

# The Venomous Sea Anemone *Actinodendron plumosum* Haddon of South Vietnam<sup>1</sup>

Lt. Peeter A. HANSEN<sup>2</sup> and Bruce W. HALSTEAD, M.D.<sup>3</sup>

The "hell's fire sea anemone" *Actinodendron plumosum* Haddon is an inhabitant of the Indo-Pacific region where it is frequently encountered in shallow reef areas. This coelenterate is of importance to marine biotoxicologists because it is one of the few species of sea anemones capable of inflicting serious and painful stings. This report resulted from the periodic stings incurred by American military personnel swimming in the vicinity of Cam-Ranh Bay, South Vietnam. Investigation of the stings revealed the causative agent to be the sea anemone *A. plumosum*. This sea anemone is commonly referred to by the local fishermen of South Vietnam as "con nhum." Very little appears to be reported in the literature concerning either the biology or venomous properties of this coelenterate. The known venomological literature dealing with this sea anemone has been reviewed by Cleland and Southcott (1965) and Halstead (1965). This is one of the few clinical accounts of stings by this interesting coelenterate. The field observations were made during the months of November, 1968, through August, 1969.

## Biology

Sea anemones are members of the coelenterate class Anthozoa and the order Actiniaria. Sea anemones are generally among the more abundant seashore animals. However, the geographical distribution of *Actinodendron plumosum*, which is thought to cover a wide range throughout the Indo-Pacific area, is apparently quite patchy in its occurrence within a given locality. In nine months of almost continuous diving by Hansen in the vicinity of Cam-Ranh Bay and nearby islands in South Vietnam, the only area in which this sea anemone was found was in the immediate vicinity of the Cam-Ranh Bay Officer's Beach (Fig. 1). Intensive search elsewhere in the nearby area failed to reveal a single specimen of *Actinodendron*. Discussions with the local fishermen supported the view that *Actinodendron* has a very patchy and circumscribed distribution. *Actinodendron* is said to be found only in a few scattered areas along the coast of Vietnam. The opinions of these fishermen were considered to be valid in that this sea anemone is highly valued as a food delicacy. The sea anemones are usually taken in nets. After careful removal from the nets,

<sup>1</sup> This study was aided in part by a contract with the Office of Naval Research, Department of the Navy, Contract No. N00014-67-C-0379 on venomous marine animals.

<sup>2</sup> *United States Air Force.*

<sup>3</sup> *International Biotoxicological Center, World Life Research Institute, Colton, California. Micronesica 7 (1-2):123-136. 1971 (July).*

the sea anemones are left to dry in the sun until they are thoroughly dehydrated and firm to the touch. They are then cut open, and the coat or outer skin is discarded. The inside of the anemone is eaten by the local residents with great relish.



Fig. 1. Photo showing area at the Cam-Ranh Bay Officer's Beach, about 8.5 miles south of the U.S. Air Force Base, Cam-Ranh Bay Peninsula, South Vietnam. This is the cove where the sea anemones *Actinodendron plumosum* Haddon were found, and the site where the stings occurred. The view is taken looking north-northeast. The water area in this photo is approximately 50 by 10 m. The depth of the water was up to a maximum of about 2.5 m.

The area involved in this particular study was a tidal pool which measured approximately 10 by 50 m. The bottom was generally silty with small patches of coarse sand. The rocky perimeter contained numerous outcroppings. Most of the rocks were partly or completely covered by corals. The depth of the pool ranged from about 20 cm to 2.5 m. The water within the pool was always calm and clear, even during the most severe weather conditions. A calm and well-protected area appears to be an important requirement for the growth of *Actinodendron*. The water temperature within the tidal pool ranged from 27.8°C to 29.4°C.

All biological observations made in the pool were limited to the daylight hours because of military conditions. The *Actinodendron* were usually found on the shady side of rocks or under coral ledges (Fig. 2). However, they were sometimes found in open areas in the middle of the pool in the center of a silty patch, but were always attached to a rock (Fig. 3). The sea anemones were never found in



Fig. 2a. An example of the "flowery-type" of *Actinodendron plumosum*. The tentacles are extended. This specimen was found on the shady side of a rocky ledge. The color of these "flowery-type" of sea anemones varied from a light beige to a dark brown. Because these sea anemones blend so well with the background, they are difficult to detect. Diameter of sea anemones 29 cm, height 10 cm.

