ILLUSTRATIONS BY GUNILD AND PETER SYMES

Marine animals with missiles

Missile Attack

Text and u/w-photos by
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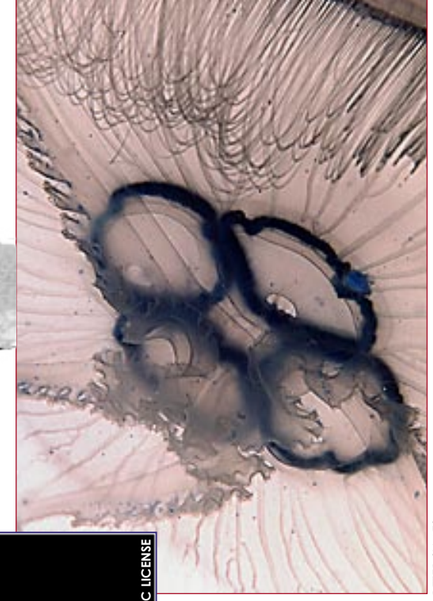
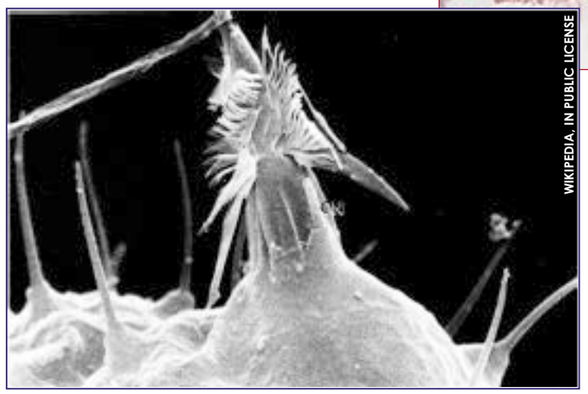


PETER SYMES

(graphic) Underside of a Moon jelly *Aurelia aurita*



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Scanning electron microscope photo of discharged nematocyst

What? Animals in the sea armed with missiles? And thousands of them? Yes, you've read correctly. No, sea lions or dolphins have not been stealing Tomahawk missiles from any of the American navy bases. But did you know that jellyfishes, sea anemones and corals contain thousands of "miniature missiles" to kill prey and sting intruders? We will look at bit closer at this missile battery mechanism here.

PETER SYMES

Common sea anemone

Jellyfishes, sea anemones, and corals comprise approximately 9000 species worldwide. They all contain thousands of unique stinging cells called cnidae – that's latin for stinging cells! (It's not always that scientists baptise animals with extremely stupid scientific names). Therefore, all these animals belong to one group, scientifically called a phylum that has been given the name Cnidaria.

Cnidaria

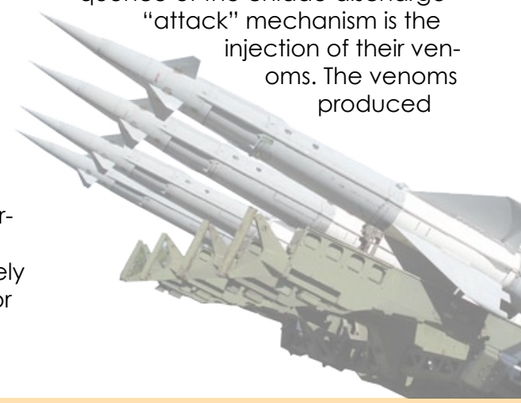
The stinging cells – the cnidae contain each an reversible hollow tube arranged in a spiral, with a harpoon like end (see b/w photo above and drawing next page). They are placed in the surface of the tentacles and the oral disk of the Cnidarians. Cnidae cells are fired into a prey, or something or someone who wants to hurt the cnidarian. In that process, the hollow tubes are unfolded extremely fast out of the stinging cell into the prey or enemy. The fastest ejections are equivalent to a missile's speed. The hollow tube contains toxins that are channelled through the tube, into the prey or enemy, which are either killed, or burned severely.

