IT'S WHAT YOU KNOW THAT COUNTS

By

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Book VII: Marine Discovery Series

1984

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Bureau of Marine Resources
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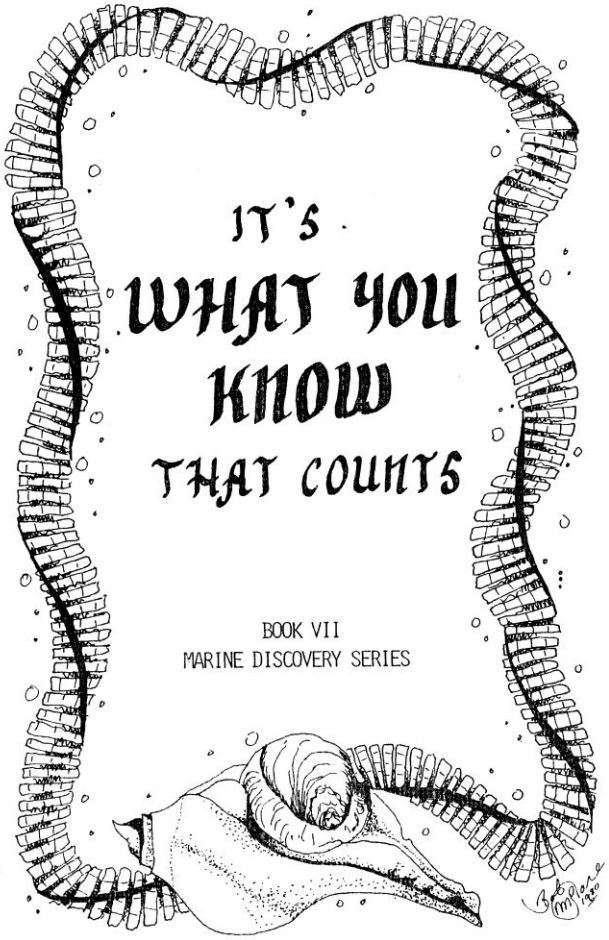

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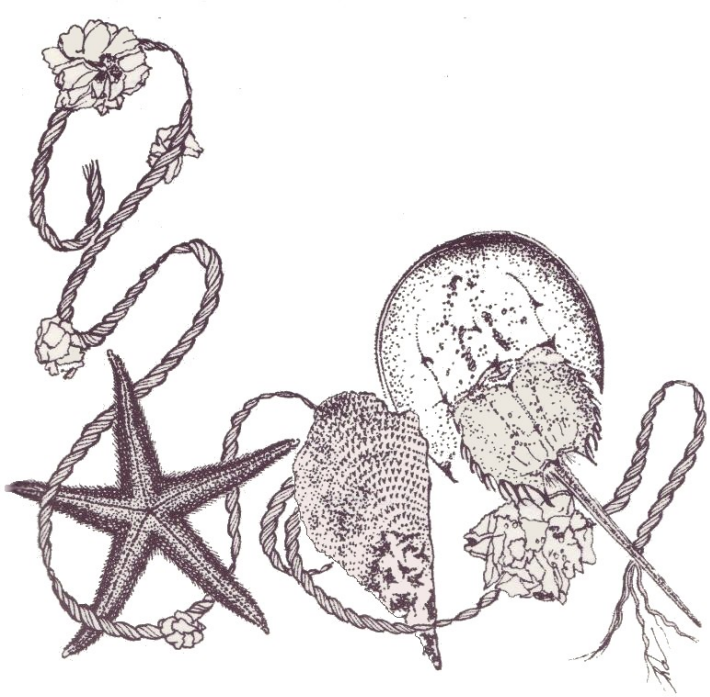
This publication was funded in part through a grant from the Office of Coastal Zone Management under the Coastal Zone Management Act of 1972, as amended.

Dedication



We dedicate this booklet to all elementary teachers, who give so much of their time, energy, expertise, and love to their students. It is these elementary teachers who, over the years, have produced a society of individuals whose scientific and technical achievements have far exceeded those of any other nation of the world.

Purpose

This elementary booklet has been written on a sixth grade level. It will be appropriate for use with the upper fifth grade level and with the seventh grade life science program.

The material has not been written from the standpoint of a highly scientific publication; rather, it has been presented to give students a general overview of the characteristics of some of the marine invertebrates of the Mississippi Gulf Coast.

The teacher may use this booklet as supplementary material to promote a marine awareness among the elementary students. By discovering some important ecological principles, the students will--it is hoped--strengthen their biological backgrounds, helping them to comprehend the importance of the wise utilization, conservation, and preservation of our marine resources for the present and the future.

It's What You Know That Counts

Jefferson Rogers is eleven--or maybe eleven-and-a-half. For some people, that might seem to be a young age, but Jefferson figures that numbers aren't really important when it comes to age. He says that his grandfather, who is close to seventy, acts like a young boy sometimes; and his best friend, Donald McTavish, occasionally acts as if he's thirty.

The important thing, Jefferson has discovered, is not how old you are--but how much you know. And since there's so much to know about everything in the whole world--even if you're a combination of Albert Einstein and Benjamin Franklin and Captain Kirk--well, there's almost too much to think about.

When he was only seven, he had a long talk with his grandfather about the whole problem.

"I'm depressed," he said when his grandfather asked what was wrong and why he wasn't out playing, as he usually was.

"That's a big word for a small boy," his grandfather smiled, sitting down beside him on the front steps.

"But you know I like big words," Jefferson said. "I like to learn new words and new things and that's part of the problem."

"Aw, it can't be so bad as all that," his grandfather said softly. "Tell me about it."

"Well, take the dictionary, for instance," Jefferson said.

"Yes?"

"All those thousands of words."

"I know."

"Grandfather, nobody could learn all those words. Not even you." Jefferson admired his grandfather enormously.

"No. Not even I," his grandfather tried to hide his smile.

"And everything else is the same way. There's just too much to learn. Today we visited the library at school. They've got rows and shelves of books and more books and stacks of encyclopedias. I'll never learn all there is to know, will I?"

"No, you won't."

"So that's why I'm depressed," Jefferson sat with his hands holding his chin, his brown eyes worried looking and his mouth sad.

"Well, I have an answer to that," his grandfather spoke softly. "Or part of the answer, anyway. You want me to tell you?"

"Please," Jefferson was interested.

"Well, it's this. Since you've already learned the first lesson--that you'll never know everything--you should take the second step on that journey to understanding."

"What's that, Grandfather?"

"That wise men usually narrow their fields of concentration--do you know what that means?"

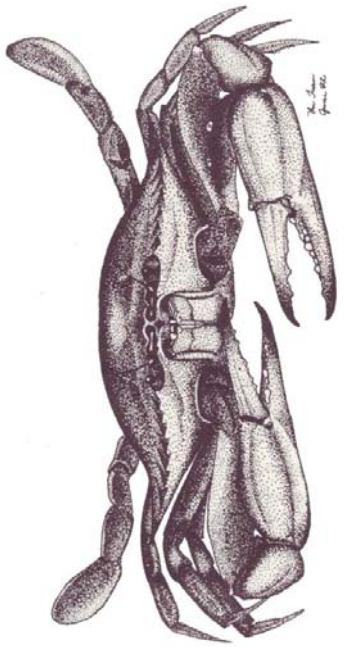
"Of course," Jefferson was confident of his vocabulary. "It means that people zero in on things that are not so big."

