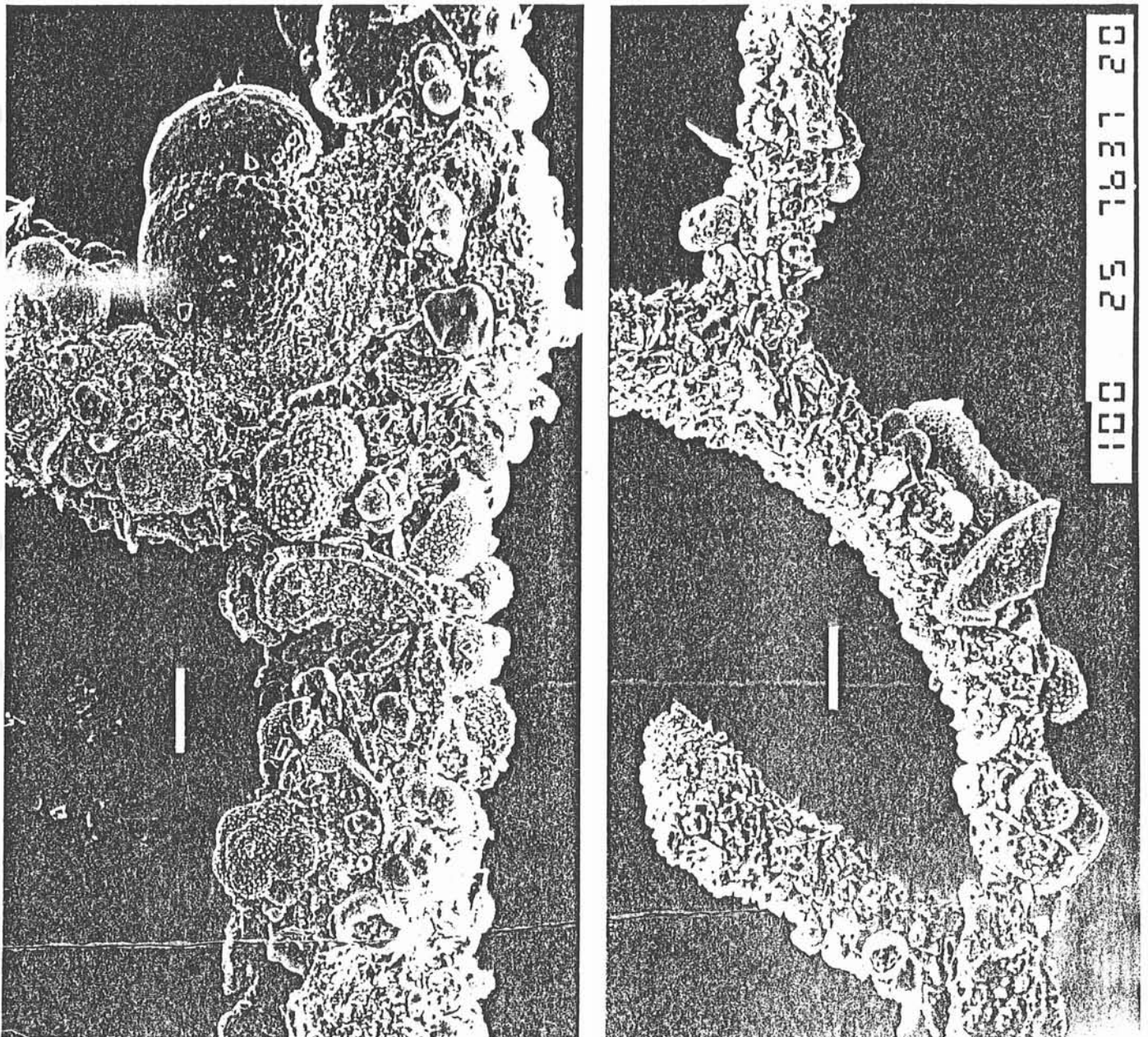
Since the earliest oceanographic expeditions were undertaken by the *Lightning* and *Porcupine*, well over a hundred years ago, it has been known that large agglutinated Foraminifera are an abundant component of the deep-sea macrofauna. Many species are placed in the Astrorhizacea. However, phylogenetic relationships within this superfamily are unclear, and the taxon has become something of a dustbin for obscure forms which are difficult to accommodate elsewhere. As part of an on-going study of agglutinated foraminifers in NE Atlantic, we have examined one supposed astrorhizacean species, *Rhizammina algaeformis*, in some detail using SEM, TEM and light microscopy.

