"Internet Interview" with Bruce Livett

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"I would not put my hand in front of a Conus extended proboscis. No way!"

Nessa edição vamos conhecer o Dr. **Bruce Livett**, chefe substituto do Departamento de Bioquímica e Biologia Molecular da Melbourne University, na Austrália, e pesquisador das neurotoxinas dos Conidae. O Dr. Livett nos contará sobre os hábitos dos *Conus*, os riscos de coleta desses animais e sobre os casos de envenenamento e morte relatados.

(An edited version of this "Internet Interview" was published in AMERICAN CONCHOLOGIST Volume 30, Number 1, pages 5 and 14, 2002)

Calliostoma: You are a well-known researcher in *Conus* and conotoxins and I'm sure our readers are going to love hearing about you. Before that, please, tell us who is Bruce Livett

Dr. Bruce Livett: I was born in Melbourne, Australia, in August 1943 and graduated with a PhD in biochemistry (neurochemistry) from Monash University, Australia. After a postdoctoral period in Pharmacology at Oxford, UK, I returned on staff to Monash for 5 years. I then took a research and teaching appointment in Neurology and Biochemistry at Montreal General Hospital and McGill University, Montreal, Canada. After 6 years I returned again this time to Melbourne University where I have been for the last 18 years in The Department of Biochemistry and Molecular Biology. I am presently Reader and Deputy Head of the Department. My research involves using the tools of modern biochemistry and molecular biology to discover novel conopeptide sequences, synthesise them and test their biological activity. I have been assisted on my field trips by family (my wife Dianne, son Andrew and daughter Erica) and by Dr. John Down, Tony Klein, David Satchell, Ken Gayler and other colleagues and by student members of my laboratory. We have mostly collected on Lizard Island, North Queensland, Australia, but have also been on field trips to One Tree Island, Heron Island and Lady Elliott Island.

Dr. Bruce Livett

***Lizard Island Research Station** is located on the Great Barrier Reef approx. one hour by air NE of Cairns, North Queensland, Australia.*

***Heron Island Research Station** is on a coral cay located at the southern end of the Great Barrier Reef near Gladstone.*

You are a neurochemist, but your research in conotoxins deals with shells. Can we call you a malacologist?

I have been a member of the Malacological Society of Australia for 5 years and recently attended Molluscs2000 meeting in Sydney where I presented a paper on video observations of envenomation of prey by *Conus*. So I think you can call me a budding malacologist!

When and how did you get involved with shells?

My interest in molluscs is relatively recent. I became interested in *Conus* through reading the scientific articles by Baldomero 'Toto' Olivera and began collecting *Conus* 8 years ago on the Great Barrier Reef, Australia. More recently I have been collecting *Conus* from the South Eastern waters of Australia. I have attended the National Shell Show in Melbourne (1999) and Adelaide (2000).

Who were your most inspiring mentors, and why?

Baldomero 'Toto' Olivera, Utah, for introducing me to the fascinating biology of *Conus*[1], Jack Austin, Cowes, Victoria, Australia, who demonstrated by his keen interest in all matters malacological that shell collecting can be an all of life pursuit. Similarly, Kevin Lamprell, Kallanger, Queensland has been inspirational in showing how an amateur interest in shells can lead to the award of a PhD at age 70. Then Allan Kohn, Univ. Washington, for his scholarly works on the biogeography and distribution of *Conus,* Jon-Paul Bingham, Queensland, presently at Yale, who showed me the importance of making contacts with shell collectors for local knowledge about shells of interest. I acknowledge the pioneering work of the late Robert Endean, Queensland, on the pharmacological activities of *Conus* duct venom. Finally, I should also note the late Milton Church, and Wayne Rumball from the South Australian Shell Club, John Singleton, Geraldton, Western Australia, and Ian Loch from the Australian Museum, Sydney for their encouragement and interest in my work. Robyn Bradbury, Melbourne has collected *Conus* for me and has a keen interest in medical applications of conopeptides. I thank Patty Jansen, Sydney, for her beautiful drawings and useful field guides to Australian shells, and Winston Ponder for his scholarly leadership of Malacology in Australia.

1- for review see Olivera, B.M. and Cruz, L.J. Conotoxins, in retrospect" Toxicon 39: 7-14, 2001

Drs. John Down and Jon-Paul Bingham *point to Conus textile depositing egg sacks*

Dr. Bruce Livett and Prof.Tony Klein *returning from a day's collecting Conus on Lizard Island*

Tell us about some most memorable malacological experiences. Which ones have affected your career?

