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CEPHALOPODS: Cuttlefish, Octopuses, Squids

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CONTENTS

	Page
Introduction.....	1
Life history.....	1
Description.....	1
Food and feeding.....	2
Locomotion.....	2
Reproduction.....	2
Familiar cephalopods.....	3
Cuttlefish.....	3
Octopuses.....	4
Squids.....	6
Enemies and protection against them.....	8
Capture.....	8
Utilization.....	8
References.....	9

INTRODUCTION

It is true but difficult to believe that the cephalopods (argonauts, cuttlefish, nautilus, octopuses, and squids) are related to such quiet and peaceful mollusks as clams, oysters, scallops, and snails.

About 600 genera and more than 10,000 species of fossil cephalopods have been described (Clench, 1959). Today, however, there are about 170 genera and more than 400 species of these marine animals.

LIFE HISTORY

Description

The body of a cephalopod (meaning feet around the head) consists of the head, the trunk, and the neck which connects the head and the trunk. The large head contains two conspicuous and well-organized eyes and usually a cartilaginous brain case. Around the front of the head, cephalopods have a group of elongated muscular arms

with suckers on the undersides. (Females and males have the same number of arms, which regrow if cut off.) Inside the circle of arms is the mouth, with two horny jaws, called a beak, and a radula, a filelike device. In addition, there are well-developed organs of hearing and smell.

The trunk, the main part of the body, is surrounded by the muscular mantle. The mantle encloses a large cavity with the two well-developed gills. The digestive tract, kidneys, and reproductive system open into the mantle cavity. The outlet of the mantle cavity is through the siphon, a short muscular tube beginning in the neck. Through it are expelled the body wastes, the eggs, and the fluid from the ink sac. Water entering the mantle cavity through the siphon carries oxygen to the gills. All cephalopods except *Nautilus*, have an ink sac which contains a deep-brown fluid.

The majority of the cephalopods have fins.

The skin contains many chromatophores (cells containing pigment, which includes black, brown, and reddish yellow). The color of the body is changed at will by contracting and expanding the chromatophores. The color changes are believed to afford protection from enemies, to help catch prey, and perhaps to express certain emotions. Many pelagic and deep-sea cephalopods possess luminescent organs.

Some of the cephalopods have external shells while others do not. *Nautilus*, the most primitive living cephalopod, has a shell into which it may withdraw its entire body. The female argonaut has an external shell, secreted by a pair of arms modified for the purpose. In the course of evolution other cephalopods lost the protective external shell, but gained speed and mobility.

Food and feeding

All cephalopods feed on other animals of the sea, preying on fishes and crustaceans, such as crabs, prawns, and shrimps. Squids will even attack and eat injured members of their own species.

These animals catch and hold prey with the arms. They sometimes thrust the radula against the body of the victim and rasp the flesh. Usually, however, they bite into the prey with the sharp beak and cut out wedge-shaped portions of flesh which they swallow whole.

Locomotion

The cephalopods have several means of locomotion. Some walk on the ocean floor with their arms. Others swim slowly by waving the fins while holding the body horizontal, as do fish. All can move rapidly by expelling water from the mantle cavity through the siphon. Bending the siphon backward sends the animal forward; however, the siphon is normally directed forward so that rapid spurts of movement backward are most characteristic.

Reproduction

The sexes are separate, and the reproduction system is complex. One of the arms of the male of most cephalopods is modified to transfer sperm to the female. With the modified arm the male takes the spermatophores (a special capsule, packet, or mass, enclosing spermatozoa or sperm cells) from his mantle cavity and places them in either the mouth or the mantle cavity of the female. This action ends his part in the breeding process. If he places the spermatophores in her mouth, she moves them to her mantle cavity. In the male argonaut the modified arm is detached and left in the mantle cavity of the female with the spermatophores (MacGinitie and MacGinitie, 1949). In the squids only the tip of the modified arm is detached.

The spermatophores release spermatozoa which fertilize the eggs. The females of the different species lay eggs which vary in size. The eggs pass through the siphon into the water. They are usually fastened down singly or in clusters on bottom debris, such as fragments of coral or stems of plants. So far as known, only the female octopus tends her eggs until they hatch, and this may take as long as 4 months (MacGinitie and MacGinitie, 1949); she does not feed during this time. Squid eggs (fig. 1) do not require this care because they are embedded in jelly. Besides protecting the little embryos from fungus growths, the jelly is distasteful or inedible to most animals. Fertilized eggs of the cephalopods hatch into young which are essentially similar to the adult; development is gradual and direct.