First described in 1879, this species has been found at bathyal and abyssal depth in most of the world oceans. Our material originates from 1320 m in the Porcupine Seabight (SW of Ireland) and approx. 4500 m in the BIOTRANS box (47°00'-47°30'N, 19°-20°W), an area being studied intensively by the Institut für Hydrobiologie und Fischereiwissenschaften, Hamburg. One of us (AG) participated in the most recent BIOTRANS cruise (Meteor Cruise 3: July-August 1986), led by Hjalmar Thiel.

The test of *R. algaeformis* is a system of branched tubes. During BIOTRANS IV, and also the earlier BIOTRANS III cruise (Hemleben & Auras 1986), these tubes were observed to form tangled clumps, several centimetres across, on the surfaces of box cores. They are composed of a thin, inner organic layer overlain by agglutinated particles. The lumen is occupied by a mass of stercomata (waste pellets) and an unbranched strand of protoplasm. In TEM the protoplasm is seen to be multinucleate (individual nuclei 2-4 µm diameter) and invaded by a labyrinthic system of spaces. These originate as deep invaginations of the outer surface of the protoplasm and are therefore extracellular. They resemble the lacunary system described by Lengsfeld (1969) in another foraminifer.

Allogromia laticollaris, and may be involved in the extracellular digestion of food particles.

Our observations on the morphology and cytology of *Rhizammina algaeformis* have convinced us that this species is not an astrorhizacean but is related to the Komokiacea. This superfamily is often very abundant in the deep sea. It was first described by Tendal & Hessler (1977) and includes a variety of strange, agglutinated foraminifers ("Diagnosis: Test consists of complex system of fine, branching tubules of even diameter. Test wall simple; agglutinated particles argillaceous. Stercomata (faecal pellets) accumulate within tubules". Komokiaceans look like "lint, nondescript organic detritus, poorly washed balls of sediment, or minor fragments from the surface of some unidentified larger organism"). *R. algaeformis* seems particularly close to the genus *Lana*. The transfer of a species from the Astrorhizacea to the Komokiacea has happened before in the case of *Normanina conferta* (Norman) (l.c.: 181). However, if *R. algaeformis* is a komokiacean, then it is a giant representative of the taxon, being an order of magnitude larger than any of the currently described species.



Piece of *Rhizammina algaeformis* tube from Porcupine Seabight (1320 m).
Left: Wider form composed mainly of complete and fragmentary *Globigerina* shells.
Right: Narrow form composed mainly of *Globigerina* fragment. Scale bar = 100 μ m.

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Erratic stones as substrates for encrusting organisms

Because manganese nodules pose interesting problems for chemists, have potential commercial importance, and are easily collected, the organisms living on their surfaces have received a certain amount of attention. The most recent and comprehensive description of this important biota is that of Mullineaux (1987). Evidence that other hard, deep-sea substrates also provide desirable residences for encrusting organisms emerged during Meteor Cruise 3, led by Hjalmar Thiel as part of the BIOTRANS project. Virtually every box-core taken in the study area (47°00'-47°30'N, 19°-20°W, 4500 m) yielded a number of erratic (ice-rafted) stones, most of them a few centimetres across and partly exposed above the sediment surface. Some totally buried stones were also collected. Many stones had a dark, almost black coating, presumably of Fe-Mn oxide.

Surfaces exposed above the sediment usually bore a variety of attached organisms. These included metazoans, notably sponges, actinarians, *Stephanoscyphus*, bryozoans and serpulid worm tubes. However, the dominant organisms were Foraminifera or Foraminifera-like rhizopods. Up to 8-9 morphologically distinct forms occurred on individual stones. Among the more obvious types noted during a cursory examination at sea were the following:

1. *Telammina* sp. and *Tumidotubus* sp.; genera first described from the NE Atlantic living inside *Bathysiphon* tubes (Gooday & Haynes 1983) and also occurring on Pacific nodules (Mullineaux 1987).
2. Delicate, soft, ?organic, mat-like encrustations of irregular outline and often considerable extent.
3. Thin, white, mat-like encrustations composed of fine sediment and *Globigerina* shells.
4. Extensive systems of dark-grey, ?organic, branching and anastomosing tubes.
5. "Whitish, irregular, flattened domes" of Gooday & Haynes (1983).
6. A variety of komokiaceans, most of them forming low, light-coloured mounds.
7. Isolated white domes (?*Crithionina*).
8. Isolated yellow domes (?*Psammospaera*).
9. *Hormosira normani* Brady.
10. Coiled, multichambered, agglutinated tests (probably trochamminaceans).

