Southern California Association of
Marine Invertebrate Taxonomists

3720 Stephen White Drive
San Pedro, California 90731

November, 2001

SCAMIT Newsletter

Vol. 20, No. 7

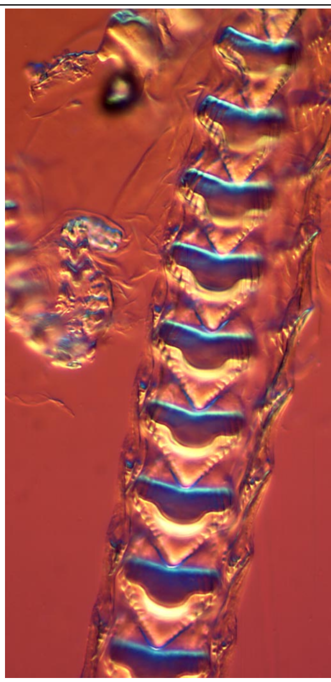
SUBJECT: No Meeting in December
HAPPY HOLIDAYS!!!

GUEST SPEAKER:

DATE:

TIME:

LOCATION:



I16(1) 7/5/01 90 ft.
Radular mount 40x
Dendronotus frondosus
Image by K. Barwick 25Oct01

NEXT MEETING:

11 January 2002. Dancing Coyote Ranch. Edwardsiids revisited. See the October Newsletter for details.

NEW LITERATURE

In recent years the utility of the gastropod radula as a species specific identification tool has been called into question. Studies have demonstrated both changes associated with use, and variation in shape of unused teeth related to food preferences of the individual snail. Jorgensen (2001) suggests that other, previously undervalued characters associated with radular structure may be more conservative, and better at reliable discrimination between related species. He demonstrates the utility of basal tooth characters with three species in the genus *Lacuna* from the Isle of Wight. These

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characters are not likely to aid in day to day identifications, but probably will feature in more in-depth studies of individual species or of group phylogeny if examined by others in the future.

Our guest speaker for this month, Dr. Angel Valdés, produced a very interesting examination of the probable paleohistory of the nudibranch genus *Phyllidiopsis*, using morphological characters and cladistic methodology (Valdés 2001). His analysis allowed the erection of several hypotheses concerning the origin and history of the genus. Since these animals produce no fossilizable remains an important line of hard evidence was unavailable. The results suggested two separate vicariant events, coincident with Tethyan and isthmian closures, had influenced the speciation in this genus. The author's interpretation seems to be externally supported by evidence in other groups which show a similar paleohistory buttressed in some cases by fossil evidence. Given the absence of nudibranch fossils, supported hypotheses which are both internally and externally consistent (such as these) seem to be the best we can do at paleohistoric reconstruction.

Even without a fossil history there is evidence to be had on the evolutionary history of a group. It is buried in the genes. Dayrat et al (2001) mine this load to produce a new cladistic analysis of the euthyneuran gastropods using 28S rRNA molecular data. The euthyneurans are those snails which have undergone detorsion somewhere in their history, uncrossing the nerves which the torsioning of the veliger larva introduced early in the evolutionary history of the phylum. This includes not only the marine opisthobranch groups, but also the landsnails, and some shelled marine groups. Their analysis reproduced much of the morphologically based tree presented by previous workers, but indicated a new clade which joins the anaspids with the gymnosome and thecosome pteropods. Methodological problems have been suggested to beset this analysis and we should wait for confirmation of these results by others prior to putting much credence in this suggested relationship.

Bivalve mollusks have an exemplary fossil record and this can be used to examine the results of evidence derived from analyses based on other types of characters. Using such morphological data requires, however, that there be a clear and consistent result. Canapa et al (2001) suggest that earlier morphologically based analyses have not produced consistent results. They provide an analysis based on 18S rRNA data (the entire gene was sequenced). The results suggest that the previous separation of the heterodont bivalves into veneroid and myoid types is not supportable, and that the myoids are firmly a part of the veneroids. A wait-for-confirmation approach seems indicated here as well.

