JELLYFISH STINGS AND THEIR MEDICAL MANAGEMENT

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STINGS from jellyfishes and related coelenterates are of frequent occurrence among swimmers, fishermen, and skin divers. Because of the nature of their activities, jellyfish stings are not uncommon among naval personnel. Fortunately, most coelenterate stings are mild in nature, and cause only minimal discomfort to the victim. In rarer instances they can produce serious injury, and on occasion sudden death. The purpose of this article is to discuss the medical significance of certain coelenterates that are considered to be especially dangerous to man, and the medical management of their stings.

CLASSIFICATION

The phylum Coelenterata, in which are grouped hydroids, jellyfishes, sea anemones, and corals, consists of simple metazoans having primary radial, biradial, or radiobilateral symmetry. They are composed essentially of two epithelial layers and but one internal cavity, the gastrovascular cavity or coelenteron, which opens only by the mouth. A dominant character of the group is the presence of tentacles equipped with nematocysts, or "stinging cells." The phylum Coelenterata generally is divided into three classes:

Hydrozoa (the hydroids)

To this class belong the hydroids that are commonly found growing in plumelike tufts on rocks, seaweeds and pilings. Small medusae are budded from these branching polyps. One of the most common stinging members of this group is *Physalia,* the Portugese-man-of-war, which is a pelagic colonial medusa.

Scyphozoa (the jellyfishes or true medusae)

This class includes the larger medusae having eight notches

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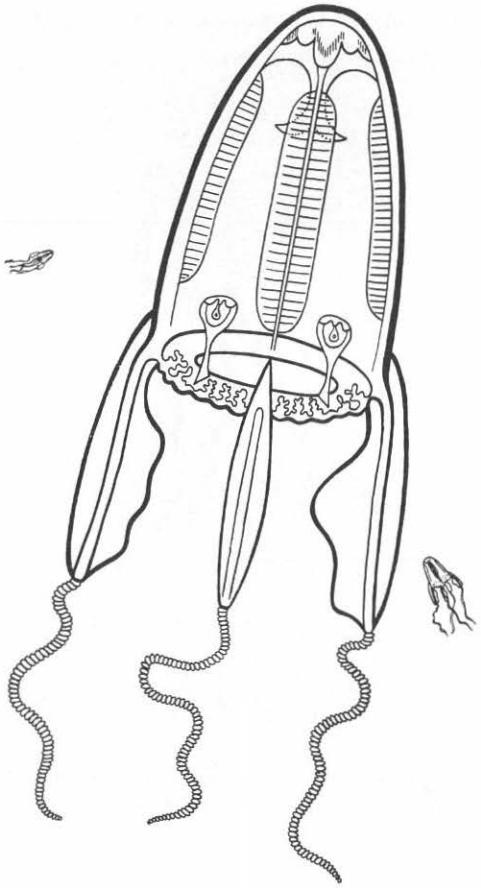

Figure 3. Carybdea alata *Reynaud—sea wasp.*

Cyanea capillata (Linnaeus) (fig. 6)—sea blubber, hairy stinger, sea nettle. North Atlantic and Pacific, southern coast of New England to the Arctic Ocean, France to northern Russia, Baltic Sea, Alaska to Puget Sound, Japan, and China. Other stinging species of this genus are found in the tropical and temperate Pacific Ocean.

Dactylometra quinquecirrha Desor—sea nettle (fig. 7). Azores and New England to the tropics, West Africa, Indian Ocean, western Pacific from Malay Archipelago to Japan, and Philippines.

Anthozoa

Acropora palmata (Lamarck)—elk horn coral. Florida Keys, Bahamas, and West Indies.