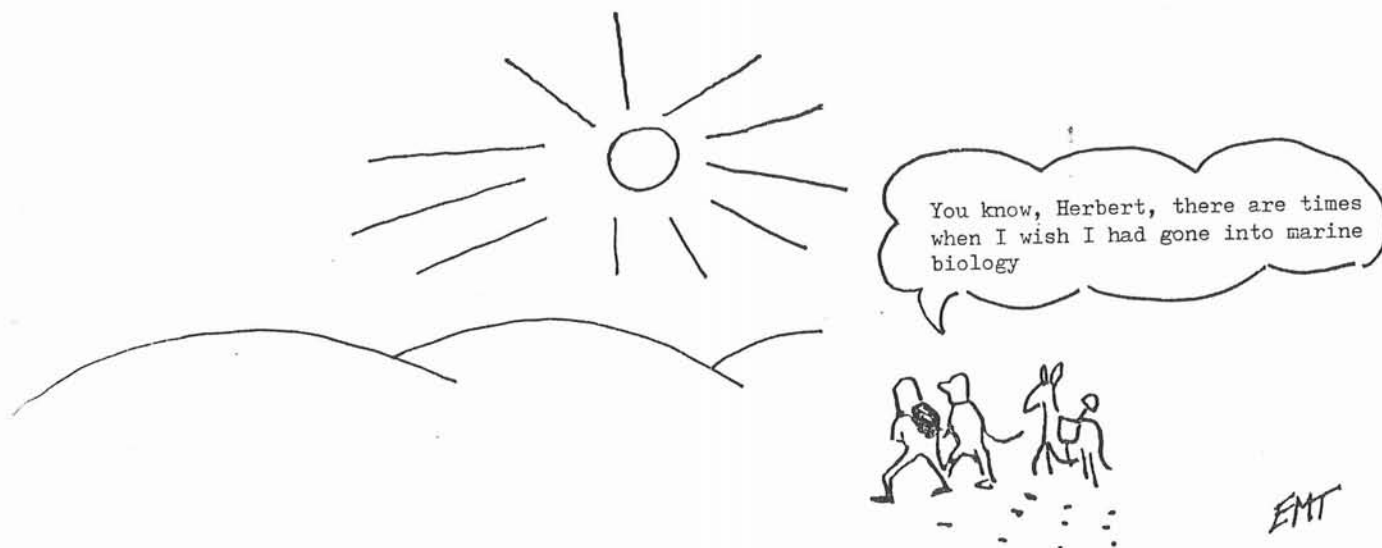
The density of coverage on exposed surfaces varied considerably. Sometimes, only a few organisms were attached; in other cases more than 50% of the surface was obscured by extensive mat-like growths. The undersurfaces of exposed stones and the surfaces of buried stones sometimes carried a few attached foraminifers but were never densely encrusted.

In general, the assemblages show a striking similarity to those recorded by Mullineaux (1987) and also include elements of the *Bathysiphon* tube fauna described by Gooday & Haynes (1983). From this very quick perusal of the BIOTRANS material, it seems that erratic stones may provide an important substrate for attached, deep-sea organisms, particularly rhizopods.

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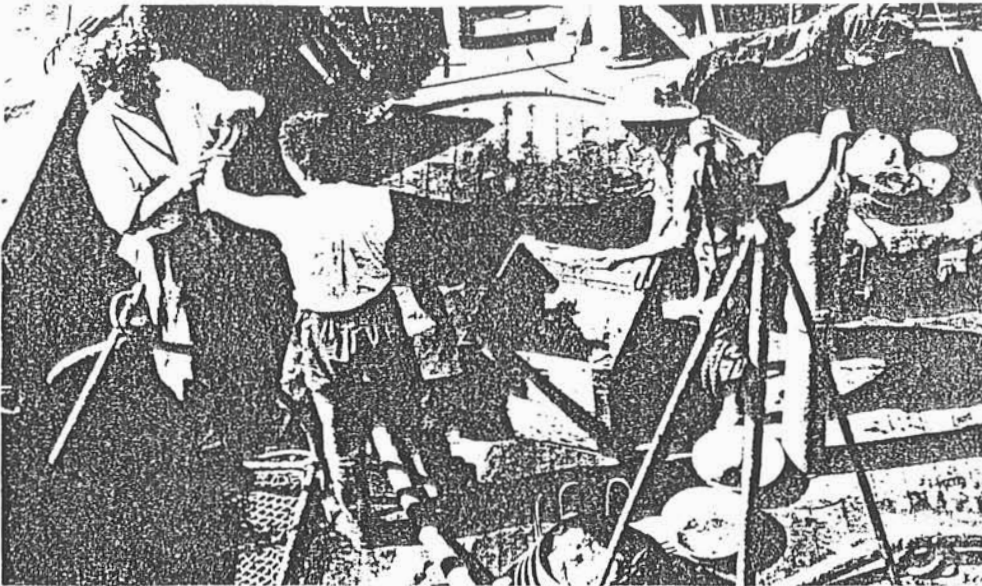
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Deep-sea biology cruise to the Portuguese slope