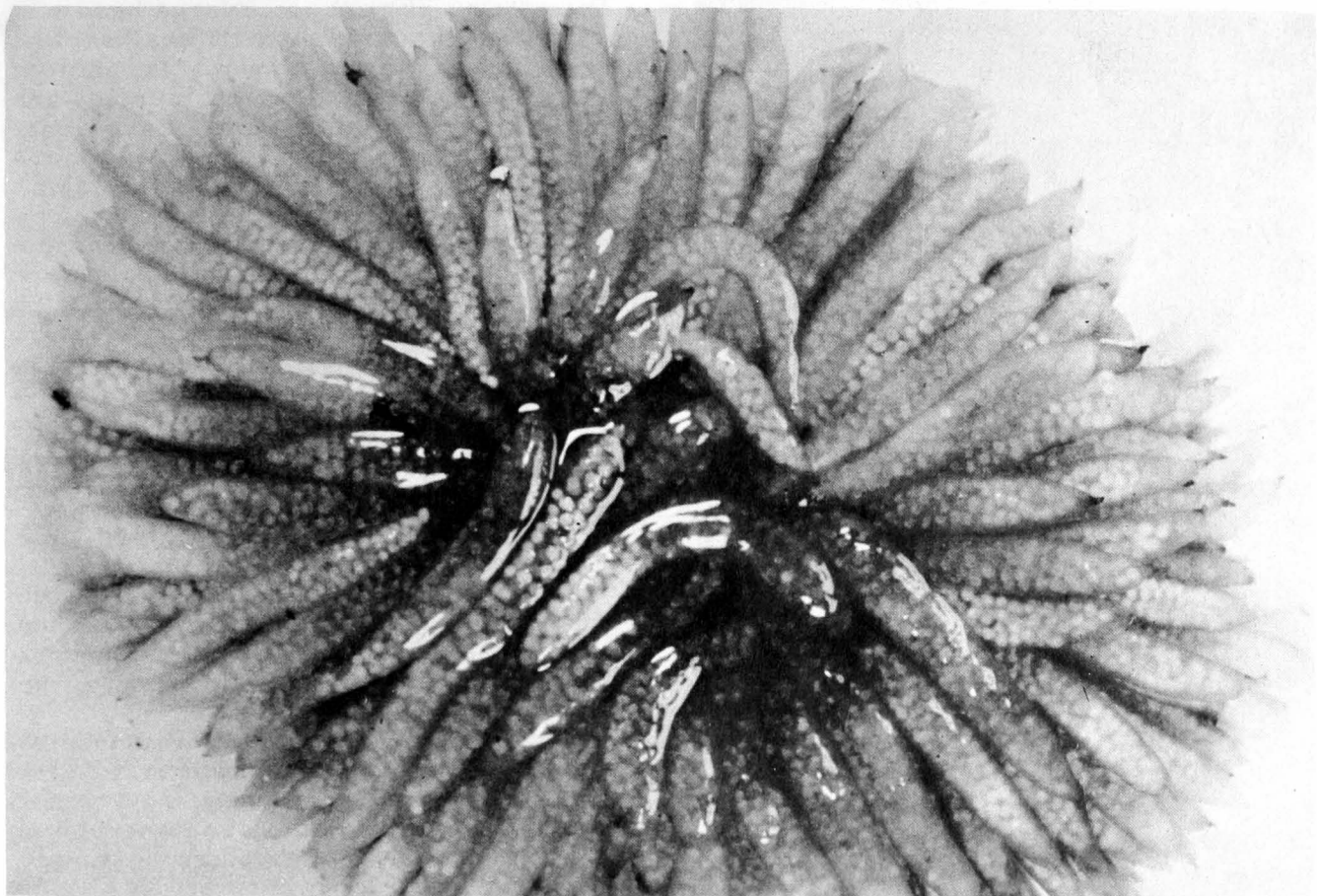


Figure 1.--Squid eggs (*Loligo pealei*). Courtesy of Robert K. Brigham.

FAMILIAR CEPHALOPODS

The most familiar living cephalopods are the cuttlefish, the octopuses, and the squids.

Cuttlefish

About 100 species of cuttlefish (family Sepiidae, group Decapoda) are known. They are found in most tropical and temperate seas but only rarely in northern waters. They mainly inhabit shallow coastal waters.

These animals have a somewhat flattened body edged by a pair of rather narrow fins. Five pairs of arms encircle the mouth. One pair (tentacles) is longer than the rest. The arms are equipped with suckers which are stalked, with horny rims that may be saw-toothed. On the shorter arms there

are four rows of suckers down the entire length of the arms, except on the male's fourth arm on the left, where they are absent toward the base. The pair of tentacles has suckers only on the club-shaped ends.

The calcified cuttlebone (fig. 2), the most characteristic feature of the cuttlefish, lies in the dorsal (back) portion of the mantle cavity.

