

triggerfish



surgeon fish



coral

parrot fish



crown-of-thorns starfish



clam



pearl fish



sea cucumber



anemone





AZURE VASE SPONGE



fig. 1.



fig. 3.





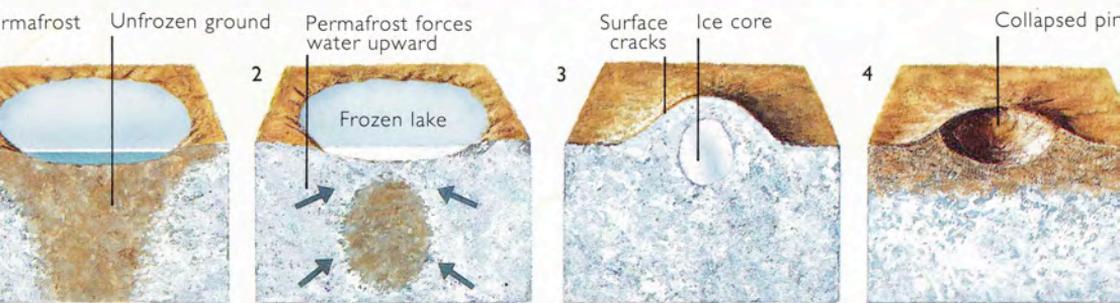
Sea Squirts (Tunicata)



SEISMIC DETECTIVE WORK

By studying telltale signs on the surface, geologists like Ken Hudnut detect the dangerous fissures down below

the world, they uncovered a different story. Folds, they warned, also grow through repeated earthquakes.





A cluster of the serpulid worm *Spirobranchus giganteus* growing on a sponge, probably *Neofibularia nolitangere*. There is also a brittle star in their midst. Photo by P. Colin.

The fire worm, *Hermodice carunculata*, is well named. The fluffy-looking tufts along the sides are extremely sharp calcium spicules able to cause a great deal of pain to a person who unknowingly picks up the worm. Photo by P. Colin.



enough to get some of them. The best specimens come in with *Porites* coral, as the animals imbed their tubes in the coral (and that saves us the problem of worrying about a substrate!). The species is aptly named, as the "feathers" which protrude to extract plankton are in spirals of decreasing size, giving a decided Christmas tree appearance. This species hails from the Caribbean, and it should be placed in a position of lower lighting so that it is not encrusted by algae.

Bristleworms (*Hermodice carunculata*)

Although this species has a certain beauty, it is the bane of the reef tank hobbyists. Actually, there are several species of bristleworms. There are two major problems with them. They are painful to handle with bare hands, as the fluffy-looking tufts along the sides are, in fact, extremely painful needle-sharp calcium spicules. Also, they are disgustingly fecund, and they can easily reproduce in the reef tank. Most hobbyists remove them whenever they see them, using either gloved hands or tongs for handling them. Although hated by most reef tankers, the many species of bristleworms are very interesting, and some hobbyists actually keep them on purpose! However, they give them a tank of their own. They feed on detritus, so their numbers should stay small in a properly cared for reef



Viewed from the side, it is no wonder that these animals are called Christmas tree worms. This is *Spirobranchus* sp. (possibly *grandis*). Photo by Cathy Church.

The calcareous tube of this serpulid worm can be seen through the feathery head appendages. Photo by Courtney Platt.

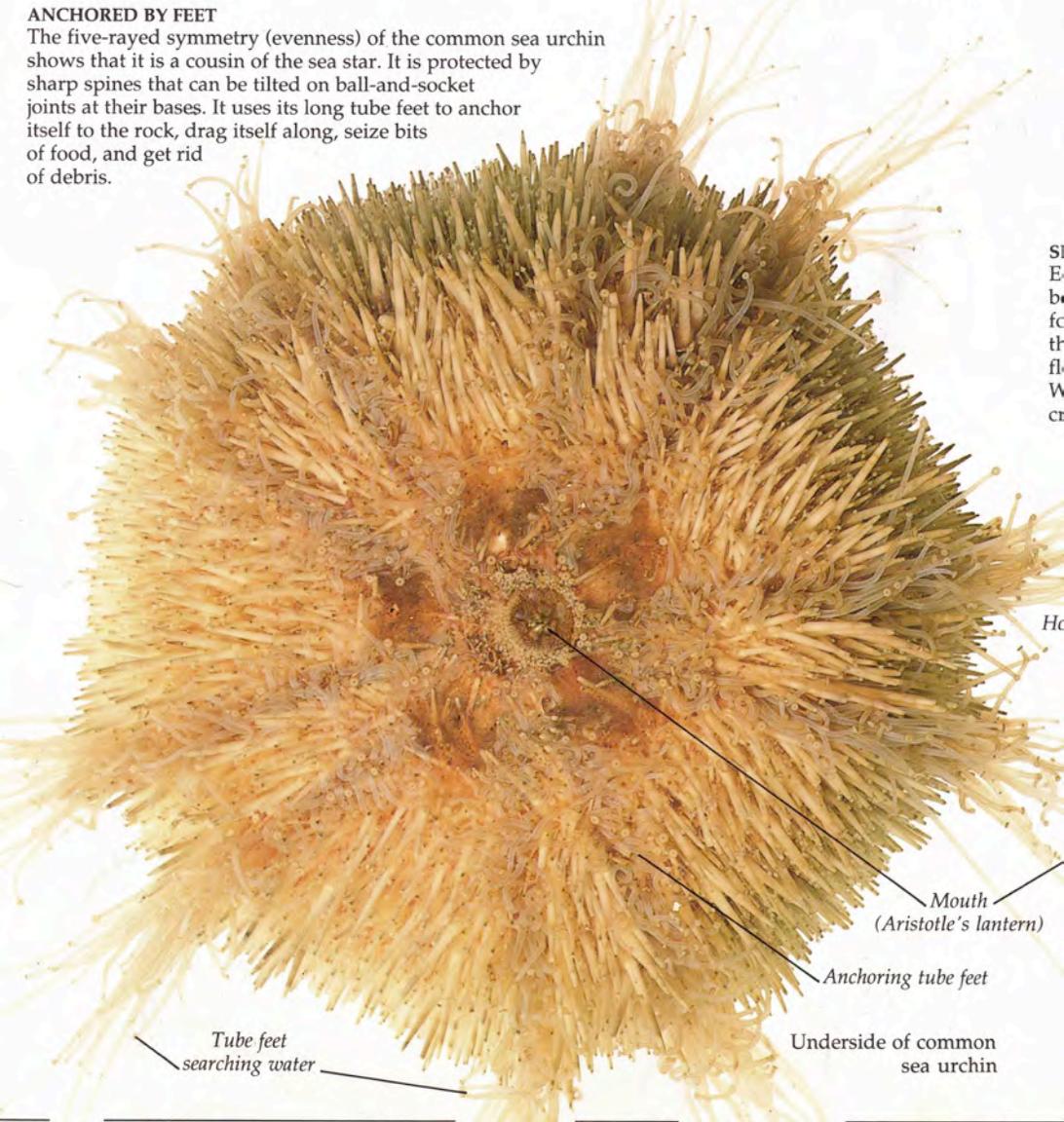


#25,058 © 1997

Tube worms

ANCHORED BY FEET

The five-rayed symmetry (evenness) of the common sea urchin shows that it is a cousin of the sea star. It is protected by sharp spines that can be tilted on ball-and-socket joints at their bases. It uses its long tube feet to anchor itself to the rock, drag itself along, seize bits of food, and get rid of debris.