In late October and early November 1986 biologists from the U.K. were involved in a cruise to examine the benthic ecology of the slope and submarine canyons off the west coast of Portugal. R.R.S. *Challenger* left Madeira on the 30th October, and the slope to the south of Cape San Vincent was sampled by box corer, Agassiz trawl and camera at approx. 500 m depth intervals down to c. 4000 m. The San Vincent Canyon was then surveyed by PDR and subsequently sampled using both camera and 2 box cores at each station at 500 m depth intervals down to 4500 m. One of the box cores was sieved to extract the benthic invertebrates which will be used to supplement data from box cores further north in the NE Atlantic taken by John Gage (SMBA). The second box core was subcored and the subcores used for geotechnical and microbial analysis by Peter Meadows (University of Glasgow) or for geochemistry and rheological properties (S.J. Wakefield and A.E. James, U.C. Swansea). Owing to deteriorating weather conditions, it was not possible to continue the box coring programme along the Portuguese slope, but this was substituted by use of the Agassiz trawl and epibenthic sled samples. Total catch was relatively small but contained a good variety of benthic invertebrates. Much of this material is being used for reproductive and bioenergetic analysis, and the isoenzyme structure of a number of species is being compared with that of those found further north in the NE Atlantic. The cruise ended at Barry, U.K. on 19 November, 1986.

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The first major assault on the Indian Ocean

A.L. Rice (ed.):
Deep-Sea challenge. The
John Murray/Mabahiss
Expedition to the
Indian Ocean 1933-34. -
UNESCO, Paris, 336 pp.,
42 figs.
(ISBN 92-3-102400-0). -
£21.

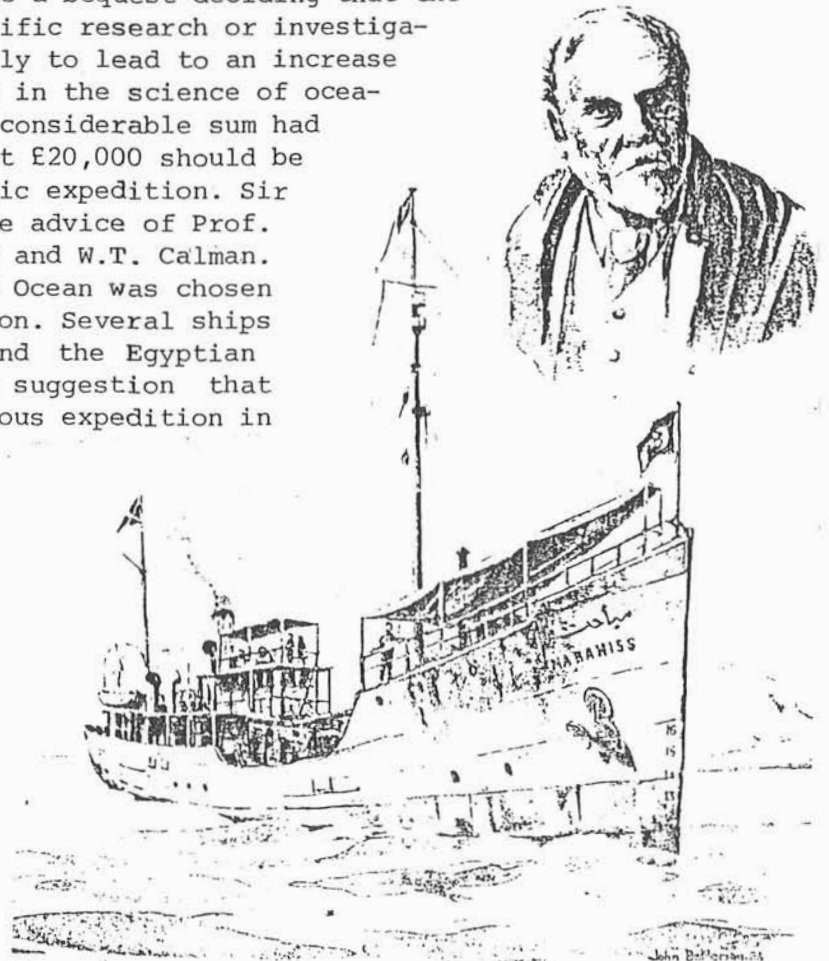
Washing a dredge haul
on deck

The early years of oceanography were characterized by a series of expeditions generally referred to by the name of the ship employed. Most of these expeditions, besides their scientific reports, resulted in more or less popular books describing the work on the ship and smaller and larger events at sea and on land.