"Exactly. And that's what I advise you to think about--what interests you most and learn as much as you can about it. You'll never learn everything about even a limited subject--but you'll learn a lot. And you can always keep on adding to it and expanding your interest. Do you follow me?"

"I think so. You mean I shouldn't worry now about learning everything in the whole world--but maybe I can concentrate," he exaggerated the pronunciation of the word, "on a few things. That's good advice, I think," he said, standing up.

Sometimes, his grandfather thought, Jefferson seemed to seven going on twenty-one.

That was the start of Jefferson's stamp collecting, which he kept up all his life, concentrating on stamps from the United States in the 1900s. And soon he moved into other fields. One year he spent most of his free time collecting rocks, concentrating on the types of rocks that could be found in South Mississippi. He kept that up until his mother and father decided that there was no more room in the house for any more rocks. One year he devoted to a study of mosses and one year to experiments with colors and a year to learning about life in the Old West. Jefferson was never bored--because there was always so much waiting for him to learn, if he just concentrated.



THE BLUE CRAB FOUND IN MISSISSIPPI COASTAL WATERS

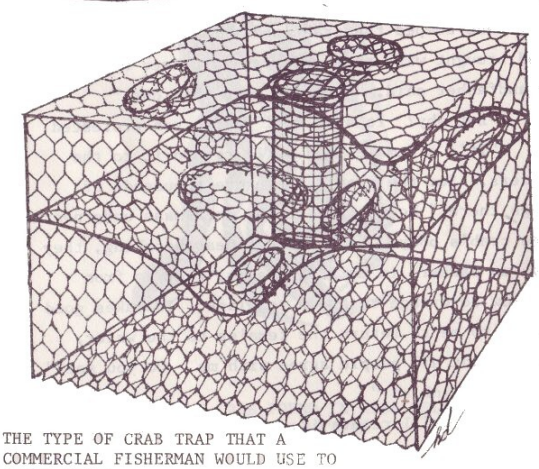
On his eleventh birthday, Jefferson received a birthday present from his grandfather. It was a book about marine life--and there was just so much to learn that Jefferson thought he would never be able to understand it all. And then he remembered his grandfather's advice. Concentrate. Narrow the field. Of course! That was still the right answer, Jefferson believed, and the field was not a mile away from his own Gulfport home--the waters of the Mississippi Sound. He already knew a lot about the Sound--from his science class. And now he would learn about life in the Mississippi waters.

After he had read one or two small books, he knew that he must narrow his research even further. And by that time he was interested in what he had learned to call the "invertebrates." His interest had really begun when his grandfather took him crabbing off the long Gulfport pier that extended out over the shallow water near shore. They had prepared the nets with bait in the center and dropped them at intervals into the water, where each sank to the bottom. Then they tied the long strings to the pier railings and waited a while before pulling them up. The first two nets held nothing, but the third had a large crab in it. Jefferson let out aloud whoop of surprise and laughed as his grandfather gingerly turned the net over and dumped the crab into a large tin tub they had brought with them. He was surprised when his grandfather said, "We won't keep this one."

THE TYPE OF CRAB NET USED BY JEFFERSON AND HIS GRANDFATHER TO CATCH THEIR CRABS.

"But why? It's so big!" Jefferson protested.

"It's a female--and we'll return it to the waters. See the eggs. There are thousands of eggs there," he pointed to the dark mass underneath the crab's body. "As the eggs near hatching, they become darker; in earlier stages, they go from yellow to orange to brown to black. It makes good sense to me to return the

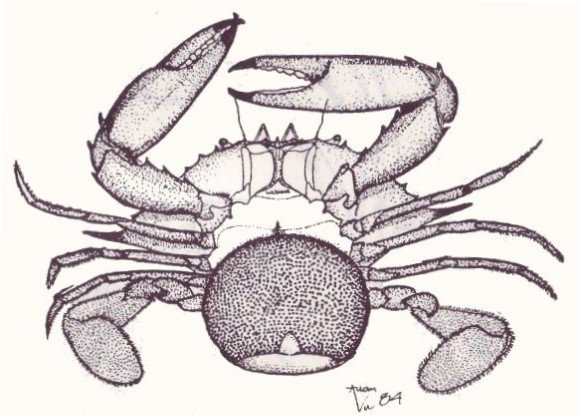


THE TYPE OF CRAB TRAP THAT A COMMERCIAL FISHERMAN WOULD USE TO CATCH CRABS.

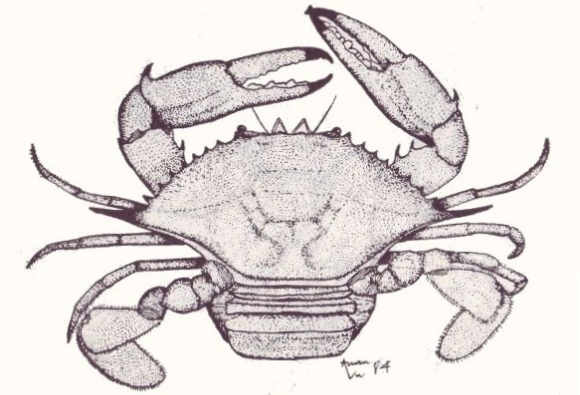
females to the water, though not all people agree with me. Do you see?"

"I think so."

"So we'll return it. And all those eggs will hatch and maybe some of these crabs will survive to become adults and--"



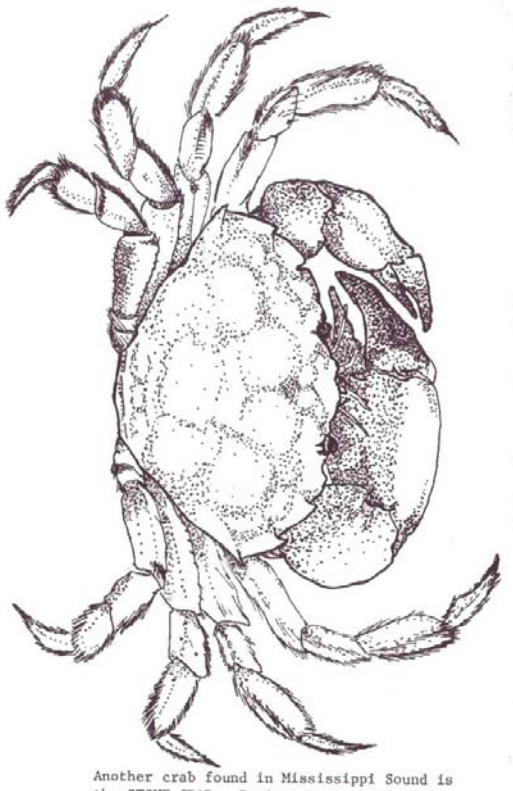
An underside (ventral) view of a FEMALE CRAB shows where she carries her eggs until they hatch.