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Ho

Mouth
(Aristotle's lantern)

Anchoring tube feet

Underside of common
sea urchin

Tube feet
searching water



Blutegel.





Gills

SEA SLUG

Many sea slugs are meat eaters. This slug lives on the soft coral known as dead-man's fingers. Some sea slugs are able to eat the stinging tentacles of anemones and keep the stings for their own protection. Sea slug eggs hatch into swimming young, which then settle and turn into adults.







THE PLUMOSE ANEMONE WITH SERPULID TUBE-WORMS

Coloured engraving from Gosse's *The Aquarium*, 1854

#7498

Marine fauna & flora

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Giant tube worms—some 10 to 12 feet tall—thrive beside an undersea “chimney” at a vent in the Galápagos Rift. Hot, mineral-rich geysers feed colonies of these organisms, whose bodies contain bacteria that metabolize nutrients from hydrogen sulfide in the seawater and make food for their hosts.





#23,005 (© 1993)
SEA CUCUMBER

Nearly anyone who has snorkeled along a tropical beach is familiar with the big greenish or black animals aptly called sea cucumbers that crawl around in full view on white sand bottoms. But another group of these fascinating animals — which are related to feather stars and starfishes — are more reclusive and are seen mainly at night. Some simply are a bit more conspicuous at night, rearing up rather like short, stubby snakes in the sand to perform what has been described as a mating dance (left). Others, more usually found on the reef, are quite slender and can reach lengths of up to a yard (right, draped over sponges). These can be seen wandering about to feed from sunset to sunrise on the reef itself.

MARINE FAUNA + FLORA



problem. Protozoans, and the amoeba is no exception, reproduce by cell division. They do not lay eggs or give birth to young, but divide, one cell becoming two. A naked amoeba manages this easily. Its cell contents arrange themselves in an appropriate pattern so that each daughter cell will possess the necessary faculties, the cell wall narrows to a waist that joins, and the cell becomes two cells. How is this possible for a protozoan which lives inside a rigid structure to which it is attached quite firmly by the cementing substance secreted at its cell wall? What happens is that some of the cell is pushed out through the opening in the shell, and assumes the bottle-like shape of a *Diffugia*. It remains quite still, while small grains of minerals are passed through the cell wall to its surface to make it into a tiny *Diffugia* 'bud' attached to the parent. At this point the cell contents divide to equip the daughter with all that it needs, and when that process is complete the tiny new *Diffugia* breaks away from the parent to lead a separate existence.

Diffugia solves this problem very neatly, but its curious method of construction allows it to evade the other main problem that faces shelled animals, namely how to grow inside a shell. They generally achieve this simply by growing more shell and adding it to the existing one. This leads to some structural complexity if the owner of the shell has to carry it around its habitat, and hence to the elaborate whorls and spirals that creep around our gardens and seashores. The baby *Diffugia* needs no such strategy. As it grows its surface area increases, the particles with which it is coated move apart, and new particles are inserted to fill the gaps between them.

Even some worms are able to construct dwellings for themselves. The

above The tube of a marine bristle-worm, *Pectinaria koreni*.

above left *Branchiomma vesiculosum*, a fan worm or 'feather duster' worm. The spots are simple eyes which are highly sensitive to sudden changes in light intensity. If an object shades the worm it will withdraw into its tube at once.

Marine fauna + flora

#18,692(1982)

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Above: One of the many wonders of underwater Mauritius: a feathery white fan worm.



Corallimorphian (not a coral).



Acropora.



Millepora.



Platygyra.



Fungia.



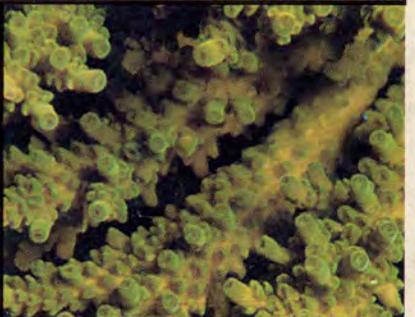
Pavona.



Millepora.



Acropora or Acrhelia.



Acropora or Acrhelia.



Goniopora.



Euphyllia ancora.



Galaxea.