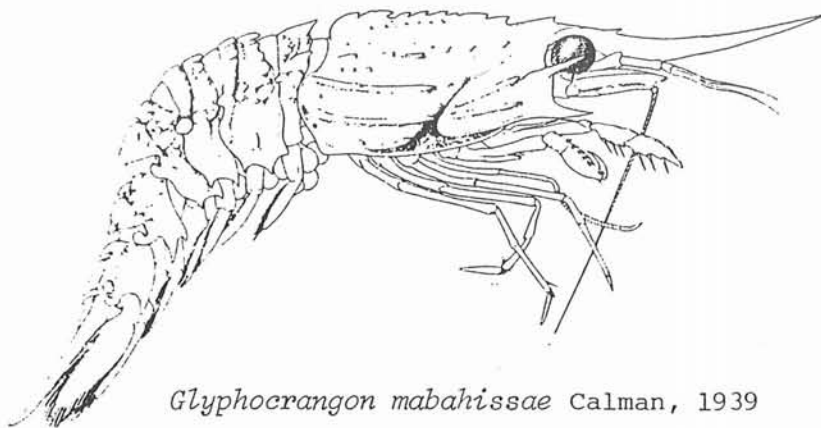
The "John Murray" expedition has been an exception: firstly its official name is that of the man whose bequest formed the economic base for the expedition; secondly it is not until now that "the book" on the expedition appears, ably edited by Tony Rice, who has also authored sections of the book, starting with an account of the historical background of the expedition.

Sir John Murray (1841-1914) made a bequest deciding that the money were to be applied to "scientific research or investigations or exploration which are likely to lead to an increase of natural knowledge and especially in the science of oceanography and limnology". By 1931 a considerable sum had accumulated, and it was decided that £20,000 should be used to finance a major oceanographic expedition. Sir John's son, I.C. Murray enlisted the advice of Prof. Stanley Gardiner and Drs E.J. Allen and W.T. Calman.

The poorly known western Indian Ocean was chosen as the working area of the expedition. Several ships were considered for the purpose, and the Egyptian government was approached with a suggestion that Egypt should undertake a synchronous expedition in the Red Sea. The government felt that they did not have the expertise required, but suggested that their vessel, the "Mabahiss" (618 displacement tons), should be used for the expedition, which should also investigate the Red Sea; Egypt would also provide staff members, including some scientists; thus the expedition developed into a joint British-Egyptian project. The appointed scientific leader was Lt.-Col. R.B. Seymour who had many years of previous experience as a Surgeon-Naturalist on the R.I.M.S. "Investigator", working in the eastern and central part of the Indian Ocean. The total staff of the "Mabahiss" amounted to 40.



H.E.M.S. "Mabahiss" and Sir John Murray



Glyphocrangon mabahissae Calman, 1939

The British Museum (Nat.Hist.) has held a manuscript by Sewell, giving a narrative of the expedition. It forms the main part of the book and gives a rather detailed picture of the daily life on the crowded ship, including the hardships and difficulties encountered. The first few days of work were far from promising, and a reader who has worked on a research vessel must feel the disappointment of the scientific staff when the gear failed or was lost. On the third day of operation

an accident happened which could have been fatal: "When there were still some 1900 metres of wire out, there was a loud bang; the strong chain by which the meter wheel was attached had parted and the heavy wheel shot away like a stone from a catapult .. passed between Macan and myself and plunged into the sea .. I felt the wind of it as it went by"; on this occasion 1800 metres of wire were lost. On the whole the expedition lost much collecting gear and other equipment and considerable amounts of wire were inadvertently deposited on the sea floor. Moreover the chief engineer was badly gassed when repairing the refrigerator, and several members got malaria following a visit to Mombasa. The crowded condition onboard was of course a problem; to add to this the limited space for a while had to be shared with 20 live sheep, purchased to provide fresh meat.

The editor has had the good idea to annotate events mentioned by Sewell with several extracts from the diary of the ship's master, K.N. MacKenzie. Thus, on the first attempts to use the gear MacKenzie commented: "The whole day spent in shooting deep-sea trawl, a perfect exhibition of the uselessness of shore people on board ship, most of them half sea-sick and flopping around deck like so many American tourists". However, on the whole the ship's company got along very well; the only indication of personality clash being that between Sewell and MacKenzie. Sewell seems to have been an excellent scientific leader.

