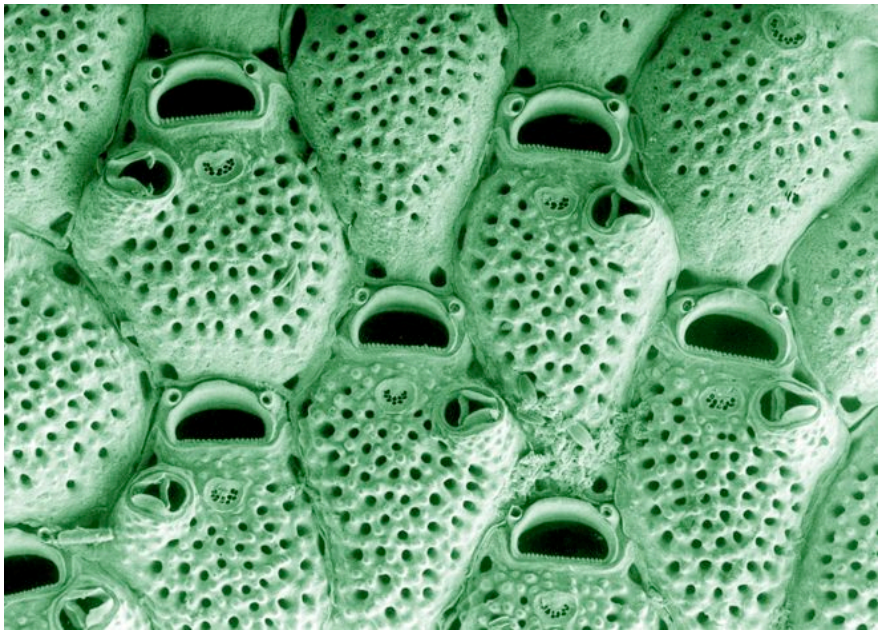
INTERNATIONAL BRYOZOOLOGY ASSOCIATION

LARWOOD MEETING 2006



Department of Geology, Trinity College,
Dublin 2, Ireland

Friday 10th March 2006

LARWOOD MEETING 2006

Department of Geology, Trinity College, Dublin, Ireland
Friday 10th March 2006
PROGRAMME

9.00 am **REGISTRATION**

SESSION 1. Chair: Patrick Wyse Jackson

9.30 am **Paul D. Taylor & Andrej Ernst:** Jurassic bryozoan diversity, disparity and biogeography

9.50 am **Björn Berning:** Late Neogene bryogeography of southern Spain revisited

10.10 am **Joanne S. Porter, Jasmine Sharpe, Mike Winson, Jo Hamilton and Peter Brophy:** Bryozoology in the new millennium; the proteomics era

10.30 am **Andrej Ernst, Baba Senowbari-Daryan, Ali Hamedani & Koorosch Rashidi:** Permian Bryozoa of Iran

10.50 am **COFFEE/TEA BREAK**

SESSION 2. Chair: Paul Taylor

11.20 pm **Anton Tsyganov:** Molecular and Morphological Phylogeny of Cyclostomate & Ctenostomate Bryozoa

11.40 am **Hanna-Leena Hartikainen & Beth Okamura:** Abundance of phylactolaemate bryozoans in relation to nutrient levels in rivers

12.00 noon **Andrea Waeschenbach, M.J. Telford, J.S. Porter & D.T.J. Littlewood:** Lophophorates – position in the Bilateria, inferences from mitogenomics

12.20 pm **Jasmine H Sharp & Joanne S Porter:** Life on the edge: Differential Fouling in *Pentapora foliacea*

12.40 pm **Margret Steinthorsdottir:** Carboniferous Bryozoa from Hook Head, Co. Wexford, Ireland

COVER IMAGE: Courtesy of Abby Smith

1.00 pm **LUNCH**

SESSION 3. Chair: Mary Spencer Jones

2.00 pm **Eckart Håkansson, Margret Steinthorsdottir & Scott Lidgard:** Dynamics, bryozoan thickets & topography * main ingredients in a paleobathymetric analysis of the Pliocene Kolymbia Limestone type area.

2.20 pm **Urszula Hara:** Oxfordian bryozoans of the southern Poland: palaeoenvironmental and biogeographical implications

2.40 pm **Eckart Håkansson, Anne Mehlin Sørensen & Lars Stemmerik:** Late Permian environmental clines and bryozoan distribution in the Late Permian of the North Atlantic region

3.00 pm **Patrick N. Wyse Jackson, Marcus M. Key, Jr. & Michael E. Burns:** Bored bryozoans from the Ordovician of Estonia: a biological reinterpretation of the ichnogenus *Sanctum* Erickson & Bouchard, 2003

3.20 pm **COFFEE/TEA BREAK**

SESSION 4. Chair: Patrick Wyse Jackson

4.10 pm

4.30 pm

7.30 pm **Meal in Patrick's house, 8 Effra Road, Rathmines, Dublin 6 (Tel: 4974674)**

POSTERS

Andrej Ernst: Devonian Bryozoa in Germany: ongoing research

T. Knowles, M. Williams, P.D. Taylor & B. Okamura: Using bryozoans to infer patterns of global warming: a pilot study.

Oscar Reverter-Gil, Eugenio Fernández-Pulpeiro & Javier Souto-Derungs: The Iberian Fauna Project: Bryozoans - a forthcoming research project.