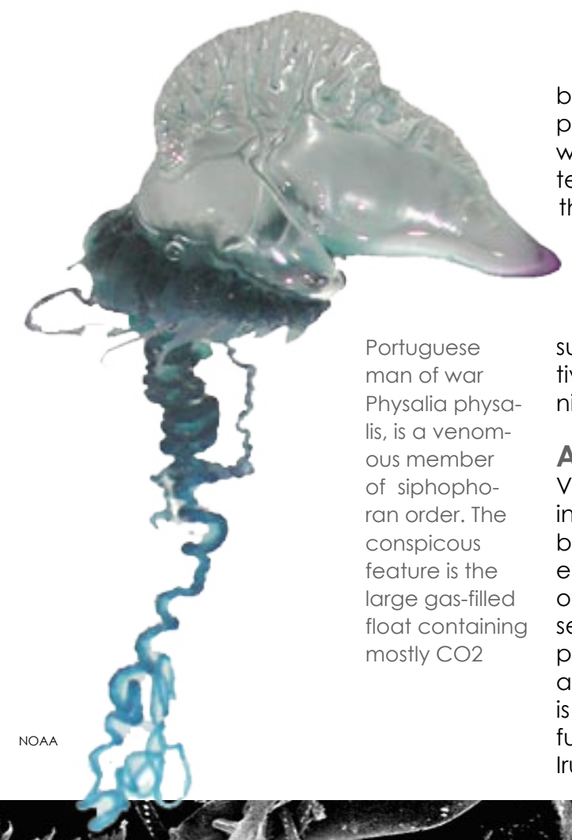
You were told not to touch

Think about what happens when you accidentally touch a fire coral (*Millepora* spp., see photo next page) when you are diving or snorkeling on the tropical coral reef. It won't kill you. But it burns so severely that you will feel uncomfortable for a few days, around the place on your body where you were stung.

Discharge

The mechanism behind discharge of cnidae and the sequence of steps that links the function of discharge is still poorly understood, though it has been investigated for decades. But generally, prey that touches a sense thread, which leads to a pressure in the cnidae capsule (a compartment in the cnidae), opens the lid, and the harpoon-like tip with the hollow tube in the end is fired. A clear consequence of the cnidae discharge "attack" mechanism is the injection of their venoms. The venoms produced





NOAA

Portuguese man of war Physalia physalis, is a venomous member of siphophoran order. The conspicous feature is the large gas-filled float containing mostly CO2

by these animals are used for capture of prey, and they have shown to interfere with key functions of physiological systems. Dependent on the mode of action these toxins can be divided into cytolysins and neurotoxins. Cytolysins act by puncturing the cells so the content is expelled, whereas neurotoxins interfere with neural activity. Because of this, such toxins can be used as an investigative tool to map physiological mechanisms.

Anemones and wasps

Venoms from sea anemones are in some instances capable of inflicting serious burns to people who touch them. However, stings from the Portuguese man-of-war (*Physalia physalis)*, the Australian sea wasp (*Chironex fleckeri*) some scyphozoans such as Stomolophus spp. may actually kill people. Irukandji syndrome is a seldom fatal, but nevertheless painful condition induced by the sting of the Irukandji jellyfish (*Carukia barnesi)*.

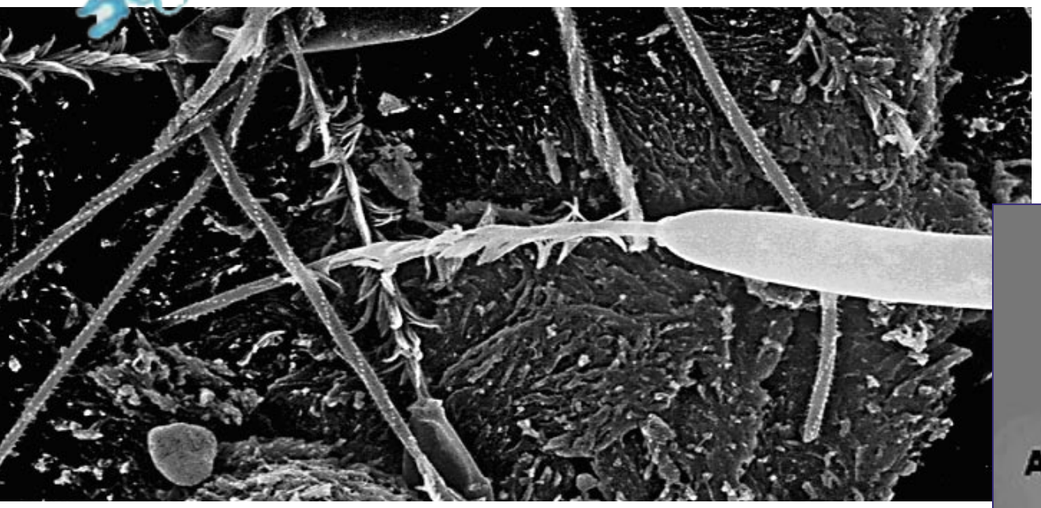
Millepora species are known as fire corals because the stinging cells (nematocysts) contained in the dactylozooids are powerful enough to cause a reaction in humans.

The Portuguese man-of-war have up to 9m long unfolded capturing arms each harbouring 700,000 toxic cnidae. If these arms are stretched they can gain a length of 50m. An adult Australian sea wasp has no less than 200 million toxic cnidae, together enough to kill approximately 250 people. Both of these stingers occur in schools, which makes them even more dangerous.