Ordinarily cuttlefish rest horizontally on or near the sea floor, with their fins gently waving, the tentacles withdrawn into pockets beneath the eyes, and the arms depressed.

The best known species of the cuttlefish is *Sepia officinalis* (fig. 3) of the Mediterranean. Oval in shape and with a slightly flattened surface, it attains a length of 6 to 10 inches. Its color usually ranges from pale gray to dark brown or neutral tints. Sometimes it has zebra-like stripes.

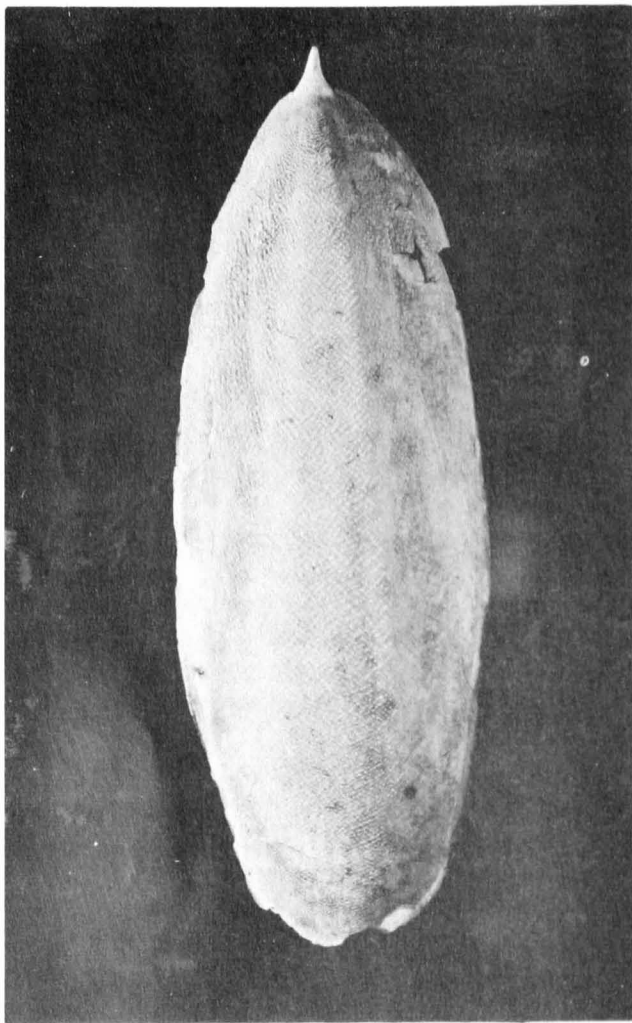


Figure 2.--Cuttlebone of the cuttlefish (*Sepia officinalis*).
Courtesy of the American Museum of Natural History.

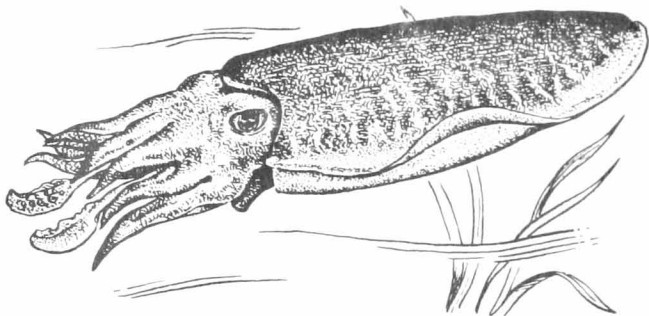


Figure 3.--The cuttlefish (*Sepia officinalis*).
Courtesy of the Encyclopedia Americana.

Octopuses

Octopuses (family Octopodidae, group Octopoda) occur in nearly all seas, but are sparsely represented in Arctic and Antarc-

tic waters. They are found chiefly in shallow coastal waters, but some occur at great depths.

The octopus (fig. 4) has a large head with a strong beak, and a small oval saclike body with an internal shell (a pair of vestigial structures to which muscles are attached) but no fins. The eight long, slender arms are of equal length and more or less united at the base by a thin membrane. Two rows of cuplike suckers, one of its distinguishing characters, extend the full length of each arm. The suckers are without stalks and without horny rims. The third arm on the left-hand side in the male is modified for sexual purposes.

Octopuses are solitary; that is, they do not live in groups. Ordinarily they live on the bottom of the sea among rocks. They hide in holes or in underwater caves, with their arms reaching out to seize victims. The position of the arms at this time reveals their hiding place. Sometimes an octopus digs its own den. It moves large stones to make the den and closes the entrance with stones when it moves inside. A pile of empty mollusk shells often marks the entrance of the den.

