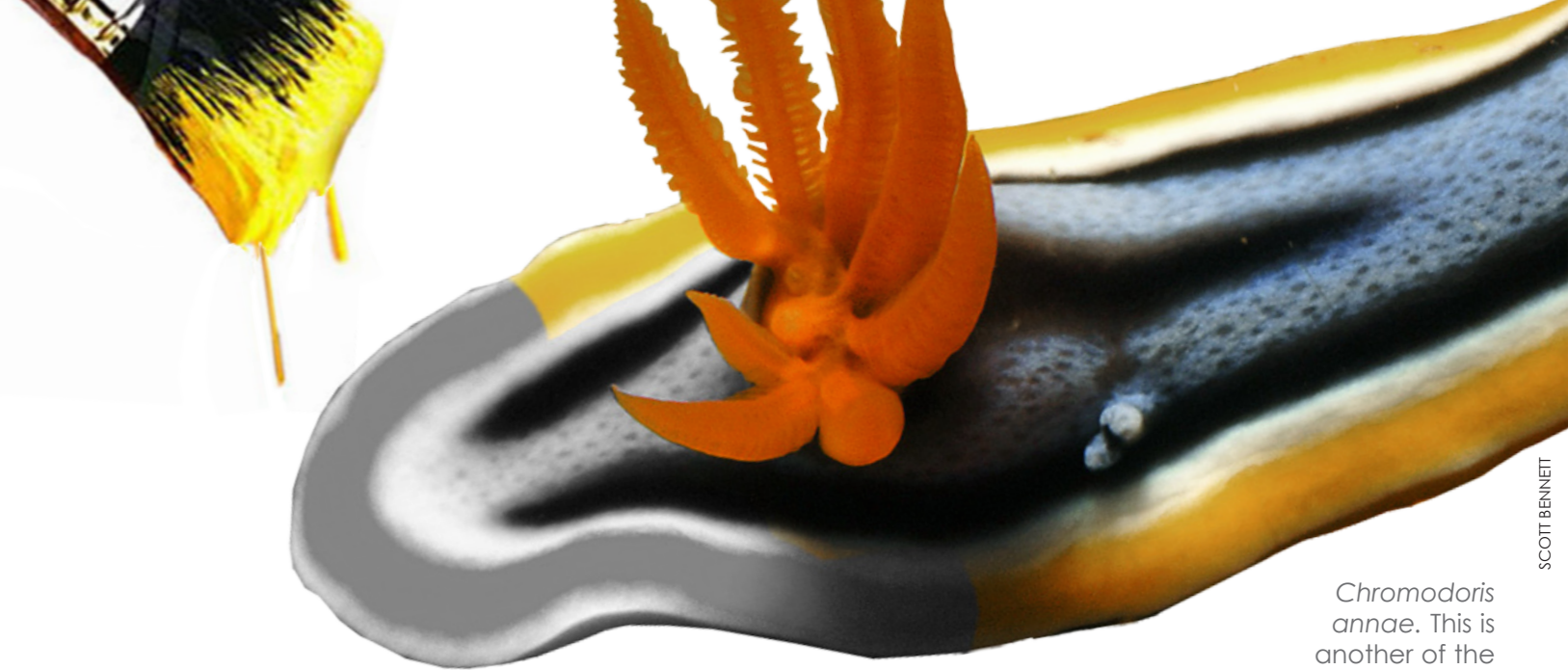
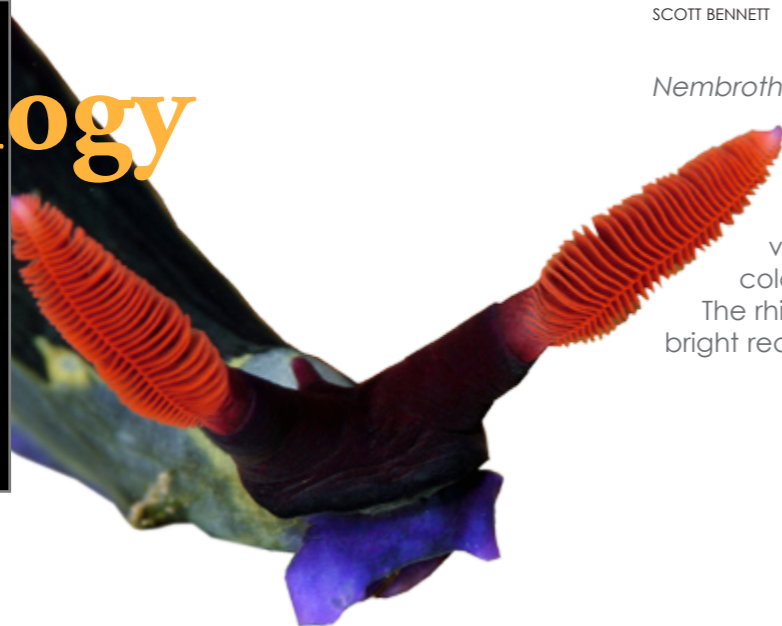