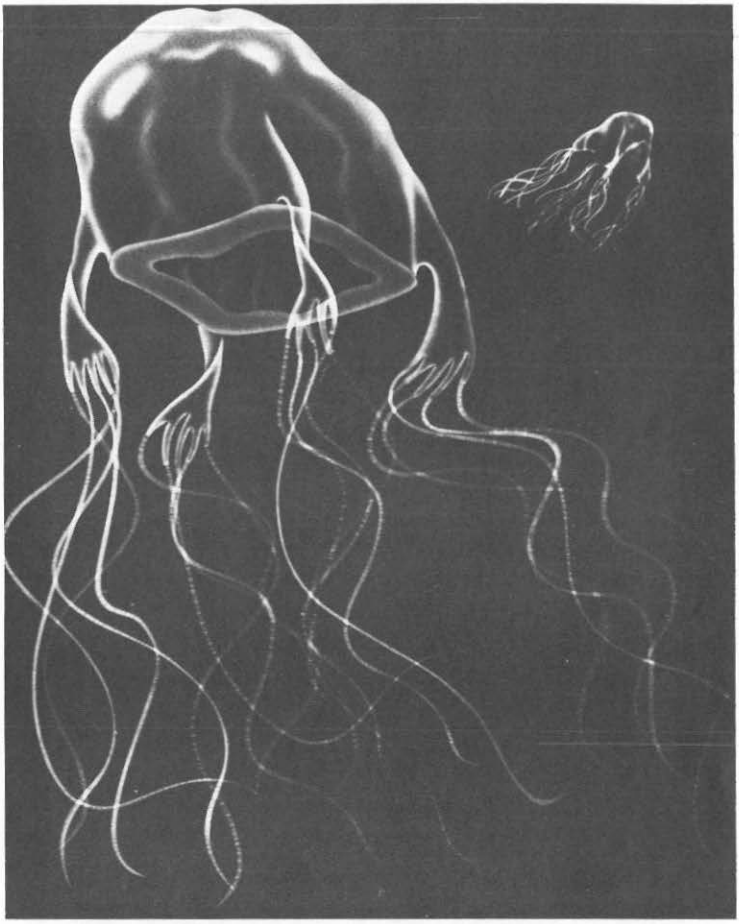

Figure 4. Chiropsalmus quadrigatus *Haeckel—sea wasp.*

Actinia equina Linnaeus—sea anemone (fig. 8). Eastern Atlantic from Arctic Ocean to Gulf of Guinea, Mediterranean Sea, Black Sea, and Sea of Azov.

Anemonia sulcata (Pennant)—sea anemone (fig. 9). Iceland to Atlantic coast of France, Mediterranean Sea, and coast of Africa.

VENOM APPARATUS OF COELENTERATES

The venom apparatus of coelenterates consists of nematocysts, or stinging cells. The term stinging cell actually is a misnomer, however, inasmuch as the structure is not a cell, but rather an organoid that is thought to be composed of chiton (fig. 10). Nematocysts usually are most abundant on tentacles, grouped on protuberances and circular or spiral ridges. They also are