Javier Souto-Derungs, Eugenio Fernández-Pulpeiro & Oscar Reverter-Gil: Bryozoans collected during the expeditions of the *Pourquoi Pas?* from the English Channel and around the British Isles: preliminary results.

DELEGATES

Ann-Margret Amui (National University of Ireland, Galway)

Björn Berning (Universität Graz)

Hans De Blauwe (Belgium)

Andrej Ernst (Universität Kiel)

Eckart Håkansson (Institute of Geology, Copenhagen, Denmark)

Urszula Hara (Polish Geological Institute)

Hanna-Leena Hartikainen (University of Reading)

Samantha Hill (University of Reading)

Tanya Knowles (University of Reading)

Joanne Porter (University of Wales Aberystwyth)

Oscar Reverter-Gil (Universidade de Santiago de Compostela)

Jasmine H Sharp (University of Wales Aberystwyth)

Javier Souto Derungs (Universidade de Santiago de Compostela)

Mary Spencer Jones (Natural History Museum, London)

Margret Steinthorsdottir (Trinity College, Dublin)

Paul Taylor (Natural History Museum, London)

Francesco Toscano (Università di Napoli)

Anton Tsyganov (University of Wales, Swansea)

Sylviane Vaucheret (National Museum of Ireland)

Andrea Waeschenbach (Natural History Museum, London)

Patrick Wyse Jackson (Trinity College, Dublin)

Late Neogene bryogeography of southern Spain revisited

Björn Berning

Geologisch-Paläontologisches Institut, Universität Hamburg, Bundesstr. 55, 20146 Hamburg, Germany. Present address: Institut für Geologie und Paläontologie, Universität Graz, Heinrichstr. 26, 8010 Graz, Austria. Email: berningb@gmx.de

During the late Miocene the connecting straits between the Atlantic-Mediterranean increasingly narrowed and, ultimately, closed during the Messinian, which resulted in the evaporation of the Mediterranean Sea, an event known as the Messinian salinity crisis (MSC). The present investigation of a bryozoan fauna from an Atlantic basin, which remained unaffected by the MSC, revealed that some 38% of the occurring species were hitherto regarded as Mediterranean endemics. Their presence in the Atlantic thus provides evidence for a greater exchange of surface water between the Atlantic and Mediterranean Sea during the late Miocene and corroborates evidence obtained from the analysis of current-indicative sedimentary structures. These suggest a westward flow of surface water through the Spanish straits. On the other hand, the great percentage of Mediterranean 'endemics' occurring in the Atlantic does not support the common held view of the existence of fully marine, intra-Mediterranean refuges during the crisis in order to explain the relatively high proportion of 'endemic' species surviving the MSC. The eastern Atlantic is therefore likely to have served as a refuge for Mediterranean faunas during the drying up of the Mediterranean Sea in the late Messinian, and as the source area for resettlement after the crisis.

Interestingly, there is only a very weak relationship between the analysed southern Spanish fauna and Neogene Atlantic faunas further to the north (NW France, North Sea Basin), while a great number of species is shared with Middle Miocene faunas of the Paratethys, and Pliocene ones of the Mediterranean Sea. This suggests that bioprovinces were communicating and relatively stable throughout the Neogene along latitudes, while longitudinal species exchange between western European regions was persistently low. In contrast, the great percentage of shared species between the modern North Sea Basin and the Mediterranean Sea strongly suggests that mankind has played a more important role in changing the composition of bryozoan faunas in (pre-scientific) historic times than previously acknowledged.

Back to the late Miocene: intraspecific comparison of morphometric data between faunas from the Atlantic and nearly coeval Mediterranean locations showed that zooid and colony size is generally smaller in species occurring in the Atlantic. Interpretation and comparison of the respective local environments, as well as a more detailed analysis of fossil and Recent *Myriapora truncata* from different Mediterranean sites, revealed that, under natural conditions, food supply may be a significant determinant of zooid and colony morphology. This is in contrast to the previously held notion that temperature is the single most important control factor.

Devonian Bryozoa in Germany: ongoing research

Andrej Ernst

Institut für Geowissenschaften, Universität Kiel, Olshausenstrasse 40, Kiel, D-24118, Germany (ae@gpi.uni-kiel.de)

Devonian bryozoans in Germany are poorly investigated. Only few publications are known, regarding mostly fenestellid and hederelloid bryozoans. However, some specimens from the Cürten-Formation, (Eifelian to Givetian) from Dollendorfer Depression (Rheinisches Schiefergebirge) contain surprisingly rich bryozoan fauna, which is excellently preserved. The fauna includes fistuliporid *Fistulipora* cf. *pavimentum* Bigey, 1988, rhabdomesid *Acanthoclema distilus* Bigey, 1988, bifoliate cryptostome *Intrapora* sp. and some unidentified encrusting trepostomes as well as different fenestrate bryozoans. The genus *Intrapora* is recorded first time from the Devonian of Europe. In course of ongoing research, Devonian bryozoans will be investigated from different localities in Germany as well as from available collections at German museums.

Permian Bryozoa of Iran

Andrej Ernst

Institut für Geowissenschaften, Universität Kiel, Olshausenstrasse 40, Kiel, D-24118, Germany (ae@gpi.uni-kiel.de)

Baba Senowbari-Daryan

Institute of Paleontology, University of Erlangen-Nürnberg, Loewenichstr. 28, D-91054 Erlangen, Germany

Ali Hamedani

University of Esfahan, Faculty of Earth Sciences, Esfahan, Iran

Koorosch Rashidi

University of Payam-e Noor, Ardakan, Iran

Permian marine sediments belonging to the Tethyan realm contain rich marine faunas including also bryozoans. Permian Bryozoa from Iran, however, are still scarcely investigated. The studied material comes from different localities in Iran.