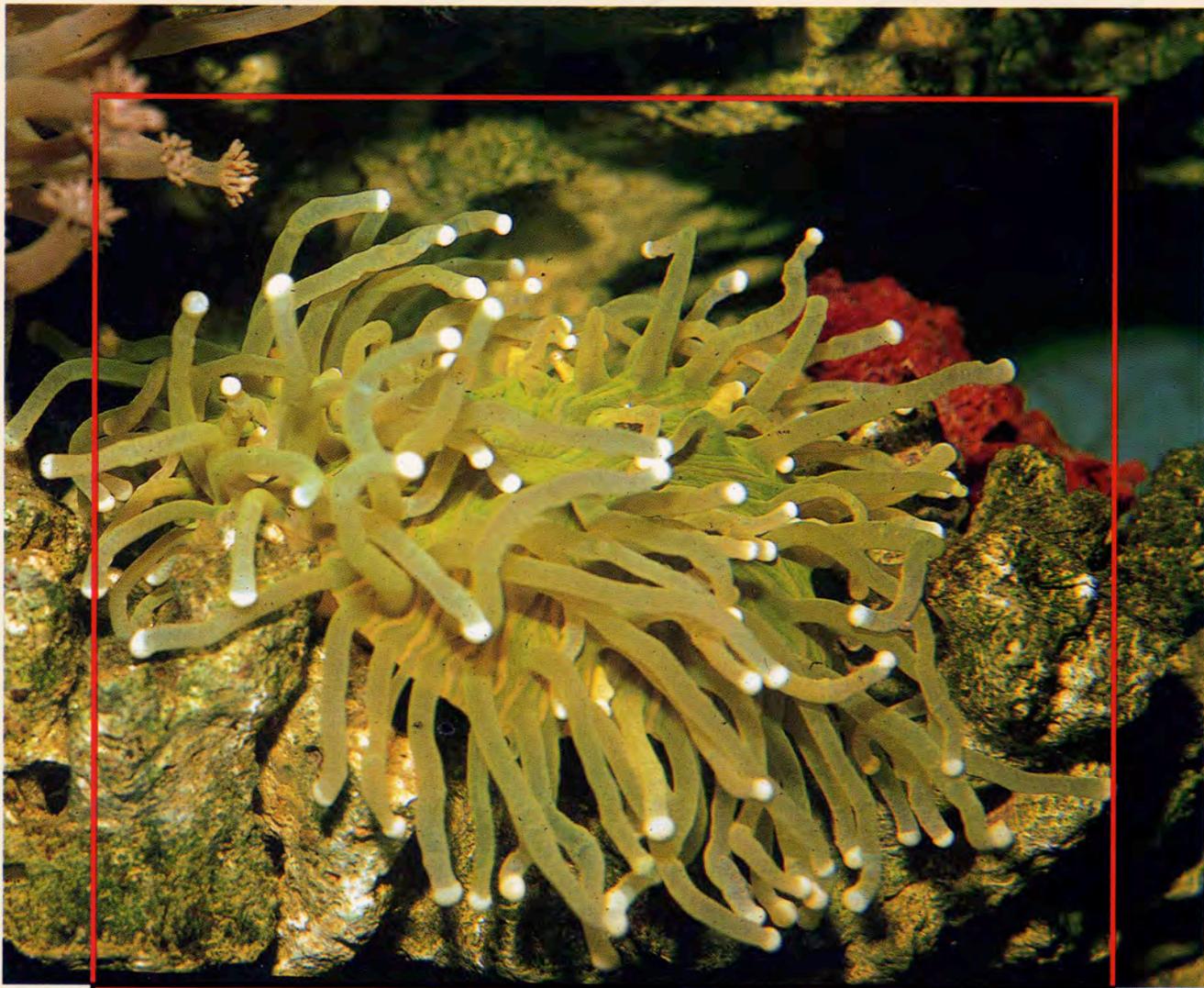
Favia.



Sabellid worms.



Acropora.



The tentacles of the free-living *Heliofungia actiniformis* are always extended during the day. They are usually gray, blue or green in color with a light-colored tip. Photo by Dr. H. R. Axelrod.



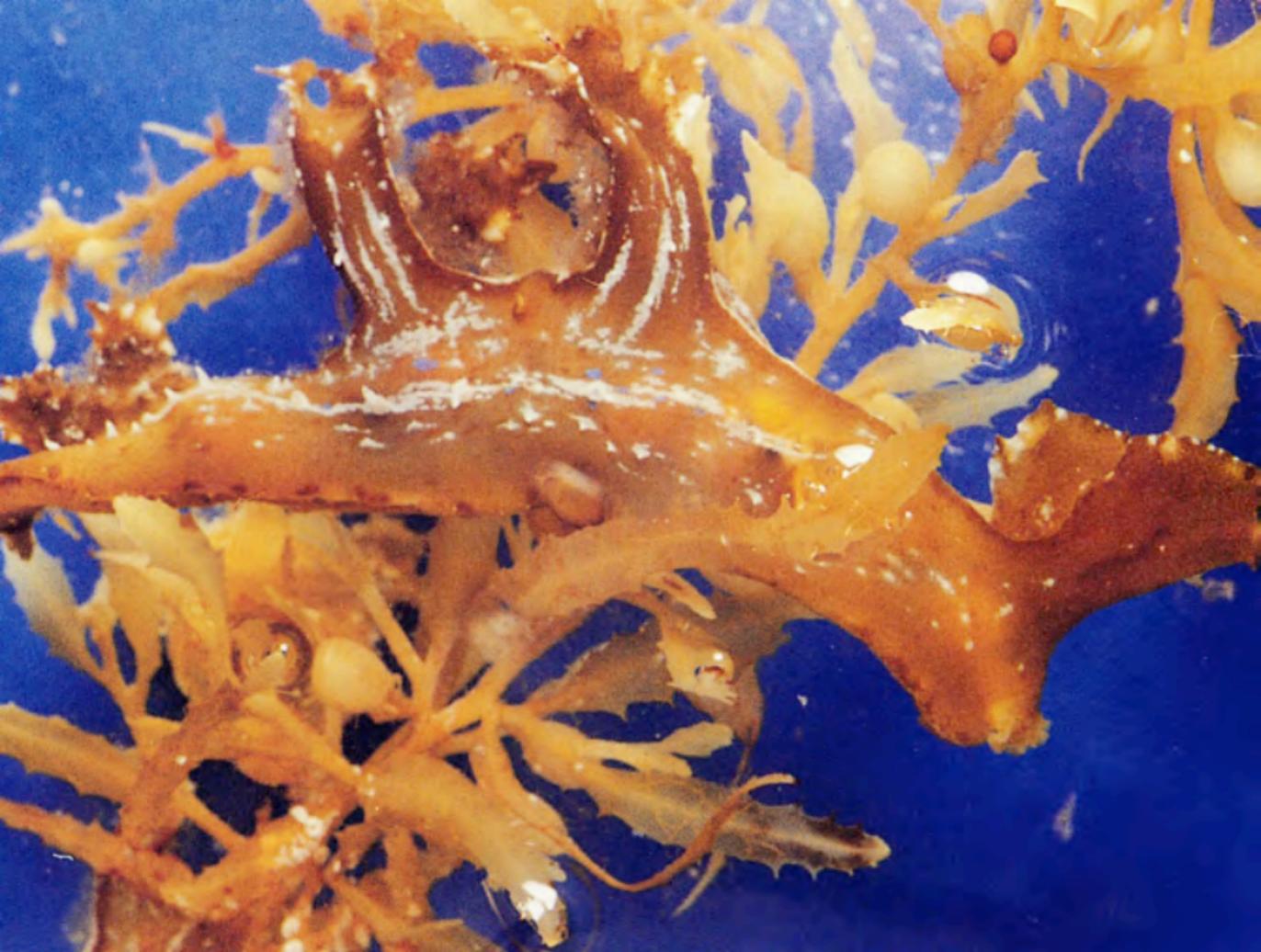
GLUED TOGETHER at about six feet deep, the eggs of a sea-snail, adhering by the secretion of its parent, undulate gracefully in the movement of the tide. For such invertebrates the coral gardens are a colourful but dangerous place.



