DEEP-SEA NEWSLETTER

No. 11, December 1985

THE INTERNATIONAL DEEP-SEA BIOLOGY SYMPOSIUM - HAMBURG, FRG, 23-29 JUNE 1985

It is quite true that Hamburg could not compete with the view over the Pacific at the deep-sea biology meeting at Scripps in 1981 (although we did overlook a winding canal which around many corners eventually led to the North Sea).

But apart from the restricted view Hamburg had a lot of advantages which contributed to make the meeting a pronounced success. With a participation of about 90 dedicated scientists with a keen interest in life in the deep sea, coming from no less than 16 different countries, there were excellent opportunities for renewing old acquaintances and establishing new ones. The meeting place at the Katolische Akademie was well chosen, since most of us could be accommodated in the same building (at a moderate price). In addition, it had a very well suited lecture hall with good coffee break facilities just outside and provided a self-service bar on the top floor for evening gatherings. Finally, it was located close to the center of the city (with further temptations).

Like at Scripps, it had been agreed that the meeting should be kept on a rather informal level, with no subsequent publication of the papers in proceedings from the meeting. However, on arrival each participant received a nicely produced copy of the program, a list of participants and all the abstracts.

Another fine idea was the mid-symposium excursion to Lübeck. It included an interesting stroll around in this old, commercial Hansestadt where attractive, local guides showed us the mediaeval highlights, followed by an excellent lunch at the Schiffergesellschaft (Shippers' Club) in wonderful surroundings, a boat trip through canals and for a while along the border to the GDR, coffee at a lake (with opulent cakes) and return by bus via Ratzeburg which is another beautiful provincial town (where the photo on page 4 was taken).

Program of the symposium

Monday, 24 June

Welcome addresses by K.-M. Meyer-Abich (Senator of Science and Research), P. Fischer Appelt (President of Hamburg University) and Hjalmar Thiel.

Human impact on the deep sea (see also the following contribution by Thiel and Rice).

Pentreath, R.J. (UK): Assessing the environmental impact of the authorized disposal of low-level packaged radioactive waste into the N.E.Atlantic Ocean.

Smith[x], C.R., P.A. Jumars & T.M.C. Present (USA): Monitoring criteria for assessing the impact of low-level radioactive waste disposal in the deep sea.

Ingram, C.L. & L.S. Gomez (USA): An overview of the biological research for the United States Subseabed Disposal Program.

Swinbanks, D.D. & Y. Shirayama (Japan): High level of natural radiation in the deep-sea infaunal xenophyophore Ocultammina profunda.

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x) Speaker underlined.

Calmet, D., S. Charmasson, A.-M. Alayse-Damet & P. Germain (France): In situ study of the incorporation of radionuclides from radiolabeled bait by the deep-sea amphipod Eurythenes gryllus.
Hessler, R.R. & G.D.F. Wilson (USA): A field study of the impact of manganese nodule mining on the benthic fauna.
Taghon, G.L. (USA): A controlled impact experiment to determine the effects of deep-sea mining on benthic communities: Project overview.
Wilson, G.D.F. (USA): A comparison of the isopod fauna of two manganese nodule environments in the equatorial Pacific.
Mullineaux, L. (USA): Distribution patterns of the encrusting fauna of manganese nodules.

Tuesday 25 June

Foell, E. & D.L. Pawson (USA): Photographic atlas of abyssal megafauna from Clipperton-Clarion fracture zone, northeastern equatorial Pacific.
Mahadevan, K. (USA): A study on the effects of deep-water munition dumps (chemical and conventional) on deep-sea benthic macrofauna of the northwestern Atlantic Ocean.
George, R.Y. (USA): Dominant megafaunal benthic communities in abyssal and hadal dumpsites in the northwestern Atlantic Ocean.
Karbe, L., H. Thiel & H. Weikert (FRG): Potential impact on the Red Sea from mining the Atlantis II Deep.
Snider, J. (USA): The environmental aspects of deep seabed mining regulations in the
Figge, K. & H. Thiel (FRG): German legal and environmental regulations for deep-sea mining.

General deep-sea biology

Maciolek, N.J., J.F. Grassle, B. Brown & J.A. Blake (USA): Study of biological processes on the Mid-Atlantic slope and rise.
Taviani, M. (Italy): The planctotrophic larval developments: A strategy enabling deep-sea benthos to colonize epicontinental seas separated by shallow sills.
Beckmann, W. (FRG): Lucicutia paraclausi (Copepoda, Calanoida) in the deep Red Sea.
Wishner, K. (USA): In situ grazing rates of deep-sea benthic boundary layer zooplankton.
Weikert, H. (FRG): Midwater transport of Calanoides carinatus (Copepoda, Calanoida) along the deep Moroccain continental slope. Evidence of the existence of the undercurrent.
Huelsemann, K. (FRG): Calanoid Copepoda between plankton and benthos.
Evening discussion on environmental regulations: How many impact regulations do we need?

Wednesday 26 June

Deming, J.W. (USA): Ecological strategies of barophilic bacteria in the deep sea.
Rowe, G.T. & J.W. Deming (USA): The role of bacteria in the turnover of organic carbon in the deep-sea sediments.
Yayanos, A.A. (USA): Role of hydrostatic pressure in the evolution and distribution of marine organisms: Evidence from studies of barophilic bacteria.
Karbe, L., A. Baufeldt & M. Meyer-Jenin (FRG): Bacterial colonization of Red Sea hot brines.
Helmke, E. & H. Weyland (FRG): Synthesis and activity of bacterial chitinases under simulated deep-sea conditions.
Desbruyères, D., A. Dinet, J.W. Deming, P. Fera (France) & A. Khripounoff (USA): The romance of the Alvin's sandwich: A boycott of American food?
Scarabino, V. (Uruguay) & P.M. Arnaud (France): Biological peculiarities of deep-sea scaphopods of the Atlantic Ocean.
Rice, A.L. (UK): Megafaunal biomass along a transect from 400 to 4000 m.
Davies, G. (UK): The physical characteristics, population dynamics and reproductive strategy of the deep-sea bivalve Nucula cancellata.
Van-Praët, M. (France): Seasonal reproductions in deep-sea anemones (metabolism, gametogenesis, spawning).
Gage, J.D. (UK): Growth rates of deep-sea animals.
Svavarsson, M.S.J. (Iceland): Reproductive pattern of an arctic deep-sea asellote isopod.
Stuart, C.T., M.A. Rex & R.D. Truesdell (USA): Patterns of gastropod species diversity in the Angola and Cape basins of the eastern South Atlantic: A comparison with the western North Atlantic.

Friday, 28 June

Richardson, M.D. & D.K. Young (USA): Abyssal benthos of the Venezuela Basin, Caribbean Sea: Standing stock considerations.

Young, D.K. & M.D. Richardson (USA): Abyssal benthos of the Venezuela Basin: Size structure and food availability.

Hecker, B. (USA): Epifaunal studies on the South and Mid-Atlantic slope.

Blake, J.A., B. Brown, N.J. Maciolek & J.F. Grassle (USA): Benthic community characterization of the continental slope and rise off the southeastern United States.

Lavaleye, M.S.S. (Holland): Abyssal meio- and macrofauna of the Northeast Atlantic dumpsite for low level radioactive waste.

Thistle, D. (USA): A current-molded deep-sea fauna at the HEBBLE site.

Ohta, S. (Japan): Reliable estimation of megabenthos using deep-sea photography in the bathyal zone of the northwestern Pacific.