The most memorable experience was the field trip I organised to One Tree Island to which George Miljanich (from Neurex Corp.) came along. The weather was perfect, the shells were in abundance and the company was great. Especially remember the late hours spent dissecting and discussing matters conchological and the numerous games of trivial pursuit.

Tell us a little bit more about this trip.

This trip followed immediately after a most successful scientific meeting on Heron Island titled "From Venoms to Drugs" at which Toto Olivera, Mike McIntosh, George Miljanich and other noted conotoxin researchers presented. The scientific meeting was organized by Dr. Paul Alewood and associates from the Centre for Drug Design and Development at the University of Queensland (and the second in this series is about to take place **July 14-19, 2002** - again on Heron Island). On one of the 'free' afternoons I led a collecting party (including Toto Olivera) out to the reef edge at low tide. Toto said it was the first time in ages that he had an opportunity to collect *Conus* himself and he really enjoyed the experience - and we all enjoyed his company. At the end of the scientific meeting I took a group of 14 colleagues and students from the University of Melbourne and the University of Queensland to One Tree Island which is a small coral cay about an hour by fast launch east of Heron Island. The Research Station at One Tree Island is managed by the University of New South Wales and has accommodation and basic laboratory facilities. It has a rich and unique fauna but little if any flora (hence the name "One Tree"). The most prominent

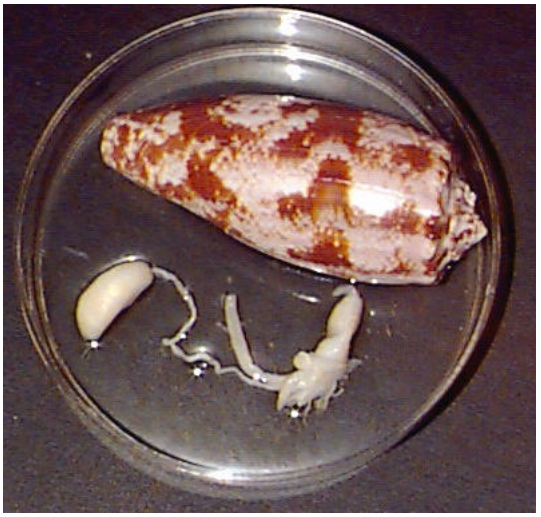
feature is the two storey toilet block which affords a magnificent view from the seated position ! Walking the reef flats at low tide resulted in collection of representatives of a dozen or more different species of *Conus*.

What was your most embarrassing or funny moment when dealing with shells?

Most embarrassing moment would have to be when my son and I booked into a motel in Harvey Bay, Queensland, with a collection of live *Strombus luhanus* that had been jostled about a bit in the bilge of the yacht during a storm that afternoon. By 3 AM that morning it was all we could do to get to the double sliding windows and let some fresh air in to the room so we could sleep. A good two hours the next morning was spent making the room livable (ie. smell nice). Amazingly, most of the strombs survived the journey back to Melbourne.

Sometime ago we had a thread at Conch-L called "The Revenge of the *Conus*". It was a nightmare about a *Conus* attack after collection. How dangerous is it to collect *Conus*?

I know that article and found it somewhat amusing. It is of course prudent to take every precaution. But mostly the cones are shy and not aggressive so it is quite sufficient to handle them slowly and carefully and always keep them in a hard plastic box not a mesh collecting bag. We always wear protective gloves and pick them up with barbecue tongs. I have observed their behavior in the wild and in aquarium and they move rather slowly. Still I would not put my hand in front of their extended proboscis. No way!



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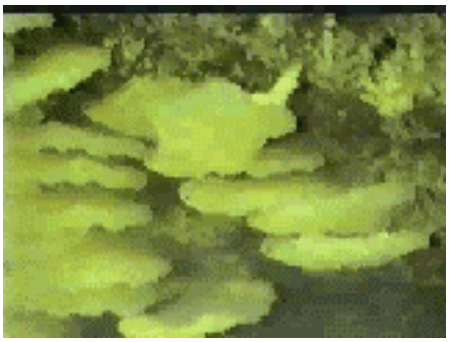
Conus geographus with venom apparatus dissected out



Egg sacks *deposited by Conus textile under a rock in our marine aquarium tank in the laboratory. Each egg sack contained up to 500 eggs.*

***Conus* poisoning are rare, about 30 confirmed deaths, and I read that you call it a "painless death.**

The witnesses report that it is a painless death. That may be because of the *analgesic** nature of some of the conopeptide components of the venom. Death usually occurs after some hours following coma that can set in within 20 minutes. Artificial respiration can help. There was a case in New Guinea not long ago where a diver was stung by a *Conus geographus* and lived to tell the tale because he was able to get to an iron lung in time. Death is usually a result of asphyxiation due to inhibition of contraction of the diaphragm muscle, which has muscle-type nicotinic acetylcholine receptors that are targeted by the alpha conotoxins in the venom. The symptoms are similar to curare poisoning.