OARED SEA-SNAILS (*phyllobranchus*) are a rarity even in New Caledonia. They live between six and nine feet deep and row themselves along with the petal-shaped organs which cover their bodies. They love the rocks, and live on minute sea-organisms.

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TUNNELLING SEA-SNAILS (the spirobranchia) dig long and deep galleries in the coral for their homes. Their breathing organs, spread on the surface of the sea, act also as their radar to warn them of danger—at which moment they retreat into their tunnel, closing a valve which can be seen in the background.

STICKY SEA-WORM, or spirographia, is a near relative to the spirobranchia. They exist in flexible, parchment-like tubes and adhere to sand, rocks or coral, building themselves there a shelter. The branched tentacles here are extended from the protective tube—it is through these that it breathes and finds food from the microscopic matter in the sea.

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Marine fauna + flora



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Maine fauna + flora

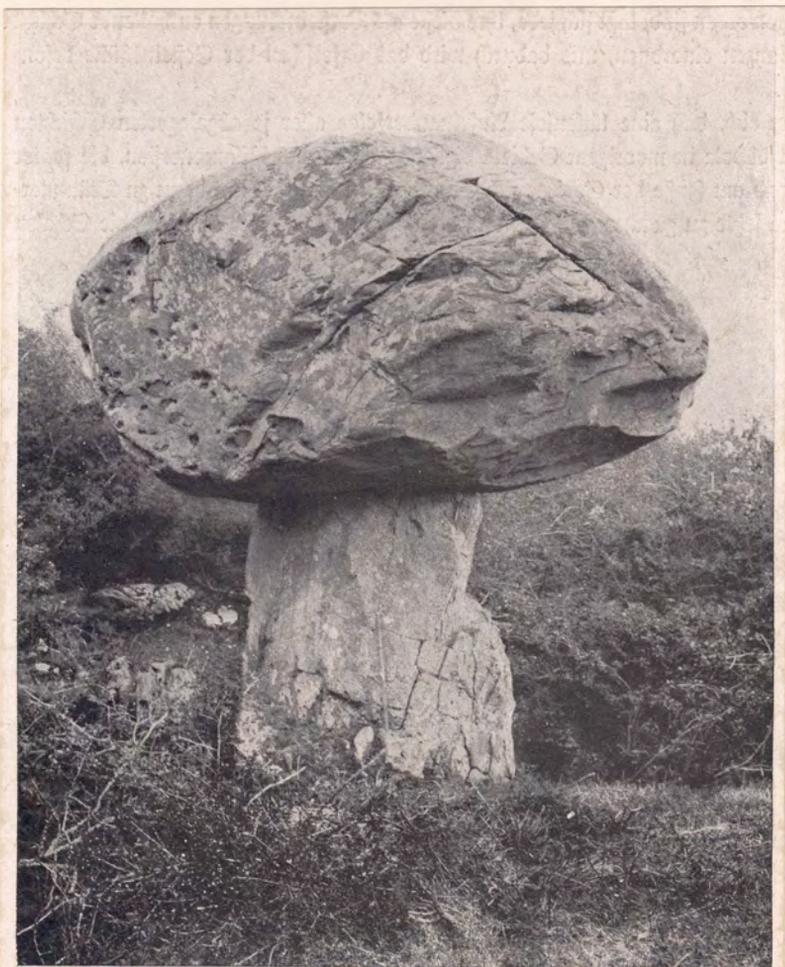


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Phot. R. Welch.

Roter Sandsteinblock der Devonzeit auf einem Stiel weichen Gesteins.
Einst ruhte der Block auf einer ausgedehnten Schicht. Diese wurde aber durch Regen, Wind und
andere Kräfte der Verwitterung abgetragen. Nur das vom Sandsteinblock geschützte Stück blieb erhalten.