The Lower Permian bryozoans from Jamal Formation, exposed in Bagh-e Vang (Shotori Mountains, northeast Iran) are represented by fistuliporids, bifoliate cystoporates, different rhabdomesids and fenestellids, and few trepostomids and girtyporids. They show connections to the Lower Permian (preferably Artinskian to Kungurian) of the Urals, Australia and Oman.

The Upper Permian part of the Jamal Formation, exposed in Lakaftari area, south of the town of Bagher-Abad, northeast of Esfahan (central Iran) contains also very rich bryozoan fauna. The majority of the 31 species from Upper Permian localities were previously reported from the Gnishik horizon of Caucasus, which is regarded as Murghabian (= Wordian) in age. Otherwise, connections with the Uralian Sea and Russian plate are also obvious. The absolutely dominating group under bryozoan fauna from the Permian of Iran are fenestellids. They are also the largest and most abundant bryozoans exceeding sometimes 20 cm in highness. Only one trepostome bryozoan has been identified among 41 species. The new genus *Lakkella jamalica* n. gen. et sp. belongs to the family Chainodictyonidae, Suborder Phylloporinina.

Some few specimens from the Upper Permian of Abadeh (northern Iran) contain different ramose *Fistulipora* species and two fenstellids, *Polypora* and *Septopora*. Their age is estimated to be younger than at Lakaftari locality, with possible palaeogeographic connections to Caucasus, Pakistan and China.

Oxfordian bryozoans of the southern Poland: palaeoenvironmental and biogeographical implications

Urszula Hara, Polish Geological Institute, Rakowiecka 4, 00-975 Warszawa;
urszula.hara@pgi.gov.pl

The Upper Jurassic (Oxfordian) bryozoan faunas of the southern Poland add to the fossil record a new taxonomical data. Distinctive, encrusting Lower Oxfordian epibenthic bryozoans in the vicinity of Cracow in Zalas are restricted to a few cyclostome genera. The basal part of the Lower Jurassic marly limestones between the Q. *lambertii* and Q. *mariae* zones has a hard ground character where the numerous accompanying fauna is abundantly covered by the dominant, encrusting unilamellar sheets and runners. In terms of the higher taxa the Zalas bryozoans are dominated by tubuloporines which form fan-shaped or discoidal (bereniciform), encrusting colonies previously so-called '*Berenicea*', a bryozoan ubiquitous in the Jurassic. The detailed morphological studies of the gynozooecia reveal the presence of the new species belonging to the *Microeciella* Taylor & Sequeiros, 1982 genus. Another encrusting, tubuliporinid colonies which form flabelliform or discoidal zoaria, are represented by *Hyporosopora* Canu & Bassler, 1929. Numerous are also undeterminated bereniform tubuliporinids. Bryozoans encrust, share and colonise the same substrate as the numerous serpulid worms suggesting an intense competition for the substrate space what often characterises the epifaunal communities. In the context of biodiversity the considerable attention should be paid to the recently studied Early Oxfordian bryozoan assemblage from the NW margin of the Holy Cross Mts. (_mielów area). Elevated parts of sea bottom were occupied since the Early Oxfordian by the sponge bioherm and than successively colonized by the coral reefs, among which the bryozoans are important element of _mielów biota. The majority of the bryozoans of the sponge bioherms reveal the massive, fungiform, encrusting and branched colony-forms, among which eight species belonging to eight genera have been distinguished: *Oncousoecia* sp., *Radicipora radiciformis* (Goldfuss, 1826), *Idmonea* sp. *Reptomultisparsa* sp., *Mecynoecia* sp. *Ceriocava corymbosa* (Lamouroux, 1821), *Theonea chlatrata* Lamouroux, 1821 and *Apsendesia cristata* Lamouroux, 1821. The analysis of the colony-growth pattern of both bryozoan assemblages as well as their state of preservation are very significant for the palaeoecological aspects connected with such factors as the morphology of the sea bottom, a kind of substratum, the hydrodynamic conditions and a water depth.The Jurassic bryozoan fauna of the southern Poland has a great significane for an answer whether they started to radiate in the Upper Jurassic, or earlier if their occurrence was mostly connected with the facies migration from the west to the east. The recently collected bryozoan material from Zalas on the other hand shows the similarities with the taxonomic composition of the palaeogeographically distant Middle Jurassic bryozoan fauna of the Carmel Formation (Utah) in the North America (see also Taylor and Wilson, 1999) but also with the Middle Jurassic fauna the Saone-Rhine basin (France) and the Swabia basin of Germany. The taxonomic studies of the moderately rich bryozoan assemblages of the southern Poland cast a new light on their evolution, distribution pattern and the migration routes especially during the Upper Jurassic, globally.

Abundance of phylactolaemate bryozoans in relation to nutrient levels in rivers

Hanna-Leena Hartikainen & Beth Okamura

School of Biological Sciences, The University of Reading, AMS Building, Whiteknights, Reading RG6 6AJ, United Kingdom

This presentation reports results from on-going research on the abundance of freshwater bryozoans in rivers with a range of nutrient levels in southeast England. We describe a new method for indirectly quantifying bryozoan abundance, without the need to locate the often elusive colonies. The research presented here is part of a larger project to investigate the abundance and growth of freshwater bryozoans across a gradient of nutrient concentrations.