In recent years a series of discoveries of exceptionally preserved material, particularly larval material from the Cambrian Orsten beds, has brought a previously unavailable developmental dimension to arthropod phylogenetic reconstruction. Schramm & Koenemann (2001) reexamine this data and suggest some alternative interpretations of previous results. Using evidence derived from developmental gene expression in extant forms, they address several competing models of the development of the arthropod limb, and the polarity of limb segmentation (i.e. multisegmented being plesiomorphic).

The relationship between developmental patterns and evolution (evo-devo) was reviewed by Scholtz (2001). He particularly concentrated on the expression patterns of engrailed, distal-less and Hox genes, and the evolutionary models that flow from their distribution. Continued investigation in this area (see for example Schramm & Koenemann above) should help us resolve fully the relationships between major groups. We are still not there, however.

In an attempt to further contribute to the debate on the basal relationships of the main arthropod groups, Hwang et al (2001) used data from mitochondrial proteins to probe the question. Their results strongly support a sister group relationship between Myriapoda and Chelicerata not resolved in earlier analyses. Their results also lent further support to the Pancrustacea, uniting insects and crustaceans as sister groups.

5 NOVEMBER 2001

There was a call from Vice President Leslie Harris for topics for upcoming meetings. Megan Lilly and Kelvin Barwick volunteered (under duress) to give presentations for the February meeting. Megan will be reviewing an unusual *Pentamera* sp., and a strange *Molgula* sp. and, if necessary, can review her latest synthesis of information regarding the occurrence of *Octopus veligero* in the Southern California Bight. Kelvin will be going over his recent findings in the world of Kamptozoans. If time permits Don Cadien will revisit the subject of the cumacean genus *Cyclaspis* in local and other waters. The subject title for the meeting will be “various and sundry phyla”. As well, this meeting will be the locale of the great “*Pista”* exchange.

Dr. Eric Hochberg will be speaking on January 17, 2002 at the San Diego Shell club meeting. The tentative subject (at the moment) for his talk is reproduction in cephalopods.

The next SCUM meeting is coming up soon as well. Please see the attached announcement at the end of this newsletter.

Don Cadien then had the floor. He was happy to announce that Ed. 4 was completed and was in the process of being distributed. The emend list has already started and Don requests that as members find errors they email him with the details. These will accumulate, and will only be implemented when Ed. 5 is imminent sometime in 2004-5.

Dot Norris was with us from San Francisco. She passed around some information regarding the World Wildlife Fund’s listing of 867 Ecoregions. She found it very interesting, but we were curious as to its limits to terrestrial environments. For more information go to their website:

http://www.worldwildlife.org/ecoregions/

Dr. Angel Valdés was then introduced as the guest speaker of the day. He is the new Curator of Mollusks at the Natural History Museum of Los Angeles County, replacing the retired and now emeritus curator Jim McLean. Angel started with a wonderful slide show and talk on opisthobranchs. Opisthobranchs are a highly derived group of animals. One character that they nearly all share is some level of reduction of the shell. However, this loss/reduction of shell seems to have occurred several times, in different lineages.

The first group to be considered were cephalaspids. Some within this group still have a shell and other species have lost it completely. Local representatives run the gamut from full shell into which the animal can contract (e.g. *Acteocina*), through internally shelled (e.g. *Philine*), to shell-less (e.g. *Philinoglossa*). Members of this group tend to be micropredators, feeding on small animals within the sediments.

The sacoglossans were seen next and again, some showed a reduction of shell while most members of the group have lost the shell entirely. It is within this group that one finds the only bivalve gastropods, *Julia* and *Berthelinia*, originally mistaken for clams. SCAMIT members see very few of these animals, which are restricted to the shallower depths where their algal prey can be found.

The anaspideans are the group which contains the largest species of opisthobranchs, some of which still retain an internal shell as a poorly calcified thin sheet, while others have none. California sports one of if not the largest opisthobranch in the world: *Aplysia vaccaria.* This animal can weigh several kilos and grow to nearly two-feet long. Anaspids are uniformly algivores and are usually found at shallower depths as are the sacoglossans. Their favored algae are often the larger, heartier reds and browns which occur deeper than the delicate filamentous algae favored by sacoglossans. Some have been caught in relatively deep water, passively carried downslope with the drift algae on which they were feeding.

