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Balazs, GeorgeNature + science. Am. museum of
natural hist
vol 6, no 8, 1969

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sea turtles is so important for the survival of these animals. Now Dr. Archie Carr tells what has been learned about how young turtles find their way to the sea, and where they go after disappearing in the surf.

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HOW DO TURTLES FIND THE SEA?

BY ARCHIE CARR

■ Two mysteries about green sea turtles are how the newly-hatched turtles find the sea, and where they go after they enter the surf. The trip to the water begins when the turtles break out of the nest buried in sand on the beach. The nest may be in full view of the sea. More likely, however, the nest is located so that the baby turtles, or *hatchlings*, see nothing but sand and sky.

The little turtles have to find the water, and unless they are eaten they nearly always do. They come out of the

nest and, almost at once, begin to crawl in the general direction of the sea. They move around, through, or over obstacles. They go up or down hills, sure of whatever sign it is that marks the ocean for them. They can find the ocean by daylight or at night, in all weather except heavy rain, with the sun or moon hidden or shining brightly in any part of the sky. Their main guiding sign is still a mystery.

Clues Along the Beach

Although sea-finding seems to involve light, it is not a simple urge to move toward light. Otherwise the hatchlings would go toward the sun or moon, which they only rarely do. Sometimes they do get led astray by an arti-

This article is adapted in part from the book, So Excellent a Fish, by Archie Carr, published by The Natural History Press, Garden City, N.Y. Copyright © 1967 by Archie Carr.

ficial light, or by some strong patch of natural light such as from a hole in the clouds. Most often, however, they move surely toward the water, no matter what the condition of the sky may be.

After they leave the soft sand behind and reach the hard beach, there are other signs to guide them, such as the white foam of waves breaking on the beach. At night a lantern set beside the direct path to the water often draws a train of hatchlings toward it. By day a shiny or white object may do the same.

The hardness and smoothness of the ground may cause the turtles to move faster for a moment. If a log blocks the way they move along it to the end, and then turn to the sea again. No normal feature of a beach keeps the turtles from following the main sea-finding signal, whatever it may be.

Several zoologists at the University of Florida, at Gainesville, set out to discover how the turtles find the sea. We learned that when hatchlings were blindfolded, they could not find the water. This seemed to prove that the turtles needed their eyes for finding the sea. In another test, we took some hatchlings just before they came out of a nest on an island in the Caribbean Sea. We flew them to the Pacific shore. There we allowed them to come out of an artificial nest back in the dunes. They went directly to the strange ocean, even though it was completely hidden from their sight.

More tests were needed to find out what turtles see on beaches, and what kinds of light they need to help them find the sea. Dr. David Ehrenfeld, now Assistant Professor of Zoology at Barnard College in New York, began a series of experiments in which he put eye glasses with changeable lenses on adult turtles (*see photo*).

The lenses for the glasses were colored to let through light of one of the colors that make up white light. A lens that let in only green light seemed to make no difference at all in the ability of the turtles to find the water. Lenses that let in only blue light caused a little trouble, but those that let in only red light seemed to make it very hard for the turtles to find the water. It seems that there is something about green and blue light that tells a turtle the direction of the sea. Or, maybe turtles just see better in green and blue light.

By Land or by Sky?

Later, Dr. Ehrenfeld wanted to find out whether turtles were using certain colors of light from the sky, or the outline of the land, to guide them to the sea. He made a round testing area 42 feet across, surrounded by a wall 18 inches high. The wall and some palm trees planted in the area hid details of the surroundings from turtles inside the circle, without blocking the light from the sky.

At different times of the day and night Dr. Ehrenfeld used a device called a *spectrophotometer* to measure the amounts of red, blue, and green light coming from the sky over the sea and land. Then he released hatchlings in the center of the testing area and watched to see the directions they chose. The spectrophotometer showed no differences between the light in the sky over the sea and that over the land.

The turtles in the walled area had trouble finding the right way to the sea. Some of them headed inland. Many did not bother to move at all. Later the wall and trees were removed. When other young turtles were put into the testing area, most of them headed directly for the sea, even though it was not visible. (*Continued on the next page*)

By putting special eyeglasses on sea turtles, Dr. David Ehrenfeld tried to discover if some color of light helps the turtles to find the direction of the sea.





Young green turtles are colored dark above and light below. This coloration may protect them from enemies as they drift and feed near the surface of the ocean.