There are numerous species of octopuses. Some species spread their arms from 12 to 14 feet. Ordinarily, however, the octopus does not attain one-half these dimensions, and many species have bodies no larger than an orange. The common octopus along the southern coast of California is *Paroctopus bimaculatus*. Farther north lives *Octopus apollyon* which has been known to have a diameter of 28 feet. *O. punctatus*, also of the Pacific coast, is said to reach 14 feet in length when the arms are outstretched. *O. vulgaris* of the Mediterranean and the temperate Atlantic reportedly attains a length of 8 feet and an arm spread of about 18 feet. *O. bairdi* is found on the Atlantic coast north of Cape Cod, where it is never particularly abundant.

Octopuses may be dangerous under certain conditions. A diver who enters the hiding place of an octopus may be trapped under water if the octopus can get a good hold on him. Another danger comes from carelessly handling even small specimens. Octopuses have a well-developed venom apparatus, and their bites can produce injurious effects (Halstead, 1959). In one instance, a diver captured a small octopus near East Point, Darwin, Australia, and permitted it to crawl over his arms, shoulders, and neck. The octopus inflicted a small bite on the back of the neck which

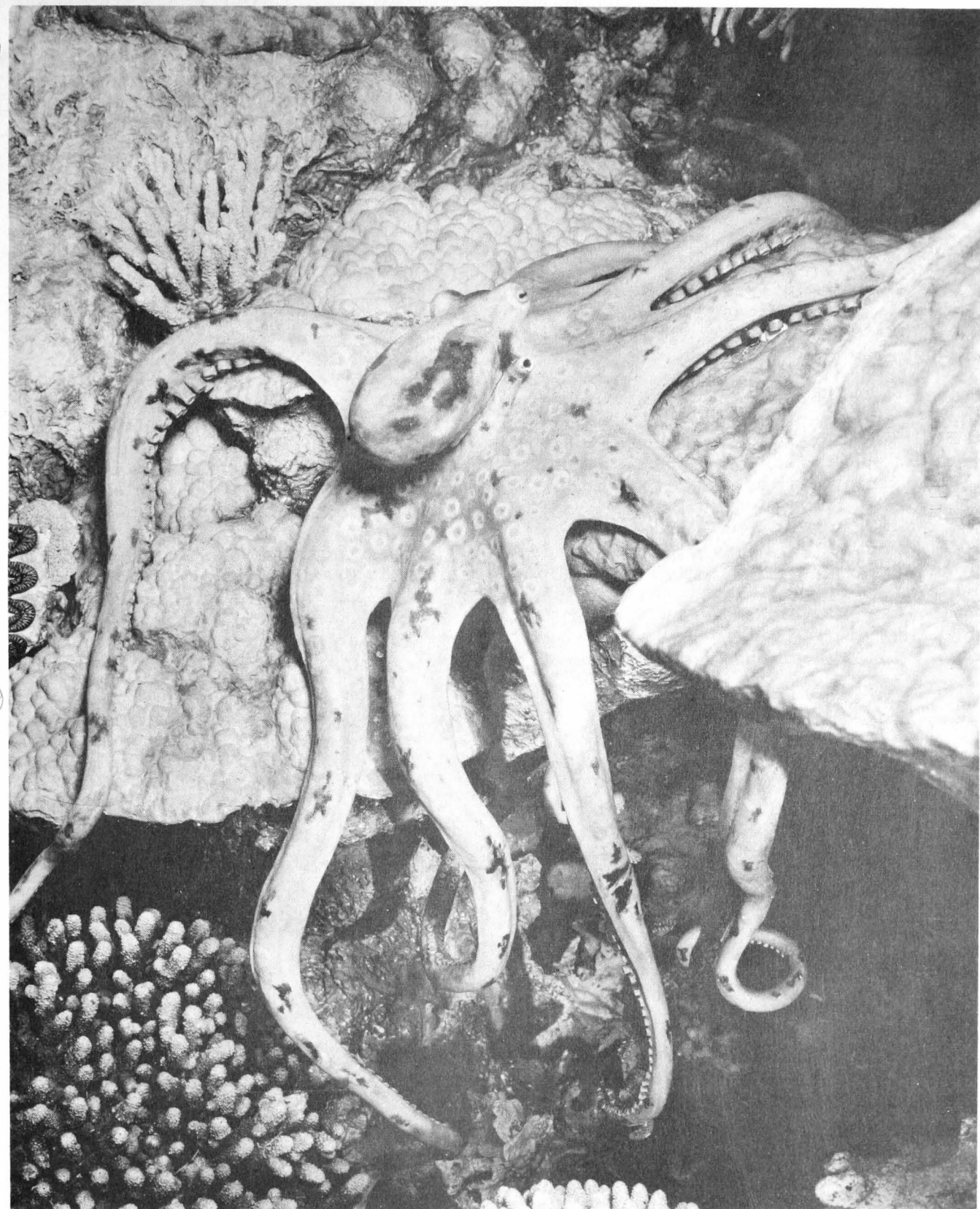


Figure 4.--This model of an octopus is shown at the entrance to a cavern in an exhibit in the American Museum of Natural History, New York City. *Courtesy of the American Museum of Natural History.*