the sand. It was evident that the sea anemones moved about because they were usually not found in the same spot where they had been previously observed. *Actinodendron* displayed two general forms. Some specimens appeared to take on a "flowery" appearance in which the tentacles were extended (Fig. 2), whereas other individuals seemed to be in a retracted state described as having a "top hat" appearance (Fig. 3). It was interesting to observe that there was a difference in the distribution of these two forms. The "flowery" types were found concentrated on the east to south-southeast side of the pool with a few individuals in the center of the pool. A total of 89 individuals were counted in this group. However, the "top hat" varieties were found concentrated on the west-northwest side of the pool with a few individuals in the center, favoring the west side. A total of 37 individuals of this latter type were counted. The color of the sea anemones varied from light beige to dark brown. The "top hat" varieties were mostly dark green. The significance of these two forms is not known. Most of the specimens ranged in size from 15 to 30 cm diameter. It was noteworthy that no specimen was found much less than 15 cm in diameter.



Fig. 2b. Close-up of *Actinodendron plumosum*. Center arrow points to oral opening. Arrows at right point to tentacles bearing batteries of nematocysts. Diameter of sea anemone about 15 cm.

*Actinodendron plumosum* is a member of the anthozoan family Actinodendronidae. The genus is characterized by having an oral disk that extends into long arms varying from 10 to 48 in number. The column is smooth. There is no sphincter. The tentacles are provided with long basitrichs which form batteries of nematocysts. The longitudinal muscles of tentacles and radial muscles of the oral disk are ectodermal. There are two broad siphonolyphs and two pairs of directives. The mesenteries are few, and most of them are perfect. The retractors are very strong and diffuse. The parietobasilar and basilar muscles are distinct. All mesenteries apart from the directives are fertile. The cnidom, or nematocyst pattern, is as follows: spirocysts and basitrichs present (Carlgren, 1949).

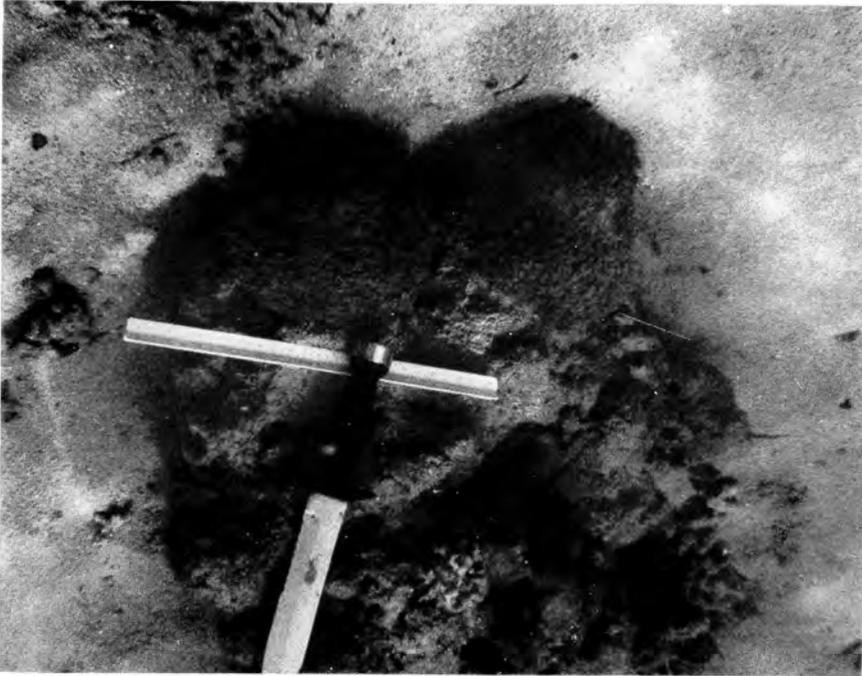


Fig. 3. Two specimens of the "top hat" type of *Actinodendron plumosum*. These specimens have shorter tentacles and when relaxed seldom exceed a length of 1.2 cm, or a length of 2 cm when disturbed. The nematocyst batteries appear to be attached to the tentacles. These nematocyst batteries are very friable and are easily torn from the anemone. An oral opening in the "top hat" variety was not evident. Specimens are located in the center of the pool area attached to rocks. Water depth was 1.3 m. Diameter of sea anemones about 15–20 cm.