By Michael Arvedlund



SCOTT BENNETT

Nembrotha chamberlaini
This recently (1997) described species has a very distinctive colour pattern. The rhinopores are bright red



SCOTT BENNETT

Chromodoris annae. This is another of the *Chromodoris* quadricolour colour group of species characterised by black longitudinal lines, bluish backgrounds and orange borders

Why are they so colourful?

Naked beauties

Most divers have seen them. Weird-looking crawling creatures with odd shapes, antennae and amorphous bodies and draped in pychedelic colours. We are not talking about aliens from outer space but nudibranchs. But why do they have to look so weird?

Photos by Scott Bennett and Nonoy Tan
Text by Michael Arvedlund and Peter Symes

Nudibranchs are found in all of the seven seas, from the tropics to the polar regions. More than 3000 species are known, and new species are being discovered and described at regular intervals. The word "nudibranch" comes from the Latin *nudus*, naked, and the Greek *brankhia*, gills, and in several languages their name translates into "naked snails".

Naked indeed, and clearly exposed as such. How do they manage to survive in a brutal world full of hungry predators?

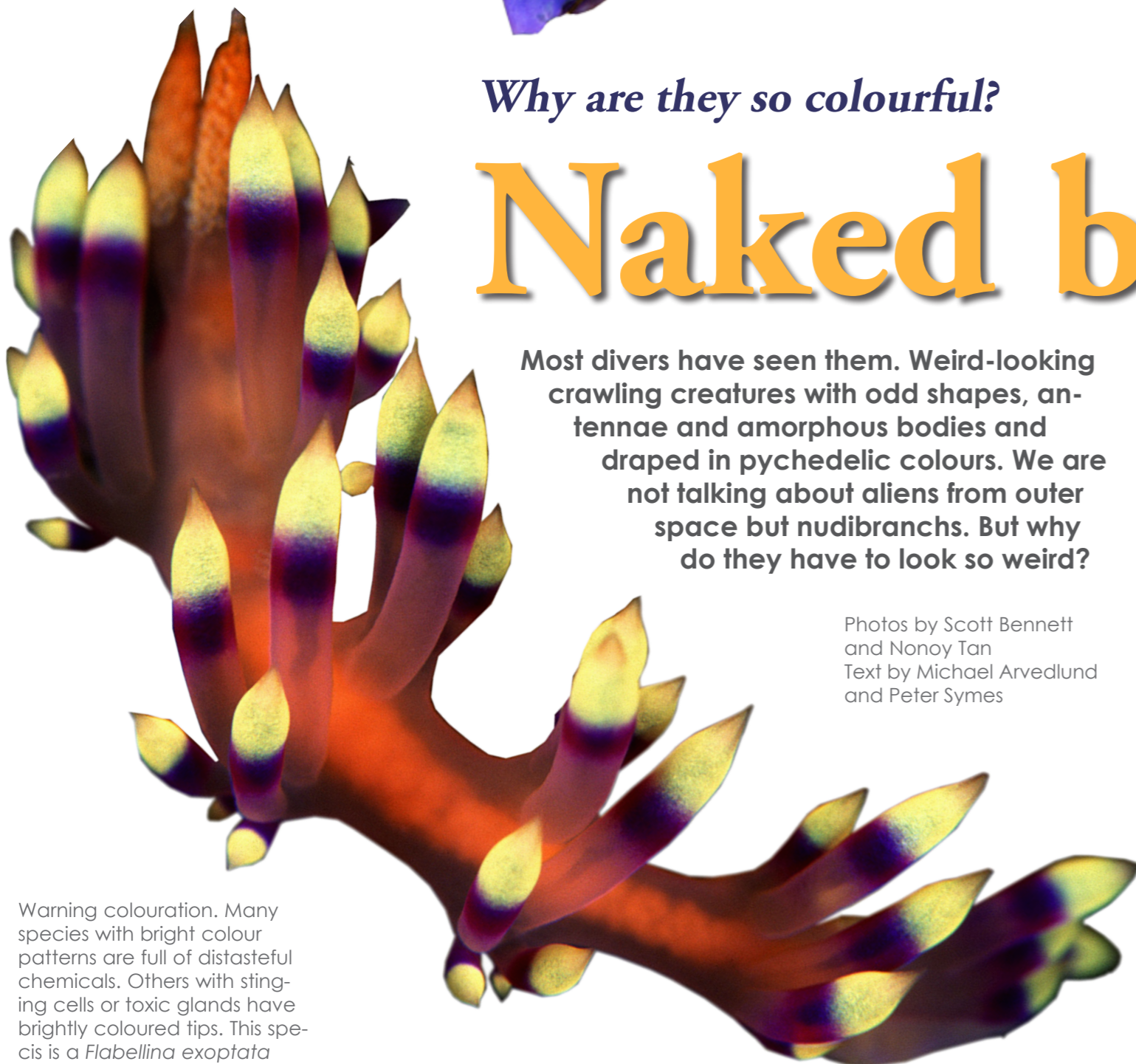
Chemical defences

Without a protective shell, nudibranchs, and other sea slugs, had to develop a number of other defensive mechanisms against predation. These include cryptic colouration, or camouflage, and behavioural modifications, such as only being active at night. But probably the most significant development has been the use

Nudibranchs have nude gills. Therefore the scientific Latin name "Nudi" (nude) "branches". LEFT: *Chromodoris Willani*



SCOTT BENNETT



Warning colouration. Many species with bright colour patterns are full of distasteful chemicals. Others with stinging cells or toxic glands have brightly coloured tips. This species is a *Flabellina exoptata*

NONOYTAN



NONJOY TAN



Many opisthobranchs are mainly active at night when predators are asleep or cannot see them. Others are able to swim for short periods when disturbed, and so escape predators.

LEFT: *Chromodoris willani*. This species is one of a group of similarly coloured species with a bluish white or translucent white background colour and dark blue or black longitudinal stripes

All different

Usually, each species has very specialised food requirements, and often its defensive molecules are also unique and differ from even closely related species. In particular, terpenoid compounds, which are derived from sponges, are concentrated around the mantle border and in the mucous secretions of the mantle. At their natural concentrations these chemicals deter crabs and reef fishes from preying on the slug.