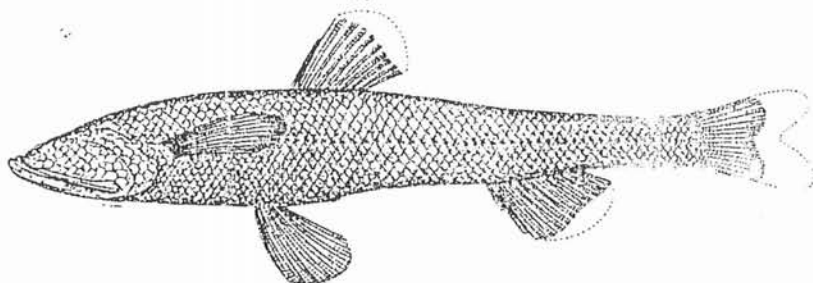
A chapter is devoted to biographical notes on the scientists and officers of the expedition, telling their later career. Two of the sections are written by members of the expedition: H.C. Gilson and T.T. Macan, both of whom switched over to limnology.

A following chapter, by Tony Rice, deals with the history of the ship, which is still extant in Alexandria, being owned by the University of Alexandria, which plans to convert it into a floating oceanographic museum.

The last chapter, written jointly by the late Dr. G.E.R. Deacon and Tony Rice, summarizes the significance of the expedition. The political importance in England was insignificant, but in Egypt it meant the starting point of oceanography.

The scientific results are stated to have been to some extent overlooked by posterity, somewhat unjustly it seems. Among the results were important contributions to the knowledge of the bottom topography of this poorly known part of the world ocean, obtained from echo-sounder records of the greater part of the expedition's track; information was obtained on water exchange between the Red Sea and the Gulf of Aden, and on the nitrogen cycle of the region; a more or less azoic area of the sea floor at depths between 100 and 1300 metres off the coast of Arabia and the Gulf of Oman was discovered; last but not least Sewell's papers on copepods should be mentioned as one of the most important biological results of the expedition.

Bathymicrops sewelli
Norman, 1939



The expedition's report comprises 64 papers in 11 volumes, altogether about 3800 pages (not 8500 as stated on p. 316!) published between 1935 and 1967; it is worth noting that Sewell himself contributed 9 papers, covering more than 1600 pages, over 40% of the total report!

The postwar upsurge in oceanographic research has no doubt made participation in research at sea less "romantic" (although still a very attractive occupation). Therefore accounts on the pioneering expeditions of the "good old days" make fascinating reading. This book is no exception; it is highly readable and attractively produced. We should be grateful to Tony Rice that his well known interest in the history of oceanography has induced him to take the trouble of having this book published.

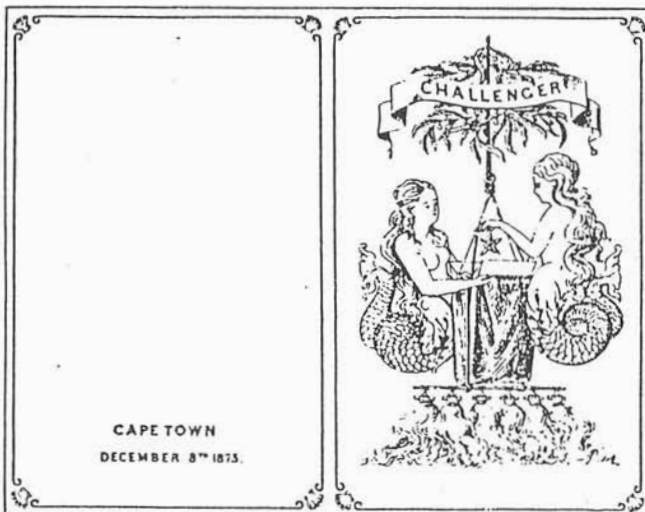
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The ships that laid the foundations

A.L. Rice: British Oceanographic vessels 1800-1950. - The Ray Society (c/o British Museum (Nat.Hist.)), 1986, 193 pp., 96 figs. (ISBN 0-903874-19-9). - £18.

Increased interest in the history of oceanography emerged about twenty years ago with the first international congress on this subject in Monaco and was greatly advanced in connection with the centenary of the Challenger Expedition. The focus has mainly been on the methods and achievements of individuals rather than on the actual oceanographic expeditions and their ships. Although much information can be found in general accounts of high standard, from Wyville Thomson and Murray, to Wüst, Margaret Deacon and Susan Schlee, there is nevertheless a pronounced lack of easily available, exhaustive and concise data on expeditions, personnel and ships, with the exception of those of a few countries.