Freshwater bryozoans (Phylactolaemata) are sometimes described as mainly occurring in non-eutrophicated waters. For example, the disappearance of the rare *Lophopus crystallinus* from the Norfolk Broads has been attributed to increased anthropogenic nutrient enrichment of these shallow basins. Conversely, bryozoans have been noted to grow in grossly polluted conditions, including in agriculturally fertilised ponds, downstream from sewage outlets and even in sewage treatment works where they can cause significant problems by clogging pipes and growing in settling pools. The research presented here is aimed at clarifying some aspects of the relationship between the abundance of these suspension feeding animals and the environmental variables that are associated with increasing nutrient enrichment in freshwaters.

High nutrient concentrations stimulate algal production and thus potentially increase the suspended food of bryozoans. To test if bryozoans are more abundant in nutrient-rich rivers than in low nutrient (mainly chalk streams) rivers, a two-year field sampling programme was started in autumn 2005. 12 sampling sites were selected using data collected by the Environment Agency on nutrient concentrations in the rivers, discharge rates and other catchment characteristics. Three replicates of funnel-shaped traps (made of netting with a 280mm size mesh) were suspended in each sampling location from September to November. Material retained in each trap was collected every 14 days, and the statoblasts present in the material were enumerated. The relative abundances of statoblasts in the sampling sites were calculated as a function of the number of statoblasts recorded in each sampling period and the total volume of water passing through the nets during the same period.

Statoblasts were present in all of the 12 sampling sites, although very few were recorded in the low nutrient rivers. Rivers with high nutrient levels had the most statoblasts and one high nutrient site had exceptionally high numbers of *Plumatella* statoblasts. Statoblasts of the rare bryozoan *Lophopus crystallinus* were not found in low nutrient rivers but were present in 3 out of the 4 high nutrient sites. *Plumatella* statoblasts dominated the samples and a variety of species were observed, including a round plumatellid statoblast not previously recorded in the UK.

Using bryozoans to infer patterns of global warming: a pilot study

T. Knowles[1], M. Williams[2], P.D. Taylor[3] & B. Okamura[1]

[1] School of Biological Sciences, The University of Reading, Reading RG6 6AJ, UK; [2] School of Earth & Environmental Sciences, University of Portsmouth, Burnaby Road, Portsmouth PO1 3QL, UK; [3] Department of Palaeontology, Natural History Museum, London SW7 3BD, UK

The amount of carbon dioxide in the Earth's atmosphere (currently about 380 ppm) has been significantly influenced by industrialisation, and is predicted to increase rapidly during this century, to levels perhaps in excess of 540 ppm (Intergovernmental Panel on Climate Change, 2001). Increasing levels of atmospheric CO^2 are strongly implicated in global warming. Fossil, geochemical and climate model evidence indicate that the last time that Earth's climate was much warmer than today was during the mid Pliocene (3.29-2.97 Ma). Thus, patterns of sea surface temperature (SST) during the mid Pliocene may exemplify temperature regimes that will arise as a consequence of current global warming. Estimates of ancient SST can be gleaned from the geochemistry of biogenic carbonates, from fossil assemblage data and from fossil morphology. Although the interpretation of SST from the Pliocene has been previously attempted using forams, failure to account for the taphonomic state of the material may have seriously compromised the validity of SST estimates based on isotopic analyses (Williams et al. 2005).

Cheilostome bryozoans offer a means of gaining important insights into palaeo-environmental temperature regimes since zooid size varies as a function of temperature. We are undertaking a large-scale study to characterize mid Pliocene temperature regimes in the North Atlantic (coastal Costa Rica, Florida, Britain) using a technique developed by O'Dea and Okamura (2000) which is based on this relationship between zooid size and temperature. The technique allows estimation of the Mean Annual Range of Temperature (MART) experienced by cheilostome bryozoans by assessing variability in zooid area. In addition to undertaking MART analysis to characterise temperature variation we will use the inverse relationship between temperature and zooid area to identify zooids budded during summer and winter. The stable isotope signature of the carbonate skeleton of zooids budded at these times can then be used as an independent proxy for assessing seasonality.

Here we report results of a pilot study that aims to compare the relative precision resulting from different approaches to estimating zooid areas. In particular we compare data on zooid areas derived from: 1) digital SEM images using the programme ImageJ; 2) digital stereomicroscope images using ImageJ; and 3) direct maximum length and width measurements using stereomicroscopy and an ocular micrometre as effected by O'Dea and Okamura (2000). The study is based on specimens from two different species, *Biflustra savartii* and *Pentapora pertusa,* both abundant in the mid Pliocene Coralline Crag deposits of East Anglia, UK.

Our pilot study should help to resolve the best approach to estimate zooid areas. We then aim to enhance our understanding of Pliocene SST's by identifying summer and winter zooids that are unaffected by diagenesis and secondary calcite deposits (using SEM) thereby avoiding false temperature signals. State of the art micromilling techniques will subsequently be used to extract material from zooid walls for stable isotope analysis.

Bryozoology in the new millennium; the proteomics era

Joanne S. Porter, Jasmine Sharpe, Mike Winson, Jo Hamilton and Peter Brophy

The application of modern molecular techniques in the study of Bryozoology has been relatively slow compared with other phyla. In recent years a number of studies on the phylogenetic relationships among bryozoan taxa have started to emerge, using the relationships of DNA sequences from different taxa.