Smith, C.R. & P.A. Jumars (USA): Megafaunal sediment mounds, disturbance and community structure in the deep sea.

Janssen, R. (FRG) & M. Taviani (Italy): Factors constraining the composition of the Red Sea deep mollusc fauna.

Levin, L.A., L. McCann & C. Thomas (USA): Xenophyophores structure infaunal assemblages on deep sea-mounts in the East Pacific Ocean.

Tendal, O.S. (Denmark): The biology of Xenophyophorea (Sarcodina, Protozoa).

Riemann, F. (FRG): Enigmatic small rhizopods are abundant at the Pacific deep-sea bottom.

Shorter, spontaneous communications:

Hecker, B. (USA): Faunal communities at the Florida Escarpment.

Hessler, R.R. (USA): Return to the Galapagos hydrothermal vent after 6 years.

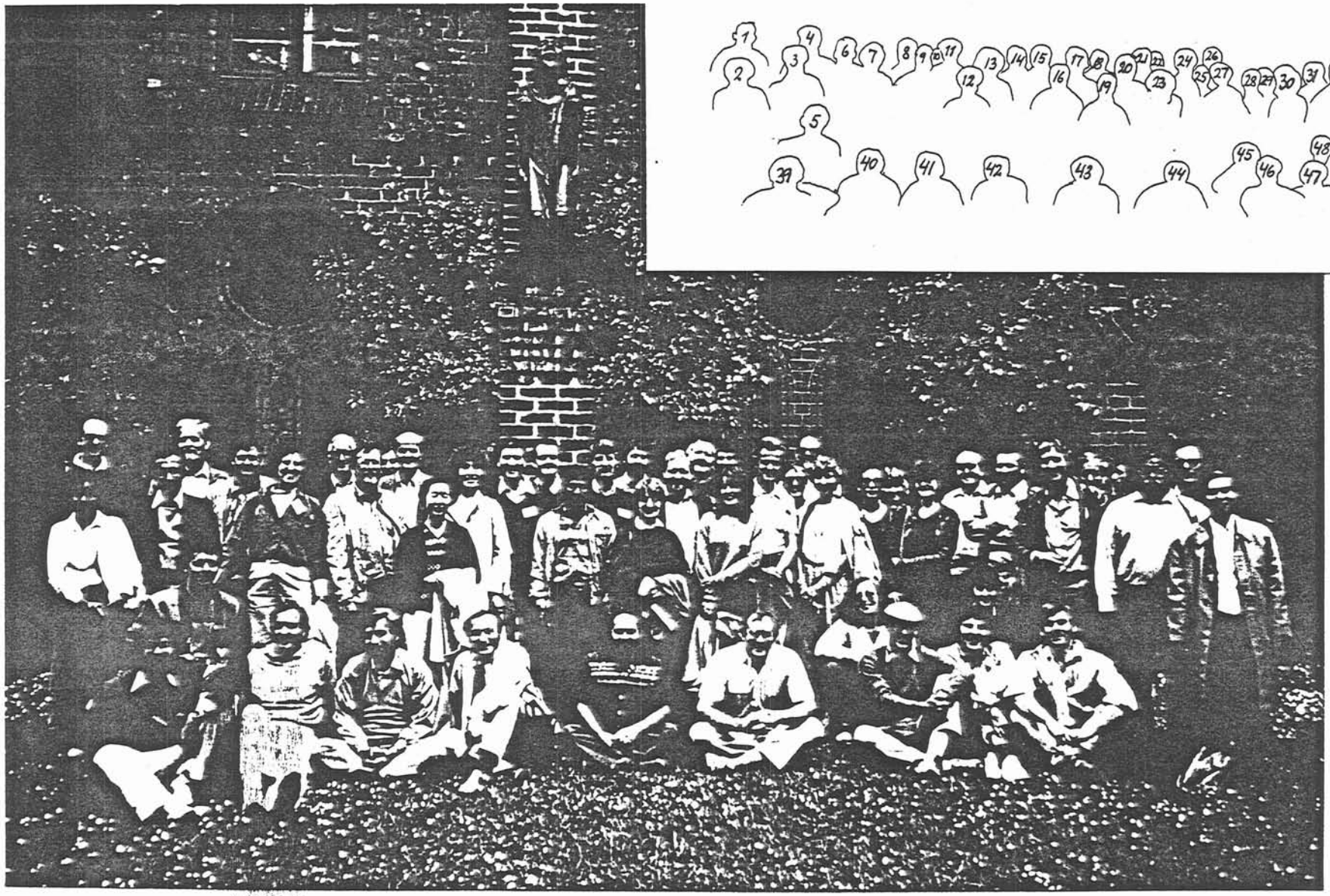
Rice, A.L. (UK): Phytoplankton on the bottom of the Porcupine Bight.

Ohta, S. (Japan): "Hot news" from the new cold seep site in the Tenryu Canyon south of Japan.

Names in the photo on the next page
(to the best of our knowledge!)

1. Bary Hargrave
2. P. Dalpadado
3. Art Yayanos
4. Hjalmar Thiel
5. ?
6. Ken Sulak
7. Karen Wishner
8. Jørgen Knudsen
9. John Patching
10. ?
11. Torben Wolff
12. Mrs. Horikoshi
13. Mrs. Taviani
14. M. Taviani
15. P.M. Arnaud
16. Kumar Mahadevan
17. Franz Riemann
18. George Wilson
19. Barbara Berghahn
20. Olaf Pfannkuche
21. John Gage
22. ?
23. Camilla Ingram
24. Jarl Strömberg
25. Mrs. Young
26. David Young
27. Myriam Sibuet
28. Suguru Ohta
29. Maren Thiel
30. Doris Haberstroh
31. Dietrich Schmidt
32. Carlo Heip
33. Jan Pentreath
34. ?
35. ?
36. Bob George
37. James A. Blake
38. Masuoki Horikoshi
39. M. Lavaleye
40. Craig Smith
41. Agamemno Xenophontos
42. Victor Zaika
43. ?
44. Eric Foell
45. Barbara Hecker
46. Bob Hessler
47. Tony Rice
48. Karline Soetaert
49. Ole Tendal

The Editor would like to have unrecognized persons identified before next issue of the Newsletter



THE PARTICIPANTS IN THE EXCURSION DURING THE HAMBURG SYMPOSIUM (Lisa Levin phot.)
(Names on the previous page)

Saturday, 29 June

Dalpadado, P. (Sri Lanka): Reproductive biology of the lantern fish Benthosema pterotum.
Sulak, K.J. (USA): Comparative ecological analysis of demersal deep-sea fish faunas in the western North Atlantic.
Felbeck, H. (USA): Recent research on hydrothermal vent animals.
Gaill, F., D. Desbruyères & A.M. Alayse-Damet (France): The interface of organisms with their environment: A study in the Pompeji worm and Riftia pachyptila from the hydrothermal vents.
Sibuet, M. & C. Lambert (France): An equilibrium between food supply to the benthos and benthic fauna densities in the deep-sea.
Strömberg, J.O. (Sweden): Some aspects of benthos biomass along a transect from 4000-200 m north of Svalbard.
Stein, D.L. & G.T. Rowe (USA): Behaviour and population estimates of abyssal benthic animals at baited traps in the northern Sargasso Sea.
Ingram, C.L. & R.R. Hessler (USA): Implications of the feeding patterns and vertical distributions of motile deep-sea scavengers.
Hargrave, B. (Canada): Feeding activity of the lysianassid amphipod Eurythenes gryllus.
Graf, G. (FRG): Adenosine-nucleotides and potential heat production in sediments from the Weddell Sea and the Bransfield Strait.
Shirayama, Y. (Japan): The respiration rate of deep-sea meiobenthos collected using a deep-sea submersible "Shinkai 2000".
Smith, K.L. (USA): Organic carbon supply to and demand by the deep-sea sediment community in the eastern and central North Pacific.

