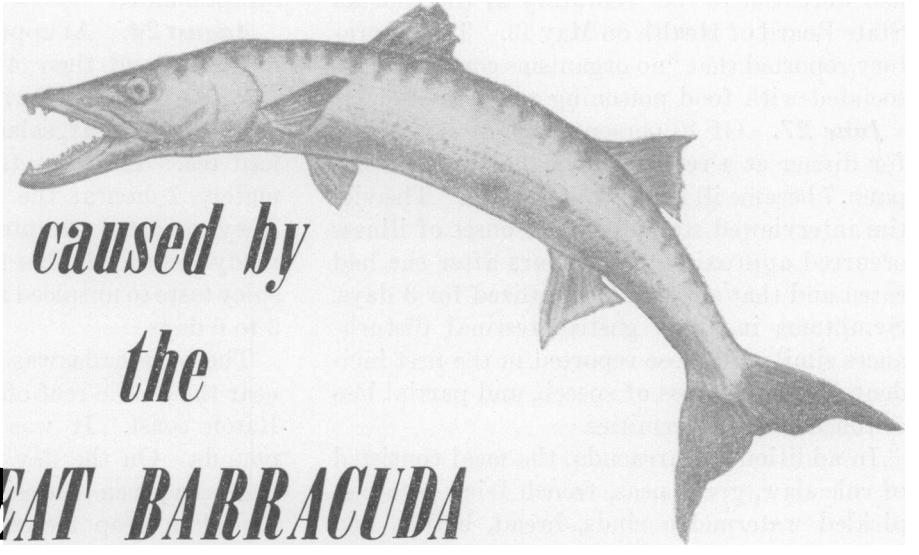
Food Poisoning caused by the GREAT BARRACUDA



By SIDNEY PAETRO, M.P.H.

DURING the spring and summer of 1954, four incidents of illness following the consumption of fish were reported to the Broward County Health Department in Fort Lauderdale, Fla. The clinical manifestations of the illness and the results of laboratory and epidemiological investigations indicated that it was fish flesh poisoning, or ichthyosarcotoxism, resulting from ingestion of the great barracuda, *Syphraena barracuda.*

May 13. The first incident was reported on May 13 by a local physician. Five persons had eaten dinner at approximately 6 p. m. the day before at a rooming house in Fort Lauderdale. The meal consisted of barracuda, succotash, eggplant, cole slaw, okra, mashed potatoes, banana pudding, hot rolls, coffee, and iced tea. All five persons became ill within 1 to 2 hours after they had eaten. Symptoms and complaints were nausea, diarrhea, metallic taste, and the unusual reactions of cold objects feeling hot and hot objects feeling cold, numbness of the arms and legs, and itchiness. Three pet cats fed only barracuda died within 24 hours.

The barracuda, estimated to weigh 6½ pounds, was caught in the Atlantic Ocean about 1½ miles off the coast of Fort Lauderdale near the 2-mile reef about 4 p. m. on May 11. It was placed in deep freeze soon after it was caught and kept there until the following evening, when it was prepared and then fried in a commercial shortening. One of the victims commented, "The fish was the prettiest, whitest, best tasting fish I ever ate."

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Three of the victims were hospitalized immediately. One was ill for 2 weeks, two for about a month, another for 6 weeks, the fifth remained in bed for 5 weeks and had aftereffects of the illness when interviewed almost 4 months later.

Specimens of both the raw and the cooked fish were sent to the laboratory of the Florida State Board of Health on May 13. The laboratory reported that "no organisms commonly associated with food poisoning were isolated."

June 27. Of 10 persons who ate barracuda for dinner at a restaurant in the city of Pompano, 7 became ill in varying degrees. The victim interviewed stated that the onset of illness occurred approximately 4 hours after she had eaten and that she was hospitalized for 3 days. Symptoms included gastrointestinal disturbances similar to those reported in the first incident, temporary loss of speech, and partial loss of touch in the extremities.

In addition to barracuda, the meal consisted of cole slaw, green peas, french fried potatoes, pickled watermelon rinds, bread, butter, and beer. Three barracuda were eaten, all 3 weighing an estimated 15 pounds. They had been caught about 2 miles off Hillsborough Inlet, north of Pompano Beach. The fish were cleaned, brought to the restaurant, broiled, and served the same day caught. No specimens were available for laboratory analysis.

July 9. Between 6 and 7 p. m. a family of eight members ate a meal consisting of barracuda, cornmeal cakes, fried onions, corn on the cob, tossed green salad, cherry pie, and the usual drinks. All 8 became ill, and 5 were hospitalized. The illness occurred from 1 to 5 hours after the meal. A small amount of the fish was given to a neighbor, and a similar quantity was fed a pet dog during the meal. Both the neighbor and the dog became ill. The symptoms in all persons were similar to those previously reported.