### Mechanism of Envenomation

Envenomations by *Actinodendron plumosum* are caused by persons coming in contact with the stinging "cells" or nematocysts of the tentacles. The venom apparatus of *Actinodendron* consists of large batteries of well-developed nematocysts. The nematocysts in *Actinodendron*, according to Carlgren (1949), are of two types, the spirocysts and the basitrichous isorhizas or basitrichs. The spirocysts are limited to the Zoantharia, the sea anemones. Spirocysts have thin-walled capsules, stain with acid dyes, are permeable to water, and contain a long spirally coiled unarmed tube of even diameter (Hyman, 1940). Spirocysts were not evident in any of the smears that were prepared from the tentacles examined. The nematocysts proper of *Actinodendron* consist of the basitrichous isorhizas or basitrich type (Figs. 4a, 4b, 4c). They have a thick double-walled capsule, stain with basic dyes, and are impermeable to water except at discharge. The tube of the basitrich is

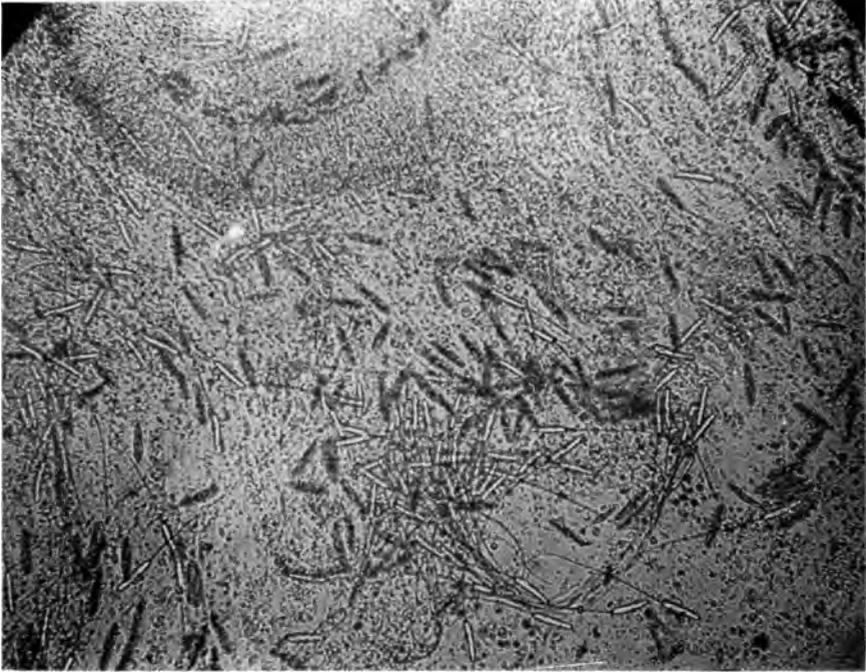


Fig. 4a.

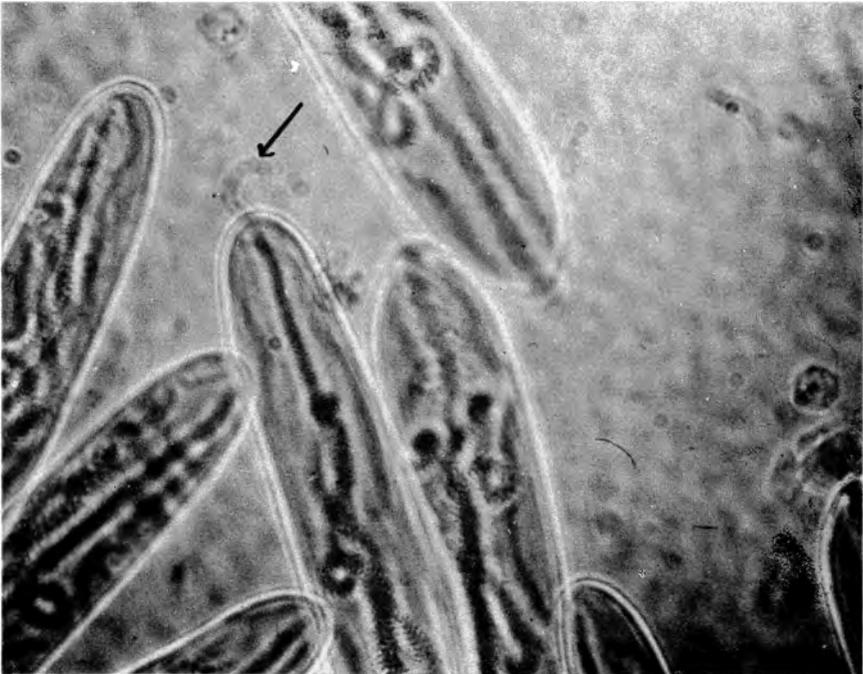


Fig. 4b.