**(*Of recent interest, several cone shell venom components (eg. omega-conotoxin MVIIA from Conus magus, and omega-conotoxin CVID from Conus catus) are being developed commercially by Elan and AMRAD, respectively, for use as novel analgesics to prevent neuropathic pain).*

Tell us a little bit more about some of the reported cases.

The first fatality was reported 300 years ago by Rumphius (1706) in "The Ambonese Curiosity Cabinet"[2]
I have collected a number of these reports together on my "**Cone Shell and Conotoxins" web page** (http://grimwade.biochem.unimelb.edu.au/cone/, specifically on the web page dealing with "Revenge of the Killer Snails",

http://www.biochemistry.unimelb.edu.au/cone/deathby.html). For those of you who would like to read further about the subject, I recommend that you visit those pages - and will relate just a few cases here.
2 - Book 2, Hard Shellfish; pp. 148-154

First the non-venomous encounters:
Adams reports in "Zoology of the Voyage of Her Majesty's ship Samarang" that Sir Edward Belcher was bitten as he picked up the *Conus aulicus* from the water at Mayo, one of the Moluccas. The wound received was accompanied by acute pain, and consisted of a small, deep, triangular mark succeeded by a watery vesicle. The pain was compared with the burning of phosphorus beneath the skin. According to J.E. Gray, in this instance the cone hung on like a leech.
3 - 1850, page 19
4 - Annals of Natural History, Volume XII, April, 1853, page 178

A relatively recent account of a non-fatal "Conus geographus envenomation", was given by David Fegan and David Andresen in the medical/scientific journal[5]. This case was treated at Honiara Central Hospital, Solomon Islands. "A 24-year-old male nurse was admitted with a 12-h history of progressive generalised weakness and poor coordination. The previous night, while collecting seashells, he had suddenly felt a mild stinging sensation in his right hand. His systemic symptoms began about 30 mins after this local injury. On examination he had a small puncture wound on the middle finger of his right hand., without erythema or swelling…His coordination was impaired without cerebellar features …. The remainder of his physical examination was normal. The shell responsible for the injury, a Conus geographus, was recovered by his relatives. He was admitted for observation and …. although weak, he could walk unaided after 48 h. He was discharged after 72 h at which time his physical examination was normal. When reviewed at medical outpatients a month later he had no complaints."
5 - The Lancet 349: page 1672, 1997.

Trying not to be morbid, I'm curious about the fatal encounters.

In a message on CONCH-L mailing list, 22 April 1997, Don Barclay from Pago Pago relates the following story (edited) of envenomation by a *Conus geographus* - the guy was diving off Wake or Midway Island and was stung by one that he had put in the sleeve of his wet suit. The guy, who made it to the shore, told his buddies, "This shell stung me," and died shortly afterward

The only fatal case (prior to 1935) of which definite information is available is the following, reported by Professor Cleland in the Sixth Report of the Microbiological Laboratory (New South Wales Government Bureau of Microbiology) for the year 1915. Professor Cleland quotes the following Reverend W. Wyatt Gill. On the island of Mare (southernmost of the Loyalty Group, immediately to the east of New Caledonia), in the doubtful light, a native "unhappily took a good-sized shellfish (*Conus textile*) and put it in his basket. He immediately felt a painful sensation running up his right arm to the shoulder. He went home. The pain increased until he writhed in agony The body swelled to an enormous size, and by daylight he was a corpse."
Of the above cases, there were two caused by *Conus aulicus* and *Conus tulipa*, respectively, and these appear to be relatively mild ; two instances of poisoning by *Conus textile*, one mild and the other fatal ; and two of *Conus geographus*, one perhaps mitigated by treatment by incision and the other severe.