The next major opisthobranch order, the Notaspidea, is composed of two different appearing groups, one with external cap shaped shells, and the other with strongly reduced internal shells. Both are united by having a single gill plume under the edge of the notum posteriorly on the right side of the animal. Notaspideans, according to Angel, are going to be split into two groups. More on this in the future.

Nudibranchs, as their name implies, have naked gills exposed to the surrounding water. Location of gills varies between the different types of nudibranchs, with some exposed, and others sheltered in a cavity. In the dorids they are usually emergent from a branchial cavity on the dorsal side and towards the rear of the animal. In some primitive forms there may be multiple gill plumes in this location. A few forms have the gills pushed off the back and located under the notum at the rear end of the animal (i.e. in the corambids). In dendronotiforms there are multiple gills in tufts around the edge of the notum or on branched structures which arise from the notal border. In the arminids the gills are represented by a series of nearly vertical plaits along the sides of the animal. In aeolids respiration is typically over the entire surface of the animal, with the cerata serving to increase the surface to volume ratio of the animal and allow sufficient diffusive area to sustain this less specialized type of oxygenation. There is an amazing variation of shape and color in the group which extends far beyond the gills and covers all aspects of body form.

The highest diversity of opisthobranchs occurs within the Diversity Triangle which includes the tropical reefs of these areas of the Indopacific: Philippines, Papua New Guinea, and Indonesia.

Opisthobranchs occupy a variety of habitat, with most being benthic. There are a few pelagic species, some free swimming and some associated with floating objects or organisms. There has been a species discovered, *Dendronotus canteti,* which inhabits areas around hydrothermal vents at a depth of approximately 1500m. It feeds on hydroids but how it survives the corrosive effects of the hydrothermal vent habitats is unknown (a very good trick for an animal whose surface is unprotected by shells or other structures).

Most opisthobranchs are brightly colored at depths to 300m, but past that point, from 300-500m, most forms are white. It was from this latter depth that the “light-house” dorid, *Pharodoris phillipinensis*, was discovered. The common name is derived from the tall, tower-like elongation of the branchial collar, which raises the gills away from the back and up into the water.

The beautiful and varied color patterns seen in opisthobranchs may not always be species specific. In a number of cases there is mimicry of both color and pattern between different opisthobranchs, and also between opisthobranchs and other phyla. Angel showed us slides of an opisthobranch followed by a slide of a platyhelminth showing the exact or very similar color pattern. The theory is that these color patterns have been mimicked by other animals as they are a chemical defense advertisement, also known as aposematic coloration; it pays to advertise... Some of the noxious chemicals produced by opisthobranchs are being used in pharmacological research trials, in regards to their use as cancricides, bacteriocides, and general biocides. For more information go to the National Cancer Institute's website.

Opisthobranchs who do not choose to advertise their unpalatability with bright colors and patterns are often particularly good at hiding via camouflage. We saw many slides in which the animal was almost impossible to discern from the background habitat. However, Angel pointed out that many animals who use camouflage also have a poisonous chemical defense system as well, in the off-chance that potential predators lack eyes.

Another type of defense system is seen in the aeolids which practice kleptocnidy. The nematocysts of their cnidarian prey are somehow digested without being fired (the mechanism remains unexplained) and then stored in the cerata of the animal. Once in place they perform their earlier function, being discharged actively by actions of the opisthobranch, or passively from physical manipulation of the cerata by a potential predator.

The dorids use the spicules in their body wall as a defense mechanism. The spicules are not from their sponge prey but are actually self produced. It is theorized that these spicules are secreted by the same cells that would secrete shells in other orders of molluscs. They may be more widespread than is currently realized as preservation frequently dissolves them entirely, leaving no trace.

Angel then briefly addressed the fossil record. Since opisthobranchs as a whole are nearly devoid of preservable parts, there is little in the way of fossil evidence to be had. There are, however, a number of primitive taxa which retain either an external or internal shell, offering the chance of preservation. In one such group the trend in shell reduction was for the shell to become smaller and less bulbous. In another, shell reductions followed the pattern of becoming more plate-like and flat, therefore covering less area.