Poster presentations

Guidi, L., F. de Bovée, R. Buscall, G. Cahet, D. Delille, J. Soyer & P. Albert (France): Meso-scale heterogeneity of the biological activity in a Mediterranean canyon (Gulf of Lyon).
Holthe, T. (Norway): Deep-sea Amphanetidae (Polychaeta).
Juniper, S.K. & Y. Fouquet (France): The effect of hydrothermal vent organisms on mineral deposition and uranium accumulation.
Karbe, L., H. Thiel & H. Weikert (FRG): Environmental impact studies and risk assessment for mining the Atlantis II deep, Red Sea.
Sibuet, M., L. Floury & G. Cahet (France): In situ deep-sea biological activity at the sediment-water interface by experiments with a submersible.
Soetaert, K., C. Heip & M. Vincx (Belgium): Deep-sea meiofauna off Corsica.
Wilson, R.R. Jr. (USA): Growth ring structure in otoliths of abyssal grenadiers of the eastern North Pacific.

Hjalmar Thiel and his associates had put a lot of work into preparing and running the meeting. They certainly did a fine job. It should also be acknowledged that the symposium was sponsored by the Behörde für Wissenschaft und Forschung (Authority for Science and Research) of the City of Hamburg and the Deutsche Forschungsgemeinschaft (German Science Foundation).

In his welcome address Hjalmar recalled that nine years ago 12 deep-sea biologists from five European countries (Germany, France, U.K., Sweden, and Denmark) met in Hamburg, exchanging views on ongoing research and the demand for future meetings. Two outcomes of our get-together were the present Deep-Sea Newsletter and an agreement that, if established, biological deep-sea symposia should be restricted to benthos (all 12 were benthologists!). Hjalmar went on to say that the number of deep-sea planktonologists seems to be low compared to ditto benthologists, while the opposite is apparently the case in the shallow-water environment. In the general biology section of the present meeting there are only five or six papers on plankton subjects against almost 40 on benthos. Hjalmar suggested that the next meeting may be arranged by deep-sea planktonologists to stimulate this line.

Whether or not this will be the case, there is an obvious demand for a continuation of these informal and informative meetings for deep-sea biologists.

During lunch on the last day some of us discussed possible locations next time, and a definite suggestion was put forward, but cannot yet be disclosed.

Just wait and see....

Torben Wolff

The Hamburg Symposium: The impact on deep-sea ecology by man's activities

Torben asked Hjalmar Thiel and me to write short reports on the "human impact" part of the Symposium and the deliberations of SCOR Working Group 76 which met immediately before the Symposium. Neither of us had, of course, produced anything by the time Torben's first deadline for this issue of the Newsletter had passed, and the following contributions have consequently been written in a rush.

Hjalmar's piece was written on the train between Hamburg and Brussels and sent to me to forward to Torben with my own.

Tony Rice

Man's impact on the deep sea

Several papers presented at the Symposium dealt with impact assessment studies associated with various types of human activity including:

- dumping of radioactive and chemical wastes and of munitions
- settlement of drilling muds
- mining of manganese nodules and of metalliferous muds
- legal aspects of these activities.

The results of these studies might be summarised as follows:

1. Impacts from dumping activities seem to have been minimal to date. However, we are unable to estimate the long-term effects, or to identify, satisfactorily, likely pathways of hazardous materials in the oceans.

2. Mining has not yet developed beyond the exploratory phase. Impact studies have been rather restricted, and the available results do not allow extrapolation to the likely effects of commercial scale mining. It appears that the required information will be obtained only by monitoring the effects of large-scale impacts on organisms and the environment. Such large-scale effects will be provided by pilot mining operations which will be conducted at 5-10% of the level of a commercial undertaking for a period of some months. Nevertheless, smaller operations should be used to develop and test assessment techniques.

During the Symposium many of us felt that we have a responsibility to make the risks known as soon as possible and to help in minimising these risks. Legal regulations, within which the commercial organisations have to operate, should insist upon risk assessment studies from a very early stage.

Hjalmar Thiel

SCOR Working Group 76 ("Ecology of the Deep Sea Floor") at the Hamburg Symposium

About two thirds of the Working Group met for two days before the Symposium in superb surroundings arranged for us by Hjalmar Thiel. We met a further couple of times for short meetings during the Symposium itself.

Our terms of reference, given in extensio in Deep-Sea Newsletter No.8, were both very broad and very vague, but the general objectives might be summarised as being to identify the types of information which would be required to measure or forecast the impact of man's activities on the deep-sea ecosystem, and to assess the extent to which we have or could obtain such information.

Under indecisive chairmanship we floundered badly at first and, in desperation, finally focussed our attention on our present ability to measure benthic and benthopelagic biomass and productivity throughout the size spectrum. We were very conscious of the lack of specialised knowledge in some areas within the group, particularly with regard to microbiology. Nevertheless, after much discussion, we came up with a series of technical requirements, presently unavailable, particularly for the study of the upper and lower extremes of the size range.

It was clearly impractical to go through the same process for all of the other aspects of deep-sea biology which require study, such as migrations, trophic relationships, reproduction and population structure. Instead, we discussed moregeneral topics

and concluded that the most practical way of accumulating information to assess the effect of a future disturbance/impact is to study actual impacts in the field. Although such impacts should ideally be designed and controlled by scientists, the technical difficulties and expense would probably be prohibitive. Instead, advantage should be taken of industrial operations, including pilot studies.

During the Symposium we learned of a joint German/French manganese nodule collector test planned for 1987. Our report therefore included a recommendation that this test project should be used as the basis of an impact study, though we were aware that past experience gives little cause for optimism that such a study would detect any significant effect (see Hjalmar's report on the meeting). It remains to be seen whether this recommendation will be acted upon.

In short, the WG meeting was rather unsatisfactory, and the future of the Group is therefore uncertain. Several members of the Group, and the SCOR Executive Committee, feel that our deliberations must be more focussed if we are to produce any useful conclusions/recommendations. We are currently exploring the nature of such a possible focus and, as Chairman of the WG, I would be happy to receive any comments/suggestions. The outcome will be reported in future Newsletters.

Tony Rice
IOS, Godalming, UK.

Fourth Symposium?

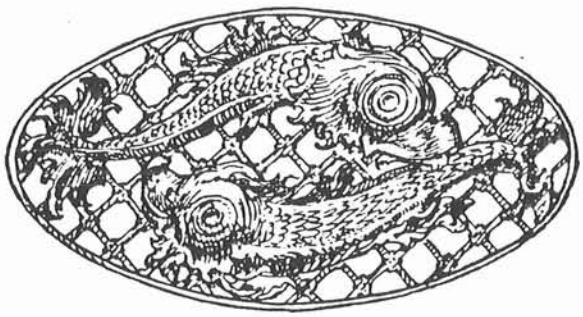
In his letter to those who had made preliminary reservations for the Hamburg Symposium, Hjalmar Thiel announced "one alteration of importance", stating that the Hamburg meeting would be the Fourth Deep Sea Biology Symposium, instead of - as earlier indicated - the Second Symposium. Quite correctly, he also counted the two symposia in 1977 in Sweden: "The Deep Sea - Ecology and Exploitation" in Stockholm and the subsequent "Deep-sea Faunas - History, Differentiation, and Adaptation" at Kristineberg Marine Biological Station.