The best-documented case appeared in The Medical Journal of Australia[4], in an article written by H. Flecker, M.B., Ch.M., F.R.C.S., from Cairns, Queensland. He relates the story of C.H.G. , a male, aged twenty-seven years, whilst on a pleasure cruise landed at Haymen Island on June 27, 1935, he picked up a live cone shell (since identified by Mr. H.A. Longman, of the Queensland Museum, as *Conus geographus*). According to an eye-witness, it was gripped in the palm of one hand, with the open side downwards in contact with the skin, whilst with the other he proceeded to scrape with a knife, the epidermis, that is, a thin cuticle covering the hard part of the shell. It was during this operation that he was stung in the palm of the hand. "Just a small puncture mark was visible,. Dr. Clouston did not see the patient until just before death, but the following details were obtained by him from the patient's mother, who was present with him. Local symptoms of slight numbness started almost at once. There was no pain at any time. Ten minutes afterwards there was a feeling of stiffness about the lips. At twenty minutes the sight became blurred with diplopia; at thirty minutes the legs were paralysed; and at sixty minutes unconsciousness appeared and deepened into coma. No effect was noted upon the skin, lymphatic, alimentary or genito-urinary systems. Just before death, the pulse became weak and rapid, with slow, shallow respirations. Death took place five hours after the patient was stung. A post mortem examination showed that all the organs, heart, lungs et cetera, were quite healthy. Mr. J.B. Henderson, Government Analyst, reports that no poison was found in the stomach contents. The victim was prior to the injury in perfect physical condition and in training for football !!. The symptoms resemble much those of curare poisoning as described in earlier reports...."
6 - April 4, 1936, page 464-466

As I could understand, I should be cautious mainly with Conus geographus.

Not only with *Conus geographus* (12 fatalities reported prior to 1980), but two other species, *C.textile* and *C.marmoreus* have been reported to kill humans, although the plausibility of these reports has been questioned on the basis of venom studies on dissected shells[7] It appears that *Conus textile* (which is much more plentiful than *Conus geographus*) is to be highly respected. Numerous instances are quoted of the dread and respect which the natives of tropical seas show to this shell ; for example, the late Charles Hedley relates that while collecting on a coral reef he once rolled over a boulder and exposed a living *Conus textile*. Before he could pick it up, one of the natives hastily snatched it away, and explained, with vivid gesticulations, its hurtful qualities. On no account would he permit Mr. Hedley to touch it, but insisted on himself placing it in the bottle of spirits.

7 - Kohn, AJ "Cone shell stings". Hawaii Med. J. 17: 528-532, 1958

What *Conus* species are most dangerous?

In general, all the fish-hunting cone shells (ie. piscivorous) such as *Conus geographus*, *Conus striatus*, *Conus tulipa*.

How dangerous are the Atlantic Ocean Conus? What can a collector expect from, for example, a *Conus regius* sting?

Conus purpurascens should be handled with care. I am not aware of reported fatal envenomations of humans by *Conus purpurascens* or *Conus regius*. Best to be careful though. You would not want to go down in history as being the first victim.

I've heard that a conotoxin is much more complex and potent than a snake poison. Is that true?

More complex yes. There are up to 50 different peptide components in a single Cone shell venom, whereas snake venom usually contains just one or two components. In the cone shell venom the different conopeptides target the different neuronal ion channels. Some conotoxins bind to and inhibit sodium channels, some calcium channels, others potassium channels and still others, glutamate and acetylcholine-gated ion channel receptors. The combined cocktail can be very effective!

We had a very interesting thread at Conch-L called "*Conus* Wars", where Don Barclay, from American Samoa described some hunting habits of *Conus* living in his aquarium. What kind of interesting live habits of *Conus* species have you observed during your researches?

I concur with these observations of Don. I have only observed for any length of time the behaviour of *Conus marmoreus*, *Conus magus* and *Conus textile*. Of the three, *Conus textile* is the most aggressive. These observations were described in the account given at Molluscs2000 and a video produced. We have kept three species of *Conus* in marine aquarium in our laboratory and have observed their behavior in the presence of other molluscs and small fish introduced into the tank. The species were *Conus textile* and *Conus marmoreus* (both mollusc-hunting cones), and *Conus magus* (a fish-hunting cone). Of the three, *Conus textile* (shown below) is the most aggressive.

***Conus textile* in attack mode**
Photo by David Paul, Zoology, University of Melbourne

Our observations show that the toxins act very rapidly. In the case of *Conus textile* (molluscivorous), the venom induced peristaltic convulsions in its prey. This is very useful as many molluscs tend to retreat into their shell upon attack and the convulsions prevented this from occurring.