Why all the colours?

Many animals, which are very distasteful or poisonous to eat, have bright colour patterns. The bright colours are considered to be a message to potential predators warning them to stay away. We call such warning colouration *Aposematic colouration*.

Yellow and black. Classic warning colouration displayed by a *Sagami Bay Tambja*



In one nudibranch family, the Chromodorididae, the colour patterns of many species are spectacular and obvious. Research in recent years has shown that these animals have specialised glands in their mantle that contain poisonous and distasteful chemicals from their sponge food. It is thought that by linking bright colour to bad tastes, these nudibranchs can teach fish and other potential predators to leave them alone.

In a development of this, we often find geographic areas where groups of unrelated chromodorids have evolved very similar colour patterns, so that they share the load of teaching fish to leave the colour pattern alone. One example of this mimicry in southeastern Australia are a group of about ten red spotted species, some of which are very difficult to tell apart. Most chromodorids have these mantle glands. ■

Egg mass from a Spanish Dancer



Many opisthobranch egg masses form a spiral ribbon, and most of these spiral in an counter-clockwise (sinistral) direction from the centre. However some such as *Melibe australis* and *Melibe engeli* seem to be dextral, coiling clockwise from the centre. There is some discussion in the scientific community as to whether spiraling tends to be counter-clockwise in the northern hemisphere and clockwise in the southern hemisphere. To complicate the matter, some species start the egg spiral from the outside, whereas the majority start from the centre, in which case, the spiral will be made turning the other way.



Spanish Dancer

NONJOY TAN

of chemicals to make them poisonous, or at least extremely distasteful, to potential predators. In fact, *Opisthobranchs* (the subclass that nudibranchs belong to) have become subjects for research by marine products chemists who are gradually uncovering just how widespread and in what complex ways chemicals are used by sea slugs. Many store these chemicals in special glands in their skin.

What has caught the attention of chemists and physiologists are the many different pathways the molecules are produced. In some cases, these compounds are absorbed from ingested prey and stored unaltered by the opisthobranch, and in other cases, the compounds undergo some modifications. They may also be produced entirely by the opisthobranch itself.