The barracuda was caught off the Fort Lauderdale coast near the third buoy at approximately 7:30 a. m. There was no refrigeration aboard the vessel, but soon after the boat docked at 9:30 a. m., the fish was placed on ice. It was prepared and deep fried in fresh commercial shortening the same evening. Comments concerning the fish included, "Nothing unusual" and "It looked beautiful and tasted delicious." A specimen of the fish which had been kept in deep freeze was sent to Dr. Bruce W. Halstead at the School of Tropical and Preventive Medicine, College of Medical Evangelists, Loma Linda, Calif. Dr. Halstead reported that tests on mice with this sample were "mildly symptomatic."

August 24. At approximately 6 p. m., a man, his wife, and their 4-year-old daughter consumed a meal of barracuda, tartar sauce, asparagus (frozen), salad, cookies, ice cream, and iced tea. The parents became ill in approximately 7 hours; the child, within 10 hours. They reported symptoms similar to those already described plus general weakness and a spicy taste to unspiced foods. The illness lasted 5 to 6 days.

The barracuda was caught, 7 weeks earlier, near the 3-mile reef off the Pompano and Boca Raton coast. It was estimated to weigh 15 pounds. On the day it was caught, a section had been given to a neighbor and the remainder placed in deep freeze. Discussing the illness with the neighbor, we learned that the neighbor and his wife had eaten the fish the day it was given to them and that they had both become ill. They were ill for 3 days.

One specimen of the frozen fish was submitted to the Florida State Board of Health laboratory, and another specimen was sent to Dr. Halstead. The State laboratory reported: "Organisms isolated culturally characteristic of the coliform group." Dr. Halstead reported that tests on mice with this sample "produced very severe symptoms in 1 mouse and 1 mouse died 27 hours after injection, which, according to our routine classification, would indicate that the barracuda sample was moderately toxic."

Health Department Action

It was not possible to obtain a list of foods each individual ate at each of the meals in question. However, a study of the lists of all foods prepared and served at each meal revealed that only one food, barracuda, was common to all.

The health department gave two news releases to the local newspapers during these

months. The first, on July 21, reported the occurrences of food poisoning recorded to that date and requested that the health department be notified should illness follow consumption of fish, particularly barracuda. The second, dated September 1, described the latest incident and urged that all instances of food poisoning be reported and that samples of suspected foods be preserved on ice for laboratory analysis. No reports were received after that of the August 24 episode.

During the course of the investigation, we gathered and studied numerous publications, research papers, and opinions in an effort to determine the cause of an illness the characteristics of which had never before been reported in this area. Presented below is some of the more pertinent information compiled from these sources.

Characteristics of Fish Poisoning

Ichthyosarcotoxism is the technical term for intoxication resulting from the ingestion of the flesh of poisonous fish.

One of the first symptoms to develop is a tingling about the lips and tongue. The tingling soon spreads to the hands and feet and gradually develops into numbness. These symptoms may appear at any time within a period of 30 hours after ingestion of the fish. Gastrointestinal symptoms are said to be reported by about 75 percent of the victims (*1*). Some persons state that their hands and feet are without feeling, whereas others report that their hands and feet hurt when placed in water. Persons with very severe cases generally suffer impairment of movement and sometimes they are unable to walk or stand (*2*).

One of the most outstanding symptoms is the generalized sensory disturbance in which temperature sensations are reversed; that is, hot objects seem cold to the touch, and cold objects seem hot. This particular disturbance has been reported from many widely scattered areas of the world for more than 175 years.

Recovery from severe attacks of fish poisoning is usually very gradual. Symptoms of weakness sometimes persist for months after specific symptoms have disappeared. An attack does not impart immunity, and there is no known specific antidote or antitoxin (*1*).

Clinical reports indicate that the ichthyosarcotoxins from many fish species are powerful neurotoxins. The symptoms are similar to those produced by such compounds as aconitine, muscarine, and curare (*3*).

There are four major types of ichthyosarcotoxism: ciguatera; Tetraodon, or puffer, poisoning; scombroid poisoning; and *Gymnothorax* poisoning. All of these have many characteristics in common, but they differ as to the predominance of certain types of symptoms. Ciguatera is the type thought to have caused the incidents reported to the Broward County Health Department.

Ciguatera, or Caribbean type fish poisoning, has been known for a number of centuries in the countries bordering the subtropical and tropical waters of the Caribbean Sea, the Atlantic Ocean, and the Pacific Ocean. Although numerous species of fish produce this type of poisoning, one of the common causative species is the *Sphyraena barracuda.*

Ciguatera is considered the least virulent form of fish poisoning. The mortality rate has been estimated to be 2 or 3 percent. Complete recovery from the weakness and myalgia can be a matter of weeks or months (*3*). Records indicate that not all persons who eat poisonous fish become ill, but one attack of ciguatera does not impart immunity to subsequent attacks.