In another segment of our video a *Conus magus* (piscivorous) is seen engulfing a small guppy head-first. The guppy remains relatively calm during this procedure which lasts approx. 5 min. and results in the whole fish being enveloped by the mouth of the cone snail. The fish is observed to attempt swimming movements while enveloped. The cone snail is not able to move much either with a fish inside. In the morning, the cone snail has expelled the skeleton of the fish. These real-time observations of envenomation of a fish by *Conus magus* dispel the popularly held notion that cone snails shoot out their "poison arrow" and wind in the prey. This may happen with other species but has not been observed with *Conus magus*. Rather, the fish are seen to rest on the sand at the bottom of the tank to sleep at night and are an easy target for a marauding cone shell.

What do you do when you're not working on shells?

I play piano and bassoon and present programs of classical music on a local fm radio station. You can listen in if you wish over the web. Every 3rd (8.30 p.m.) and 4th (7pm) Thursday of the month on 3mbs-fm 103.5 http://www.3mbs.org.au. Just click on

the radio that appears to listen live over the web ! When not playing music, I like to take my Aussie dog, 'Cadbury' (a chocolate-brown kelpie) for a run, or go sailing with my good mates, Ken Gayler (Molecular Biologist) and David Satchell (Zoologist).

Nowadays shell clubs in America and around the world struggle with a lack of newbies. What would you do to encourage beginner collectors?

Take along as many young people as possible to local meetings and Shell Shows and encourage shell-collecting activities at local beaches during the summer. It's easier said than done, I agree.

What three pieces of advice would you give a beginner shell collector?

Make friends with other collectors. Go on as many field trips as you can. Attend annual shell shows.

Lately live shell ban has come into fashion everywhere and also in Australia. Do you think shell collectors really impact the environment?

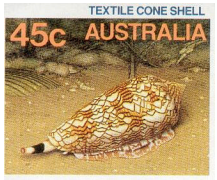
No - not in my experience. To collect in Australia I have to apply for a permit. The numbers I can remove eg. from the Great Barrier Reef are very restrictive (no more than 5 of any one species). I think that natural elements, storms, run-off water, pollution, and wave action make much more impact.

For you, what is the role of amateur collecting in modern malacology/conchology?

Amateur collectors are the life of malacology. The new finds are more likely to come from amateurs than from the few professionals. Amateurs are also in my experience very attuned to conservation issues. I am all for encouraging amateur members belonging to shell clubs and malacology societies.

Malacologists are making increasing use of the Internet to keep in touch and exchange information. How has your work been influenced by this form of global communications?

I have found listservers such as CONCH-L invaluable in providing information and contacts about all aspects of malacology. The ability to obtain answers to questions quickly and from experts in the field is invaluable. In turn, I have found maintaining a web resource on **Cone Shells and Conotoxins Homepage** (http://grimwade.biochem.unimelb.edu.au/cone/) a great satisfaction and fun as well. My lab research is at http://www.biochemistry.unimelb.edu.au/bch/research/blivett_rp.htm



Recently I have collaborated with Tom Walker, Reading, UK to provide a web page with images of all the **cone shells on stamps**. (http://grimwade.biochem.unimelb.edu.au/cone/cones_on_stamps.html) This resource provides a convenient way to find the location of specific cone shell species in different countries throughout the world. You are invited to pay a visit. My colleagues and fellow malacologists often email me with advance notice of scientific papers or images of cones that they have just published and that information is made available on the **"What's New" page**. The site receives about 30 hits per day and is often the first port of call by film makers (eg. National Geographic and Discovery channels) in obtaining information about who's who in the field as they research for a TV series. But it is always nice to meet face to face with friends that I have come to meet and know well only electronically. This interview is a prime example of how a small seed sown 6 years ago as a summer student project ("Charmaine's Killer Snail Homepage", as it was known then - Charmaine Griffiths was a 'placement student' from Bath, UK who spent 3 months in my laboratory), has developed into an internationally recognized web resource with credibility - and hopefully, an ongoing interest for me in the years to come.

What message would you like to send to our readers?

This being the first day of the new millennium, I would like to wish all of you the very best for the New Year and the millennium ahead - and good shelling.

Would you recommend a Conus as a pet? ;-)))

Definitely. They are very pretty, don't each much, rarely ask for credit and always tell good stories which, like this one, end with a sting in the tail !

~

Dr. Livett was interviewed, March 2001, by Eduardo Moreira - edumoreira@zaz.com.br
All pictures were provided by Dr. Livett. Photo of "*Conus textile* in attack mode" taken by David Paul, Zoology, University of Melbourne
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