Geology

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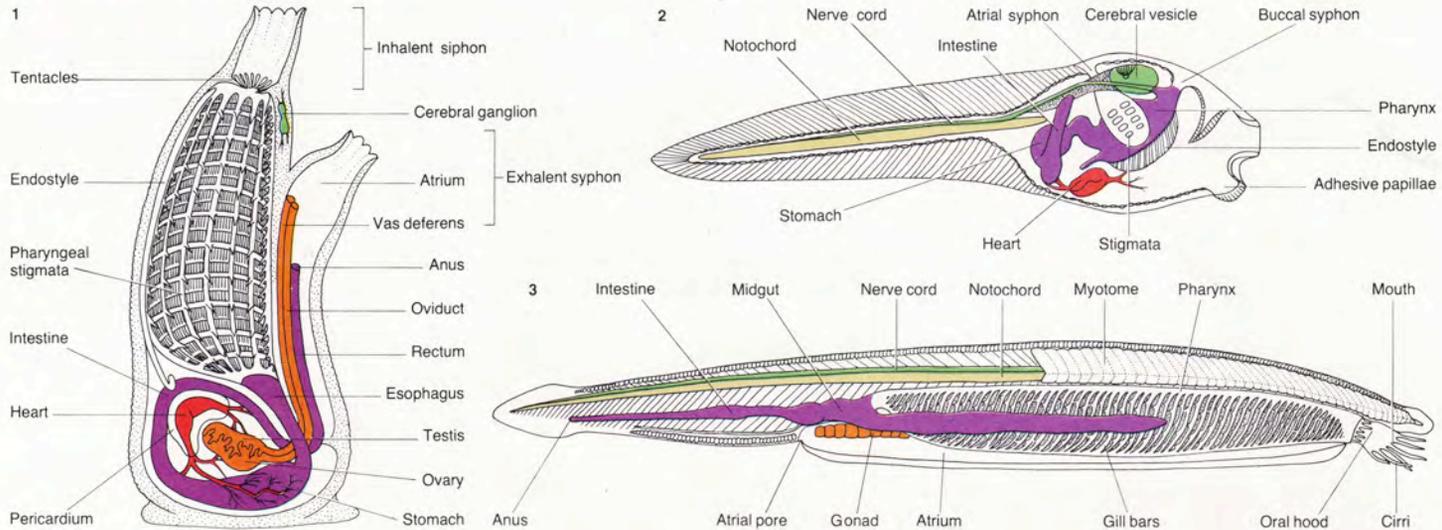
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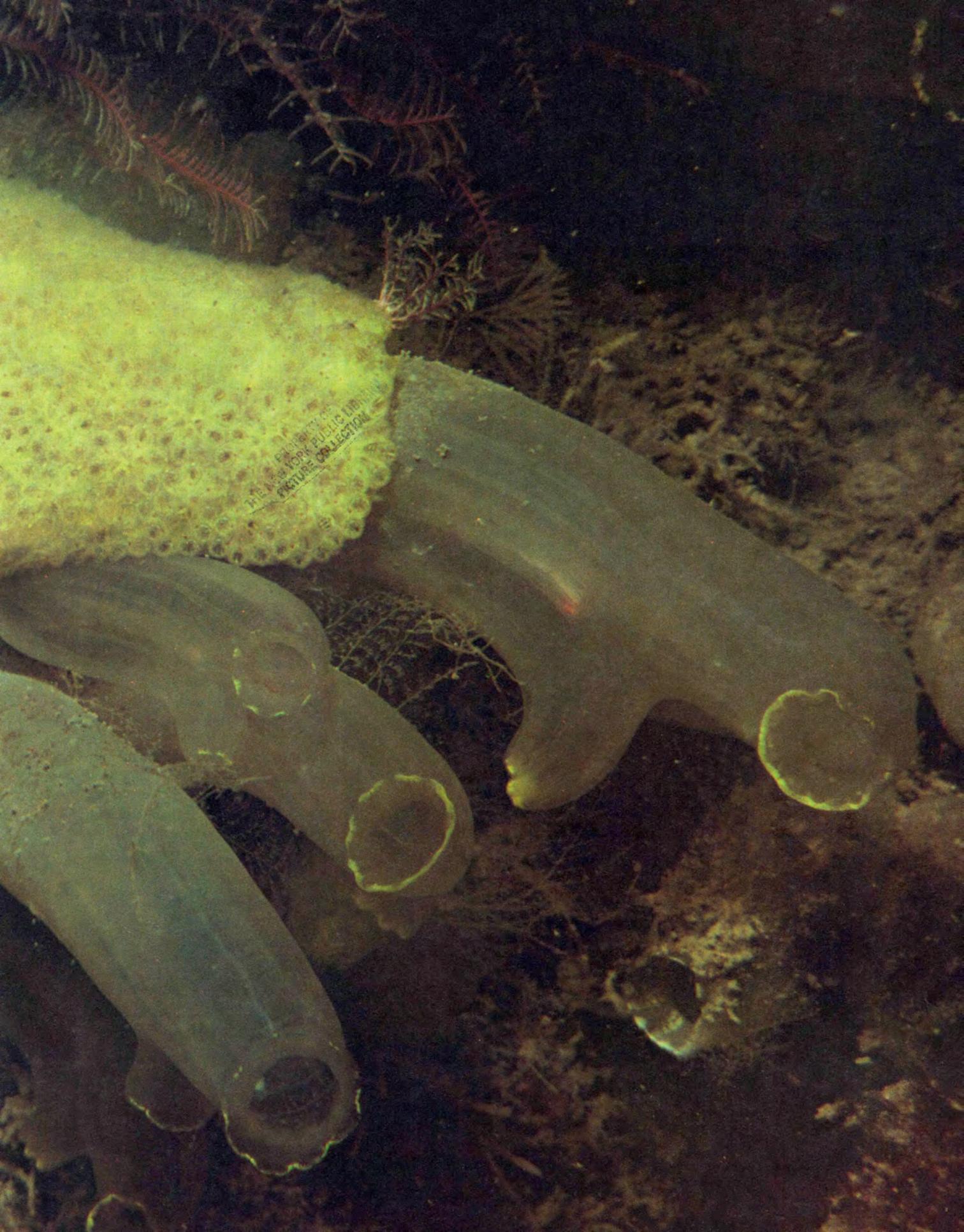
encrusting the hulls of ships and other marine structures. They are also of considerable evolutionary and zoological interest.

The other urochordates, thaliaceans (salps and others), and the larva-like larvaceans, have characters fundamental to the group but have evolved along pelagic and not bottom-dwelling lines. Members of one thaliacean order, the Pyrosomidae, are commonly found in warmer waters and emit phosphorescent light in response to tactile stimulation. These pelagic animals (eg *Pyrosoma* species) live in colonies, but some other types exist as solitary individuals. They have complex life-histories. *Oikopleura* is a larvacean genus of small animals like the tadpoles of sea squirts. Rhythmic movements of the tail draw water through the openings of the gelatinous "house" in which they live and which is secreted by the body.

The lancelets are a minor group of chordates containing only two genera and under 20 species. These small, apparently fish-like animals are known as lancelets because of their elongated blade-like form. They show primitive chordate conditions. The notochord, which in sea squirt larvae merely supports the tail, extends into the head (hence the term cephalochordata). There is no cranium as in the craniates or



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Geo Thermal Area
North Island New Zealand

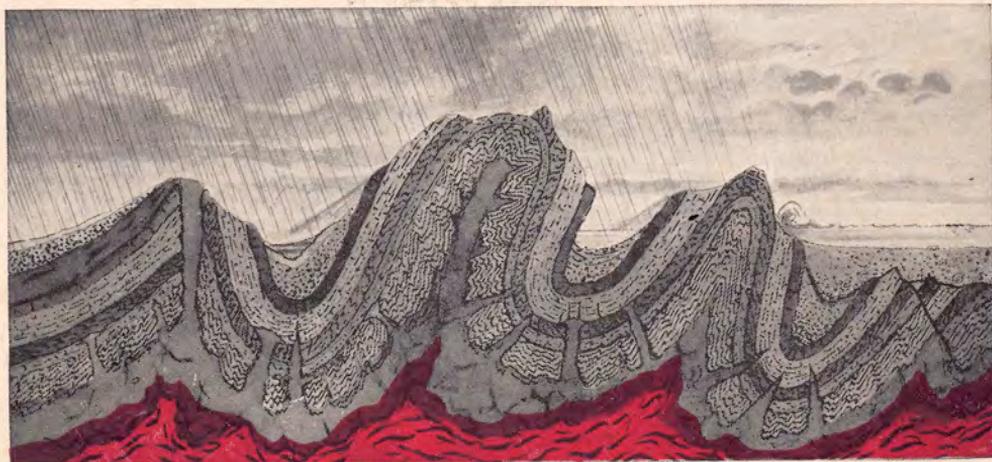
Geology



CRUMPLING AND WEARING OF THE EARTH



The great crumples and folds in the early crust of the earth, with molten igneous rock forced into them, and in one place bursting through.