However, since the war there has been at least one additional major symposium on deep-sea biology. In connection with the 14th International Congress of Zoology in Copenhagen in 1953, R. Spärck, President of the Congress, and Anton Bruun, Secretary General and Leader of the Galathea Expedition 1950-52, arranged an IUBS and UNESCO sponsored symposium, "On the Distribution and Origin of the Deep-Sea Bottom Fauna", with 14 contributions. One of the highlights was the paper on the deep-sea fauna in the NW Pacific by Professor L.A. Zenkevich, Moscow. For the first time the extensive exploration with the new "Vitjaz" in the Kurile-Kamchatka Trench was made known to the western world. The work was started in 1949 at bathyal and abyssal depths (one station at 8100 m) and included in 1953 another five stations at hadal depths.

If there are other international symposia on deep-sea biology which should also be included before we stop counting, the Editor would very much appreciate being informed.

Torben Wolff

P.S. Remaining copies of the 1953 Symposium publication (IUBS, Série B, No.16, 1954, 90 pp.) are available and will be sent by the Editor on request.



Salad days for swimming sea-cucumbers

Ever since Ludwig's (1894) exciting discovery of swimming holothurians, "Pelagothuria natatrix (pelagisch!)", pelagic sea-cucumbers have continued to be a source of wonderment whenever they have fallen prey to a pelagic net. Little is known of these marine cinderellas but recent discoveries have taken us some way to fitting the slipper.

Barnes et al. (1976) were the first to experience a close encounter of the holothurian kind when they literally bumped into aggregations of Peniagone diaphana swimming within 70 m of the seabed off southern California. John Miller (Harbor Branch Foundation) and Dave Pawson (Smithsonian Institution), amongst others, have also had some exciting experiences in the "Johnson-Sea-Link" submersible, observing and videotaping the graceful swimming movements of Enypniastes eximia in the western Atlantic (Pawson 1976; Miller & Pawson in prep.). In addition, Enypniastes has been studied in the Pacific by Ohta (1984), who has produced some magnificent stereo-pair photographs of this holothurian, while a remarkable new species, Peniagone leander (a real bruiser growing to at least 30 cm), has been described by Pawson & Foell (in press) from 5000 m in the Clipperton-Clarion Fracture Zone in the east Pacific. Are these holothurians merely freaks or are they representatives of a hitherto unrecognized component of the deep-sea benthopelagic fauna? The latter would seem to be true.

Recent work by the Institute of Oceanographic Sciences, UK, in the northeast Atlantic using trawls and photography has shown that pelagic holothurians are a conspicuous group of fauna living close to the seabed in all abyssal areas between 10 and 50°N. Three species, Peniagone diaphana, Enypniastes diaphana and Scotothuria herringi can be considered as truly pelagic holothurians, but nevertheless they appear to feed preferentially on superficial sediment. Their density is greatest close to the seabed, but some specimens have been collected hundreds and even thousands of metres above the seabed. Details are given in Billett, Hansen & Huggett (1985) which suggest that some holothurians may be capable of extensive migrations up through the water column acting as a link between deep-sea sediments and the upper waters of the ocean. The reasons for the migrations and their frequency are unknown. Some of the high-flying holothurians may be indulging in ontogenetic migrations. Further, the juveniles of several benthic holothurians have been found in the deep-sea plankton. These species, Psychropotes longicauda, P. depressa, Benthodytes lingua and B. typica produce large eggs, up to 4.5 mm in diameter, which are released into the water column and, in case of P. longicauda, develop into a juvenile several cm long.

The deep-sea benthopelagic zone, therefore, is a veritable hot-bed for swimming sea-cucumbers. They descend to the seabed to feed and as a consequence have been collected occasionally by benthic trawls. Some specimens, however, appear to make sortie up the water column. Our knowledge of these fascinating beasts is still in its infancy, but it is hoped that further specimens reaped from the deep-sea will mature these, our salad-days of swimming sea-cucumber research.

References:

Barnes, A.T., L.B. Quetin, J.J. Childress & D.L. Pawson, 1976: Deep-sea macroplanktonic sea-cucumbers: suspended sediment feeders captured from deep submergence vehicle. - Science 194: 1083-1085.

Billett, D.S.M., B. Hansen & Q.J. Huggett, 1985: Pelagic Holothurioidea (Echinodermata) of the northeast Atlantic. - Proc.Int.Conf.Echinoderms, Galway, Sept. 1984.

Ludwig, H., 1894: The Holothurioidea. Reports of an exploration ... "Albatross" 1891. - Mem.Mus.comp.Zool.Harv. 17: 1-183.

Ohta, S., 1984: Photographic observations of the swimming behaviour of the deep-sea pelagothuriid holothurians, Enypniastes (Elasipoda: Holothurioidea). - J.oceanogr. Soc.Japan 41: 121-133.

Pawson, D.L., 1976: Some aspects of the biology of deep-sea echinoderms. - Thalassia jugosl. 12: 287-293.

- 1982: Deep-sea echinoderms in the Tongue of the Ocean, Bahama Islands: a survey using the research submersible "Alvin". - Mem.Aust.Mus. No.16: 129-145.

- & E.J. Foell: Peniagone leander, new species, an abyssal benthopelagic sea-cucumber (Echinodermata: Holothurioidea) from the eastern central Pacific Ocean. - Bull.mar. Sci. (in press).

D.S.M. Billett
Inst. of Oceanogr. Sciences, Wormley

Bent Hansen
Zoological Museum, Copenhagen

The composition and distribution of the hydrothermal vent fauna

During 1985 I have prepared for a Danish popular scientific periodical ("Naturens Verden") an extensive survey article on many aspects of the hydrothermal vent communities.

Part of the preparation was a compilation of a list of all vent animals which have either been described or referred to in the already very extensive literature.

In order to throw light on a number of doubtful records and/or get more specific information I brought a copy of the list with me to the Hamburg deep-sea meeting and showed it to some of those who have been actively engaged in hydrothermal vent research.

In Hamburg several persons urged me to publish the list in English also, as they found that it represented a useful survey of the vent fauna. The list is of course primarily based on papers describing the vent species. In addition, many data were compiled from papers on vent ecology and articles of a more general nature, published in popular scientific periodicals and - should I thankfully add - the DEEP-SEA NEWSLETTER!

Several people have helped me in various ways: Daniel Desbruyères kindly supplied many of the data on the occurrence of vent species at 13°N, studied by the French during "Biocyatherm" in 1982 and "Biocyarise" in 1984; I am also grateful for the assistance given by James A. Blake (on new polychaetes published simultaneously with this Newsletter), by Bill Newman and by Bob Hessler. Bob's survey of the occurrence, feeding type and mobility of the megafauna of the Galapagos Rift vents (1984) induced me to try to include such information for as many vent animals as possible.

In spite of all care there may very well be errors in the list. I should be grateful to have such discrepancies pointed out.

The hydrothermal vent fauna at present contains 55 named species and another 43 decidedly new species plus at least three sea anemones and an unknown number of isopods, amphipods and probably other peracarids, etc.