Discodoris boholiensis. This species is characterised by the narrow visceral hump, which forms a narrow median ridge from the rhinophores to the gills, and wide mantle skirt



Taxonomy & Trivia

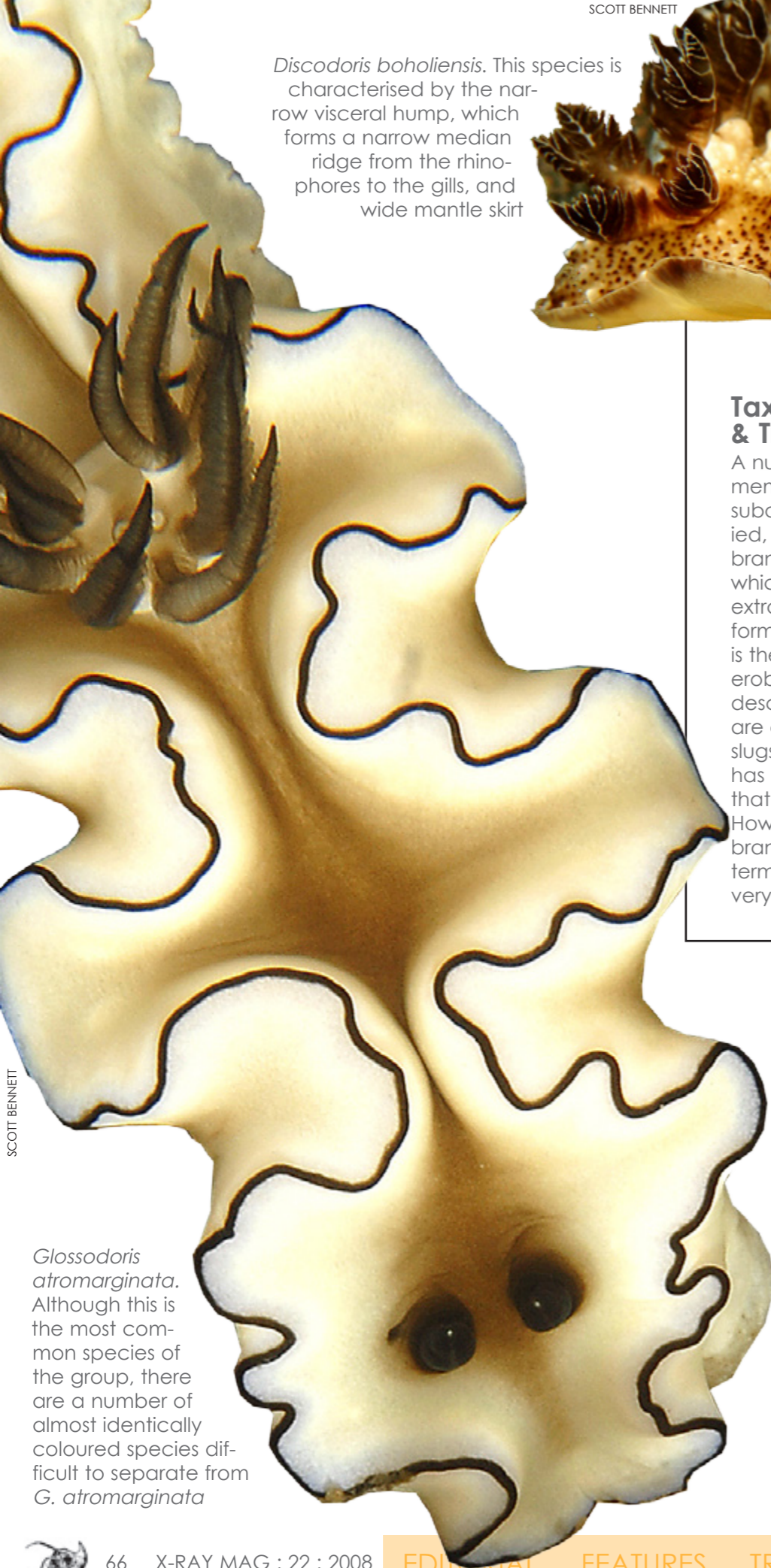
A nudibranch is a member of one suborder of soft-bodied, shell-less marine opisthobranch gastropod mollusks, which are noted for their often extraordinary colors and striking forms. The suborder *Nudibranchia* is the largest suborder of heterobranchs, with more than 3,000 described species. Nudibranchs are often casually called "sea slugs", a non-scientific term that has led some people to assume that every sea slug is a nudibranch. However, while it is true that nudibranchs are very numerous in terms of species, and are often very attractive, there are numerous