The Bryozoa are not model organisms, in the molecular sense, and hence there is currently no nuclear genome mapping project in progress. Recent progress has however been made in terms of the sequencing of the first mitochondrial genome and this in turn has led to the development of markers which will be important in the future study of bryozoan population genetics, phylogeography and phylogenetics. These sequences together with a limited number of nuclear genes are deposited in the NCBI/EMBL databases. Such sequences have been deposited as a result of specific projects on individual genes, mainly from population surveys.

A different approach to bryozoological studies can be taken by looking at the proteome ie. the complement of proteins activated in a bryozoan at any particular time. The complement of proteins present at any time is indicative of the processes taking place within the organism at that particular time, and also indicative of the environmental conditions in which the organism is living.

Here we present for the first time, results of a study of the proteome of *Flustra foliacea*. Techniques used involve 2DE gel electrophoresis, enabling the resolution of proteins in two dimensions. Initial results have revealed that adult *Flustra* has a proteome of more than eight hundred proteins, the function of which have yet to be elucidated by mass spectrometry methods. The development of this type of analysis in the Bryozoa is a step in a new direction for functional approaches to the study of these organisms and how their biological processes are controlled and how they respond to changing conditions.

The Iberian Fauna Project: Bryozoans - a forthcoming research project

Oscar Reverter-Gil, Eugenio Fernández-Pulpeiro & Javier Souto-Derungs

Departamento de Bioloxía Animal, Facultade de Bioloxía, Universidade de Santiago de Compostela, 15782 Santiago de Compostela, Spain.

Faunistic data concerning a particular zoological group are usually dispersed in studies of diverse nature, which makes it very difficult to know the precise existing fauna in a particular geographical area.

We consider that up-dating catalogues must be a fundamental task in the work of a taxonomist, that is why in the next years we intend to collect, systematize and update all the information on the Iberian Bryozoans which has been accumulated until now. At the same time we will share the new data so as to make possible not only to expand the bryozoological check-list of the Iberian Peninsula but also to help improve the knowledge about the different species of Bryozoans. As the number of species listed up to now in our waters rises to approximately 450, it is necessary to tackle their study in different parts; in the first part of the project we will be concentrating on species belonging to O. Ctenostomatida and O. Cheilostomatida (Anascina), which mean approximately 150 species.

In order to carry out this research study, firstly, we are going to elaborate an updated inventory of the Iberian Bryozoans; to revise and check all the material previously cited in the Iberian coasts and which is kept in different collections; to study the material collected in different campaigns and which has not been identified yet; finally, to collect samples on the Portuguese coast.

Once the data are collected, we will carry out a monograph which will include general aspects of the examined groups, identification keys, descriptions, illustrations, remarks and information on the biology and distribution of each one of the studied species. It will also be started a data base, compatible with the existing ones in 'Fauna Ibérica' and the ERMS, likely to be improved and be updated, and available to the scientific community.

To be able to achieve these objectives we hope to have receive our first financial support from Spanish Government as well as the backing help of the project 'Fauna Ibérica', which has been developing in Spain since1988.

Life on the edge: Differential Fouling in *Pentapora foliacea*

Jasmine H Sharp & Joanne S Porter

Biofouling is an increasingly important economic concern, currently estimated to cost the US maritime industry $6.5 billion per year. Fouling organisms can be found on all submerged surfaces, but occurrences on some marine organisms are significantly less common. It is of growing importance to understand the mechanisms behind biological fouling control in order to harness their potential for commercial anti-fouling development.

Casual observance of bryozoans in situ suggests that individual bryozoans are not homogeneously fed in the natural environment. Previous studies by Pukall *et al*. (2001), have suggested surface fouling of the bryozoan *Flustra foliacea* is predominantly fouled around the operculum, but is significantly less fouled at the distal end than the proximal end. This suggests that the antifouling strategy of this bryozoan is more complex than the universal production and release of secondary metabolites, and is of particular relevance for metabolite extraction investigations.

The present study uses a large scale Scanning Electron Microscopy (SEM) approach focussing on the fouling microbes associated with colonies of the Cheilostome *Pentapora foliacea*. In particular we investigate the distribution and extent of surface fouling on this bryozoan species, looking at the degree of surface fouling and the type of cover between a) proximal and distal parts of the same zooid, and b) zooids from the older parts of the colony and zooids from the growing edge.

Over 300 images were analysed for the degree of surface cover and the complexity of cover. Statistical analysis of these SEM images revealed some interesting results which are presented here. The cover and intensity of fouling appears to decrease away from the growing edge of the colony, indicating a higher level of control over fouling in these areas. It is hoped that these results can be incorporated into a metabolite extraction study in order to determine the nature and functional aspects of the fouling inhibition. This also forms part of a larger study into the interactions between bryozoans and micro-organisms.

Bryozoans collected during the expeditions of the *Pourquoi Pas?* from the English Channel and around the British Isles: preliminary results.

Javier Souto-Derungs, Eugenio Fernández-Pulpeiro & Oscar Reverter-Gil

Departamento de Bioloxía Animal, Facultade de Bioloxía, Universidade de Santiago de Compostela, 15782 Santiago de Compostela, Spain.