produced a trickle of blood. A few minutes later the victim complained of dryness in his mouth and of difficulty in swallowing. He developed a loss of muscular control, suffered from respiratory distress, and was unable to speak. Placed in a respirator at a hospital, he died about 2 hours after having been bitten. The man may have been particularly sensitive to octopus bites, and his reaction unusually severe.

Squids

There are many species of squids (eight families, group Decapoda). They range from less than 1 inch to 75 feet or more in length when the arms are extended.

Widely distributed, squids occur along shores, on high seas, and from the surface down to great depths. Having broad environmental tolerances, these schooling, swift animals seek areas where food abounds.

The squid has a long, tapered body (streamlined for rapid swimming), with a triangular caudal fin on each side (fig. 5). Like the cuttlefish, it has 10 arms--8 muscular arms and 2 longer tentacles. Both the arms and the tentacles are equipped with suckers which, like those of the cuttlefish, are stalked, with horny rims that may be saw-edged. The suckers appear only

at the tips of the tentacles, but extend the full length of the arms. The tentacles, like those of the cuttlefish, are retractile.

In squids the internal shell is reduced to a long horny structure, called the "pen," which extends the length of the trunk.

The most abundant of the American squids belong to the genus *Ommastrephes* (called flying squids because they leap from the sea during storms and when pursued by enemies, sometimes landing upon the decks of vessels) and the genus *Loligo*. *Ommastrephes illecebrosa*, varying from about 8 to 14 inches in length, ranges from southern New England to Newfoundland. *Loligo peali* occurs from New England to Florida, Gulf of Mexico, and Central America to Venezuela; it reaches a length of 12 to 18 inches. *L. opalescens* ranges along the Pacific coast from Puget Sound to Lower California, Mexico, and reaches a length of about 12 inches; it is popular in the Chinese markets of the western United States. These are the species most familiar to fishermen.

The giant squids (genus *Architeuthis*), occurring at great depths in the Arctic and Antarctic waters, are the largest living invertebrates (fig. 6). They are rarely seen by man and then generally only as dead specimens washed up on beaches.