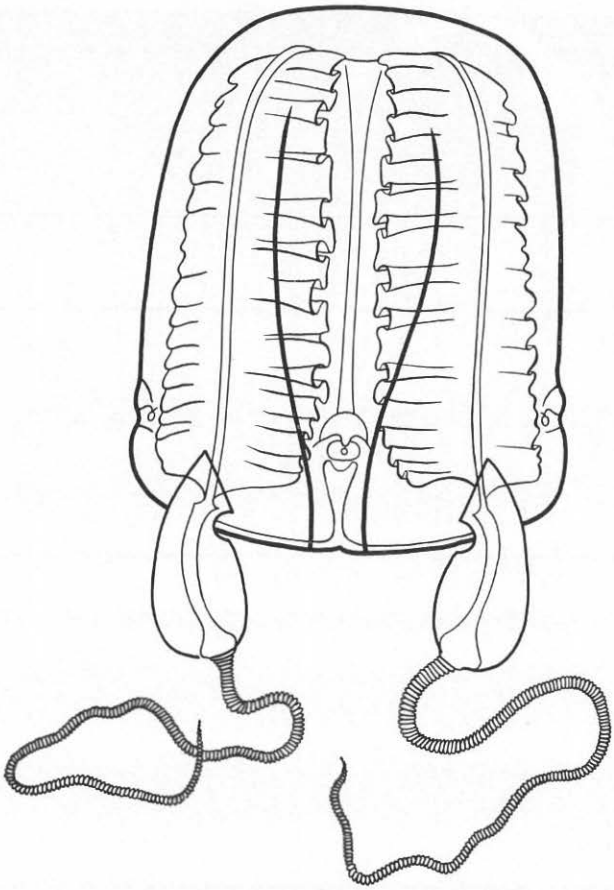

Figure 5. Chiropsalmus quadrumanus *(Müller)—sea wasp.*

found in the epidermis of the oral region, and on internal tentaclelike structures; *i. e.*, the gastric filaments, the septal filaments, and the acontia. Nematocysts initially develop inside interstitial cells, termed cnidoblasts or nematocytes. The developmental site of the nematocyst is usually some distance from the region in which it is finally utilized. Transportation of the cnidoblasts containing developing nematocysts is by ameboid movement through the body wall or by way of the gastrovascular cavity to their final destination in the ectodermal epithelium.

The essential features of the nematocyst apparatus are as follows: The capsule-like nematocyst is contained within the outer cnidoblast, which is fixed in the epidermis by a slender stalk connecting with the mesogloea. Projecting at one point on the outer surface of the cnidoblast is the triggerlike cnidocil.

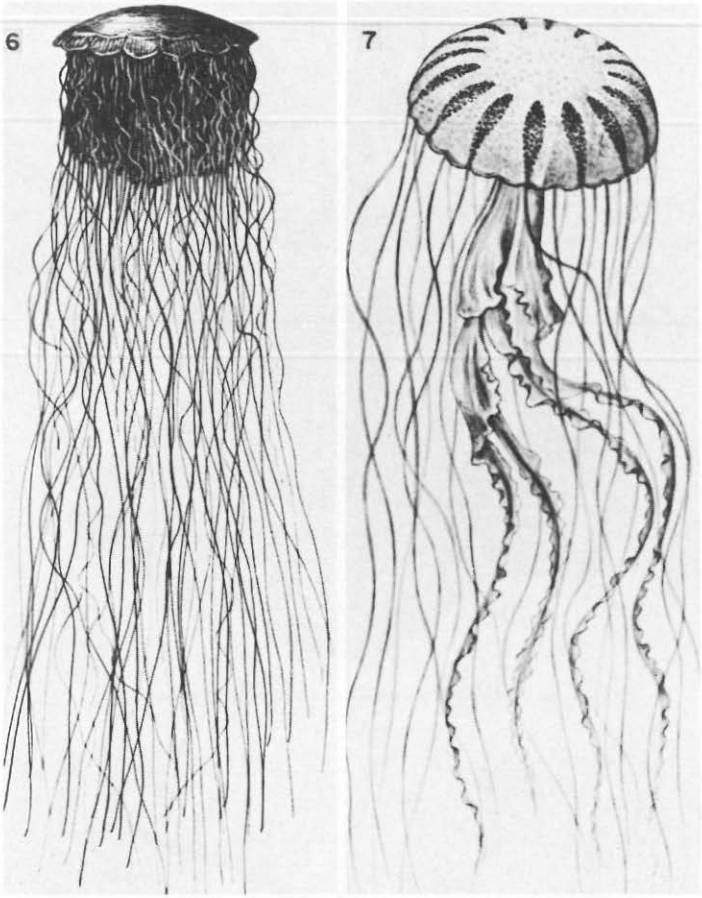

Figure 6. Cyanea capillata *(Linnaeus)—sea blubber. Figure 7.* Dactylometra quinquecirrha *Desor—sea nettle.*

Near the base of the cnidocil, in the periphery of the cnidoblast, there usually is found a circlet of stiff rods, probably of a supporting nature, and frequently a basketwork of sinuous fibrils that extend down into the stalk of the cnidoblast. Contained within the fluid-filled capsule is the hollow, coiled, thread tube containing the folded spines. The opening through which the thread tube is everted is closed prior to discharge by a lidlike device called the operculum. The fluid within the capsule is the venom. Stimulation of the cnidocil appears to produce a change in the capsular wall of the nematocyst causing the operculum to spring open and the thread tube to evert (fig. 11). The exact nature of the mechanism is not understood.