The French oceanographic ship *Pourquoi Pas?* carried out during her active service oceanographic campaigns in different geographic areas such as the Antarctic, the Artic, the Mediterranean, Bay of Biscay, English Channel and the surrounding area of the British Isles. The dredgings carried out during the accomplishment of these campaigns allowed to collect great amount of fauna, among which there is a great amount of Bryozoans, which at the moment are kept in the collections deposited in the *Muséum National d'Histoire Naturelle* of París.

These collections have not been studied for a long time, and it even seems that part of the material is lost. Only recently Dr J.-L. d'Hondt has worked with the material collected in the Arctic region

For the accomplishment of this study, it has been reviewed the material collected in the English Channel, yielded by the *Muséum National d'Histoire Naturelle* of Paris. Among the material presumably coming from the study area we have found specimens unequivocally coming from the Antarctic; unfortunately, the only information shown on their labels is the number of station, but the coordinates or the collection region are not indicated. The presence of this material has made our work difficult, since it was necessary to previously select the samples whose label indicated that they had been collected in the research area.

Until now, 82 species of Bryozoans have been identified, of which 67 belong to O. Cheilostomatida and 15 to O. Cyclostomatida. Data have been compiled about the habitat of each species and for some of them the distribution ranks will be extended, as in the case of *Electra pilosa* (Linnaeus, 1767), that has been found at a dept of 110 m on a rocky substrate. Some of the species will be the subject of a deeper study, as it is the case of those belonging to genus *Ellisina*, that will be studied comparatively with material recently collected both in the Mediterranean Sea as well as on the coasts of Galicia (Spain), together with samples kept in different institutions.

Jurassic bryozoan diversity, disparity and biogeography

Paul D. Taylor

Department of Palaeontology, Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom (p.taylor@nhm.ac.uk)

Andrej Ernst

Institut für Geowissenschaften, Universität Kiel, Olshausenstrasse 40, Kiel, D-24118, Germany (ae@gpi.uni-kiel.de)

The Jurassic was a key transitional period in the evolutionary history of bryozoans, with the beginnings of the replacement of the stenolaemate-dominated, quintessentially Palaeozoic biota by the modern gymnolaemate-dominated biota. Our new taxonomic database reveals the existence of 176 described species of Jurassic bryozoans after probable synonyms are eliminated. Most of these species are cyclostomes - the Jurassic is the only geological period in which cyclostome species outnumber those of other bryozoan orders. Also present are ctenostomes, preserved either as borings or through bioimmuration, and the two oldest known species of cheilostomes.

Bryozoans were uncommon and depauperate in the Early Jurassic, but diversified in the Middle Jurassic to reach a Bathonian peak, before declining again to lower levels in the Late Jurassic. The reappearance in the Cretaceous of some genera (Lazarus Effect) suggests that part of the Late Jurassic decline is due to an incomplete fossil record. Over 75% of Jurassic bryozoan species are 'weedy' encrusters and comprise uniserial runners, pauciserial ribbons or multiserial sheets and spots. Erect trees and fronds can be locally abundant but are lacking in most biotas. Some colony-forms are rare or absent; for example, mesh-like unilaminate ('fenestrate') and free-living colonies are unknown in the Jurassic. Shallow-water carbonate deposits in the Middle Jurassic of northwestern European are the principal source of Jurassic bryozoan species. Few Jurassic bryozoan species have been described from outside Europe and nearly all are weedy encrusters; supposed erect bryozoan species often turn out to be neuroporid sponges. It appears that a significantly greater patchiness in global bryozoan distribution existed in the Jurassic than at the present day or during most other geological periods.

Bioimmured soft-bodied ctenostomes, including stem-group cheilostomes, are quite diverse and abundant in the Upper Jurassic, although most have yet to be formally named. It seems possible that the geographically patchy and depauperate nature of the Jurassic cyclostome biota provided a favourable ecological context for the emergence of cheilostomes which went on to radiate explosively during the Cretaceous.

Molecular and Morphological Phylogeny of Cyclostomate & Ctenostomate Bryozoa

Anton Tsyganov

School of Biological Sciences, University of Wales Swansea, Singleton Park, Swansea SA2 8PP, Wales, UK

Current systematic status and phylogenetic relationships between Cheilostomatida Ctenostomatida, Cyclostomatida and within their families are uncertain. Present Bryozoan classification is based on zooids frontal wall, however, there is an inconsistency with the molecular data (16S gene) – Ctenostomes, Cyclostomes and Cheilostomes were shown to be paraphyletic (Dick, 2000). Larval morphology has also been emphasised as an area lacking sufficient information. Previously (Zimmer & Woolacott, 1977) devised a system of larval types based on the external and internal morphology, this system identifies seven larval types.

In this study molecular data have been collected (18S rRNA gene) for further phylogenetic reconstruction. Bryozoa-specific 18S rRNA primers were developed, tested and optimised for various families. Currently a database of sequences for 12 species of Stenolaemata, Cyclostomatida and Cheilostomatida is built. Sequences for additional species are planned to be added in Winter/Spring 2006. Preliminary analysis of collected sequences has been performed. Once the data for all required species are collected, a comprehensive analysis incorporating RNA secondary structure will be performed. The results of several computational methods of phylogenetic inference will also be compared.