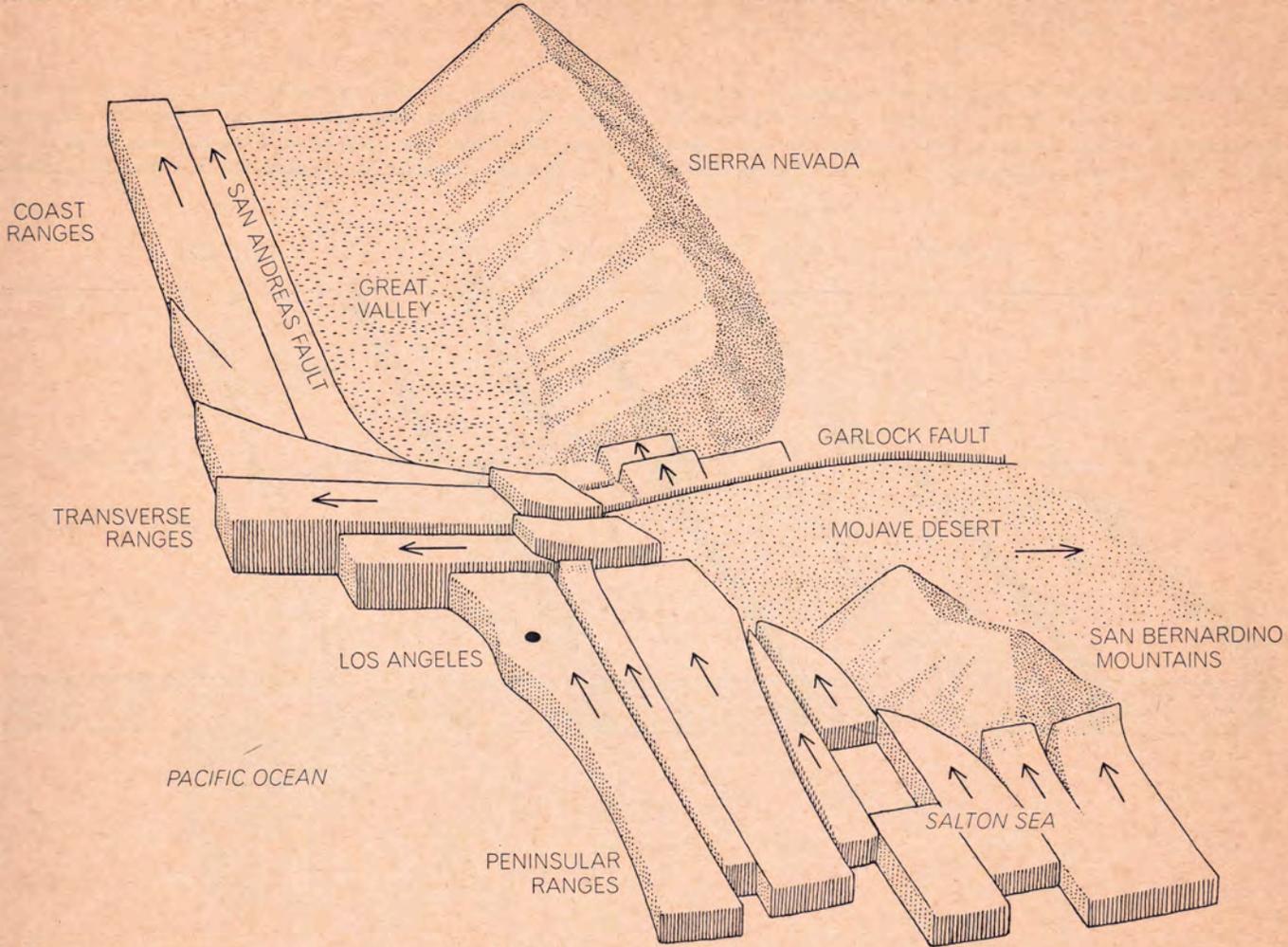


The folds many years later when rain, rivers, frost and wind have greatly worn them down.



The folds in modern times still more worn down, showing valleys, hills, sea, and soil.

240



MOTION OF EARTH'S CRUST in southern California is generally northwest except where the lower group of blocks encounters the deep roots of the Sierra Nevada. At this point the blocks are diverted to the left (west), creating the transverse ranges and a

big bend in the San Andreas fault system. Above the bend the blocks continue their northwesterly march, carrying the Coast Ranges with them. The Salton Sea trough at the lower right evidently represents a rift that has developed between two blocks.





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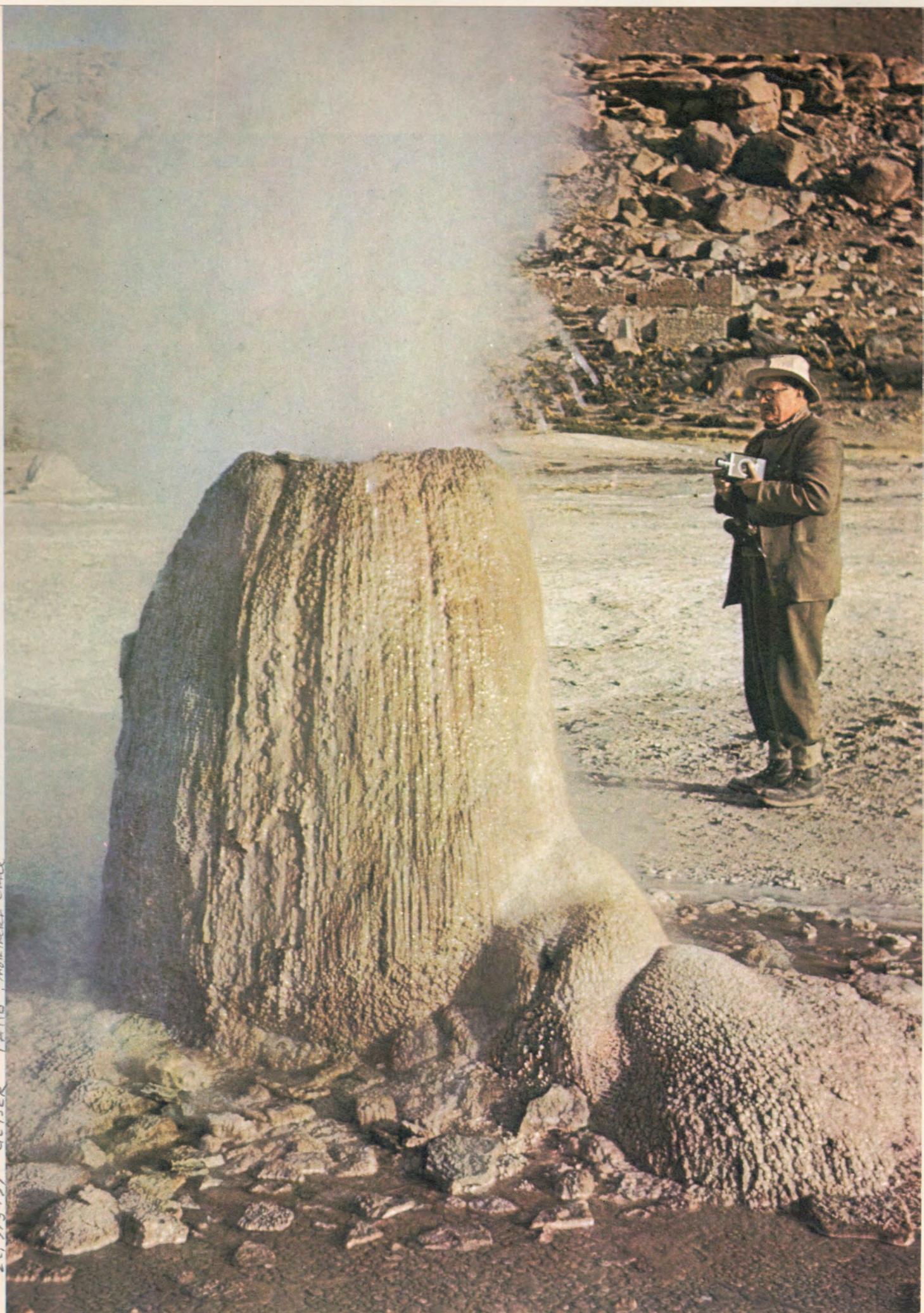
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Broken Layers of Basalt
at Hadley Rille, Moon.