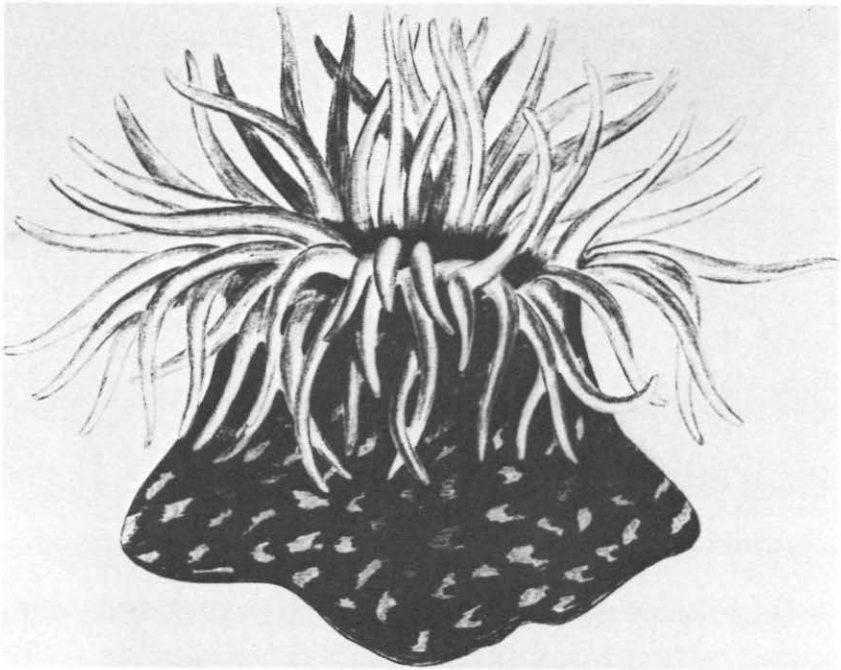

Figure 8. Actinia equina *Linnaeus—sea anemone.*

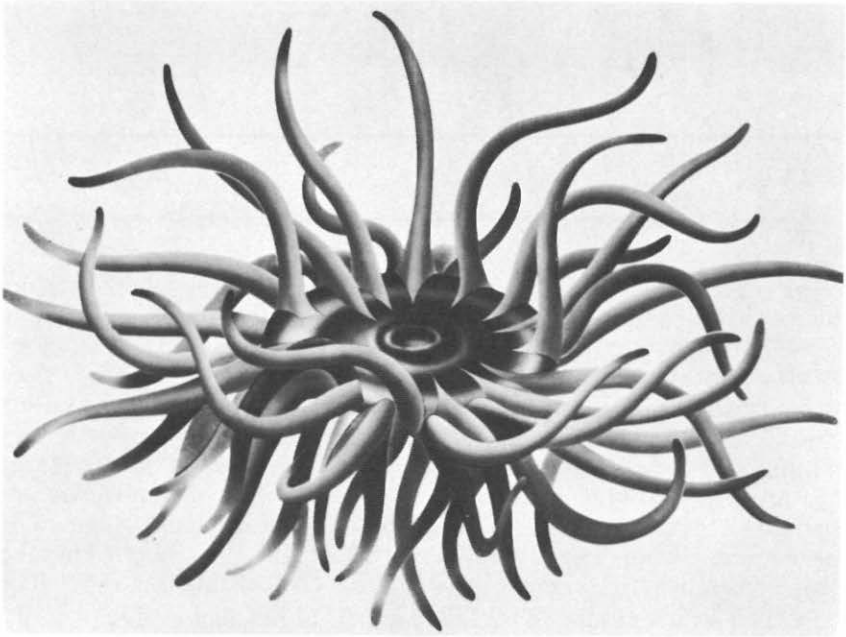

Figure 9. Anemonia sulcata *(Pennant)—sea anemone.*

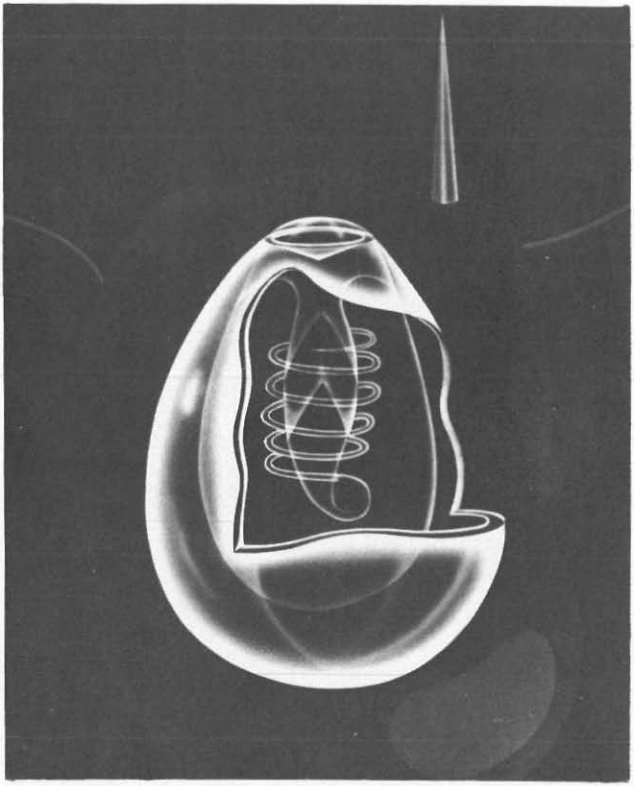

Figure 10. Undischarged stinging cell or nematocyst of a coelenterate. Note the coiled threadlike tube which conveys the venom. (Semidiagrammatic, greatly enlarged)

MEDICAL ASPECTS

There are no accurate statistics regarding the incidence of jellyfish stings among American military personnel, but Southcott[1] stated that while serving as regimental medical officer to a battalion attached to an Australian beach group at Palm Beach, north of Cairns, Queensland, during the period from December 1943 to January 1944, there were about 100 persons stung by jellyfish. One would assume from this that the over-all incidence is probably quite high. Unfortunately, there is even less information available regarding other types of coelenterate stings.

Clinical Characteristics

The symptomatology of coelenterate stings varies according to the species, the site of the sting, and the person. In general, the symptoms produced by hydroids and hydroid corals are primarily local skin irritations. Sea anemones and true corals produce a similar reaction, but this may be accompanied by general