other kinds of sea slugs belonging to several taxonomic groups that are not very closely related to nudibranchs. A fair number of these other sea slugs are colorful, and thus, even more easily confused with nudibranchs. Other marine shell-less gastropods or "sea slug" groups include additional heterobranch shell-less

tropod groups such as the *Cephalaspidea* sea slugs including the colorful *Aglajidae*, and other heterobranchs such as the *Sacoglossa*, the sea butterflies, the sea angels, and the often rather large sea hares. The word 'sea slug' is also sometimes loosely applied to the only very distantly related, pelagic, caenogastropods within the superfamily *Carinarioidea*, and may also be casually used for the even more distantly related pulmonate sea slugs, the *Onchidiidae*. (From Wikipedia). ■

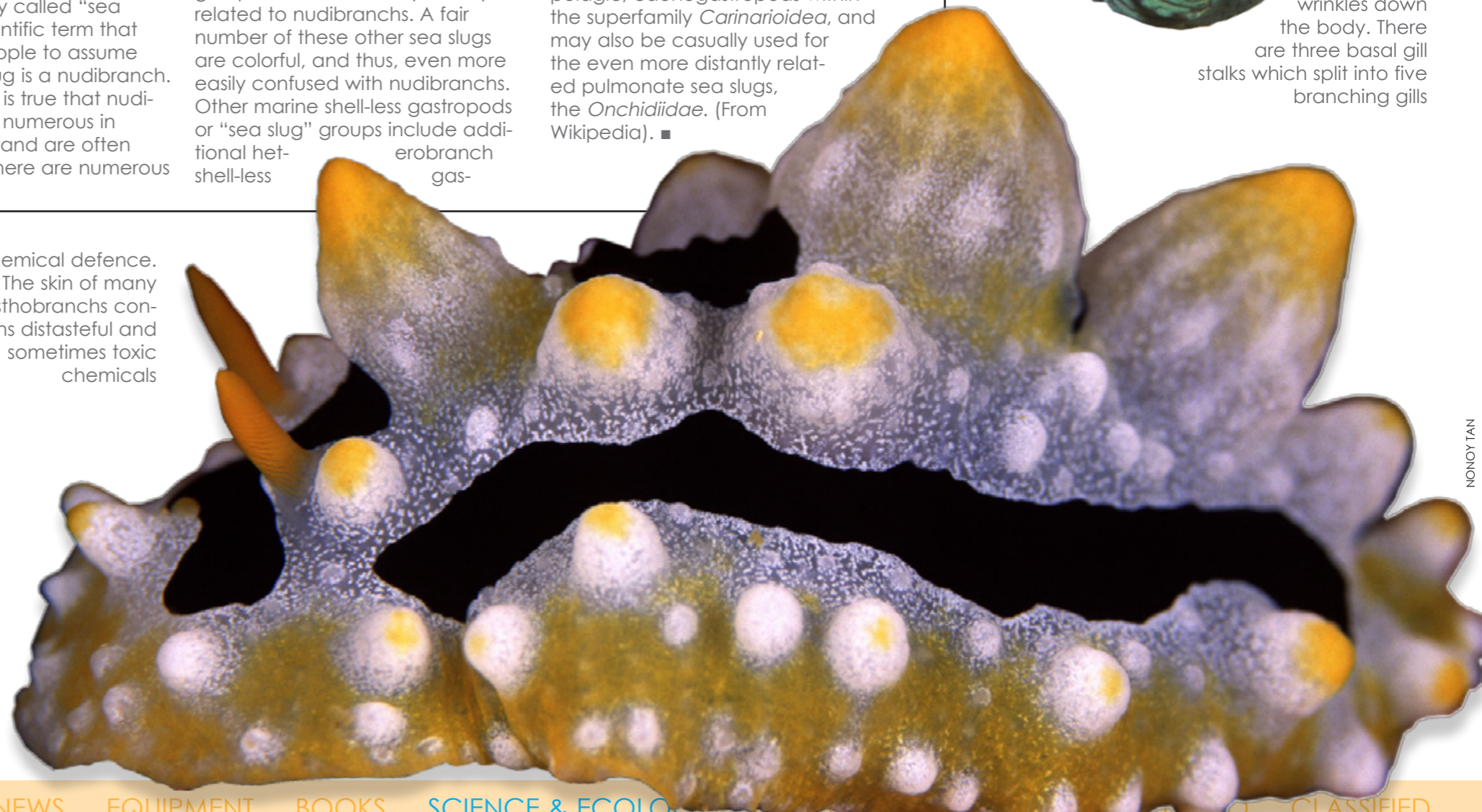


Millers Nembrotha, *Nembrotha milleri*. One widespread method of defence is to hide from predators by having a colour, shape and/or texture that matches their food or background environment. Grey-green to dark green body with blackish longitudinal wrinkles down the body. There are three basal gill stalks which split into five branching gills



Glossodoris atromarginata. Although this is the most common species of the group, there are a number of almost identically coloured species difficult to separate from *G. atromarginata*

Chemical defence. The skin of many opisthobranchs contains distasteful and sometimes toxic chemicals



New nudibranch books

Neville Coleman's new *Nudibranchs Encyclopedia – a review and how it compares to the new Debelius and Kuitert *Nudibranchs of the World*.*

Tim Hochgrebe, Underwater Australasia



The long awaited *Nudibranchs Encyclopedia - Catalogue of Asia and Indo-Pacific Sea Slugs* by Neville Coleman has finally arrived and what an encyclopedia it is!

Neville Coleman has made the excellent decision to publish this massive book as a hardcover, and with its over 400 pages, it really needs to be. The hardcover makes the book more professional, and naturally, it will last longer in any diver's library. He still managed to keep the book quite compact in its dimensions (160