Fig. 4c.

Fig. 4a. Photomicrograph of the nematocysts of the basitrich type taken from the tentacles of *Actinodendron plumosum*. Both discharged and undischarged nematocysts are present. The discharged nematocysts are seen with their tubes extending from them.  $\times 120$ .

Fig. 4b. Photomicrograph of the undischarged basitrich nematocysts. Note that the tubes are seen coiled up within the nematocysts. Also note the spines on the tubes. The arrow points to the cnidocil, a trigger-like device which when touched causes the nematocyst to discharge its contents. Just prior to discharge the cnidocil begins a vibratory or rapid circular motion.  $\times 1200$ .

Fig. 4c. Photomicrograph showing the spiny base of the tube of a discharged basitrich nematocyst.  $\times 600$ .

open at the tip, without a butt, and is spiny only at the base. The nematocysts examined all stained readily with methylene blue. It is believed that the stings inflicted by *Actinodendron* are due primarily to the basitrich nematocysts.

### Medical Aspects

Clinical Characteristics: Sea anemone stings generally tend to be more localized in their effects. The initial effect is that of a stinging sensation which in the case of *Actinodendron* more closely resembles that of a bee sting rather than the usual coelenterate sting such as might be caused by *Chironex* or *Physalia*. The initial stinging is soon followed by a burning sensation, redness, and swelling.

Throbbing pain may continue for a period of time. In addition there may be petechial hemorrhages, ecchymosis, local necrosis, and ulceration. Severe secondary infections may ensue in untreated cases. Localized symptoms may be accompanied by such generalized effects as fever, chills, malaise, abdominal pain, nausea, vomiting, headaches, a feeling of extreme thirst, and prostration.

Treatment: There are no specific antidotes for sea anemone stings. However, the following treatment has been used with varying degrees of success. The affected area should be washed immediately with soap, alcohol, sun lotion, oil, or almost any material that is readily available in order to inhibit the activity of adherent nematocysts. Natives frequently use a bleach such as chlorox or lime powder mixed with coconut oil. Soaking the limb in hot water has also been recommended. Topical or oral cortisone preparations are sometimes useful. Oral antihistamines and topical antihistaminic creams are helpful in alleviating urticarial lesions and symptoms.

Prevention: When wading or swimming in waters inhabited by *Actinodendron* a person must take care to avoid contact with them. Although this sea anemone resembles an encrusted moss-covered rock or a piece of sponge and may be difficult to recognize, with a little effort a person can soon learn to detect them. It is a good habit to wear some sort of protective diving clothing when working in tropical waters. The wearing of good quality leather, heavy canvas, plastic, or rubber gloves is important and affords protection to the hands and wrists. The nematocyst batteries of *Actinodendron* are sticky and may cling to the skin, thus providing an opportunity for them to continue to discharge their venomous contents. It is therefore important to remove the adherent nematocysts as rapidly as possible by using a towel, rag, seaweed, stick, or a handful of sand. The skin should then be promptly washed with soap, alcohol, bleach, or any other material available that is likely to inactivate whatever nematocysts may be clinging to the skin.

### Case Reports

The overall incidence of stings from *Actinodendron* in South Vietnam is unknown. The following six case reports are representative of a series of stings due to *Actinodendron plumosum* which occurred at the Cam-Ranh Bay Officer's Beach, Cam-Ranh Bay, South Vietnam. These case reports are of particular biotoxicological interest because they are among the very few documented accounts of stings by this sea anemone. One noteworthy point in connection with these stings was the fact that although the Cam-Ranh Bay Officer's Beach was opened to swimming in 1966 the first case of stings in this area was not known to occur until November 1968. Whether this situation reflects a cyclic phenomenon of some type in which *Actinodendron* is venomous only during certain stages of its development, or whether a population of these coelenterates are new to the area and only recently became established is not known.