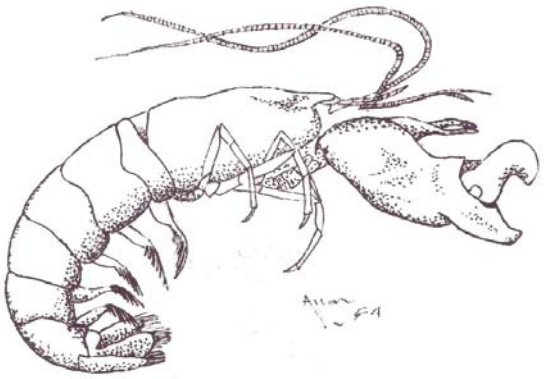
The top of the CRAB also changes its appearance when carrying eggs. It was easy for Jefferson's grandfather to identify those crabs with eggs.

There was much more in his first lesson with the invertebrates of the Mississippi Sound and in the ecology of the coastal waters.

The beach itself became a kind of classroom for Jefferson, beginning with that day as he and his grandfather walked along the beach while waiting to check their crab nets. His grandfather called it "beachcombing," and Jefferson was amused by the word. "You'll be surprised by what you can find when you're beachcombing," his grandfather said, lifting up a small log that lay at the water's edge, half-submerged, and reaching down to point toward a small creature scuttling back to safety.



Another crab found in Mississippi Sound is the STONE CRAB. It is not as abundant as the blue crab.



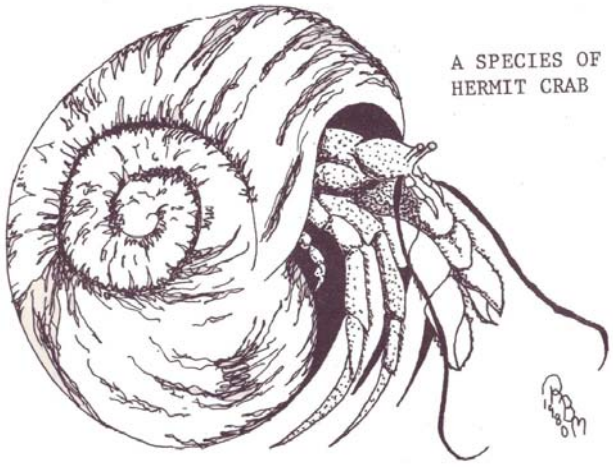
A PISTOL SHRIMP

"What is that?" Jefferson asked.

"It's called a pistol shrimp--some people call it a snapping shrimp because it can make a popping noise. It does that to frighten away its enemies." The pistol shrimp grows to about one or two inches long and has one claw greatly enlarged. Where the tip of the claw is divided into two sections, one of the sections can close with great rapidity and force, producing a popping noise. "You'll find them under logs and in burrows," his grandfather said, continuing his walk along the white sand beach.

Jefferson looked for shells along the beach and found a few that he placed in a small bag that his grandfather took from his pocket. He didn't take any shells that were being used as a home by any sealife. Then he saw something peculiar.

"What's that?" he questioned, when he found a larger shell in the shallow water and pointed to it. "A snail shell--but something's on it."

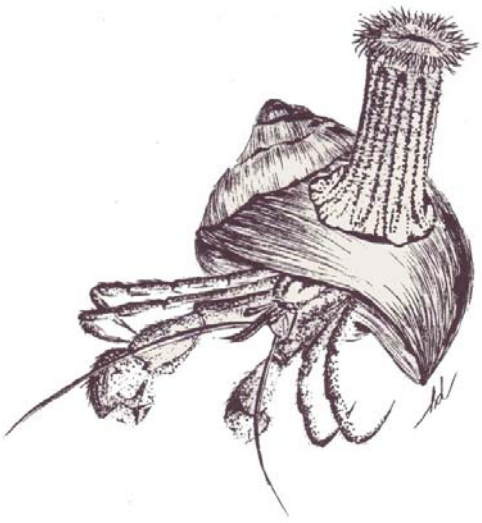


A SPECIES OF HERMIT CRAB

"That's a sea anemone," his grandfather said. "They're usually found near the shores of the offshore islands--but sometimes the shells wash up on our beaches or a fisherman might have thrown the shell overboard and it washed up here. The sea anemone is tubular and has tentacles on one end and a pedal disc at the other for attaching itself to some solid object."

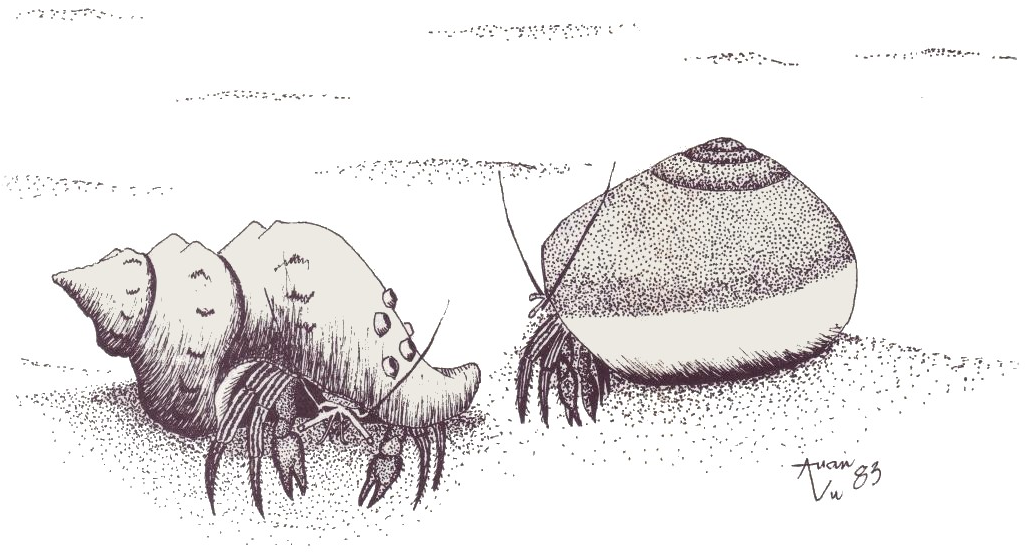
"Do they sting?"

"Well, the tentacles have stinging cells the anemone uses to capture live organisms, mainly fish and invertebrates for food. Sometimes they're found on shells that have hermit crabs in them."



A SEA ANEMONE ATTACHED TO A SNAIL'S SHELL OCCUPIED BY A HERMIT CRAB.

The hermit crab, Jefferson decided, was one of his favorite invertebrates, particularly after his grandfather helped him to find several that day on the beach. He looked up the hermit crab in a science book that afternoon and began to make notes about it.



HERMIT CRABS can live in different types of shells. They also move to other shells after growth periods.

The hermit crab, he discovered, is a crustacean that cannot make its own shell; instead, it has to find a shell once occupied by a snail, which has died or been eaten by predators, and fit itself into the shell for safety. When the hermit crab locates an empty shell, it carefully inspects the shell with its claws. Once satisfied, the crab backs into the shell, abdomen first, and remains there as long as it is comfortable. The hermit crab uses a structure called a uropod to hook itself securely in place. Since the shells are of various kinds, the hermit crab may be found in many kinds of shells, depending on the type of snail that originally made and occupied the shell. As the hermit crab grows, it must select a larger shell to live in, but it will not leave the old shell until the new one has been selected. "Sometimes it's almost like the hermit crab went shopping for a new house," his grandfather told him.