x 235 mm), and for nudibranch fans, this book will still fit into their travel case.

The first 30 or so pages is dedicated to nudibranch biology, which makes this book much more than just a reference book to identify that strange new nudibranch you found on your last dive. He talks about the different habitats where nudibranchs are found and also how to find them. He explains how they see, smell, hear, taste and feel and all with beautiful photographs to illustrate each fact.

There are some excellent sections on nudibranch behaviour, including tailing of individuals, burrow-

ing and mantle flapping behaviour, and of course, nudibranch sex and defence.

In his typical emotional style of writing, Coleman manages to draw the reader into the passion and excitement that these critters bring to his life. This makes the book much less 'dry' than many of the books written by scientific 'purists'.

Another difference to Coleman's previous nudibranch publications is the fact that he openly invited many nudibranch lovers from around the world to contribute their findings and

images to this book. It is great to see how many people share the passion and enjoy finding new and previously unseen species and behaviour. By accepting other people's contributions, the scope of the book has certainly widened, and the quality of the imagery has improved, as there were more images to choose from.

Over 3000 images are contained in this work, which makes it the most comprehensive publication on nudibranchs in the world. And since it focuses solely on Asia and Indo-Pacific sea slugs, it is clear that this book is to become 'the bible' for slug lovers diving this region of the planet.

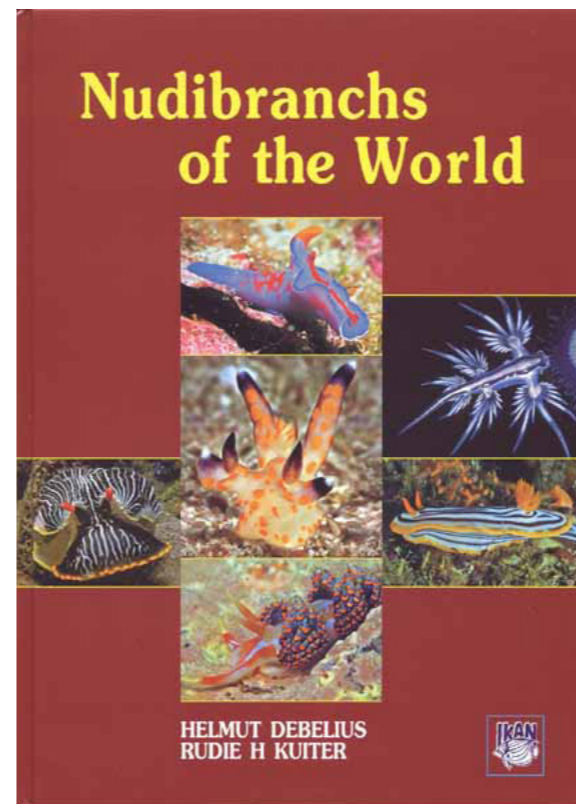
Another new book on nudibranchs is Helmut Debelius and Rudi Kuitert's title *Nudibranchs of the World*. This book is much larger in size (210 x 280 mm), and therefore quite a bit heavier. Pages within the book have excellent print quality and stunning photography. *Nudibranchs of the World* feels more like a coffee table book of nudibranchs than a reference book,