In parallel to molecular data collection, a method of larval analysis and visualisation has been developed using confocal laser microscopy (CLM) with fluorochromes (Mitotracker Orange & Bisbenzimide Hoechst 33342) for staining mitochondria and nuclei of larvae respectively. This method facilitates observation of the external morphology of larvae including a partial 3D reconstruction so that their morphotype based on Zimmer & Woolacott system can be identified. This method allows relatively easy and fast larval morphology observation compared to other methods (such as SEM for example). It is also superior to previously used fluorescent microscopy due to its much higher resolution and lower amount of artefacts encountered. Based on the data collected so far, 3D images for several larvae were obtained, and their larval types identified. Based on established technique more data are planned to be collected in the year 2006.

Finally a combined phylogenetic analysis of molecular and morphological data will be carried out.

Lophophorates – position in the Bilateria, inferences from mitogenomics

A. Waeschenbach, M.J. Telford, J.S. Porter & D.T.J. Littlewood

Natural History Museum London, Department of Zoology, Cromwell Road, London, SW7 5BD, UK (A.Waeschenbach@nhm.ac.uk)

The position of the Lophophorata in the Bilateria has been a topic of debate amongst morphologists and molecular phylogeneticists for many years. Lophophorates exhibit both deuterostome and protostome characters, hence no consensus position could be established based on developmental data. Molecular evidence almost always places lophophorates in the protostomes. We have added to this body of molecular data by sequencing the first complete mitochondrial genome of a bryozoan, *Flustrellidra hispida*. Analyses of both nucleotides and amino acids place the lophophorates in the Lophotrochozoa, however, their exact position within this clade could not be unambiguously established. *F. hispida* exhibits a unique mitochondrial gene order when compared to other bilaterians. Similarly, the brachiopods *Laqueus rubellus* and *Terebratulina transversa* have highly derived gene orders when compared to the ancestral lophotrochozoan gene order. In comparison, the brachiopod *Terebratulina retusa* and the phoronid *Phoronis psammophila* have retained long stretches of ancestral lophotrochozoan gene orders. The occurrence of ancestral and derived characters promises mitochondrial gene order to be a useful marker for reconstructing lophophorate phylogeny. Furthermore, the sequencing of the complete mitochondrial genome of *F. hispida* provides data for primer design for as yet unexplored genes for population and taxonomic studies of bryozoans.

Bored bryozoans from the Ordovician of Estonia: a biological reinterpretation of the ichnogenus *Sanctum* Erickson & Bouchard, 2003

Patrick N. Wyse Jackson

Department of Geology, Trinity College, Dublin 2, Ireland (wysjcknp@tcd.ie)

Marcus M. Key, Jr. & Michael E. Burns

Department of Geology, Dickinson College, P.O. Box 1773, Carlisle, PA 17013-2896, USA

Trepostome bryozoans have often provided domiciles or refuges for a variety of organisms, and their borings have been variously attributed to *Palaeosabella* or *Trypanites*. In 2003 Erickson and Bouchard described the new ichnogenus and species *Sanctum laurentiensis* from the Ordovician of North America that they attributed to the activity of crustaceans. 150 hemispherical and ramose trepostome bryozoans collected from fifteen localities in the Middle to Upper Ordovician Darriwilian to Caradoc Stages of Estonia contain similar traces. Of the 68 ramose colonies 71% were bored with over two tubes per colony; in longitudinal section 10% of colony area was bored, with tubes 2.1 mm in diameter and on average 7.1 mm long. Hemispherical colonies were more susceptible (89%) to being bored than ramose forms; in cross-section each contains over 3 borings that mined 8% of the cross-sectional area, with tubes being the same diameter as in ramose colonies. Borings on surfaces of hemispherical colonies are more common on the upper surface (83% with 11 openings per bored colony) than on the flat base that usually sat on the sediment surface (74% with 6 openings per bored colony). In eighteen colonies borings contain clear infills, which we interpret as being 'ghosts' of the original trace-producing organism. These had a circular cross-section 1.2 mm in diameter and were up to 3.9 mm in length. Its burrows are nearly 1 mm in diameter wider than its body, but were probably excavated by feathery lateral appendages now not preserved. Margins of burrows comprise shattered autozooecial chamber walls that suggest the organism produced borrows by mechanical destruction rather than by dissolution. Rare regrowth surfaces suggest the bryozoans and trace organism lived commensally. It is unlikely that the producer targeted the bryozoan colonies as a nutrient source as no grazing traces were found along surfaces of colonies where bryozoan zooids are concentrated. The producer of *Sanctum laurentiensis* was probably an annelid filter-feeder rather than a group of arthropods as originally postulated. The boring shapes originally described by Erickson and Bouchard are more a function of bryozoan colony internal morphology than the borer's morphology. The borer used the bryozoan colony as a domicile to elevate it above the sediment surface into clearer water.

Late Permian environmental clines and bryozoan distribution in the Late Permian of the North Atlantic region

Eckart Håkansson[1)], Anne Mehlin Sørensen[2)] & Lars Stemmerik[3)]

[1)] Geological Institute, University of Copenhagen, Øster Voldgade 10, DK-1350 Copenhagen, Denmark
(eckart@geol.ku.dk)
[2)] Geological Institute, University of Copenhagen, Øster Voldgade 10, DK-1350 Copenhagen, Denmark
(anne@geol.ku.dk)
[3)] GEUS, Geological Survey of Denmark and Greenland, Øster Voldgade 10, DK 1350 Copenhagen, Denmark (ls@geus.dk)

In the mid Late Permian (Ufimian-Kazanian) a shallow, dead-end seaway developed in the proto-Atlantic rift-zone between Norway and Greenland. Reaching from the extensive carbonate platform system occupying the northern margin of Laurentia and Baltica to the Zechstein Basin in North-Central Europe this seaway stretched for more than 1000 km in a N – S direction, encompassing several climatic zones. Thus, by the time of the Zechstein Basin formation, the North Greenland/Svalbard region at the northern entrance of the seaway had drifted into the boreal zone, while the region of the Zechstein Basin was still within the subtropics. In addition to the pronounced temperature gradient the proto-Atlantic seaway was also characterized by a dramatic salinity gradient from the open marine conditions in the North Greenland/Svalbard region to massive evaporation in the Zechstein Basin.