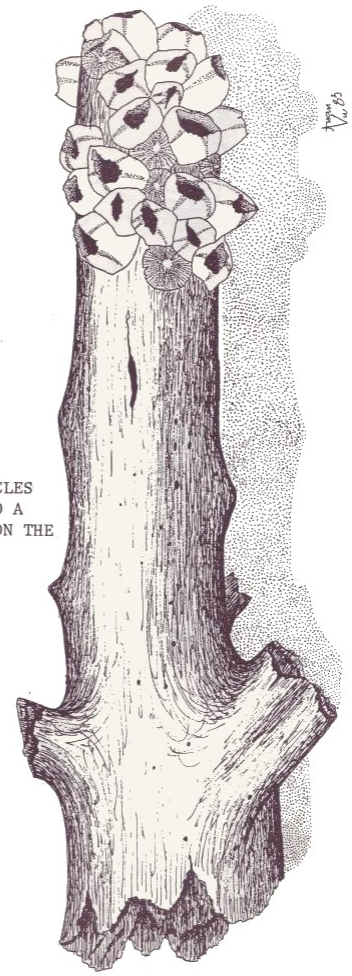
"Are they important? I mean, are they good for anything?"

"Well, I suspect that everything is good for something," his grandfather said quietly. "But if you mean 'are they good to eat,' well, no, they aren't. They're important as scavengers in the food chain; they also eat other organisms that they gather in the sandy or muddy bottoms or catch in the water."

After that day, Jefferson would ask his grandfather to take him beachcombing often--and he learned something new every time they went to the beach. "You can learn a lot if you just keep your eyes open and really look," his grandfather said. "And if you

keep on asking questions." He smiled when he said that, because he did not think Jefferson would ever stop asking questions.

Jefferson learned that many of the shells used by hermit crabs were oyster drill shells. The oyster drill is a snail which feeds on oysters or other bivalves. Because they prefer high salinity habitats, they come farther into the Sound when there has been less rain and the water is more salty. When heavy rains come, the oyster drills go out into deeper water. He learned, too, that the oyster drill has a unique feeding organ called the radula, which bears a number of rows of teeth. The oyster drill can project this radula in various directions, and it also has a gland which secretes an acid to soften the oyster shell. This makes it easier to drill through the oyster shell. When the oyster drill matures, it will dissolve an area of the shell in order to feed on the oysters.



DEAD BARNACLES ATTACHED TO A LOG FOUND ON THE BEACH.

Another result of their beachcombing was the finding of pieces of wood that had floated onto the beach; many times the wood was covered with barnacles, which attach themselves to larger objects, sometimes rocks or pilings. To Jefferson, they looked like little shell volcanoes. Actually, barnacles are filter-feeders that secrete their protective covers. These animals kick out a feathery-looking body part to catch food. Jefferson noticed that the barnacles were not free swimmers but were attached to something.

It was Jefferson's beachcombing which helped make him decide what his next project would be.

His mother and father were patient, because they had been through so many of Jefferson's projects before.

"I guess it's better than collecting rocks," Mr. Rogers said wearily. "For a while, I thought we'd have to move out and let the rocks take over."

"I know," Mrs. Rogers nodded. "But he seems content with reading and doing research about this new interest. Maybe he won't be bringing too many things home."

DEAD BARNACLES FOUND ATTACHED TO A FLOAT AND ON A BOTTLE.

In that hope, they were wrong--but they did not know it then. It would be much later that Jefferson would decide that he needed even closer study of the invertebrates and that would require--well, they would find out.

At first, his grandfather was the source of much of his information, as he had so often been when Jefferson began a new project.

It was when they were going home with a tub half full of crabs--which Jefferson's grandmother would use in the seafood gumbo that all the family liked so much--that his grandfather told him more about the crabs. It was almost as if Jefferson were in class, and his grandfather was the teacher.

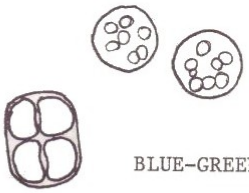
"Crabs are invertebrates," Grandfather Rogers said.

"That means 'without a backbone,'" Jefferson said, remembering. "Not like birds, mammals, and fishes."

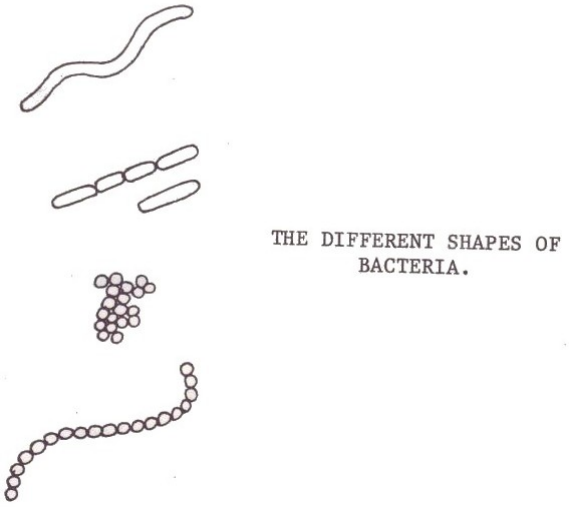
"Yes. Not like them. Scientists classify those animals with backbones as vertebrates. We're talking about animals that don't have backbones, such as crabs, shrimp, oysters, clams, and even things you can't see with the naked eye, like bacteria."

"Bacteria!" Jefferson exclaimed.

"Yes--one-celled organisms that grow in groups and in clusters and are necessary to the food chain. Most bacteria are beneficial to man--but some are harmful. Bacteria probably outnumber all other organisms on this planet. They are the smallest cells known and are found everywhere on earth where it's possible for life to exist. They're important in our waters because they bring about the decay of dead plants and animals. However, bacterial are in a special group of organisms whish are different from other invertebrates."

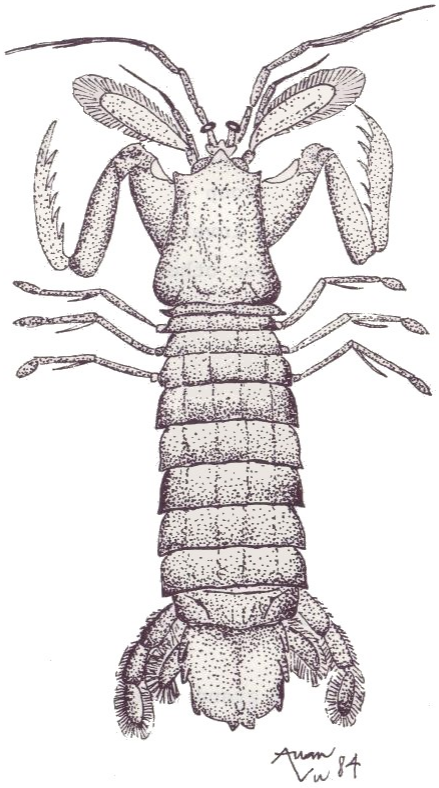


BLUE-GREEN ALGAE



THE DIFFERENT SHAPES OF BACTERIA.

"But what about those other invertebrates?" Jefferson pronounced the word very slowly and distinctly. "They'd be more interesting to me."



Although not thought of as a shrimp, this animal is called a MANTIS SHRIMP, KING SHRIMP, and SEA LOUSE. Jefferson discovered that there were many crustaceans other than crabs.

a whole new project for me. Won't Mom and Dad by happy about that!"