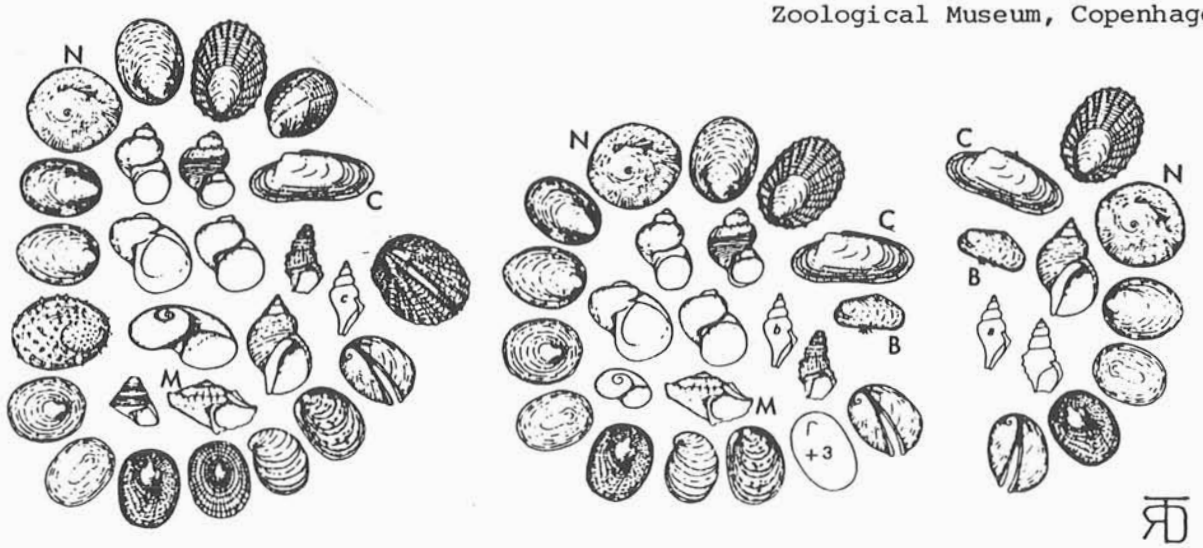
The excessive endemism of the hydrothermal fauna is clearly demonstrated by the list. If we deduct the 31 not yet described limpets and other gastropods from the 98 species, no less than 25 of the remaining 67 species (37%) belong either to two endemic superfamilies (3 crabs, 1 limpet), to four endemic families (5 polychaetes, 5 vestimentiferans and 1 enteropneust or acorn worm) or to four subfamilies (9 polychaetes and 1 scalpellid cirriped).

The above 25 species belong to 16 endemic genera; another 13 genera are also endemic. Thus, 61% of the 59 genera are endemic.

Finally, of a total of 98 species only two polychaetes, one shrimp and three fish species (which are not true vent animals) are not endemic species.

A similar endemism on the family, genus and species level is unknown anywhere else on this planet.

Torben Wolff
Zoological Museum, Copenhagen



Diversity in hydrothermal vent molluscs: altogether 35 species from the Galapagos area, 13°North and 21°North on the East Pacific Rise. B = Bathymodiolus thermophilis. C = Calyptogena magnifica. M = Melonodrymia aurantica. N = Neomphalus fretterae. (From R.D.Turner & R.A.Lutz, "Oceanus", 1984).

THE HYDROTHERMAL VENT COMMUNITY

(as of December 1985)

Endemism: ***** = endemic superfamily, family or subfamily; **** = endemic genus; * = endemic species. Distribution: (+) = identification uncertain; - = highly probable that the species is not found at the locality. Occurrence: nv = near vent, but not in vent opening; os = outside vent area; pe = periphery of vent area; vo = in vent opening. Feeding type: car = carnivore; chm = chemoautotroph; com = commensal; dep = deposit feeder; omn = omnivore; par = parasite; sca = scavenger; sus = suspension feeder. Mobility: sm = strongly mobile; wm = weakly mobile; ss = sessile.

Major taxon	Genus and species	Family	Galapagos	13°N	21°N	Occurrence	Feeding type	Mobility
CNIDARIA								
Actinaria	Small, transparent		+			vo	sus	ss
	Large, transparent, many tentacles		+	(+)		vo,nv	sus	ss
	Elongate, papillae in rows on column		+	(+)		pe	sus	ss
Siphonophora	****Thermopalia taraxaca* Pugh, 1983	Rhodaliidae	+	+	(+)	pe	sus	ss,?sb
	Smaller species				+		sus	ss,?sb
ANNELIDA								
Polychaeta	Harmothoe **macnabi* Pettibone, 1985	Polynoidae	+			vo	car	sm
	Iphionella **risensis* Pettibone, 1985	Polynoidae			+	vo	car	sm
	Macellicephala **galapagensis* Pettibone, 1985	Polynoidae	+			vo	car	sm
	****Levensteiniella kincaidi* Pettibone, 1985	Polynoidae	+	(+)	+	vo	car	sm
	*****Lepidonotopodium fimbriatum* Pettibone, 1983	Polynoidae		+	+	vo	car	sm
	*****Lepidonotopodium riftense* Pettibone, 1984	Polynoidae	+		+	vo	car	sm
	*****Lepidonotopodium williamsae* Pettibone, 1984	Polynoidae	+		+	vo	car	sm
	*****Branchipolynoe symmytilida* Pettibone, 1984	Polynoidae	+	+		vo,nv	com	sm
	*****Branchiplicatus cupreus* Pettibone, 1985	Polynoidae		+	+	vo	car	sm
	*****Branchinotogluma hessleri* Pettibone, 1985	Polynoidae	+		+	vo	car	sm
	*****Branchinotogluma sandersi* Pettibone, 1985	Polynoidae	+		+	vo	car	sm
	*****Branchinotogluma grasslei* Pettibone, *****Opisthotrochopodus alvinus* Pettibone, 1985	Polynoidae	+		+	vo	car	sm
	*Euphrosine **rosacea* Blake 1985[1]	Euphrosinidae	+			vo	?car	wm