Case 1. A 32-year-old Caucasian U.S. Air Force nurse was swimming at the

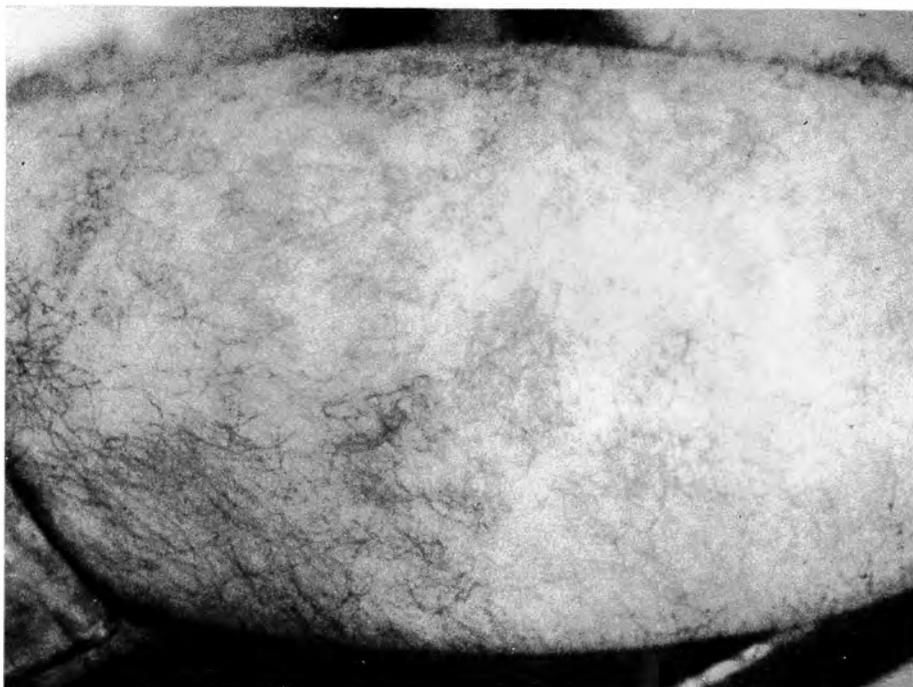


Fig. 5a. Sting inflicted by *Actinodendron plumosum* on the right upper leg of U.S. Air Force airman. The initial symptom consisted of a mild burning or stinging sensation which became progressively worse. The skin lesion shown in this photo is typical of the erythematous macular rash which is observed during the first few days of the stinging. Edema at this time was only minimal. Unfortunately the patient was transferred out of the area, and there was no follow-up of this case. The whitish tinge to the skin is because of the calamine lotion which the victim had applied. Photo taken 24 hours after the stinging.

Cam-Ranh Bay Officer's Beach on 8 November 1968 when she was stung on the left ankle. Three days later she was admitted to the hospital because of pain and swelling of the left ankle in the vicinity of the medial malleolus. Immediately upon contact with the sea anemone she developed a sharp stinging sensation. Apparently no particular treatment was applied to the initial sting, but over the period of the next three days the ankle became swollen and painful. Upon arrival at the hospital the patient was given Benadryl and ice packs to the ankle. However, the pain and swelling continued, involving the lower third of the leg. An ecchymotic area about 2 by 8 mm was present on the inner ankle region just above the medial malleolus, and there were superimposed on the ecchymosis about six to eight pustular vesicles. There were no other pertinent physical findings. The patient was admitted to the hospital, placed at bed rest, and the leg was elevated with warm soaks applied to the ankle. After about three days the ecchymotic area became necrotic and ulcerated. After about a week the ulcer began to fill in with granula-