"I'm not sure," his grandfather said, remembering all of Jefferson's other projects and the way they sometimes turned things upside-down at home.

Jefferson soon learned that sponges, too, are animals among the invertebrates. They are classified under a group whose Latin name means "bearing pores." Sponges have many canals and pores by which water enters into the body of the sponge. The water is continuously moved in and out of the sponges by special cells.

The sponges are simple animals with no organs or specialized nervous structures. Most sponges are marine and sessile, which means that the animals grow attached to some surface and never move.

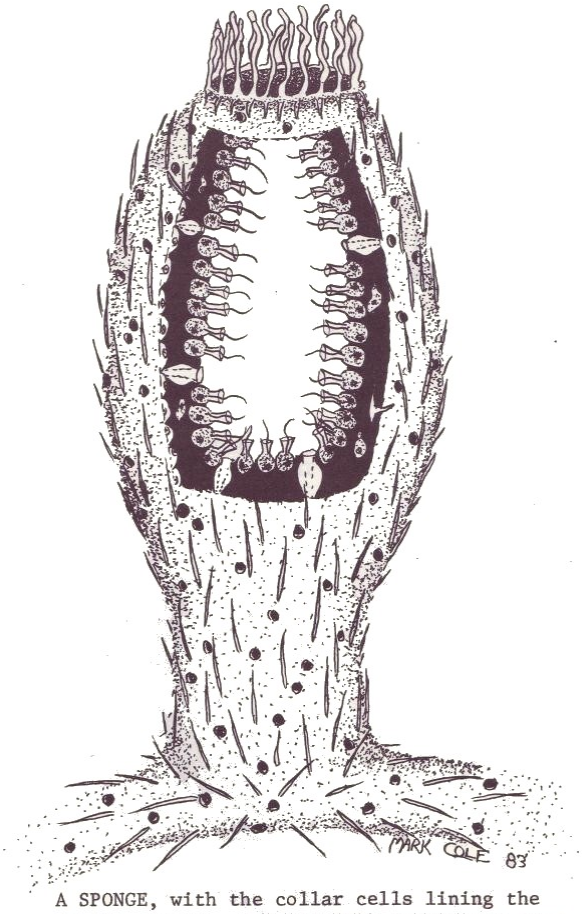
"I suppose they might be," his grandfather agreed. "Anyway, you already know about the hermit crab, blue crab, oyster drill, barnacle, and anemone. And other invertebrates include sponges, jellyfish, worms, mollusks, shrimp, fiddler crabs, periwinkles, whelks--there are a lot of them."

"It's a lot to learn," Jefferson said. "But if I just--"

"Concentrate," his grandfather said, smiling.

"Yes. If I just concentrate on the invertebrates this year, it will be

THREE SPECIES OF JELLYFISH, ILLUSTRATING THEIR TENTACLES.



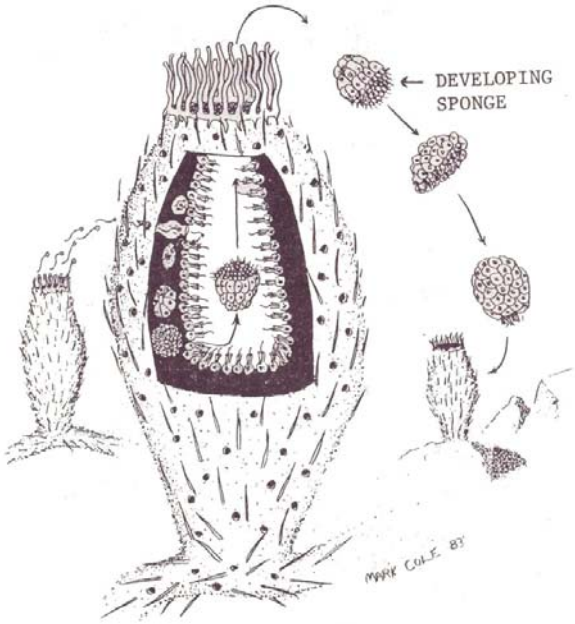
A SPONGE, with the collar cells lining the inside cavity. The whiplike structures beat constantly to keep water moving in and out of the sponge.

Not all sponges are soft and absorbent. Some are hard, due to their skeleton (supporting structure) which is made of small pieces (called spicules) of hard material. This hard material may be silica, like the material glass is made of, or it may be calcium carbonate, like the material which makes up an oyster shell.

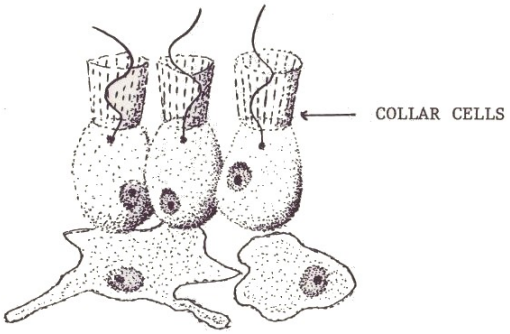
In the Mississippi Sound, Jefferson found a boring sponge that lives in shells. A shell that has many holes in it--about one to three millimeters large--may have been providing the living area (habitat) for many boring sponges.

Jefferson made up a joke about it for his grandfather.

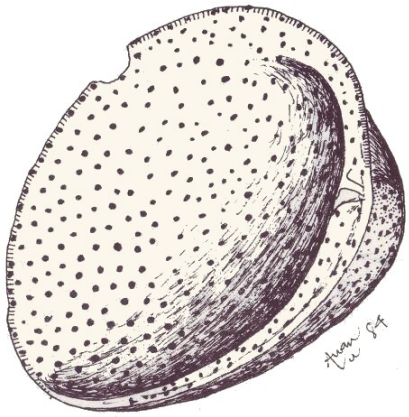
"What's interesting and boring at the same time?" he asked, and they laughed together at his answer.



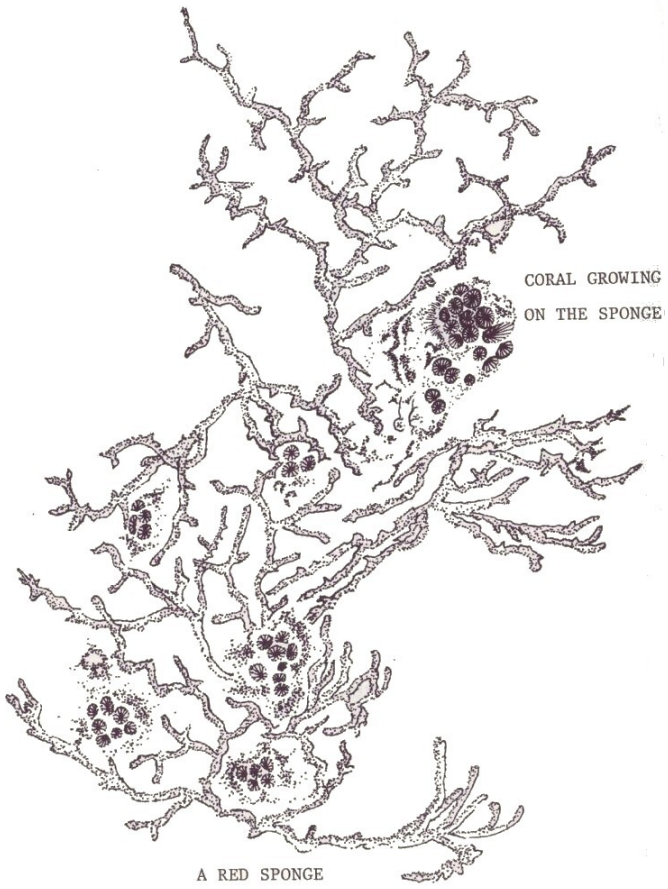
THE REPRODUCTION OF A SPONGE, SHOWING THE LARVAL STAGE.