The subject of radulae was then considered, illustrated by SEMs of the structure in question. Most have hooked-shape denticles, but there are those with straight denticles and those with extremely long shafts with denticles at the tip. As one might expect the form of the radular teeth and the radula itself are affected by the uses to which it is put. Animals who graze on sponges tend to have radulae very different from those which feed on cnidarians, and from those whose main food is plants. Some genera have secondarily lost the radula, in particular the group which feeds on sponges. These animals, instead, have tiny oral glands which secrete enzymes to dissolve the sponge and then the resulting soup is sucked up. This approach neatly sidesteps the thorny issue of handling the megasclere spicules which prominently defend many sponges.

The reproductive system of opisthobranchs contains the highest number of characters for use in systematics. The usual sexual state for all opisthobranchs is simultaneous hermaphroditism. This means that nearly all inseminations are reciprocal, with both partners wandering off to lay egg masses. Many species have modifications of the reproductive structures which allow the two partners to stay together during a prolonged copulation. This often includes spiny penes and spiny vaginas (at this point there was much cringing among the crowd at large). Large egg masses, often with several thousand eggs produced by each of the hermaphroditic partners, are laid following copulation and small larvae are later hatched. There are some instances of direct development within the egg to hatching as a miniature adult. In a few species (most notably in the sacoglossan *Alderia modesta*) the reproductive mode is flexible, with some eggs having direct development, some producing small planktotrophic veligers, and some producing large non-feeding lecithotrophic larvae.

The skin can also be used as a systematic characteristic. As seen with SEM micrographs, the construction of the skin is very different between groups. Much ultrastructural research remains to be done in this area before comparisons across all opisthobranch groups can be performed.

Eating is an all important past time for most animals and opisthobranchs do not deviate from this pattern. Most use their rhinophores to sniff out food through sampling the chemical traces currents bring them. A common prey is sponges but some species are cannibalistic and swallow their smaller cohorts whole. Fish eggs, hydroids, octocorals, corals, anemones and ascidians are also consumed, while some species are herbivorous. Sacoglossans tend to be very specific feeders with prey items being filamentous or utriculous algae of various types. Occasionally a sacoglossan may use its specialized piercing radular teeth to feed on eggs (ala *Olea hansineensis*) but this is rare.

Symbiosis also occurs in the opisthobranchs. *Kaloplocamus* has special organs on its back which house bioluminescent bacteria, although how the nudibranch acquires these bacteria is not known. The aeolid *Phyllodesmium* feeds on soft corals and then harbors the zooxanthellae symbionts of the soft coral in its own tissues for their photosynthetic capabilities. Sacoglossans, similarly are known to extract chloroplasts from algae (a process known as kleptoplasty) and house them in their own tissues, utilizing their photosynthetic by-products as a food source and going for long periods without eating.

With that subject the talk was complete and there followed an enjoyable question and answer period with Angel after which we all had lunch. Upon returning to the lab we talked about SCAMIT species of nudibranchs and some specimens were exchanged and examined. Angel has been given the responsibility of working on the collections of opisthobranchs resulting from the MUSORSTOM cruises in the deep waters of the Western South Pacific. This, along with other projects (he is, for instance working on the opisthobranchs gathered in the British Virgin Islands as part of the Guana project mentioned in previous NL's), limits the time he currently has available to work on the local fauna. He is interested, however, and hopefully we can involve him in some of the more interesting animals which SCAMIT members have encountered in the last few years (such as the philinoglossid from off San Diego, and the *Akera* taken in the Channel islands during B'98).

JOB OPENING
ARIZONA-SONORA DESERT MUSEUM SCIENCE WRITER/GRANT WRITER POSITION

The Arizona-Sonora Desert Museum (Tucson, AZ) is seeking a science writer to assist in science grant and report writing, and for general assistance in grants management. The position will begin at half-time (with benefits), but has the possibility of going to full-time in the near future. This position will report directly to Dr. Rick Brusca, Director of Conservation and Science at the Museum.

A minimum of a bachelor's degree (preferably in natural science) and 3 years experience is required. Good writing skills and self-direction are essential. A list of primary job functions follows:

(1) Research and writing grant/contract proposals, particularly to private foundations.
(2) Coordinate grant/contact submission process.
(3) Plan, arrange and participate in workshops and seminars to promote the proposal process

and grant-based research.
(4) Prepare, or assist in the preparation of research project reports and other writing projects.