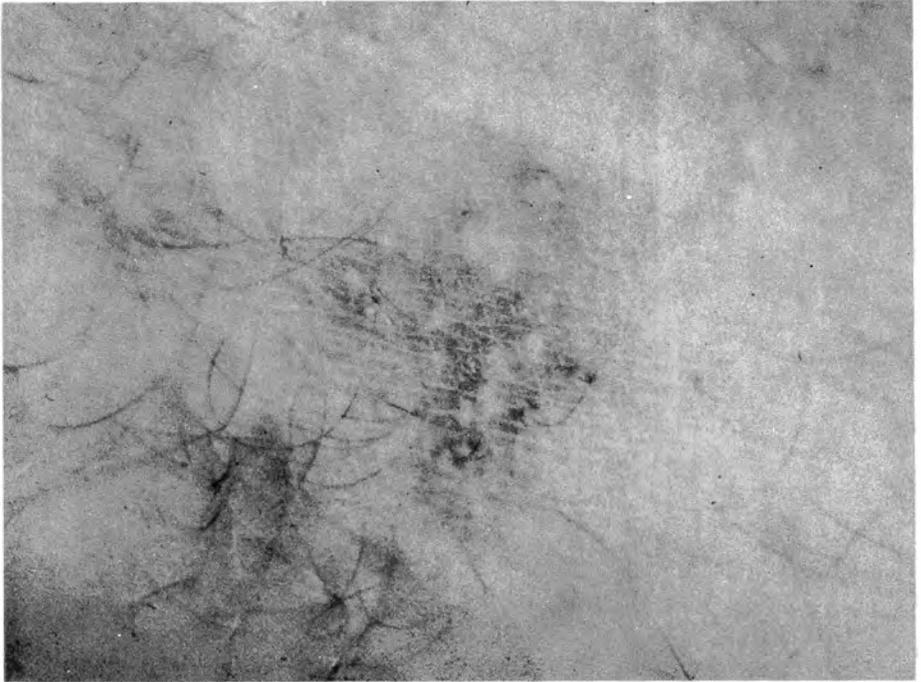


Fig. 5b. Close-up of lesion shown in Fig. 5a. This shows the typical early skin lesion produced by *Actinodendron* with multiple small whitish macules surrounded by a zone of erythema. The whitish macules became pustular after a few days. There was no follow-up of this case.

tion tissue. Discoloration of the skin and edema of the ankle persisted for several months thereafter. During most of this time the patient complained of continual tenderness and sweating in the area of discoloration. These conditions continued to persist nine months later. No further reports on the patient's condition were available after that.

Case 2. A 19-year-old Caucasian U.S. Army private was swimming at Cam-Rahn Bay on 22 February 1969. While wading in a shallow area he brushed up against a "sponge-like creature" with the toes of his right foot. The "sponge" was about 20 cm in diameter. Immediately upon contact he felt a sharp stinging sensation in his foot. Because of the continuous pain he reported to the Emergency Room of the nearby military hospital. Examination of the sting revealed multiple 2 mm in diameter greyish macules surrounded by an area of ischemia over the dorsum of the first and second toes of the right foot. There were no other pertinent physical findings. At the time of admission the patient was started on a course of 50 mg of Prednisone which was given as a single dose each morning. He was placed on bed rest and given warm compresses to the involved areas. After several days in the hospital the lesion became edematous, hemorrhagic, and then necrotic and later sloughed, leaving large open crusty ulcerations. After about one month

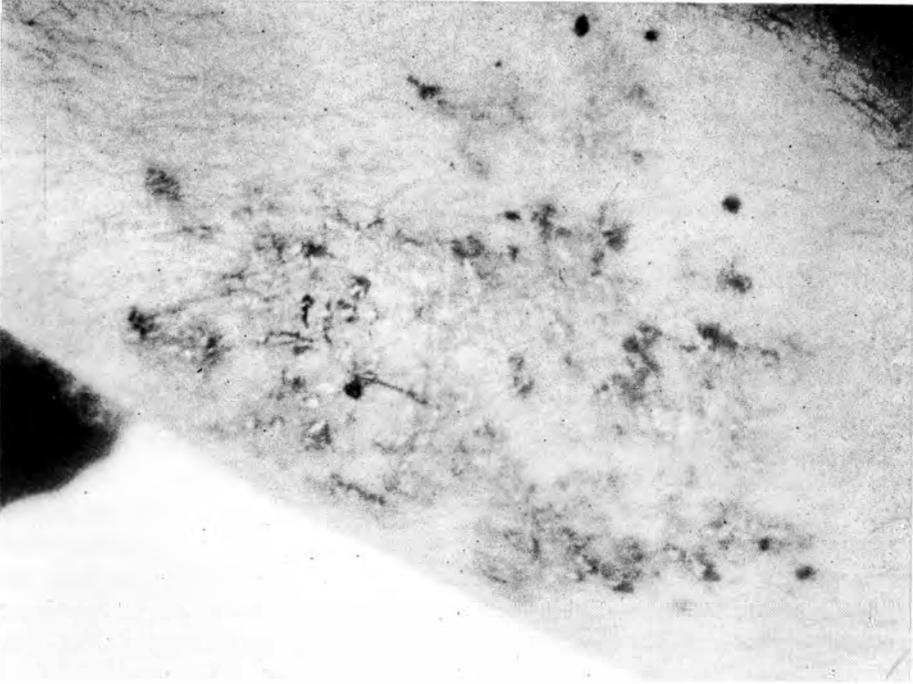


Fig. 5c. *Actinodendron* sting on leg of victim. The small multiple areas where ecchymoses developed are still visible. There are also seen small areas that were ulcerated and are now beginning to heal. Treatment consisted of bed rest, elevation of the leg, warm saline soaks, and administration of Prednisone. Photo taken 2 weeks after the stinging.

of bed rest the patient was permitted limited ambulation. The Prednisone was continued during this period and then gradually attenuated. The recovery although slow was uneventful. He was discharged from the hospital 1 April 1969.