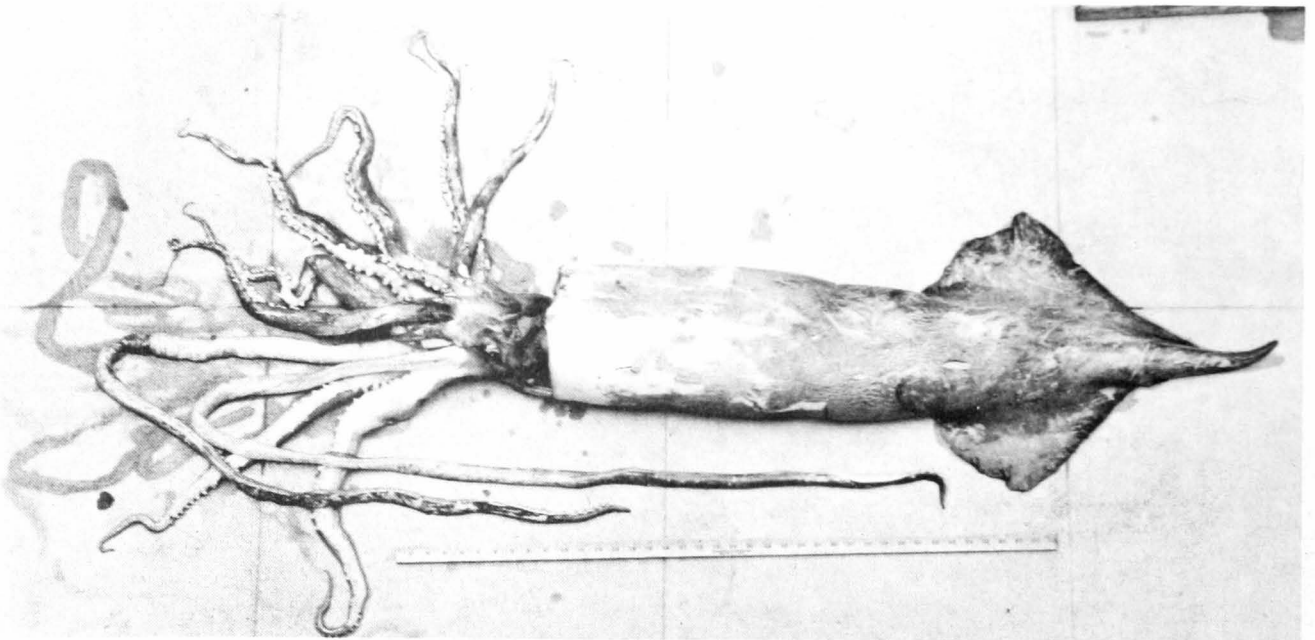


Figure 5.--Squid, *Moroteuthis robusta* (9 feet 8 inches long), captured in a trawl net in November 1954 by the State of California research vessel *N. B. Scofield*. Courtesy of the State of California Department of Fish and Game and Jack W. Schott.

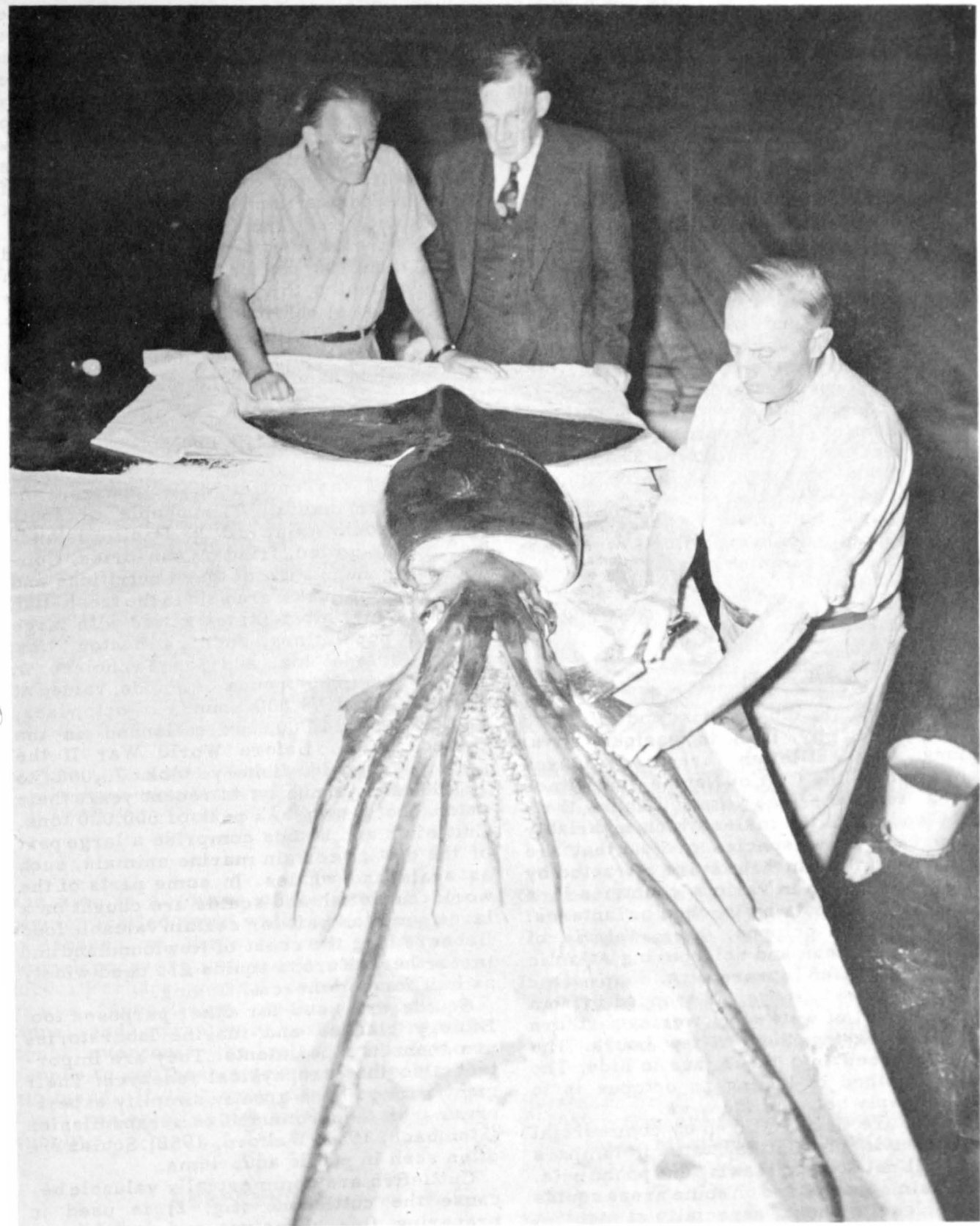


Figure 6.--A giant squid (*Architeuthis*) taken in the Humboldt Current off the Pacific coast of South America by American Museum of Natural History expedition, headed by Michael Lerner (left). *Courtesy of Michael Lerner.*

They reach a length of more than 50 feet including the tentacles and a weight of 1,000 pounds. Each sucker is almost 2 inches wide. Large squids, living in the Humboldt Current, rise at right in untold thousands and, when disturbed, squirt sepia-colored, ink-laden water for many yards (Duncan, 1941).