For more information, contact Rick Brusca at 520-883-3007 or, rbrusca@desertmuseum.org.

PLEASE NOTE NEW EMAIL ADDRESS

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RECOGNITION COGNITION or *What you see is what you already know to look for*

A redescription of a taxa often occurs as methods of observation improve. In previous years, most workers attempted to differentiate cirratulid polychaetes primarily with the use of dissecting microscopes. It was later found that use of a compound microscope produced a finer detail view of setae and this could be used to differentiate additional genera and species. More recently people have amplified and expanded other descriptions and diagnosis of polychaetes using biological stains such as methylene blue or green. These efforts of higher power examination and whole body stain patterns are all attempts to obtain new reliable visual cues that can be used to differentiate one taxa from another.

Changes in taxa recognition also occur when someone discovers anatomical features that were overlooked or unnoticed. This may require no new method of observation other than the realization that the feature is present if an observer knows to looks for it. Once notified of such new features, reexamination often demonstrates that the feature was present on already collected and identified specimens. Resulting re-identification of these specimens or a split in nomenclature contributes to the "taxonomic drift" found in long term survey programs. Examples of this situation include the following:

> Prostomial ridges on monticellinid cirratulids are clearly visible using standard methodology. Until these features were discovered for their taxonomic value, the descriptions and non-photo illustrations were typically lacking depictions of these features.
>
> *Prionospio lighti* prostomial peaks are first reported and illustrated in1985. Specimens of this species are commonly collected and observed, but recognition of these peaks is not relied upon until they are more directly demonstrated as taxonomically important in 1994.
>
> The hesionid *Podarkeopsis* sp A is described as possessing digitate lobes on most parapodia but these structures were not visually recognized by most taxonomists until they were demonstrated as diagnostic.
>
> *Terebellides stroemi* was uniformly identified locally. When it was shown that only some specimens possessed very long and visible setiger 1 notosetae, taxonomists began to recognize this. The species *T. reishi* and *T. californica* both were described from this new recognition.
>
> *Aricidea ramosa* was described and illustrated with a particular branched prostomial antennae. Workers used this description but did not notice that the local specimens had a very different branching form. This required no improved technique, just visual recognition of the difference between an illustration and the specimen.

In his book Phantoms in the Brain, neuroscientist V. S. Ramachandran from the Salk Institute and U.C. San Diego details several recent discoveries about the human visual system. Much like the genetic knock-out mice that demonstrate gene function through gene failure, Ramachandran studies people with organic neurological defects impacting vision and recognition. It is clear that humans do not take "photos" through their eyes and project them in their visual brain centers like a broadcast on a TV screen. Experimental evidence has shown that people see only a portion of the view available and their brains automatically "fill-in" details using complex cross communication between different portions of the distributed brain visual centers. This automatic process relies upon both visual memories and brain "expectations" to fill in details of the visual information. This is demonstrated by a perpetual blind spot in each eye created by the optic nerve. This blind spot is ignored by the brain visual centers. Close one eye and the blind spot is not obvious because the brain merely fills in a view with "other visual data" creating the illusion of a complete field of view.

A recent research effort from Dr's. Rosa and Werblin at U. C. Berkeley has demonstrated that relatively sparse visual information is transmitted to the brain from the retina from 10-12 separate "cellular channels". The brain then interprets this information as the conscious "complete" view. This complete view is actually filled in with other data. Retina cells are now known to process the light-based information into a picture extraction for reconstitution by the visual centers of the brain. Not all of what our brain recognizes as the "view" is transmitted by the retina.

Researchers Bachman, Malik, and Persona state that visual recognition of an object requires that the image and a memory of the object be associated for comparison. This unconscious use of a model to establish recognition of the object we "see" requires that we must first view an object before we can refer to its visual memory-based model. Given this system of vision, it becomes understandable how multiple observations of specimen conditions could fail to recognize a feature available for view. Once focused on, a feature may become a commonly seen condition.