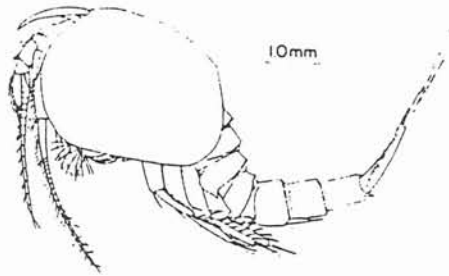
			Gala-pagos	13°N	21°N	Occur-rence	Feeding type	Mobility
Polychaeta	**Galapagomystides aristata Blake, 1985	Phyllodocidae			+	vo	car	sm
	Protomystides *papillosa Blake, 1985	Phyllodocidae			+	vo	car	sm
	**Hesiolyra bergi Blake, 1985	Hesionidae		+	+	vo	omn	sm
	Nereimyra *alvinae Blake, 1985[1]	Hesionidae	+			vo	omn	sm
	Orseis *grasslei Blake, 1985[2]	Hesionidae				vo	omn	sm
	Hesiospina *vestimentifera Blake, 1985	Hesionidae	+		+	vo	omn	sm
	Nereis *sandersi Blake, 1985[1]	Nereidae	+	+	+	vo,nv		sm
	Ceratocephale loveni pacifica Hartman, 1960[2]	Nereidae				pe		sm
	Glycera profundi Chamberlin, 1919[2]	Glyceridae				nv,pe	car	sm
	Ophryotrocha *akessoni Blake, 1985[1]	Dorvilleidae	+	+	+	vo,nv	?omn	wm
	Ophryotrocha *platykephale Blake, 1985[2]	Dorvilleidae				nv	?omn	wm
	Exallopus *jumarsi Blake, 1985	Dorvilleidae			+	nv	?omn	wm
	Orbiniella *aciculata Blake, 1985[3]	Orbiniidae	+			os	dep	wm
	Scoloplos (S.) *ehlersi Blake, 1985[3]	Orbiniidae	+			os	dep	wm
	Eunice *pulvinopalpata Fauchald, 1982	Eunicidae		+	+	vo	car	sm
	**Xandaros acanthodes Maciolek, 1981	Spionidae	+			vo	dep	ss
	Laubierellus *grasslei Maciolek, 1981	Spionidae	+			vo	dep	ss
	Prionospio (Minuspio) *sandersi Maciolek, 1981	Spionidae	+	+		vo	dep	ss
	Nichomache *arwidssoni Blake, 1985	Maldanidae	+	+	+	nv	dep	ss
	Amphisamytha *galapagensis Zottoli, 1983[4]	Ampharetidae	+	+	+		dep	sm
	***Alvinella pompejana Desbruyères & Laubier, 1980	Alvinellidae	-	+	+	vo	chm	ss
	***Alvinella n.sp., juvenile of A. pompejana	Alvinellidae	-	+	+	vo	chm	sm
	***Paralvinella grasslei Desbruyères & Laubier, 1982[4]	Alvinellidae	+	+	+	vo	dep	ss
	***Paralvinella n.sp.1 Desb.& Laubier[5]	Alvinellidae						
	***Paralvinella n.sp.2 Desb.& Laubier[5]	Alvinellidae						
	***Paralvinella n.sp.2, subsp.	Alvinellidae			+			
	**Laminatubus n.sp. Hove & Zibrowius	Serpulidae	+	+	+	nv,pe	sus	ss
	Protis *n.sp. Hove & Zibrowius	Serpulidae	+	+	+	nv,pe	sus	ss
Hirudinea	**Bathybdella sawyeri Burreson, 1981	Piscicolidae	+			vo	par	sm
VESTIMENTIFERA								
Axonobranchia	***Riftia pachyptila Jones, 1980	Riftiidae	+	+	+	vo	chm	ss
Basibranchia	***Tevnia jerichoana Jones, 1985	Tevniidae	-	+	-	vo	chm	ss
	***Oasisia alvinae Jones, 1985	Tevniidae			+	vo	chm	ss
	***Ridgeia piscesae Jones, 1985[5]	Ridgeiidae				vo	chm	ss
	***Ridgeia phaeophiale Jones, 1985[5]	Ridgeiidae				vo	chm	ss

			Gala-pagos	13°N	21°N	Occur-rence	Feeding type	Mobility
MOLLUSCA								
Bivalvia	Calyptogena *magnifica Boss & Turner, 1980[6]	Vesicomyidae	+	+[7]	+	vo	chm,?sus	wm
	**Bathymodiolus thermophilis Kenk & Wilson, ?1985	Mytilidae	+	+	-	vo	chm,?sus	wm
		Pectinidae		+			sus	ss,?wm
Gastropoda	***Neomphalus fretterae McLean, 1981	Neomphalidae	+	+	+	vo	sus,dep	ss,wm
	Limpets[8]		+	+	+	vo	sus,dep	ss,wm
	**Melanodrymia aurantica Hickman, 1984	?Trochacea[9]		+	+	vo	?dep	sm
		Turridae[10]	+	+	+	nv,pe	car	sm
	Various gastropods[11]		+	+	+	vo-pe		sm
Cephalopoda				+		vo,nv	?car	sm
CRUSTACEA								
Copepoda	**Ceuthoecetes algeri Humes & Dojiri, 1980	Dirivultidae	+	(+)	+	vo	sus	sm
	**Benthoxynus spiculifer Humes, 1984[5]	Dirivultidae				vo	sus	sm
	**Isaacsicalanus paucisetus Fleminger, 1983	Spinocalanidae			+	vo	sus	sm
	Parasitic copepod, on vent fish		+			vo	par	ss
Cirripedia	***Neolepas zevinae Newman, 1979	Scalpellidae		+	+	vo,nv	sus	ss
	Scillaelepas *n.sp.	Scalpellidae			+	vo,nv	sus	ss
	Verruca *n.sp.[12]	Verrucidae		+	+	vo,nv	sus	ss
Leptostraca	**Dahlella caldariensis Hessler, I984	Nebaliidae	+	+	+	vo	sus	sm
Isopoda Epicar.	**Thermaloniscus cotylophorus Bourdon, 1983	Cryptoniscina[9]		+		?vo	par	sm
Isopoda Asellota		Eurycopidae & Munnopsidae	+	(+)	(+)		dep	sm
Amphipoda[13]			+	+	+	vo,nv	dep,sca	sm
Caridea	**Alvinocaris lusca Williams & Chace, 1982	Bresiliidae	+	+		vo	dep,sca	sm
	Lebbeus *carinatus Saint Laurent, 1984	Hippolytidae		+		nv,pe	dep,sca	sm
	Small, red species		+			nv,pe	dep,sca	sm
	?Nematocarcinus sp.	Oplophoridae	+	+	+	pe	dep,sca	sm
	Systellaspis braueri (Balss, 1914)	Oplophoridae		+		pe,os	sca	sm
Anomura	Munidopsis *lentigo Williams & van Dover, 1983	Galatheidae	(+)	(+)	+	nv	sca	sm
	Munidopsis *n.sp., cf. subsquamosa Henderson, 1885	Galatheidae		+		nv	sca	sm
Brachyura	***Bythograea thermydron Williams, 1980	Bythograeidae	+	+	+	vo,nv	sca,car	sm
	***Bythograea microps Saint Laurent, 1984	Bythograeidae		+	+	vo,nv	sca,car	sm
	***Cyanagraea praedator Saint Laurent, 1984	Bythograeidae		+	+	vo,nv	sca,car	sm

			Gala-pagos	13°N	21°N	Occur-rence	Feeding type	Mobility
CHELICERATA								
Acari	Copidognathus *papillatus Kremtz, 1982	Halacaridae	+			vo	car	sm
BRACHIOPODA								
Inarticulata		Craniidae or Discinidae	+	(+)		pe	sus	ss
ECHINODERMATA								
Holothuroidea					+	vo	dep	sm
Ophiuroidea			+	+		pe,os	dep	sm
HEMICHORDATA								
Enteropneusta	***Saxipendium coronatum Woodwick & Sensenbaugh, 1985	Saxipendiidae	+	-		nv-os	?sus	ss
VERTEBRATA								
Osteichthyes	?Diplacanthopoma *n.sp.	Bythitidae	+	(+)	-	vo	?chm	sm
	Coryphaenoides bulbiceps (Garman, 1899)	Macrouridae	+			nv-os	sca,car	sm
	Coryphaenoides anguliceps (Garman, 1899)	Macrouridae	+			nv-os	car	sm
	Bassozetus sp.	Ophidiidae	+			nv-os	car	sm
	Acanthonus armatus Günther, 1878	Ophidiidae	+			nv-os	car	sm
	Pachycara sp.	Zoarcidae		+	+	nv-os	sca,car	sm
		Zoarcidae	+			nv-os	sca,car	sm
	Halosaur (dark)	Halosauridae	+	(+)		nv-os	car	sm
	Halosaur (pale)	Halosauridae	+			nv-os	car	sm
	Skate (broad snout)	Rajidae	+	-		nv-os	car	sm
	Skate (narrow snout)	Rajidae	+	-		nv-os	car	sm