Besides the usual symptoms of fish poisoning, ciguatera has these characteristics:

1. The onset occurs from 1 to 10 hours after ingestion of the fish.
2. There is a distinct metallic taste in the mouth.
3. There is a tingling sensation and itchiness which may last for days (*4*).
4. Malaise, chills, fever, prostration, profuse sweating, generalized motor incoordination, muscular weakness, and joint aches are common (*3*).
5. Cramps may occur in the extremities (*4*).

Theories Regarding the Cause

Many theories regarding the cause of fish poisoning have evolved over the centuries. Following are some of these theories and the opin-

ions of scientists who have done research in this field.

Food-Chain Theory

According to the food-chain theory of fish poisoning, the flesh of fish is made toxic by the consumption of poisonous plants or animals, such as manchineel berries, certain algae, dinoflagellates and other marine invertebrates, jellyfish, corals, swarming palolo worms, mollusks, and crabs.

Halstead and Bunker state that if this theory is correct, the distribution of the toxin within the fish is probably governed by three principal factors: venous draining of the intestine, detoxication, and metabolic processes of the fish (*5*). Therefore, a high concentration of the "toxin" should be found in the liver and intestine and a low concentration in the somatic muscle if the fish is captured soon after feeding, and the reverse situation if the fish is caught at a later time.

Hiyama tested organ and muscle tissue of poisonous fish in feeding experiments (*2*). He did not find that the poison was limited to any particular organ, but he did find that muscle tissue produced the most obvious indication of poisoning. On examination of the stomach contents of poisonous fish, he found neither seaweed nor fragments of echinoderms, but unidentifiable digested remains of small fish. Examination of fish collected in areas inhabited by poisonous crabs showed that most of the fish had been feeding on small siganids; no crab fragments were found. In his opinion, there was no connection between feeding habits and toxicity of the fish.

Poisonous fish have been found at all depths of the ocean; therefore, nothing valid can be deduced from their living habits.

Copper-Contaminated Waters

The theory that fish may become poisonous from underwater deposits of copper, copper-lined bottoms of sunken vessels, or war materials containing copper has received some attention. The copper compounds, according to this theory, are absorbed by the fish and become a part of its body composition, making the fish toxic.

Arcisz considered this theory improbable since all fish caught near copper banks are not toxic, and, conversely, toxic fish are found where there are no known copper banks (*4*). The same logic can be applied to sunken vessels or war materials found on the ocean bottom.

Size, Sex, and Development

Many investigators consider the size of the fish an important factor in fish poisoning. They regard large fish as generally more toxic than small ones of the same species. A few authorities believe that small fish are never toxic (*4*). However, little dependable information is available in this regard.

Hiyama was unable to detect any variation in toxicity with sex of the fish, but he observed a variation in toxicity with age in a number of different species (*2*). Phillips and Brady believe that sexual maturity is not necessarily a factor in toxicity (*6*).

Bacterial Contamination

Another theory holds that the toxin is produced as a result of bacterial contamination. The contamination may be on or in the fish before it is caught, or it may be introduced during handling or processing after it is caught.

In studying ichthyosarcotoxism, Halstead and Lively found that the freshness of fish had no relation to virulence of the toxin (*3*). Cohen and his colleagues (*7*) and Yasukawa (*8*) do not believe that the toxic agent is of bacterial origin.

Endogenous Theory

Yasukawa found that the location of the poison varied with different species of fish (*8*). It is found chiefly in the gonads, particularly in the ovaries, and sometimes in the liver. In his opinion the toxin is not produced until the fish reaches maturity and is most virulent in its action during the spawning season.

Tani found that the toxicity of the puffer was highest during the spawning season of the year (*9*). The toxicity reached a peak a short time before the spawning season, continued at the same level for a few weeks after spawning, and then gradually declined.

It is known that the reproductive organs and roe of certain fish may be poisonous, but

Phillips and Brady are of the opinion that these cannot contaminate the flesh of the fish directly (*6*).

An Unexplained Phenomenon

None of these theories would seem to explain why the consumption of barracuda caught off this part of the east coast of Florida in the spring and summer of 1954 resulted in illness. Hundreds of the same species of fish were caught in the same waters during the same period and were eaten without harmful effects. Barracuda from these waters have been eaten in the years before and since; yet no other illnesses of a similar nature are on record.

On the basis of the food-chain theory of fish poisoning, the possibility that the incidents were associated with the phenomenon known as red tide was considered early in the investigation. It was dismissed, however, when we learned that the dinoflagellate responsible for red tide, *Gymnodinium brevis*, has never been observed along the eastern coast of Florida, although it is found periodically along the Gulf Coast.

It is earnestly hoped that research on fish flesh poisoning will be intensified so that outbreaks such as those described here can be prevented. Basic knowledge is needed regarding the factors that cause the flesh of sometimes edible fish to become poisonous, the chemical and pharmacological properties of the toxins, and means by which poisonous fish can be recognized.

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