Though we are all familiar with some optical illusions, a brief examination of their wide variety demonstrates that many different types of eye/brain puzzles exist. Consistent techniques of observation and specimen orientation may actually increase the likely hood that visual fill-ins occur and obscure recognition of otherwise viewable features. The retina provides a surprisingly limited view and we rely on a combination with visual brain center communication to finally see. This requires us to seek out new ways of recognizing morphological features. The use of whole body stains help create a new view. Using digitized photographs of specimens manipulated to provide false color images may also be beneficial in training our brains to recognize more of a specimen's true morphology. - Tom Parker (CSDLAC)

BIBLIOGRAPHY

Buhmann, J. M., J. Malik, P. Perona. 1999. Image recognition: Visual Grouping, recognition, and learning. Proceedings of the National Academy of Sciences (96):14203-14204.

Canapa, Adriana, Marco Barucca, Annalisa Marinelli, and Ettore Olmo. 2001. A molecular phylogeny of Heterodonta (Bivalvia) based on small ribosomal subunit RNA sequences. Molecular Phylogenetics and Evolution 21(1):156-161.

Dayrat, Benoit, Annie Tillier, Guillaume Lecointre, and Simon Tillier. 2001. New Clades of Euthyneuran Gastropods (Mollusca) from 28S rRNA Sequences. Molecular Phylogenetics and Evolution 19(2):225-235.

Hwang, Ul Wook, Markus Friedrich, Diethard Tautz, Chan Jong Park, and Won Kim. 2001. Mitochondrial protein phylogeny joins myriapods with chelicerates. Nature 413:154-157.

Jorgensen, Aslak. 2001. Variation in radular teeth and acuspid side of the radula in *Lacuna pallidula*, *L. parva* and *L. vincta* (Gastropoda: Littorinidae) from the Isle of Wight, United Kingdom. Helgoland Marine Research 55:905-100.

Ramachandran, V. S., S. Blakeslee. 1998. Phantoms in the Brain. Quill William Morrow. N.Y. 328 pages.

Roska, B., F.S. Werblin. 2001. Eye strips images all but bare essentials before sending visual information to brain, UC Berkeley research shows. http://www.eurekalert.org/releases/ucb-esi032601.html

Scholtz, Gerhard. 2001. Evolution of developmental patterns in arthropods - the analysis of gene expression and its bearing on morphology and phylogenetics. Zoology 103:99-111.

Schram, Frederick R., and Stefan Koenemann. 2001. Developmental genetics and arthropod evolution: part I, on legs. Evolution and Development 3(5):343-354.

Valdés, Angel. 2001. Depth-related adaptations, speciation processes and evolution of color in the genus *Phyllidiopsis* (Mollusca: Nudibranchia). Marine Biology 139:485-496.

Please visit the SCAMIT Website at: http://www.scamit.org

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Single back issues are also available at cost.

SCUM VI: 6th ANNUAL GATHERING
SOUTHERN CALIFORNIA UNIFIED MALACOLOGISTS

Saturday, 26 January 2002
Farrand Hall – 10:00 to 4:00
Santa Barbara Museum of Natural History
2559 Puesta del Sol Road
Santa Barbara, CA 93105

Hosts: F.G. Hochberg, Henry Chaney & Paul Valentich Scott

SCUM is an informal association of southern California professional, amateur, and student malacologists & paleontologists, who are active or interested in research on mollusks. The purpose of the annual gathering is to facilitate contact and keep one another informed of research activities and opportunities. There are no dues, no officers, and no publications. SCUM is patterned after the Bay Area Malacologists (BAM), which is hosted by malacologists at different institutions each year.

This year's meeting will be hosted by the Santa Barbara Museum of Natural History.

- All persons interested in Recent and/or fossil mollusks are invited to attend.
- Presentations on current research topics or discussions on other molluscan related subjects are encouraged but should be informal and brief (10 minutes).
- A slide projector, LCD projector and/or overhead projector will be available for those wishing to present visual information.
- Please let us know if you want to present a talk so we can prepare a general schedule for the day.
- Coffee, tea, and breakfast goodies will be provided.
- We will break at noon. Box lunches will be provided at a cost of about $10. A number of restaurants are within a short drive if you want to go off campus for lunch.
- Parking in the museum's visitor lot is free.
- A map to the museum is available at: http://www.sbnature.org/htmls/sbmap.htm
- Please mention at the admissions desk that you are attending the SCUM meeting
- Please phone, FAX, or e-mail your RSVP so we will have enough breakfast snacks on hand for everyone. Order lunch at the same time.

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