THE TYPES OF CELLS IN SPONGES WITH THE WHIPLIKE STRUCTURES THAT CREATE THE MOVEMENT OF WATER IN THE SPONGES



A CLAM SHELL WITH HOLES MADE BY BORING SPONGES.



A RED SPONGE

During the summer Jefferson's cousin Robert, who was twelve, visited him from his home in North Mississippi. Robert liked going to the beach every day, though there were times when it was unwise for them to be in the water.

"Jellyfish," Jefferson explained.

"I can hardly see them in the water," Robert said. "Why can't we go in?" He hated to miss a day of his vacation near the water, so different from Corinth up in the northeast corner of the state.

"Let me tell you about them," Jefferson said, consulting his notebook and beginning to read. Robert nodded in agreement as Jefferson read, because he had become interested in Jefferson's project, too.

"Well, they look kind of umbrella-like or tube-shaped, and all of them have tentacles that are used for stinging."

"Do all of them sting?"

"Yes, but we don't feel the stings of all of them. During the winter and spring, very small jellyfish are often found near the mainland. In the summer during strong southerly winds larger jellyfish are brought into the Sound--and swimmers often get stung by some of them, like the ones called sea nettles. They drift with the current and undulate to move." He stopped reading for a moment. "You want to hear about the Portuguese man-of-war?"

"Sure. It sounds dangerous."

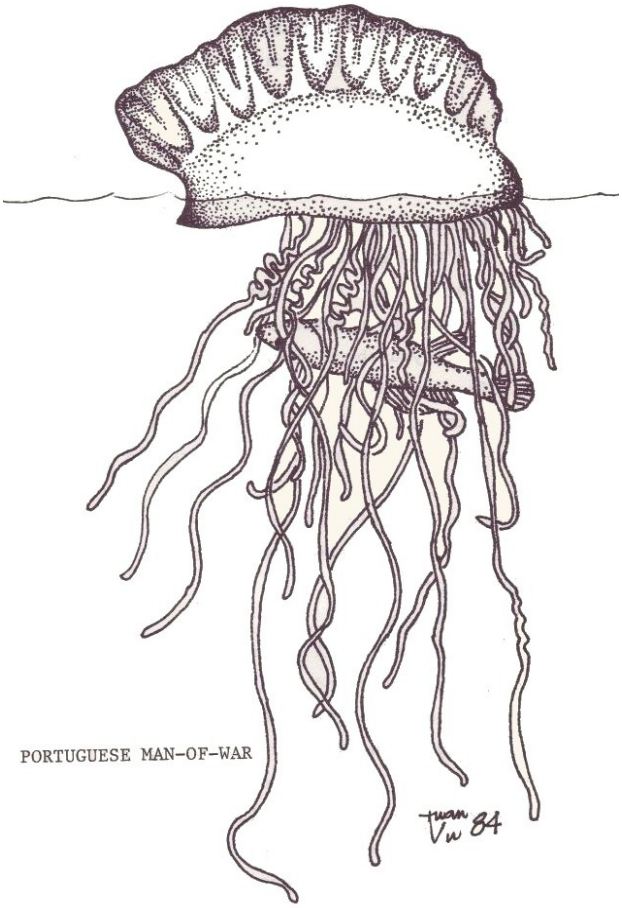
"Well, the Portuguese man-of-war is not one animal; it's made up of several jellyfish. It's a floating colony made up of several types of jellyfish that have a purple-blue part that floats on the water like a balloon. Hanging from this balloon are long, stinging tentacles they use to capture fish and other animals, which the man-of-war eats. One interesting thing about them is that the leather back sea turtle eats these creatures."

"You know just about everything," Robert said admiringly.

"Well, not everything," Jefferson was modest. "But if you zero in on a few things, you can learn a lot that way. That's what Grandfather taught me."

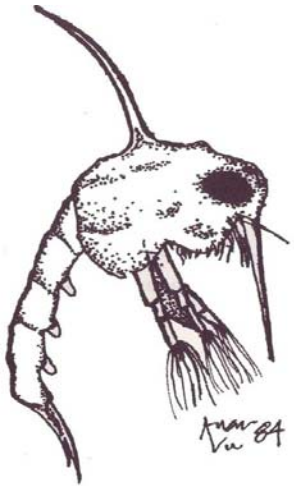
Their grandfather took them both crabbing again before the summer vacation for Robert ended. Like Jefferson, Robert was fascinated by the crabbing expedition. Then, too, Jefferson lost no opportunity to let Robert know more about these crustaceans. His cousin listened carefully.

Jefferson's notebook was beginning to fill up with the information he had collected from his reading and from his own research on the beach.



PORTUGUESE MAN-OF-WAR

"Crabs are part of the group called Arthropoda," Jefferson recalled from his notes. "The name comes from a Greek word meaning 'jointed feet.' These animals have an exoskeleton or shell on the outside of the body."



A YOUNG CRAB WHICH MUST SHED MANY TIMES BEFORE IT LOOKS LIKE THE ADULT CRAB (NOT DRAWN TO SCALE).

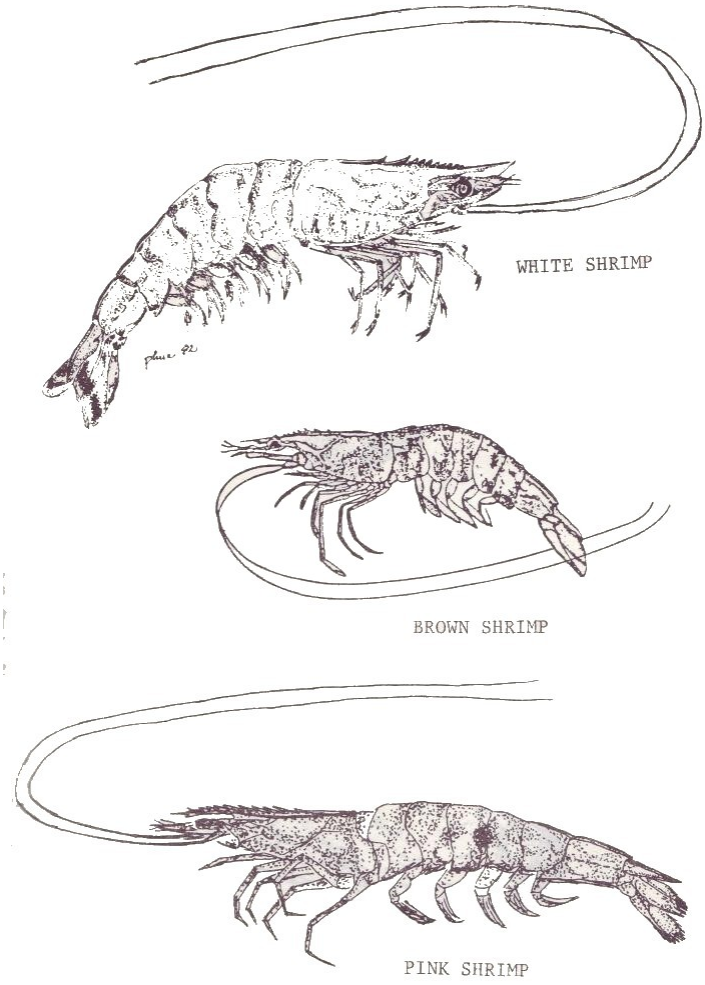
There was much more information to share, and Robert listened carefully. The arthropods, the largest invertebrate group, he learned from Jefferson, include insects, millipedes, centipedes, arachnids, and crustaceans. The most abundant marine arthropods are the crustaceans.