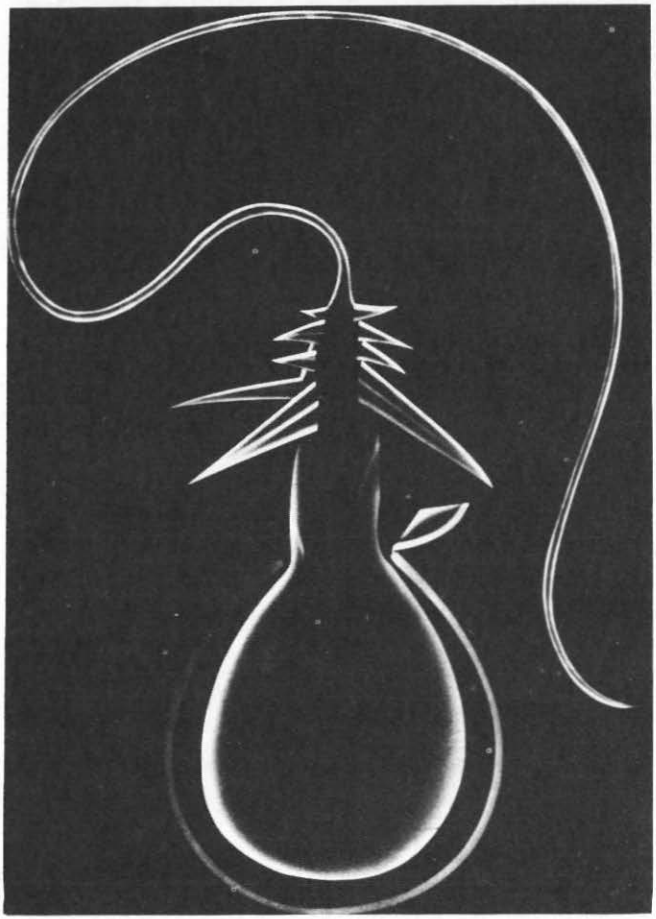

Figure 11. The discharged stinging cell or nematocyst of a coelenterate. (Semidiagrammatic, greatly enlarged)

symptoms. Ulcerations of the skin may be severe in the sponge-fishermen's disease produced by *Sagartia.* Symptoms resulting from siphonophores and scyphozoans vary greatly. *Physalia* stings may be very painful. The sting of most scyphozoans is too mild to be noticeable, whereas *Cyanea, Dactylometra, Chiropsalmus,* and *Chironex* are capable of inflicting very painful local and generalized symptoms. *Chiropsalmus* and *Chironex* are probably the most venomous marine organisms known and may produce death within 3 to 8 minutes in man.[1-8]

Contact with the tentacles of coelenterates results in symptoms ranging from an immediate mild prickly or stinging sensation like that of a nettle sting to an intense burning, throbbing, or shooting pain which may render the victim unconscious.

In some cases the pain is restricted to an area within the immediate vicinity of the contact. In others it may radiate to the groin, abdomen, or axilla, depending on the initial site of the lesion, or it may become somewhat generalized. The localized pains may be followed by a feeling of numbness or, sometimes, hyperesthesia. The area coming in contact with the tentacles usually becomes erythematous. This is followed by pronounced urticaria, blistering, swelling, and petechial hemorrhages. In sponge-fishermen's disease there may be a rash that becomes cyanotic, followed by multiple abscesses, necrosis, and sloughing of the tissues. Jellyfish may cause redness and flushing of the face, increased perspiration, lacrimation, coughing, sneezing, and rhinitis. An asthmatic-like condition has been reported as a result of inhaling dust containing dried jellyfish tentacles.[9]

The above-mentioned signs and symptoms may be accompanied by headache, malaise, primary shock, collapse, faintness, pallor, weakness, cyanosis, nervousness, hysteria, chills, and fever. In severe cases there may be muscular cramps, abdominal rigidity, diminished tactile and temperature sensation, nausea, vomiting, backache, aphonia, frothing at the mouth, sensation of constriction of the throat, respiratory distress, paralysis, delirium, convulsions, opisthotonos, cardiac standstill, and death.

The recovery period varies from a few hours to several weeks. Gunn[10] reported a case in which there was complete disappearance of the subcutaneous fat in the vicinity of the lesion. Stings from coelenterates may result in developing a sensitivity to the toxin, and a subsequent sting may produce a fatal anaphylactic reaction. An important factor in jellyfish-sting fatalities is primary shock and subsequent drowning before the victim can be rescued.

The following case report is representative of the more severe types of coelenterate stings.

CASE REPORT

A six-year-old Filipino boy was swimming in about 2 feet of water at Camantilis, Hundred Islands National Park, Pangasinan, Luzon. His sudden piercing screams brought several men running to his rescue. One of the men found a jellyfish by the side of the boy. Within moments the child was picked up and rushed to his home, which was within 10 yards of the seashore. He was found to be frothing at the mouth, and his respiration was spasmodic. His arms appeared to be partially paralyzed. There were large, irregularly shaped, dark-brown welts on his chest, arms, and neck, wherever the tentacles of the jellyfish had come in contact with his body. In less than five minutes after his rescue the child died. After his death his face, neck, and arms became severely swollen.