Based on a combination of own studies and literature accounts this contribution compares the bryozoan part of the faunas from the tropical, saline conditions in the Zechstein Basin, over the intermediate conditions as exemplified in central East Greenland, to the boreal, normal marine conditions in Svalbard and North Greenland. All five Paleozoic orders of bryozoans are recorded, but the record of the omnipresent Fenestrata has in part been based on exterior characters only. With this reservation a total of 44 bryozoan genera have been recorded in the proto-Atlantic seaway in the Kazanian: 37 genera in the Svalbard/North Greenland region, 14 in central East Greenland, and 13 in the Zechstein basin. Thus the combined effects of the environmental clines are quite obvious even in the simple diversity figures. This result is further corroborated by the distributional data, and the overall composition of the fauna is compatible with the notion that the Zechstein Basin apparently never developed any marine connections to the Tethyan Ocean. The marine fauna and flora of the entire seaway must therefore have originated exclusively from the northern entrance – i.e. from the North Greenland/Svalbard region.

Dynamics, bryozoan thickets & topography – main ingredients in a paleobathymetric analysis of the Pliocene Kolymbia Limestone type area.

Eckart Håkansson[1], Margret Steinthorsdottir[2] & Scott Lidgard[3]

[1]Geological Institute, University of Copenhagen, Øster Voldgade 10, DK-1350 Copenhagen, Denmark; (eckart@geol.ku.dk)
[2]Department of Geology, Trinity College, Dublin 2, Ireland; (steinthm@tcd.ie)
[3] The Field Museum of Natural History, University of Chicago, 1400 S Lake Shore Drive, Chicago, IL 60605-2496, USA; (lidgard@fieldmuseum.org)

The Kolymbia Limestone represents most of the transgressive systems tract in the eustatically driven transgressive-regressive cycle characterizing the Plio-Pleistocene Rhodos Formation on the island of Rhodes, Greece. At the type locality for the Kolymbia Limestone, Cape Vagia, the overall eustatic trend is punctuated by a series of coarse-grained, fossil rich event beds.

The talk focuses on the paleobathymetric history of the limestone at Cape Vagia based on the following elements:

A) The bryozoan fauna
Most taxa found in the Kolymbia Limestone are still living in the Mediterranean Sea, and the bathymetric distribution of the better known species therefore provide good, direct evidence. In addition the paleobathymetry is evaluated from an analysis of colonial morphology.

B) Dominant biotic elements in the event beds
The bryozoan *Celleporaria palmata,* the brachiopod *Gryphus vitreus,* the bivalves *Pecten jacobeus* and *Ostrea lamellose*, as well as red algal rhodoliths, dominate in the five most prominent event beds. Their present bathymetric distributions indicate substantial mixing, and the varying combinations in which they are found reveal a general deepening.

C) Paleotopography and basin configuration

It is concluded that deposition of the Kolymbia Limestone commenced at a depth of 40 to 50 m by the establishment of an effective, local carbonate factory on the basement high bordering the basin to the East. At a depth of around 120 m deposition of limestone ceased, when continuous sea level rise finally drowned the carbonate factory and pelagic, siliciclastic deposition took over. It is argued that most of the fossil rich event beds were formed by earth-quake generated down-slope slumping, while a single event bed may represent isostatic shallowing as a result of intra-basin fault movements.

Ecological succession & evolution of an Early Carboniferous bryozoan fauna, Hook Head, County Wexford, Ireland

Margret Steinthorsdottir
Department of Geology, Trinity College, Dublin 2, Ireland; (steinthm@tcd.ie)

The Hook Head peninsula in southeast Ireland offers excellent exposures of a Lower Carboniferous geological succession and fine preservational state of the contained fossil fauna. The stratigraphy comprises mainly of limestones, deposited during the Tournaisian (about 354-342 mya), in shallow warm seas. Larger faunal components such as brachiopods and crinoids have been the focus of most attention to date, whereas the bryozoans have not been extensively documented.

The first part of this project is to gather and document the extensive collections at the Geological Museum, Trinity College. This work is near completion. Collections from Hook Head in other museums and material collected during fieldwork sessions will be included if and when necessary.

The taxonomy of Hook Head bryozoans will then be revised and brought up to date. The bryozoan fauna will be (re)classified to genus level and to species level when possible. New species/ genera will be described and published.

The abundance and diversity of bryozoans will be utilized to develop a high-resolution depositional model for the Hook Head area and to clarify the ecological conditions in which the invertebrate fauna lived at the time of deposition. The focus will be on community structure in space and time as well as microecology and intracolonial variation. Large, well preserved colonies will be utilized to clarify the microecological and intracolonial variations, by measuring relevant morphometric characters on the colonies.

Last but not least, the entire Hook Head succession will be sampled & analyzed to determine the influence of low-grade diagenesis on C- and O-isotopic signature. This will hopefully aid in the calibration of the isotopic findings for the Carboniferous.