Case 3. A 25-year-old Caucasian U.S. Air Force enlisted man was wading in waist-deep water in Cam-Ranh Bay on 25 February 1969 when suddenly he felt a sharp stinging sensation on the dorsum of the toes of his left foot from bumping into something attached to the bottom. Upon leaving the water he noted that he had a red rash in the area of the sting. The burning sensation continued and by the following day he observed that the rash was turning black. He went to the Army dispensary and was started on Benadryl 50 mg four times a day and was instructed to soak his foot in hot water. By the third day his foot had become edematous and the swelling was extending up his leg, whereupon he reported to the local military hospital for treatment. Examination of the skin area on the dorsum of his toes on his left foot revealed numerous erythematous and violaceous macules. There was considerable pitting edema which extended up to and above the malleoli. There were no other pertinent physical findings. The patient was started on 40 mg of Prednisone daily, given bed rest, and the limb elevated. Gradually the edema sub-

sided, and the dosage of Prednisone was reduced accordingly. The patient was discharged from the hospital on 3 March 1969. His recovery was uneventful.

Case 4. A 23-year-old Caucasian U.S. Air Force enlisted man was skin-diving on 23 February 1969 at Cam-Ranh Officer's Beach. While standing on the bottom he bumped into something and felt a sharp sting on the ankle of his right foot. The patient did not seek immediate medical attention. His ankle became reddened, swollen, and painful. This situation continued for a period of two days whereupon he went to the military hospital and requested treatment. Upon admission the patient was prescribed bed rest, elevation of the involved extremity and warm saline soaks. After a few days the lesion became necrotic, ulcerated, and then gradually healed. The edema of the ankle continued up to the time of release from the hospital which was on 11 March. Recovery was uneventful.

Case 5. A 26-year-old U.S. Air Force First Lieutenant was swimming on 2 March 1969 at the Cam-Ranh Bay Officer's Beach on 2 March 1969 when he suddenly felt a stinging sensation on the outer aspect of his right ankle. He swam to shore, and upon leaving the water he noticed that the area of the sting was red and swollen. He reported to the flight surgeon who admitted him to the military hospital for treatment. Physical examination revealed a 2 by 3 mm patch of erythema and ecchymosis on the medial aspect of the right ankle which was further surrounded by a zone of erythema and edema. The patient was prescribed bed rest, Prednisone 40 mg daily, and warm saline compresses four times a day. The patient improved rapidly. By 6 March the edema subsided and was returned to full ambulation on 9 March. Gradually the Prednisone dosage was reduced, and on 12 March he was discharged from the hospital. Recovery was uneventful.

Case 6. A 34-year-old U.S. Air Force major, pilot, was swimming on 2 March 1969 at the Cam-Ranh Bay Officer's Beach when he brushed his foot against a rock upon which various marine creatures were growing. He felt a stinging sensation on the dorsum of his 3rd, 4th, and 5th toes of his left foot. When he examined his foot he found a series of small welts which resemble mosquito bites. That evening his foot began to swell, and by morning it was quite edematous. He was admitted to the hospital on 4 March. Physical examination revealed a cluster of tiny, erythematous, and ecchymotic macules on the dorsum of the 3rd, 4th, and 5th toes of his left foot. Also, the entire foot was reddened and edematous. The patient was prescribed bed rest, Prednisone 49 mg per day, elevation of the foot, and warm saline soaks four times a day. Improvement was rapid. Gradually the Prednisone dosage was reduced. The patient was discharged on 13 March 1969.

### Discussion

The chemical and pharmacological properties of the nematocyst toxin produced by the sea anemone *Actinodendron plumosum* are unknown. However, the skin lesions presented in the clinical cases at hand closely resemble those produced by certain other species of coelenterates, and it is believed that similar chemical

constituents may be present in the nematocysts of *Actinodendron*.