1) Also at Guaymas in Baja California. 2) Only at Guaymas. 3) In old vent site. 4) Also at Juan de Fuca (off Oregon, 45°N). 5) Only at Juan de Fuca. 6) Also in cold seep area at 2000 m off Oregon. 7) Only dead specimens. 8) Altogether 18 species (5 common to all three localities, 5 common to 13°N and 21°N, 4 only at 13°N and 4 only at 21°N). 9) Only referred to superfamily. 10) Three species, one at each locality. 11) Altogether 10 species (1 only at Galapagos, 1 common to Galapagos and 21°N, 5 common to 13°N and 21°N, 1 only at 13°N and 2 only at 21°N). 12) Two species, one at each locality. 13) Several species.

Zoëa of Bythograea thermydron



Dahlella caldariensis

Mode of occurrence of Calyptogena soyoae observed from the Japanese submersible "Shinkai 2000" in Sagami Bay.

Precisely thirty years ago Dr. Takashi Okutani obtained several dead specimens of a species of the giant clam Calyptogena on muddy bottom in the eastern part of Sagami Bay at 35°05.1'N 139°33.3'E, 750 m. These specimens, two conjoined and several odd valves, were collected by a beam trawl of Agassiz-Sigsbee type on board the R/V "Soyo-Maru" of the Tokai Regional Fisheries Research Institute (Tokyo). After the cruise Dr. Okutani kindly showed these specimens to the senior author (M.H.), and we discussed the taxonomy of this bivalve, which was apparently new to the Japanese malacofauna. Although the species is similar to Akebiconcha kawamurai Kuroda, which was described in 1943 from off Odawara in the northwestern corner of Sagami Bay, the Soyo-Maru specimens were longer, more slender and compressed in outline, and had an inwardly arcuated, ventral margin. They were rather similar to a Japanese fossil species of Miocene age, Calyptogena nipponica Oinomikado & Kanehara, 1938. Dr. Okutani named the new species Calyptogena soyoae after the research vessel.

Soon after this, the senior author had a chance to look at an abundant occurrence of the fossil Calyptogena nipponica in the Ikego Formation, near a town at the north-eastern corner of Sagami Bay. Many conjoined valves of fossil were seen stacked in a matrix of sedimentary rock composed of pyroclastic sand grains, which gives a vivid impression of the gregarious mode of life of this bivalve (this locality and another one were later described by Shikama & Masujima, 1969).

It was natural to assume that living forms also have a similar mode of occurrence on a level bottom of mud or sandy mud, and to expect that it should be possible to dredge numerous live specimens. Three years later, in 1958, Dr. Okutani collected five more conjoined valves, but found no live specimens (Okutani, 1962). Later the present senior author established a good number of trawling stations in Sagami Bay, hoping to collect some of these interesting species - but in vain. It has been a puzzling question for both of us why living specimens of such a gregarious bivalve have not been collected in Sagami Bay. However, it was long after the initial finding of live specimens and observation of mode occurrence of fossil forms in the mid-1950ies that an answer to our unsolved puzzle was given.

Since 1983, Japanese marine scientists have been able to make deep-sea dives in the Japanese submersible "Shinkai 2000" ("Deep Sea 2000") of the Japan Marine Science and Technology Center (JAMSTEC). During Dive 115 (5 June 1984), Mr. K. Egawa of the Kanagawa Prefectural Fisheries Experimental Station observed both living specimens and empty shells of Calyptogena soyoae in the northwestern part of Sagami Bay (35°01'N 139°12'E) at 1134-476 m. The shells were seen on a black muddy bottom at depths between 1100 and 800 m, together with several specimens of a lithodid crab (Sugiura & Egawa, 1985; Okutani & Egawa, in press).

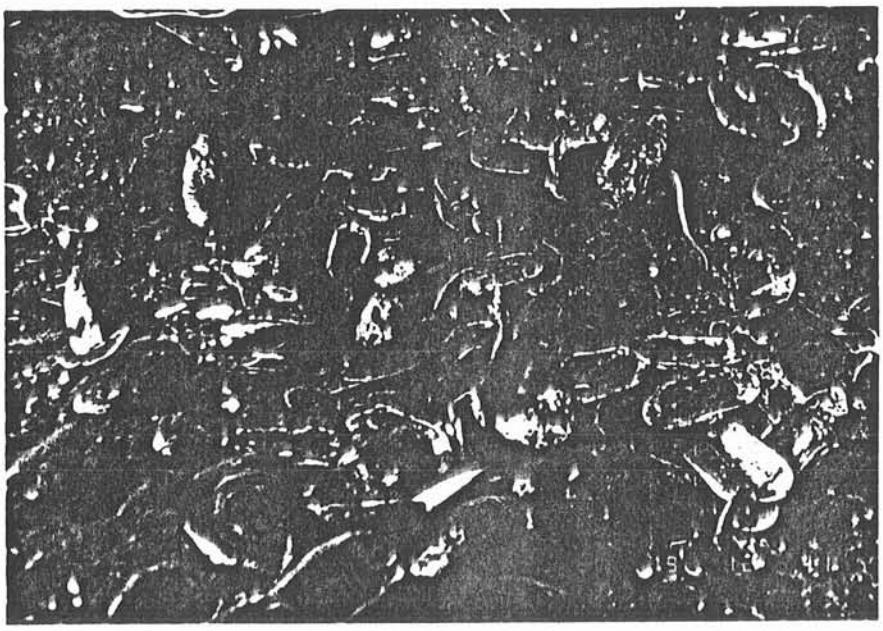


Fig. 1.

A colony of Calyptogena soyoae in the western part of Sagami Bay. Several live specimens standing on the black muddy bottom are seen. (T. Ishii photo)

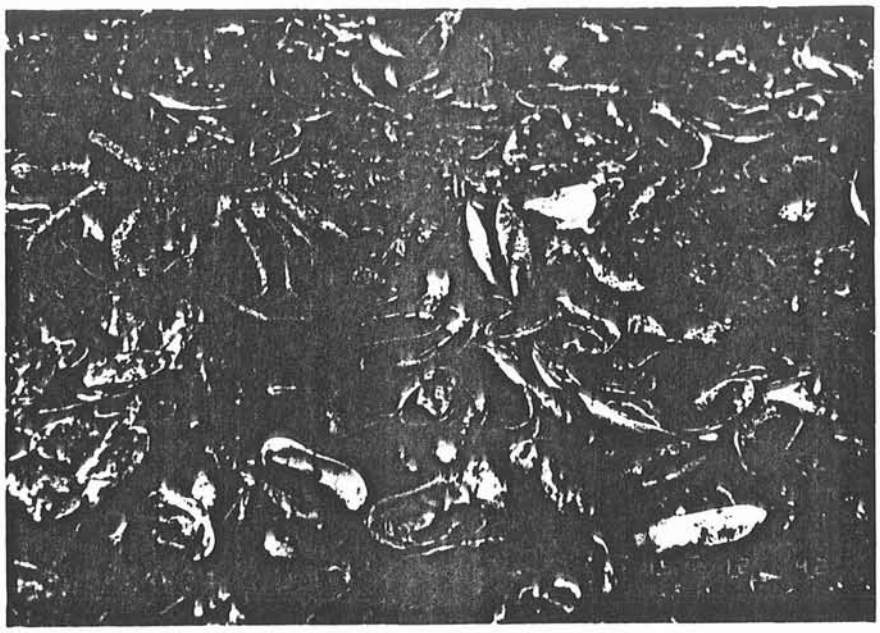


Fig. 2.