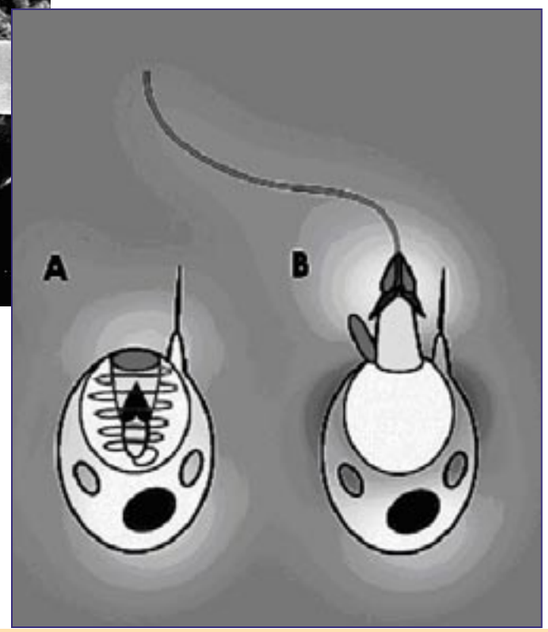
Jellyfish stings are a common summer hazard for sea bathers throughout the world. For example, it is estimated that in excess of 10,000 jellyfish stings occur alone in Australia each year.

One of the most common corals in the Northern Red Sea are the fire corals (*Millepora* spp.). The fire coral is the brown-yellow coral dominating the image. Touching a fire coral will produce a sting with a burning sensation that will last a couple of days. The fire coral is actually a Hydroid, contrary to most tropical corals that are Anthozoan. The fish on this image are the fairy basslet *Pseudoanthias squamipinnis*. The single anemonefish in the lower centre of the image is the endemic Red Sea two banded anemonefish *Amphiprion bicinctus*

MICHAEL ARVEDLUND



Aided by a high powered scanning electron microscope, we can glimpse how one of these very tiny stinging nettle cells, a cnidae, that has discharged its hollow tube into the skin of a fish. This nettle cell was attached to a clownfish host sea anemone. Clownfishes, or anemonefishes, do not provoke nettle cells to fire for reasons that are not yet known other than the fishes' protection lies in their mucus. The fish on this image was not an anemonefish but a sand goby. Scale: Horizontally the image is about .5 mm acros Image by Michael Arvedlund



Drawing of a nettle cell before and after firing. Drawing by Tyge Dahl Hermansen

Antivenoms

Moreover, in at least some parts of the Pacific, the incidence of envenomation from marine bites and stings appears to be rising due to increasing marine activities by both local and tourist populations.

In this context, new envenomation syndromes and new species of medically significant jellyfish are likely to be encountered according to Dr Kenneth D. Winkel at the Australian Venom Research Unit, University of Melbourne, who leads an international team team of Australian and American scientists conducting research into the development of new jellyfish antivenoms.

More research needed

Dr Winkel states in a recently published overview: "If snake antivenoms are considered orphan drugs, then jellyfish antivenoms are the poorest of the orphans. Despite the diversity, ubiquity and toxicity of the venomous cnidarians, only a single antivenom is available for jellyfish stings worldwide. That antivenom, an ovine whole IgG product, is directed against the Sea wasp (*Chironex fleckeri*).

IGG: Immune Globulin G, the type of antibody produced late in the immune response.

Only a single antivenom is available for jellyfish stings worldwide.

It also neutralises the venom of closely related cubozoans such as *Chiropsalmus quadrigatus*. The recognition of the life-threatening effects of various other jellyfish demonstrates the need for broadening the specificity of the existing product and/or developing additional specific jellyfish antivenoms."

Jellyfish are a common summer hazard especially in Australia

NOAA / KEVIN RASKOFF.

Chrysaora jellyfish

Dr Winkel also mentions in his overview that the first reports of use of this antivenom to treat stings from sea wasps stems from a case in 1979 where it was noted that the antivenom had a dramatic effect against the necrotising local tissue reaction.

Cases of Irukandji syndrome have also been treated with this antivenom but with a generally uncertain outcome.

Its efficacy for Chirodropidae stings has also been established experimentally with no adverse reactions (apart from a single instance of mild generalised rash) reported following its use in over 100 cases. It also appears to be safe for use in pregnancy. Concerning the Portuguese man of war, no antiserum exist yet, but one of the pioneers into the research of cnidae and their venoms, Professor David Hessinger from Loma Linda University in California, USA, has made significant advances with the research concerning the composition of this venom, but no antiserum will be produced before the venom has been fully understood.

Ask the locals

It is always wise to check up with local divers or dive clubs, or the local police, if you are uncertain about the local situation with deadly stingers. Deadly stingers occur along the coast in Australia from November to May. However, if you are on a beach far offshore, then you should be in the clear.

In any case, and regardless of your destination, it is always an easy safety precaution to ask the locals and do what they do. ■

PETER SYMES

Hydriods, perhaps *Hydractiinia* spp, living on a snail shell inhabioted by a small hermit crab. This is a classical example of symbiosis. The crab gets a little extra protection while the hydriods gets transportation, exposure to more water and perhaps some scraps of the hermits meals