As many will know from his papers, Tony Rice has a keen interest in the history of oceanography, although he modestly regards himself as an amateur historian. In order to save himself the trouble of repeatedly looking up the same information Tony, in the late 1970's, started an index on various details, references, etc. on vessels, particularly the less well-known ones. This has gradually evolved into a whole book. There is, however, a far cry from his simple index to the present book with its wonderful illustrations and enormous wealth of information, collected and edited by the so-called



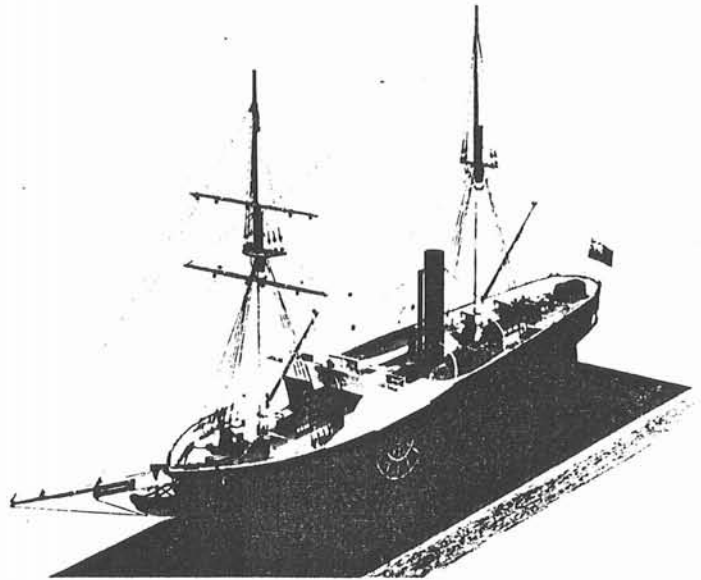
when he promissed a 1st dance about 5th 10th looked on to his disengaged arm & the back view of the ^{male} ~~lady~~ was simply the wall flowers of the ship we went about luteing & deciding with the soldiers we also attended to the old fudge at supper then King's university during the to leave the ball a late stage was Harry disconsolate packide having left with his usual good sense he had dropped his card in the middle of the ball some hapless picked it up & found 17 Hills & one

The specially designed program for the Challenger Ball given for the citizens of Cape Town in December 1876 and extract from Sub.-Lieut. A. Channer's journal, showing Sub.-Lieut. W.J.J. Spry escorting two ladies of dramatically differing build.

amateur mainly in his spare time.

Model of H.M.S. *Lightning*. Natn. Maritime Mus.

The scope of the contents was limited to British ships, partly because including foreign ships might have extended the work for years, but also because of the obvious domination of the British in marine open-ocean research during most of the 19th century. Hopefully, some day Tony will succeed in editing a similar book on other nations' oceanographical vessels, aided by selected and dedicated people in those countries.



The starting date of 1800 was chosen rather arbitrarily. In her Foreword Margaret Deacon outlines 17th and 18th century examples of what might more or less reasonably be defined as scientific research at sea, but by the early 1800s this research was well established as an integral feature of maritime exploration. 1950 and shortly after represents the termination of the rather protracted and sometimes circumnavigating expeditions which were initiated by the *Challenger* in 1870's and which by 1950 had been generally substituted by multi-ship operations or individual cruises with more distinct scientific and geographical objectives.

The determination of whether a ship can be considered as an "oceanographic vessel" and thus be included must have been a difficult one. The author's definition is "all vessels from which significant oceanographic observations were made as long as this work was conducted in the open ocean, that is beyond the Continental Shelf". Thus, fishery research vessels, ships operated by the marine laboratories, and naval vessels have, with certain exceptions, been excluded.