A lithodid crab, Paralomis multispina, actively feeding in the colony of Calyptogena soyoae, in Sagami Bay.
(T. Ishii photo)

Earlier this year the junior author (T.I.) also had an opportunity to make a closer examination of this bivalve in the same area, during Dive 177 (19 June 1985 at 35°0.1'N 139°13.7'E, 1250-1005 m). Between 1050 and 1030 m there was a precipitous cliff, in a part of which was seen a basaltic lava flow with a pillow-lavalike appearance.

On a level bottom at the foot of the cliff (1210 m) a colony of Calyptogena soyoae was found, together with a "graveyard" (dead assemblage) of the same species in a shallower location (1100 m). The sediment within the 8x4 m colony was dark gray to black sandy silt, showing a clear contrast to the surrounding sediments of fine grayish green silt. There were many dead shells, either conjoined or odd valves, and several living specimens with reddish soft parts projecting either perpendicularly or obliquely from the bottom (Fig.1) A lithodid crab, Paralomis multispina (Benedict), was also seen in this area (Fig.2). The crabs were observed actively scooping up the black sediment and feeding on it in the same way as described by the later Professor Gunnar Thorson (1971) in the case of the hermit crab, Pagurus bernhardus. The feeding activity of crabs occurred exclusively within the confines of the black mud of the bivalve colony, and no crabs were found in the immediate vicinity of the colony.

This seems to indicate that the sediment was more nutritious than in the surrounding area, and suggests that the bivalve colony may have developed in a small area of seepage of underground water. Similar circumstances were also inferred for colonies of at least two Calyptogena species found and collected by French and Japanese geologists and geophysicists off the south coast of Central Japan and in the Japan Trench, during dives of the French submersible "Nautile" as part of the French-Japanese project "KAIKO" (1984-1985: CNRS, IFREMER, MONBUSHO, PIROCEAN). The biological results of the KAIKO dives will be reported by Professor Lucien Laubier and Dr. Suguru Ohta, the coordinators of the biological studies of the KAIKO Project on the French and Japanese sides, respectively.

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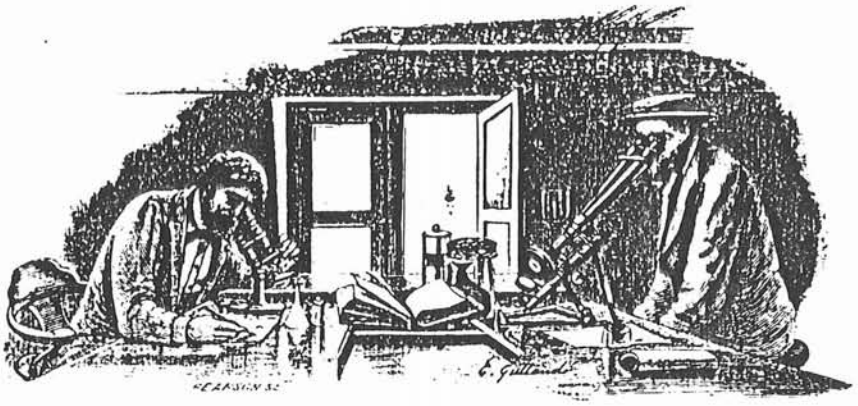

Cold seep communities at 3800 and 5850 m off Japan

During June, July and August 1985, the new French deep-sea research vehicle, "Nautile", has been utilized by a French-Japanese scientific group of geophysicists, geologists and geochemists to study the subduction process in the Japan and Naukaï Trenches. This submersible is able to dive to 6000 m depth, and some 45 dives have been performed. Deep-sea biologists did not participate in this project.

One of the major results of this program, named Kaiko (i.e., trench, in Japanese), was the discovery of several types of cold-water oases at depths of 3800 and 5850 m. Before describing these cold-water animal communities, the geological and geophysical framework must be recalled: due to the subduction processes, sediments are strongly compressed at the subduction edge between the continental plate and the oceanic crust; heavy accumulations of sediments also occur on the so-called accretive prism. Under such conditions, the pore water seeps out of the sediment. This pore water, from its composition in methane and minerals, seems to originate from several kilometers below the sea bottom.

One of the hypotheses of the Kaiko program was that such pore water, enriched by methane and other minerals, might support chemosynthetic, methylotrophic bacteria, with possible associated invertebrates. Such a phenomenon was discovered in mid-1984 by the US "Alvin", diving at 2000 m off the Oregon coast, where the oceanic plate is subducted below the American continent. The community off Oregon is characterized by the vestimentiferan Lamellibrachia barhami and the large vesicomyid clam Calyptogena magnifica, together with several other "ordinary" deep-sea species. The pore water seeps out of the sediment without temperature anomaly, and is rich in methane and ammonia.

The Japanese deep-sea oases are characterized by large bivalves. No Vestimentifera have been seen during the dives of the "Nautile". At both depths, 3800 and 5850 m, the oases appear as circular spots 2-3 m in diameter with high-density accumulations of bivalves, about 1-200 individuals per square meter! Assuming an individual total fresh weight of a few tens of grams, the total biomass of a given oasis represents a huge quantity of organic matter.

At 3800 m in the Tenryu Canyon and along the Zenisu Trench, the bivalves belong to the well-known vesicomyid genus Calyptogena. At least two species occur, and they both differ from the large hydrothermal clam C. magnifica. Like several other species of the genus, their tissues are strongly coloured in red by respiratory pigments.

Several "ordinary" deep-sea species are concentrated at the edge of the oases: holothurians (elasipods), actinians, serpulids, gastropods and others.

A preliminary report on these oases was presented at the Hamburg meeting by Dr. Suguru Ohta. At the time of the meeting, the deeper oases at 5850 m had no yet been discovered. These have been found at two localities in the Japan Trench, chosen because of the presence of submarine volcanoes coming in collision with the Japanese plate: mounts Kashima and Erimo. The oases are similar in size and appearance to the Calyptogena ones. But the bivalves belong to a completely different family, as yet unidentified, with long and slender shells. These animals measure 18-20 cm in length. Their tissues are densely pigmented red by some kind of respiratory pigment. When broken by one of the prehensile arms of the "Nautile", a bloodlike fluid spreads in the water!

The "opprotunistic" fauna is very scarce compared to that of the 3800 m depth oases; this could be due to the greater depths.

These discoveries demonstrate that chemosynthetic processes with high-biomass animal communities can occur in subduction zones, and that they are not limited by the depth, at least up to 6000 m. Such animal communities can also be used to locate geologically critical areas.

The study of the biological samples collected by the "Nautile" will be performed with respect to the general policy of the Kaiko project, i.e., a joint Japanese-French research program: Japanese and French biologists should work together, and papers should be cosigned by scientists from both countries. We hope to be able to present a comprehensive account during a Kaiko scientific symposium scheduled for the autumn of 1986 in Tokyo, Japan.

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