Some of the crustaceans found on the Mississippi Coast include copepods, amphipods, hermit crabs, shrimp, and barnacles. A beachcomber will occasionally mistake the "shed" of a crab or other arthropod for a dead animal. They must shed their shells, or molt, periodically so that they can grow.

After Robert had returned to Corinth, Jefferson began his sketches of the crustaceans he liked most. He enjoyed art almost as much as he liked science fiction and collecting rocks and reading about the Old West. He began to sketch some of his discoveries, making neat and

painstaking drawings which required him to examine every facet of the marine life he found. His father helped him use small nets and sand strainers, and they carefully examined everything they caught.

The blue crabs seemed to him the most colorful and exciting. The crabs were highly prized food items along the Gulf coast. Jefferson's sketches of them made them seem almost ready to reach out and nip a finger.

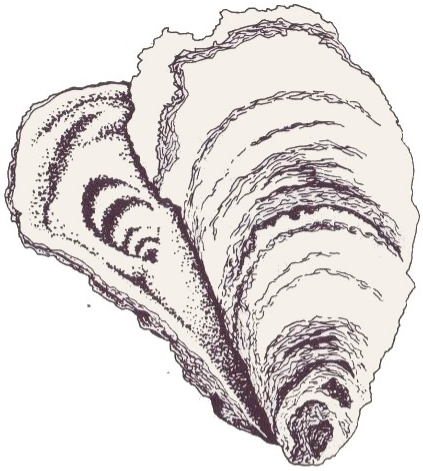


Of all the invertebrates, Jefferson learned most about the shrimp of the Mississippi Sound--and they were his favorites--not only because they are such good eating, but also because he found them the most interesting.

Shrimp, like crabs, have five parts of jointed legs. Shrimp and crabs also have similar life histories, or life cycles. Adult shrimp live in offshore deep salty waters and spawn in those waters. The female lays as many as a million eggs, which hatch into larvae within twenty-four hours. Only a small number of the larvae grow to adulthood. The larvae are carried by tides and currents to the protected waters of the estuaries, where they grow. When they are old enough, they move back to the deeper waters of the gulf of Mexico, where their life cycle begins again.

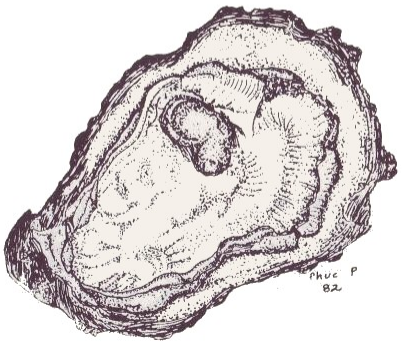
Mississippi Sound contains brown shrimp, pink shrimp, and white shrimp, with the brown shrimp being most plentiful.

Oysters, too, are among the most important invertebrates in Mississippi waters.



AN OYSTER SHOWING BOTH SHELLS. An oyster is a bivalve.

The oysters are found in shallow, warmer waters. The adult female oyster has immense egg-production capacities, producing as many as 16-million to 60-million eggs in a year. Within forty-eight hours after hatching, the shell begins to form. In the next two weeks the oyster moves about as part of the plankton, drifting with the tides and currents. Later they gain weight, sink to the bottom, and attach themselves to materials like oyster or clam shells. Once it settles to the bottom, the oyster secretes an adhesive and "sets"; then it no longer moves by itself.

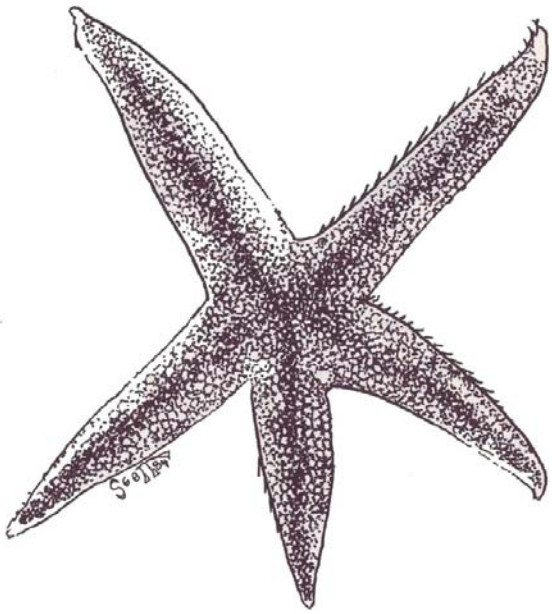


OYSTER INSIDE SHELL

Oyster reefs are found in areas where the salinity is conducive to their growth and where they do not have too much fresh water. With too much salinity, they are attacked by abundant predators, like the oyster drill. With too little salinity, they die--especially during periods when there is a great deal of rain or flooding or when the Mississippi River spillway is open for a long time. The largest reef on the Mississippi Coast is south of Pass Christian.

Oysters are affected by water quality because the filter tiny bits of food from the water.

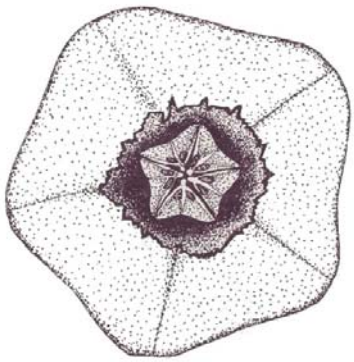
Jefferson's research soon took him into a study of other types of invertebrates. He learned to recognize the starfish, brittle stars, sand dollars, and sea cucumbers.



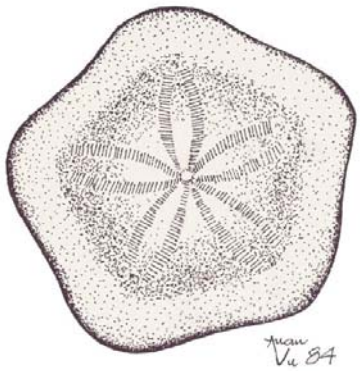
THE TOP (ABORAL) VIEW OF A STARFISH.

The starfish have varying numbers of arms, depending on the species; most of them are spiny creatures, with mouths underneath the center discs. Starfish feed mostly on mollusks, like clams.

Not all of his research was done on the beaches and in the waters along the beach. Much of his most interesting work came when he went with his grandfather to a marsh area bordering one of the bays. One of his first discoveries was an isopod (called the sea roach) which lives around piers and rocks and in the marshes, estuaries, and even in the sand; some of them could be found in fresh water habitats, including damp land niches. They are called sea roaches because they are flattened from top to bottom and look like a small roach.