Apollo 15; 1971.

22, 913 121 GEYSER TATIO, Northern Chile



#22,913 (©1971)
GEYSER TATIO, Northern Chile



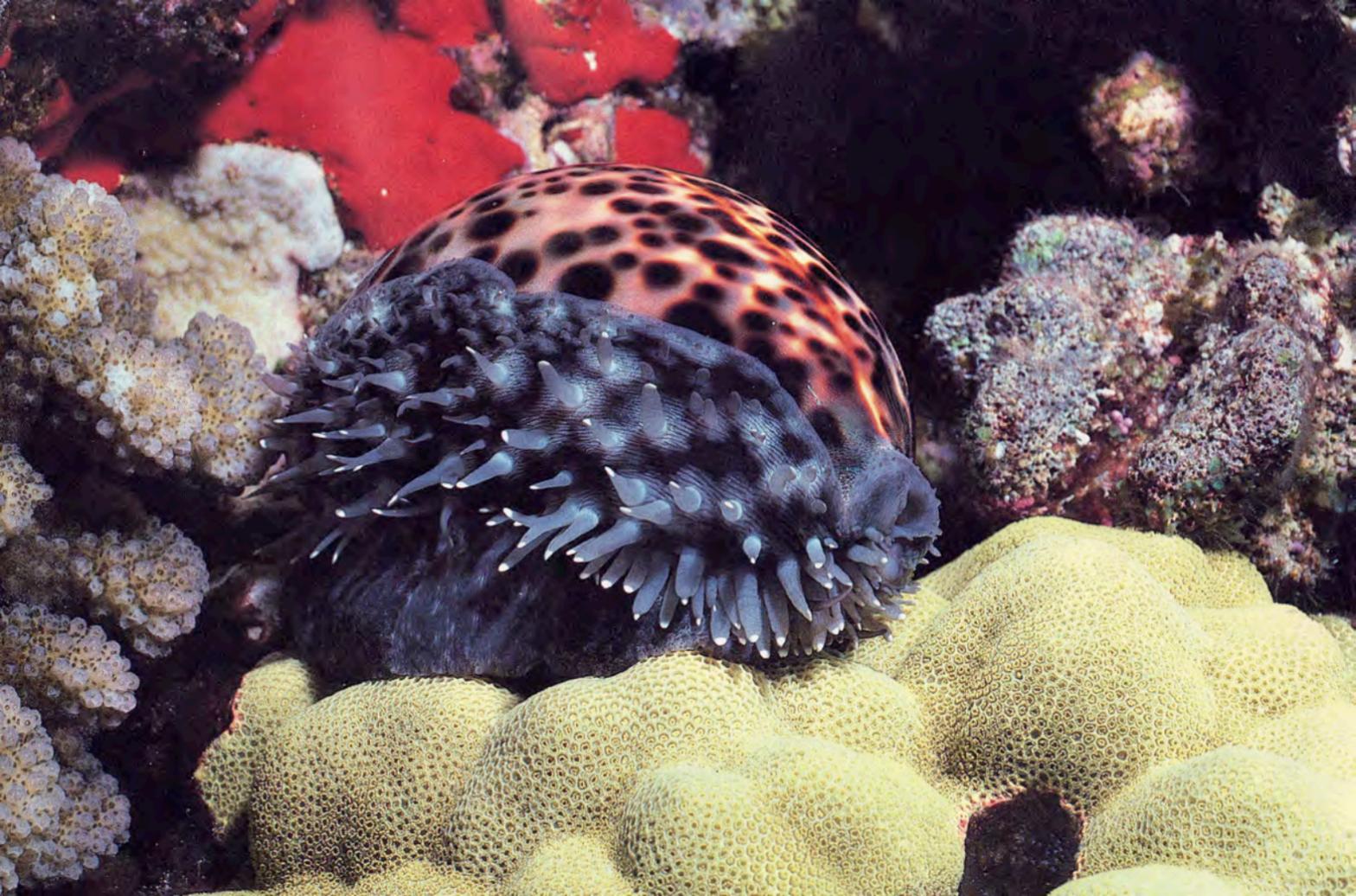


The sea cucumber has evolved two remarkable ways to distract predators. Sometimes the bottom-dwelling creature releases the sticky white stringlike substance shown here. As the mass entangles the attacker, the sea cucumber moves to a safer location. In other cases, the sea cucumber eviscerates its digestive and respiratory tracts and gonads. The predator gets an easy meal, and the sea cucumber crawls away and regenerates these organs.