How Do Turtles Find the Sea? (continued)

So it seems that whatever sign guides turtles to the sea, it is not located high in the sky, but low over the horizon. We still don't know for sure whether it is the color of light, or the outline of the land, or something else that guides them. Only further study may solve this mystery.

Where Have All the Turtles Gone?

Another puzzle is the disappearance of young sea turtles for their first year of life. At most of the known nesting grounds, the water in front of the beach is an unfit living place for the hatchlings. I haven't been able to find them there at any time after the hatching season. They must move farther out to sea.

Other facts agree with that idea. The coloring of the young green turtle is like that of fish that live in the open ocean: dark above and white below (see photo). The white underparts make the turtle less visible to an enemy seeing it from below against the sky, while the dark back mixes with the dark depths of the water to hide the turtle from birds overhead.

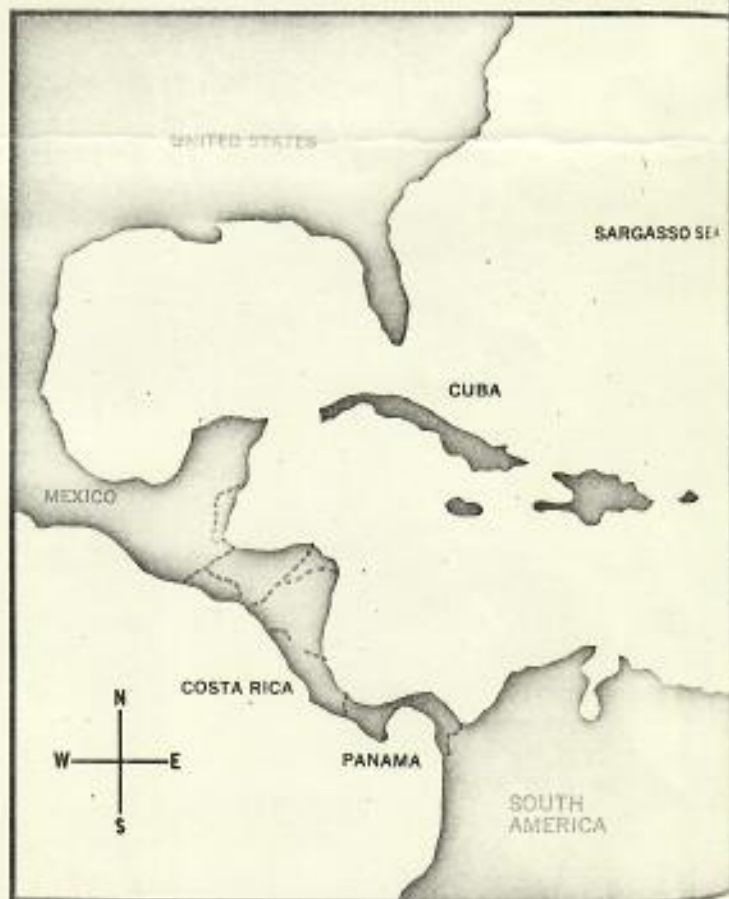
The most likely idea to account for the disappearance of the little turtles seems to be that they drift in the open sea for a time. If this is so, the turtles must be picked up by currents along the shore and carried wherever the currents go. The trouble with this idea is that nobody knows where the currents go.

The search for the hatchling turtles goes on. The smallness and weakness of young turtles' jaws must keep them

in places where they can find plenty of small, soft-bodied animals for food. In tanks no more than two or three feet deep, they feed equally well at the bottom or at the surface. In deeper water, however, they have trouble finding and working with food on the bottom. Perhaps the young turtles live at the surface in some part of the sea where there is a sure supply of floating food.

There is only one place I can think of where, at the surface of the open ocean, there might be food that baby turtles could find and eat. That place is in the North Atlantic in the Sargasso Sea (see map), which is filled with sargasso weed, a type of brown algae. It is estimated that 10 million tons of sargasso weed float in that part of the ocean. Many animals live among the weeds and perhaps young sea turtles find their food among them.

But I have never been able to find a place, or anybody who knew of a place, where young sea turtles could be caught. Wherever it is that hatchlings seem to lose themselves, they cannot really be lost. They are just in some place that hasn't been thought of by zoologists. Until that place is found, there will be another big mystery in our understanding of the lives of sea turtles ■



The young turtles disappear after they enter the sea along the eastern coast of Central and South America. They move far out into the ocean, perhaps to the Sargasso Sea.