ENEMIES AND PROTECTION AGAINST THEM

The cephalopods use speed, ink clouds, color changes, and their beaks against foes such as dolphins, porpoises, seabirds, seals, turtles, and whales. The octopus must combat the savage conger and moray eels, and the giant squid has to meet the formidable swordfish and the sperm whale. While depending heavily on speed for escaping enemies, those cephalopods that have an ink sac use it effectively. They squirt out a cloud of black ink which quickly darkens the water, distracting the enemy, and perhaps temporarily paralyzing its sense of smell. Changing color at the same time to almost complete transparency, the cephalopod may escape to a safer site.

As soon as they hatch, larval cephalopods begin to fall prey to fishes.

CAPTURE

The cuttlefish, the octopus, and the squid are captured by man in various ways. During the cuttlefish breeding season fishermen in the Gulf of Naples sometimes tow a female *Sepia officinalis* behind their boats and catch the males which invariably follow her. Some species of *Sepia* that are partly nocturnal in habits are attracted by lights; fishermen in various countries lure them into their nets by torches or lanterns.

The common octopus, *Octopus vulgaris*, of the Mediterranean and neighboring Atlantic coasts, is often speared. A deep-water species, *Eldone moschata*, is trapped in from 60 to 120 feet of water by lowering earthen jars and leaving them a few hours. The animals creep into these jars to hide. The choice method of killing an octopus is to stab it deeply between the eyes.

Squids are usually taken by commercial fishermen in the United States in lampara nets, gill nets, otter trawls, and pound nets. In certain seasons and in some areas squids come close to shore, especially at night. A light on a boat, a pier or shore will attract small baitfish, and squid will often gather to feed on them. The squids can often be

caught with seines or dip nets. Squids are sometimes stranded on shore in large numbers, especially late at night, and can be picked up by hand. They can also be snagged with triple hooks on the end of a line if the hooks are baited with one or two shiny baitfish. An expedition of the American Museum of Natural History to the Humboldt Current off the Pacific coast of South America landed intact some giant squid with rod and reel (Duncan, 1941). Some were nearly 9 feet long and weighed more than 100 pounds (fig. 7). Their tough beaks slashing through wire leaders of the toughest steel obtainable, these giant squids showered the fishing boat with ink.

Squids, like octopuses, have been known to bite when handled.

UTILIZATION

Most of the cuttlefish, octopuses, and squids are useful. The people of south Europe, south Asia, and the Pacific islands eat them--boiled, fried or sun-dried. Considerable quantities of these nutritious and palatable mollusks are sold in the fresh-fish markets of United-States cities with large foreign populations, such as Boston, New York, Philadelphia, and San Francisco. In 1959, 23,554,000 pounds of squids, valued at \$576,000, and 99,000 pounds of octopuses, valued at \$14,000, were landed in the United States. Before World War II the Japanese squid fishery took 75,000 to 150,000 tons annually; in recent years their catch has grown to a peak of 600,000 tons. Cuttlefish and squids comprise a large part of the diet of certain marine animals, such as seals and whales. In some parts of the world cuttlefish and squids are caught on a large scale as bait for certain valuable food fishes. Along the coast of Newfoundland and in northern Europe squids are used widely as bait for commercial fishing.

Squids are used for other purposes too. Biology classes and marine laboratories use them in experiments. They are important also in neurophysical research. Their giant nerve fibers greatly simplify experiments in neuromuscular transmission (Steinbach, 1951; Walford, 1958). Squids are often seen in public aquariums.

Cuttlefish are commercially valuable because the cuttlebone (fig. 2) is used in preparing fine abrasives and dentifrices, and for supplying caged birds with lime and salts. Fashionable Romans once used finely ground cuttlebone as a cosmetic. The ink