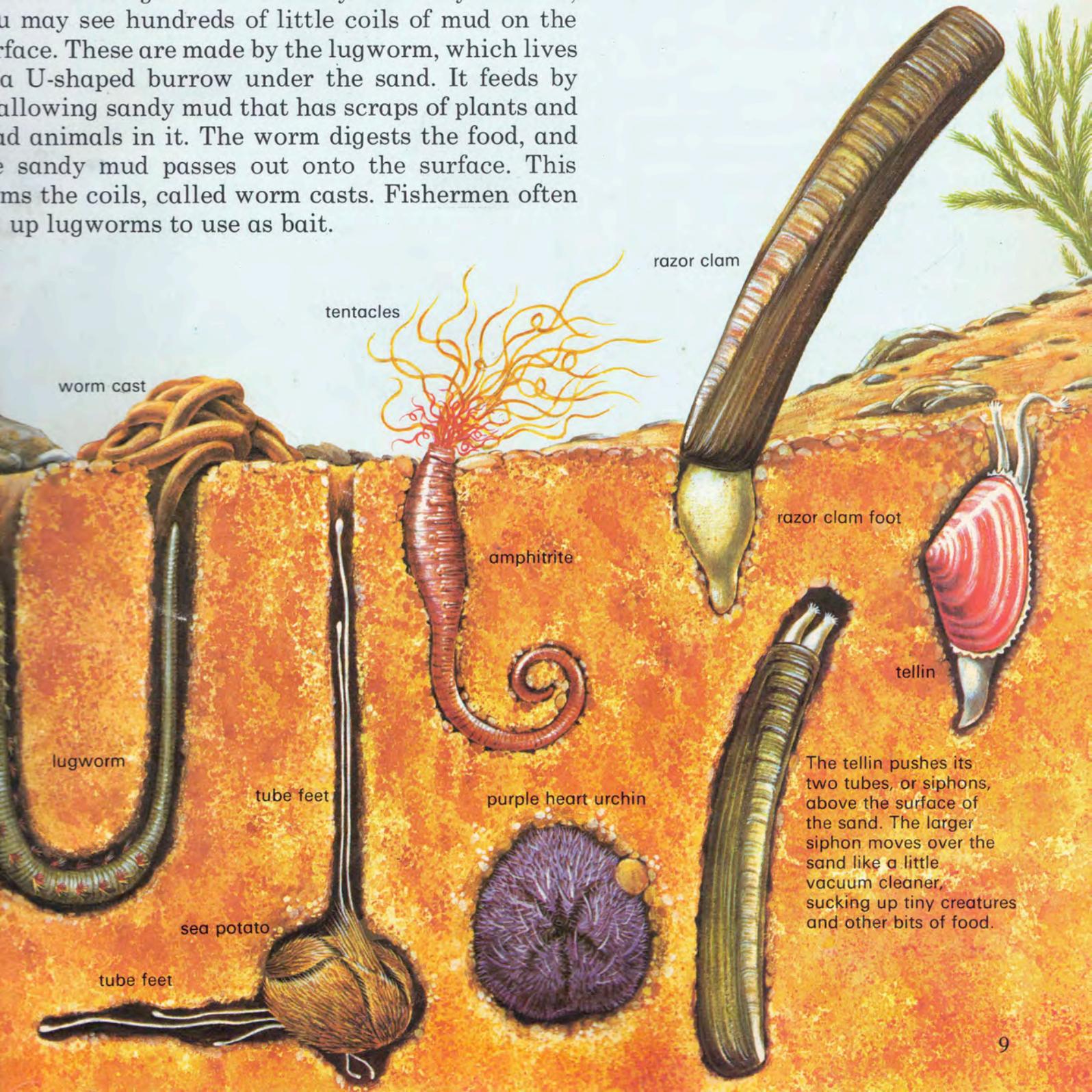
Nudibranchs are marine relatives of the far less colorful terrestrial slug. Dozens of species inhabit the Great Barrier Reef. Researchers describe them as elusive, if not rare, and continue to discover new species every year.







... may see hundreds of little coils of mud on the surface. These are made by the lugworm, which lives in a U-shaped burrow under the sand. It feeds by allowing sandy mud that has scraps of plants and animals in it. The worm digests the food, and the sandy mud passes out onto the surface. This forms the coils, called worm casts. Fishermen often use lugworms to use as bait.



razor clam

tentacles

worm cast

razor clam foot

amphitrite

tellin

lugworm

tube feet

purple heart urchin

sea potato

tube feet

The tellin pushes its two tubes, or siphons, above the surface of the sand. The larger siphon moves over the sand like a little vacuum cleaner, sucking up tiny creatures and other bits of food.



SWAMP

MARSH

BOG

PAINTING BY JOHN DAWSON

No narel
1987



354
407
407





MARINE FAUNA & FLORA

#23,005 (© 1993)
ANEMONE with ANEMONE Shrimp
Photo by JEFFERY L. ROTMAN



TRIDACNA SP.



TRIDACNA SP.



NUDIBRANCH: CHROMODORIS BULLOCKI



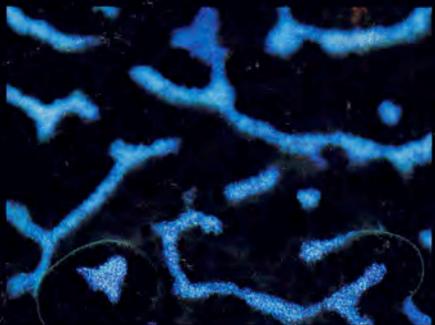
SHRIMP: RHYNCHOCINETES DURBANENSIS



CHAETODON MYERSI



TRIDACNIDAE



TRIDACNA MAXIMA



FLATWORM: PSEUDOCEROS SP.



SHRIMP: PERICLIMENES COLEMANI



FORCIPIGER LONGIROSTRIS



TRIDACNA ROBUSTA



TRIDACNA SIPHON



FLATWORM: PSEUDOCEROS SP.



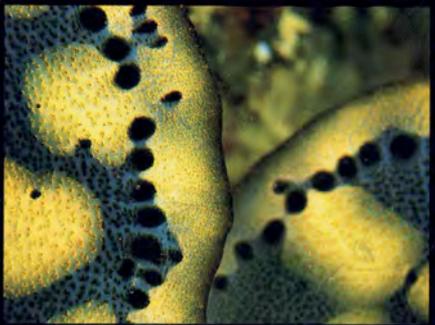
MAJID CRAB: XENOCARCINUS DEPRESSUS



POMACANTHUS IMPERATOR



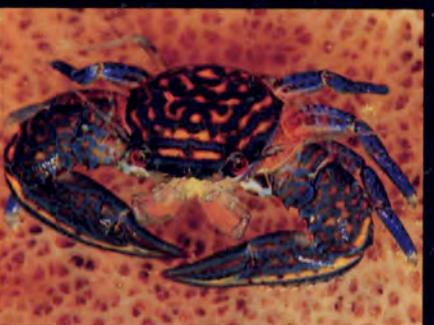
TRIDACNA AURATA



TRIDACNA SP.



NUDIBRANCH: NEMBROTHA SP.



CRAB: ALIAPORCELLANA SP.



POMACANTHUS XANTHUS