In contrast to Coleman's book, which includes ophitobranch (non-nudibranch) sea slugs, *Nudibranchs of the World* only covers true nudibranchs and sorts them in a more evolutionary or scientific manner. It has an introductory section to each family that highlights the specific features that differentiate each family from the others. Over a third of

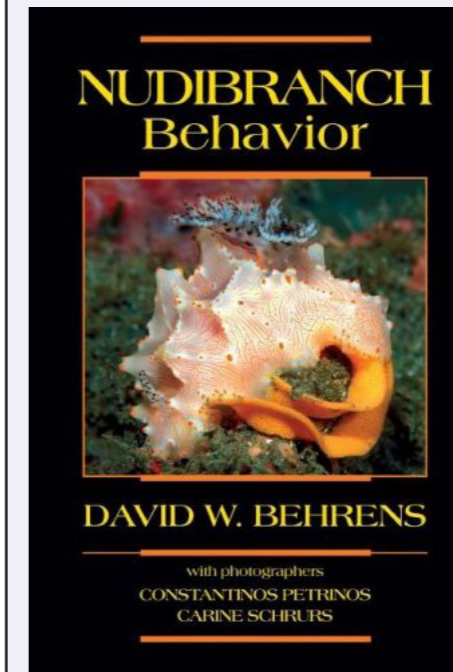
the Debelius/Kuitert book focuses on the family *Chromodoridae*. It is amazing to see the regional colour variations in some species.

In summary, as a big nudi lover, you will obviously have to have both books. The Debelius/Kuitert book really made me want to go and spend more time diving outside the Asia and Indo-Pacific region, as there are so many beautiful nudibranchs I have yet to discover. In terms of usefulness, I prefer Neville's book—there are more images, it is focused on my favorite region, and will definitely become the first book to open when I see a new nudibranch, or when people submit images to the Underwater Australasia photo galleries and ask questions about the identity of their find.

To purchase your own copy of these books, have a look at the book section at the link below: [underwater bookshop](#). ■



Not new but still very handy



The book should really be titled Sea Slug Biology ... I also find the term behaviour a bit misleading. It is, however, a great book.

Nudibranchs are among the most beautiful creatures on the reef, with colors and shapes that dazzle and delight. Unlike fish that may disappear before our eyes in a flash, the showy nudibranch glides slowly along the substrate, allowing us the time to savor this extraordinary sight. With their shell-less unprotected bodies, how do they survive in seas filled with hungry mouths? How do these sightless creatures navigate the reefs to find food and mates? What and how do they eat? How do they reproduce? What special relationships have they developed with other reef inhabitants? These and many more questions are answered in this informative and lavishly illustrated book. You will never look at nudibranchs the same way again. ■

Soft cover: 177 pages
Size: 180mm x 250mm
ISBN: 1-878348-41-8

Good to know: *Aeolid cnidosac*

The *Aeolid cnidosac* is one of the most remarkable examples of recycling in the animal kingdom. These animals feed on cnidarians (sea anemones, corals, hydroids, jellyfish, etc.) and are capable retaining at least some of the cnidarian's stinging cells (nematocysts) in a functional state, so that they are able to reuse them in their own defence.

The *Glaucus atlanticus* (below) is an example of a nudibranch that can severely sting humans.



Cnidarians, or coelenterates, have a wide range of nematocysts, some of which are used for poisoning prey, some for catching by harpoon-shaped barbs, others for entangling with sticky secretions or entangling coils. The three nematocysts in the cnidosac photo above are barbed nematocysts. When they are triggered, the spiral thread, which is easily seen in the photo, uncoils as a long thread to attach the barb to the cnidarian, or in this case, to the cnidosac.

It is now thought that nematocysts reach a state of physical but not physiological maturity in the cnidarian. Usually, after some time, they then become part of the cnidarian's functional armoury. It is thought that the nematocysts, which are captured and able to be used by the aeolids, are those that are physically mature when eaten, but not yet physiologically mature. ■

TARO TAYLOR