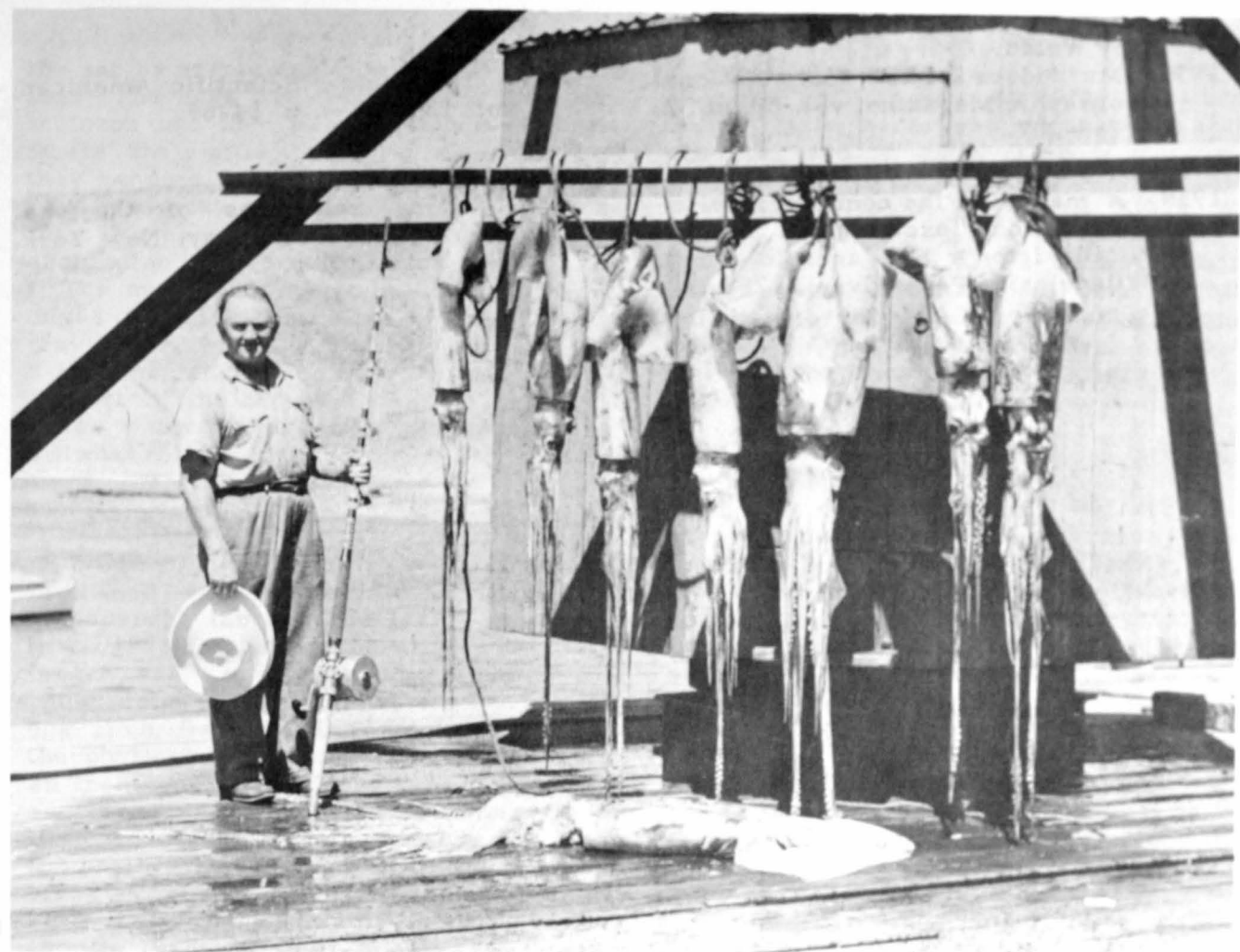


Figure 7.--Giant squids (*Architeuthis*) taken in the Humboldt Current off the Pacific coast of South America by American Museum of Natural History expedition, headed by Michael Lerner (pictured above). The smallest squid exceeds 6 feet in length, and the largest one, weighing more than 100 pounds, is nearly 9 feet long. *Courtesy of Michael Lerner.*

sac also is a source of the natural brown pigment called sepia which artists use.

Because of their curious appearance, cephalopods are not widely used as human food. Perhaps market development programs, advertising, cooking demonstrations, and attractively packaged products could overcome the reluctance of most people to eat these nutritious and palatable mollusks. If that were done, cephalopods could materially add to the world's food supply.

REFERENCES

Berrill, N. J.

1951. Submarine rockets. *Natural History*, vol. 60, no. 1, p. 128-132.

Clench, William.

1959. Cephalopoda. *Encyclopedia Americana*, vol. 6, p. 216-218.

Duncan, David D.

1941. Fighting giants of the Humboldt. *National Geographic Magazine*, vol. 79, no. 3, p. 373-400.

Halstead, Bruce W.

1959. *Dangerous marine animals*. Cornell Maritime Press, Cambridge, Maryland, 146 p.

MacGinitie, G. E., and Nettie MacGinitie.

1949. *Natural history of marine animals*. McGraw-Hill Book Company, New York, New York, 473 p.