In the cases reported, there was observed a fairly consistent pattern in the development of the skin lesions. The initial findings consisted of an area of blanching or ischemia at the site of the sting which was usually surrounded by a zone of erythema. The cutaneous findings were accompanied by a sharp stinging sensation. Shortly thereafter the affected part became edematous and generally remained so for a prolonged period of time. The site of the sting usually became ecchymotic after a few hours. Within a few days the lesion became necrotic and formed a slough, leaving an ulcer which in the due course of time filled in with granulation tissue. This sequence was sometimes complicated by a secondary infection.

In previous studies conducted on nematocyst venoms, it was found that 5-hydroxytryptamine (5-HT or serotonin) was one of the principal constituents of many coelenterate venoms, including those found in the nematocysts of sea anemones such as *Metridium* and *Calliactis* (Lewis, 1958; Welsh, 1961; Halstead, 1965; Russell, 1965). 5-hydroxytryptamine is a potent pain producer and a histamine releaser. 5-HT acts directly on vascular smooth muscle and may evoke vasoconstriction or vasodilation depending upon the fascular bed and the dosage received (Goodman and Gilman, 1965). The cutaneous erythema, hemorrhaging, and edema could be attributed to the presence of the 5-HT in the *Actinodendron* venom. However, it is likely that other proteins of a low molecular weight may also be present and contributing to the development of these cutaneous effects. It is noteworthy that itching, which is usually caused by 5-HT, was either absent or of no consequence in any of the cases reported.

It appears that the venom of *Actinodendron*, whatever its constituents, is absorbed slowly, and the clinical effects continue in some cases for many months. *Actinodendron* envenomations usually respond slowly to treatment. This is an interesting coelenterate venom and worthy of biochemical and pharmacological evaluation.

### Summary

The sea anemone *Actinodendron plumosum* Haddon inhabits the Indo-Pacific region and is capable of inflicting a painful sting. Although *Actinodendron* has a wide geographical range, its distribution is patchy and circumscribed. Very little is known concerning the biology of this sea anemone. *Actinodendron* seems to require a quiet protected habitat, where it is sheltered from storms and turbidity is minimal. This study centered around the Cam-Ranh Bay Officer's Beach, Cam-Ranh Bay, South Vietnam, where numerous stings by this sea anemone have occurred since November, 1968. Stings by *Actinodendron* are inflicted with the use of a nematocyst apparatus. The cnidom of *A. plumosum* consists of spirocysts and basitrichous isorhizas. Six clinical cases of *Actinodendron* stings are reported. There is a fairly consistent pattern in the development of the skin lesions: initially a painful stinging sensation and blanching at the site of the sting, usually surrounded by a zone of erythema, is followed by edema, ecchymoses, necrosis, and ulceration;

gradually the ulcer fills in with granulation tissue. The chemical and pharmacological properties of the venom have not been studied, but it is believed that 5-hydroxytryptamine is one of the principal constituents. This is one of the few biotoxicological reports to deal specifically with the venomous properties of this sea anemone.

### Literature Cited

- Carlgen, O.** 1949. A survey of the Ptychodactiaria, Corallimorpharia and Actiniaria. Kungl. Svenska Vet. Acad. Handl. 1(1), 121 p., 4 pls.
- Cleland, J. B., and R. V. Southcott.** 1965. Injuries to man from marine invertebrates in the Australian Region. National Health and Medical Research Council (Spec. Rept. Ser. No. 12), Canberra, Australia. 282 p., 10 pls.
- Goodman, L. S., and A. Gilman, eds.** 1966. The pharmacological basis of therapeutics. 3rd ed. The Macmillan Company, New York. 1785 p., 75 figs.
- Halstead, B. W.** 1965. Poisonous and venomous marine animals of the world, vol. 1. U.S. Gov. Print. Office, Washington, D.C. 994 p., illus.
- Hyman, L. H.** 1940. The invertebrates: Protozoa through Ctenophora, vol. 1. McGraw-Hill Book Co., New York. 726 p., 221 figs.
- Lewis, G. P., ed.** 1958. 5-Hydroxytryptamine: Proceedings of a Symposium held in London on 1st and 2nd April, 1957. Pergamon Press, New York. 253 p., illus.
- Russell, F. E.** 1965. Marine toxins and venomous and poisonous marine animals p. 255-384. *In* F. S. Russell, [ed.], Advances in marine biology, vol. 3. Academic Press, London.
- Welsh, J. H.** 1961. Compounds of pharmacological interest in coelenterates p. 179-186. *In* H. M. Lenhoff and W. F. Loomis, [ed.], The biology of Hydra and of some other coelenterates. Univ. Miami Press, Coral Gables, Fla.