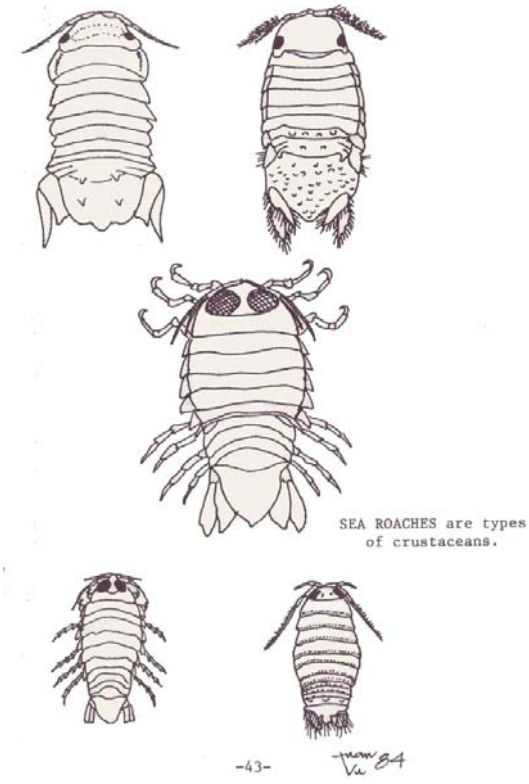


THE INSIDE VIEW OF THE MOUTH OF A SAND DOLLAR SHOWING THE TEETH.



SAND DOLLARS

Many of the sea roaches filter their food from mud, sand, or sea water. They eat both plants and animals. Some of them are scavengers, feeding on dead fish, crustaceans, and plant material. They are important in the ecosystem because the serve as reducer organisms, which make smaller parts out of dead and decaying organisms. Jefferson learned, too, that there are different types of sea roaches, which vary in their methods for obtaining food; they may be parasites, wood borers, plankton feeders, plant eaters (herbivores), or meat eaters (carnivores).

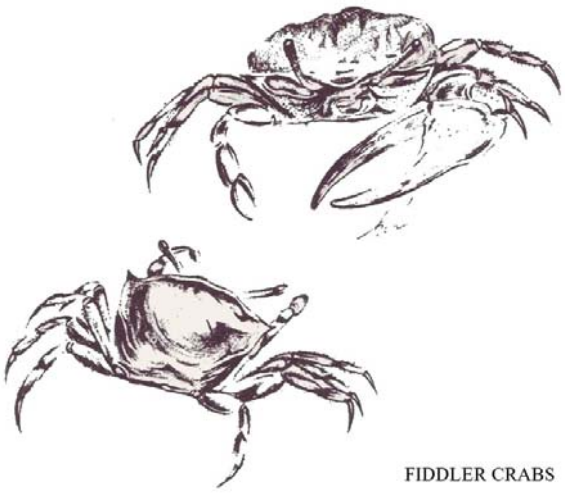


SEA ROACHES are types of crustaceans.

He also found periwinkles in the marshes. Periwinkles are snails (mollusks) that are found in many parts of the world. He found these snails on marsh grasses and around rocky areas or boat ramps. Usually drab-colored, the periwinkles are not considered prized shells by shell collectors; however, interesting studies have been made of their biorhythms or "internal" clocks which help them predict the rising and falling of tides. Periwinkles are mainly algae feeders, he learned.

Fiddler crabs were also among the unusual marsh residents he learned to recognize. These animals are intertidal, living in the area from the line of the highest tide to that of the lowest tide. They live in burrows, beneath stones, and in other niches where they can be protected in brackish water, marshes, sandy beaches, or estuaries. At low tide, these crabs come out to feed, often in enormous numbers. They are called fiddler crabs because the males have one claw larger than the

other. This claw looks like a fiddle. During mating season, the male crabs wave these large claws to challenge the other males.



FIDDLER CRABS

Jefferson could hardly wait to tell his parents when he made new discoveries or found some interesting fact he wanted to share with them. Many of the invertebrates, he discovered, could be kept alive in an aquarium--and that gave him his very best idea of all.

He sat with his parents in the living room while he explained his new project. Mr. and Mrs. Rogers nodded and smiled happily; both of them had always encouraged him to learn new things, to explore and read and do research on his own.

"And I have a wonderful idea for continuing my research this year," he said.

"Yes, dear," Mrs. Rogers nodded. "Go on."

"You know we don't use the back bedroom at all--"

"No, we don't."

"And it's just there and nobody ever uses it--"

"I know, dear."

"And wouldn't it be wonderful for my research?"

"What, dear?" she was puzzled.

"My research. We'll get an aquarium--maybe two--and I can gather marine life and concentrate on the invertebrates and be able to watch them and see how they grow and take care of them and sketch them--and it will be wonderful. My new project!" Jefferson said happily, looking expectantly at his parents.

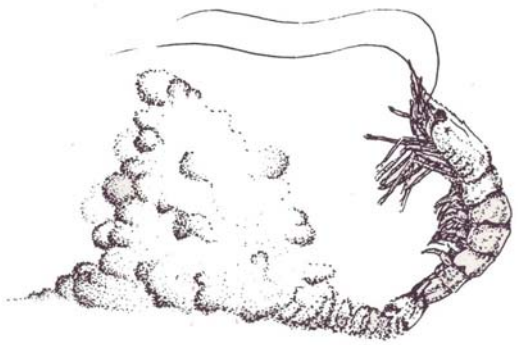
"Why, yes, dear," Mrs. Rogers stammered, looking to her husband for assistance. "But maybe we should wait and--"

"Oh, no. We need to start right away," Jefferson said, jumping up to give them one quick hug before he ran to check the catalogues his grandfather had given him. "Won't it be wonderful! Won't it be great! My own laboratory!"

He was running out of the room and did not hear his father groan.

But the groan turned into a laugh, and soon both of his parents were laughing.

"Jefferson!" they said. "You never know what's going to happen next. It's wonderful!" they said, already preparing for Jefferson's new project and wondering just where it would lead them.



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NOAA Technical Memorandum NMFS-SEFC-96

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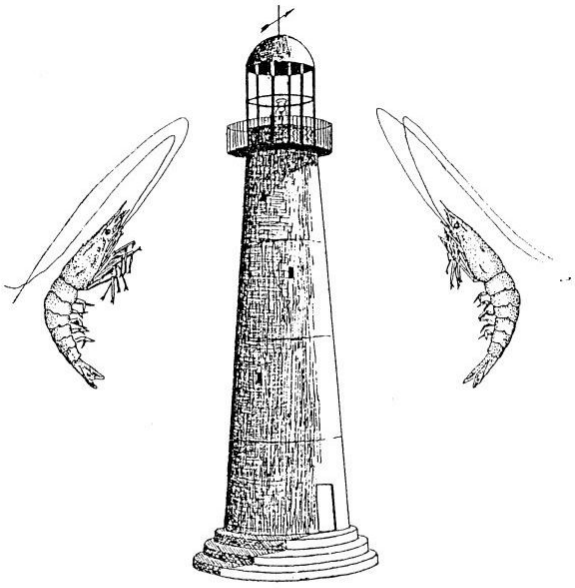

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