

Brilliant show of natural light

CHESTER OBSERVER, 15 FEBRUARY 1968 N.M.

outshone the stars

In 1157, Alexander Neckham described how the seas around Britain and France glowed like fire for five days on end giving off so much light that it was impossible to distinguish night from day; and there are other medieval accounts of the seas around Britain "glowing altogether like a lamp".

Charles Darwin, in his account of *The Voyage of the Beagle* (1845), described another brilliant display of luminescence, this time in South American waters, when the sea glowed brighter and

brighter day after day until eventually the light became so intense as to outshine the stars: "While sailing a little South of the Plata during what should have been the hours of darkness, the sea provided a wonderful and most beautiful spectacle. There was a fresh breeze, and every part of the surface, which during the day is seen as foam, now glowed with an intense light. The vessel drove before her bows two billows of liquid phosphorus, and in her wake she was followed by a milky train. As far as the

eye reached, the crest of every wave was bright with a light which rendered the moon and stars invisible . . . the sea-water, when placed in a tumbler and agitated, gave off sparks".

In certain sheltered bays in the Tropics, the sea gives off light all year round. Two famed "fire lakes" occur in the Caribbean, one being Oyster Bay near Falmouth, Jamaica, and the other a small bay near Parguera, in Puerto Rico, known as Bahía Fosforescente, "Phosphorescent Bay". In these bays, every fish that makes the slightest movement is outlined with white fire, and every wave looks as if it were aflame.

The "burning of the sea", as medieval authors described it, has always intrigued observers. Tachard proposed the elegant theory that the sea absorbed the heat and light of the sun by day and, under certain unspecified circumstances, emitted it again by night. The great Irish physicist Sir Robert Boyle (1627-91) believed that the light was caused by friction between the waves and the atmosphere. But the real cause of the burning of the ocean remained a mystery until 1750, when two Venetian naturalists, Vianelli and Grixel-

lini, studying the phosphorescence of the Adriatic, implicated a tiny single-celled animalcule known as *Noctiluca*.

The phosphorescence of the Adriatic and many other seas is caused by drifting blooms of luminous zooplankton which emit photons of light as a by-product of photoelectric chemical reactions. These zooplankton favour tropical and sub-tropical seas, but blooms are sometimes carried into, or in warm summers develop in, temperate waters.

Harmless

Many marine bacteria are brilliantly phosphorescent too, and these are often responsible for more local displays of phosphorescence. Such as the phenomenon known in Sussex dialect as "shell fire" where piles of sea-shells or pieces of driftwood washed up on to beaches glow like beacons in the dark of the night. Some of their relatives are responsible for the way unrefrigerated meat and fish glow in the dark. The bacteria that cover the ghostly meat or fish are harmless but vigorous; cultured on nutrient jelly they grow into splotchy colonies of light.

Raphael Dubois created

a spectacular display at the turn of the century with cultures of luminous bacteria. "In 1900," he writes, "at the Palace of Optics at the International Exposition in Paris, I have been able to illuminate, as from the clearest light of the moon, a vast chamber, using large flasks containing very brilliant photobacteria. In the evening as soon as one entered the chamber one could read a book, and see all the people in the room."

Many deep-sea squid have light-producing organs or photophores full of luminous marine bacteria set just above their eyes to act as searchlights emitting a beam of photons - the ultimate elementary particles of light - into the dark of the abyssal depths. The symbiotic photobacteria derive nourishment from their hosts, and in return act as the light-producing elements of a pair of living lamps. But squid make an even more ingenious use of luminous bacteria.

It would appear that one of the best defensive tactics of the squid, that of producing a dark smoke screen with "ink", would be lost in the darkness of the abyssal depths five, ten, or even 20,000 feet below the surface of the sea. But deep water squid

have adapted to the darkness by producing luminous "ink": they pour from their funnels a cloud of light which is really a cloud of tens of millions of glowing bacteria, each one a minute speck of living light a hundred thousand times smaller than the head of a pin. This shifting cloud of living light dazzles and confuses the predator which lunges blindly at the bright shape while the squid shoots off into the darkness with powerful squirts of its jet system.

Ghostly

During World War Two, Japanese soldiers found another excellent source of light in the remains of the tiny ostracod *Cypridina*. Ostracods are tiny crustaceans related to shrimps and prawns but much smaller, and many of the marine forms are luminous, emitting tiny puffs of blueish light as they swim through the water. They can be preserved dry for up to thirty years without losing their ability to phosphoresce. Japanese officers, when too close to the enemy to risk a bright light, or too near to explosives to risk a naked flame (all living light is cold light), would place small amounts of dried ostracod powder in the palms of their hands, moisten the material, and read the dispatches by the ghostly light of the long dead *Cypridina*.

Andrew Allen