The jellyfish measured about 6 inches in diameter, with tentacles four feet in length. The organism was later identified by some of the local authorities as *Chiropsalmus quadrigatus* Haeckel.

Treatment

A variety of measures have been suggested for the therapeutic management of coelenterate stings. Treatment must generally be directed toward accomplishing three primary objectives: relieving pain, alleviating neurotoxic effects, and controlling primary shock. Morphine sulfate has been found to be effective in relieving pain. Intravenous injections of calcium gluconate have been recommended for the control of muscular spasms. Histaminics by mouth and topical cream are useful in treating the urticarial lesions. Dilute ammonium hydroxide, sodium bicarbonate, olive oil, sugar, ethyl alcohol, and other types of soothing lotions have been used with varying degrees of success. Artificial respiration, cardiac and respiratory stimulants, and other forms of supportive measures may be required. The use of steroids also has been suggested. There are no known specific antidotes for coelenterate venoms.

Preventive Measures

Particular care should be exercised by bathers swimming in areas in which dangerous coelenterates, especially the cubomedusae, *Chiropsalmus, Chironex, Carybdea,* and *Physalia,* are known to exist. It should be kept in mind that the tentacles of some species may trail a great distance from the body of the animal; consequently, they should be given a wide berth. Tight-fitting, long, woolen underwear or rubber skin diving suits are useful in affording protection from attacks from these creatures. Jellyfish washed up on the beach, even though appearing dead, may be quite capable of inflicting a serious sting. The tentacles of some jellyfish may cling to the skin. Care should be exercised in the removal of the tentacles, or additional stings will be received. Use a towel, rag, seaweed, stick, or handful of sand. Swimming soon after a storm in tropical waters in which large numbers of jellyfish were previously present may result in multiple severe stings from remnants of damaged tentacles floating in the water. Upon being stung the victim should make every effort to get out of the water as soon as possible because of the danger of drowning. Diluted ammonia and alcohol should be applied, and other therapeutic measures should be instituted as promptly as possible.

Since coral cuts are frequently associated with coral stings, a few remarks regarding these lesions are pertinent to the general subject. Anyone handling or wading around corals soon suffers from their sharp traumatogenic exoskeletons.

If coral cuts are left untreated, a mere scratch may within a few days become an ulcer with a septic sloughing base surrounded by a painful zone of erythema. In general, the symptoms appear to be far in excess of the visible lesions present. The severity of coral cuts is probably due to a combination of factors: laceration of tissues, introduction of foreign substances into the wound, *i. e.*, minute bits of calcium carbonate from the animal's exoskeleton and possibly nematocyst venom, secondary bacterial infection, and adverse climatic and living conditions. Treatment consists of prompt cleansing of the wound, removal of foreign particles, débridement if necessary, and the application of antiseptic agents. In severe cases it may be necessary to give the patient bed rest with elevation of the limb, kaolin poultices, magnesium sulfate in glycerin solution dressings, and antibiotics.[11-13] Levin and Behrman[14] found roentgen therapy to be useful in resolving a chronic coral ulcer with keloidal formation.

TOXICOLOGY

The venom of coelenterates is believed to contain three toxic fractions.

Thalassin

According to Richet,[15-22] Pawlowsky,[23] and Maass,[28] intravenous injection of this fraction into dogs was found to produce sneezing, pruritus, urticaria, genital excitation, vasodilatation, edema of the face, nervousness, redness, coughing, rhinitis, rolling on the ground, conjunctivitis, nervous depression, cardiac arrest, and death. Thalassin is especially characterized by its pruritogenic properties. The lethal dose in dogs is said to be 0.02 gram per kg. Thalassin was first obtained from the tentacles of *Anemonia sulcata,* but is believed to be present in most other coelenterates.