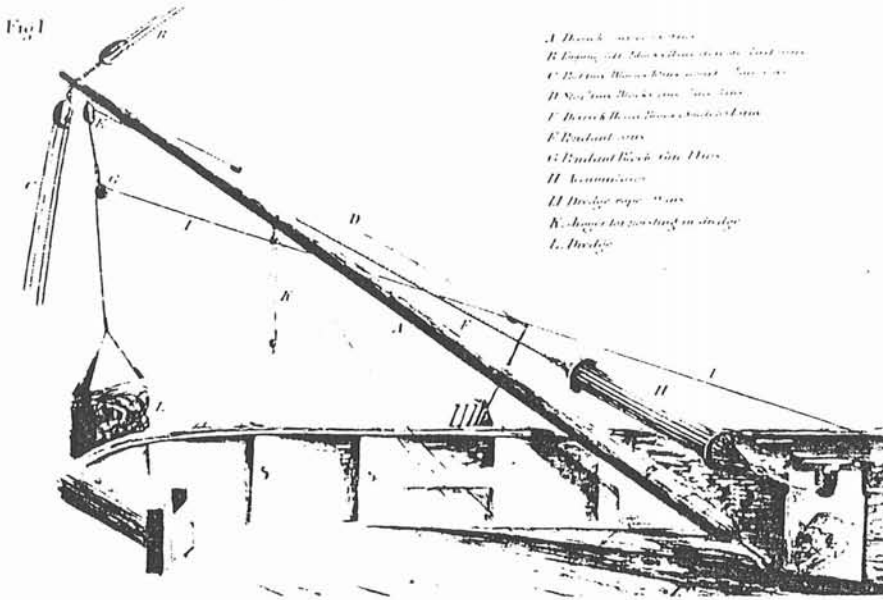
The total number of ship entries is 119. The ships are arranged alphabetically according to their name while serving as research vessels. For each vessel the following data are given, if available: type of ship, length and beam measurements, tonnage (with a very desirable explanation of the six(!) different categories), engine power, locality and date of building, personnel (chief scientist and, if significant, other scientists, the commander and other crew members), date and general route of oceanographic cruise or cruises, main categories of work carried out and major scientific results.

Such a long list of items may sound pretty boring, but the text is vividly written and Tony has been successful in his attempt to put the main voyages into the overall context of developing science. Thus, with the aid of the chronologically arranged list it is possible to get an impression of the progress of ocean science, particularly in Britain, by following the expeditions in the order in which they were carried out. Since appropriate technology has played a great role in the development of oceanography the use of specific instruments is often included in the accounts.

Of course the amount of data presented has to be kept brief, but each entry contains references to both contemporary and subsequent sources of more detailed information. The bibliography comprises more than 250 references, the compilation of which must have kept Tony very busy indeed.

What makes the book particularly attractive are the illustrations. Tony has succeeded in digging up paintings, drawings or photographs of about 60% of the vessels, many with a lot of atmosphere and some shown in a sea-sickening gale. There are three wonderful photographs of stern-looking personnel, on the *Challenger* in 1873, on the *Alert* in 1875-76 and on the old *Discovery*, with personnel of the *William Scoresby*, etc. (year not given). The book also contains about 25 useful charts with routes, redrawn from old sources or reconstructed from accounts of the results. There is even a sketch of an unknown fish species found frozen to the bows of H.M.S. *Terror* and eaten by the ship's cat before it could be properly studied!

In addition to the chronological list and the references the book contains an



Deck arrangement for dredging aboard H.M.S. *Porcupine*.
From Capt. E.K. Calver's 1869 *Porcupine* Journal.

shown by Buchanan to be merely precipitation of calcium phosphate from the sea water when alcohol was added to the samples. Or the Mediterranean expedition of the *Beacon* in 1941-42 during which Edward Forbes formulated his influential "Azoic theory". This was contradicted by a number of findings which were remarkably overlooked: e.g. the living deep-sea starfish obtained by John Ross on the *Isabella* already in 1818, the brittle stars collected by the *Bulldog* in 1860, not to mention the "teeming animal life" on the antarctic continental slope discovered by the *Erebus* and *Terror* in 1841 (two years later both ships were abandoned in the Canadian Arctic; none survived, and as recently as 1984 the remarkably well-preserved body of one member of the party was uncovered).

The final blow to the azoic theory came with the enormously significant Northeast Atlantic cruises of the paddle gunvessels H.M.S. *Lightning* in 1868 and H.M.S. *Porcupine* the following year, as well as the *Shearwater* in the Mediterranean in 1871, immediately followed by the epic *Challenger* circumnavigation. Less well-known, later achievements were those of the *Oceana* in 1898 and the Percy Sladen Trust Expedition on the *Sealark* in 1905.

Tony Rice hopes that his book may be regarded as "a tribute to the many sailors and scientists who often made their contribution to the progress of oceanography under far from ideal conditions". I feel sure that his hope will not be disappointed.

P.S. Tony Rice has been told of two errors in official information he was given. The picture of the *Shearwater* is of a ship of 1901. The photograph of the *Egeria* is of another ship.

Torben Wolff



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THE DEADLINE FOR THE NEXT ISSUE OF D.-S.N. IS 1st APRIL 1988

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