Congestin

According to Richet[16, 20-21, 24-27] Pawlowsky, and Maass,[28] intravenous administration of the poison into dogs resulted in vomiting, bloody diarrhea, evidence of abdominal pain, prostration, decrease in blood pressure, intense splanchnic vasodilatation, respiratory paralysis, and death. Congestin received its name because of the characteristic intense splanchnic congestion that it produces. The lethal dose in dogs is said to be 0.005 gram per kg of animal weight. This drug was likewise first obtained from the tentacles of *Anemonia sulcata.* Dujarric de la Riviere[29] isolated a substance from the tentacles of the jellyfish, *Rhizostoma cuvieri,* which he termed medusocongestin; however, it is believed to be identical with congestin.

Hypnotoxin

This substance is characterized by producing a central nervous system depression affecting both motor and sensory elements. Symptoms most commonly encountered are inactivity, coma, muscular paralysis, and cutaneous anesthesia when injected intramuscularly into laboratory animals. Death was reported from respiratory paralysis, but the lethal dose is not known. Hypnotoxin was first obtained by Portier and Richet[30, 31] from the tentacles of *Physalia.*

CHEMISTRY

Richet[17-19, 27] distinguished between thalassin and congestin on the basis of difference in solubility in alcohol. Ackermann, Holtz, and Reinwein[32] investigated the problem of the structure of coelenterate venom and believed it to be identical with tetramethylammonium hydroxide. Proof of identity was said to be in the coincidence of certain physical properties of a number of derivatives of the toxin as compared to the properties of the same derivatives prepared from this quaternary base. The question that remains is whether all of the physiologic properties ascribed to thalassin can be accounted for in terms of tetramethylammonium hydroxide. A subsequent study by Sonderhoff[33] did not provide an answer to this question. More recently Welsh[34] has reported that the pain-producing factor in coelenterate tentacle extracts is probably serotonin (5-hydroxytryptamine), whereas paralysis could be due to two or more related quaternary ammonium bases such as tetramethylammonium and urocanylcholine.

According to Portier and Richet[30, 31] hypnotoxin is believed to be a heat-sensitive, nondialyzable toxin with protein properties. Crutchfield[35] corroborated the heat sensitivity of the toxin and observed that it was digestible by trypsin. Little else is known about the chemistry of these interesting venoms.

SUMMARY

Stings from jellyfishes and related coelenterates are of frequent occurrence among persons swimming in tropical waters. The venom apparatus of coelenterates consists of the nematocysts or "stinging cells" that are largely located on their tentacles. The symptomatology of coelenterate stings varies according to the species, the site of the sting, and the person. Deaths from some species of jellyfish may occur within 3 to 8 minutes. Morphine sulfate, calcium gluconate, histaminics by mouth, and various soothing lotions have been used in the treatment of these stings with varying degrees of success. Coelenterate venom is believed to be comprised of three basic fractions, which have been called thalassin, congestin, and hypnotoxin. The principal

effects produced are pruritus, vasocongestion, and central nervous system depression, respectively. Little is known regarding the chemistry of the venoms. It is believed, however, that the pain-producing factor is probably serotonin (5-hydroxytryptamine), whereas paralysis may be due to two or more related quaternary ammonium bases such as tetramethylammonium and urocanylcholine. The dearth of reliable scientific data on this subject suggests the need for additional research on coelenterate venoms.

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IMPAIRMENT FROM ALCOHOL

"The effects of alcohol vary with individual tolerance and length of usage. In an individual of average weight, two ounces of whiskey are enough to produce a blood alcohol level of 0.05 percent—an amount sufficient to produce an average impairment of 25 percent. Alcohol is eliminated from the blood at the rate of about one-third of an ounce per hour. Physiological impairments thus are likely to last for hours, depending on the amount consumed."

—MORRIS S. SCHULZINGER, M. D.
in *Industrial Medicine and Surgery*
p. 453, Oct. 1956