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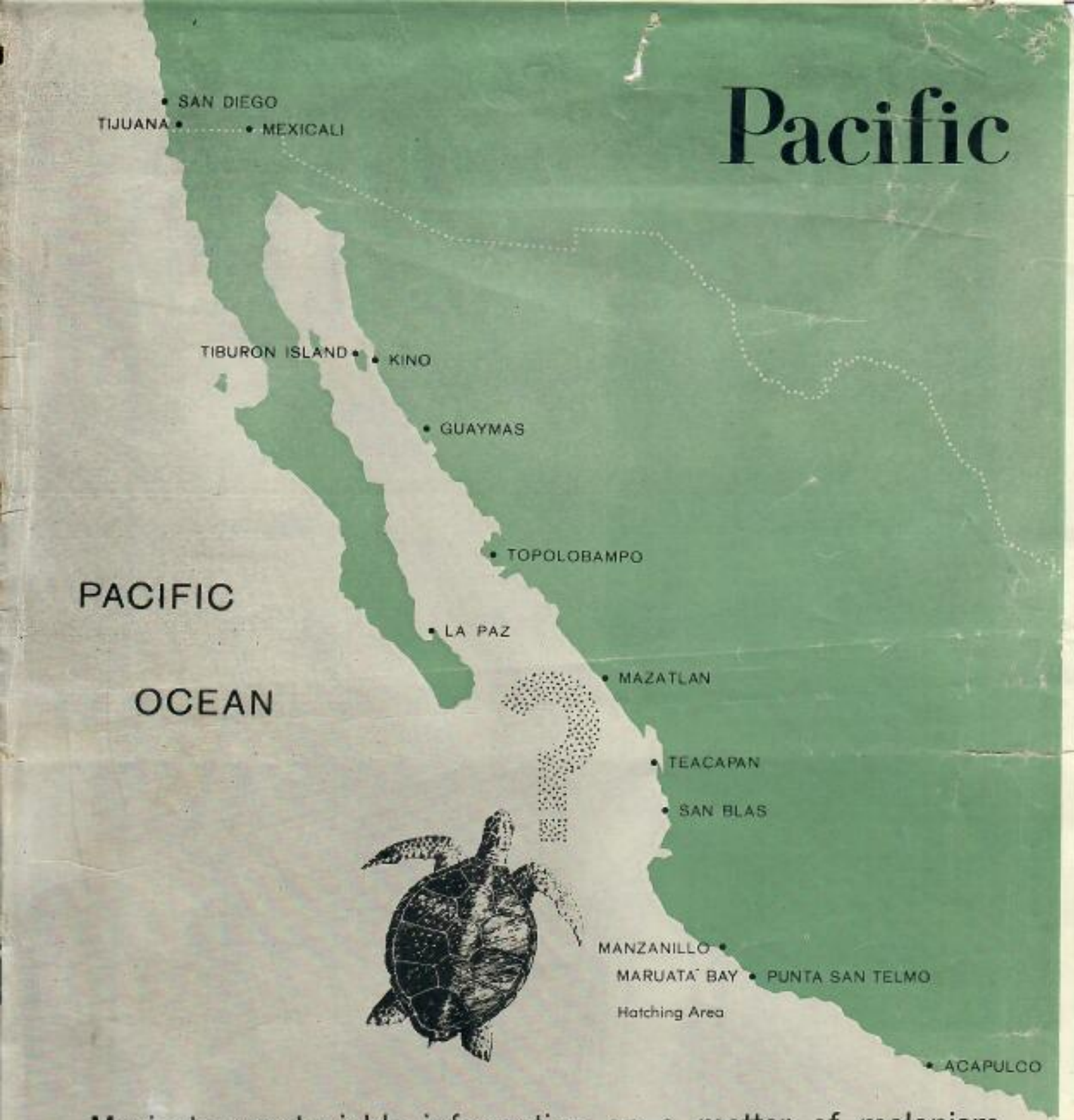
PREGVNTAS V.M. RESPONDELAV DON PHELIPE ELTER

AUTHOR'S DREAM of presenting chronicle to Philip III, King of Spain, was never realized. But the Andean Indian did meet the King in fantasy, in this drawing of himself kneeling before the ruler of the oppressors of his people.



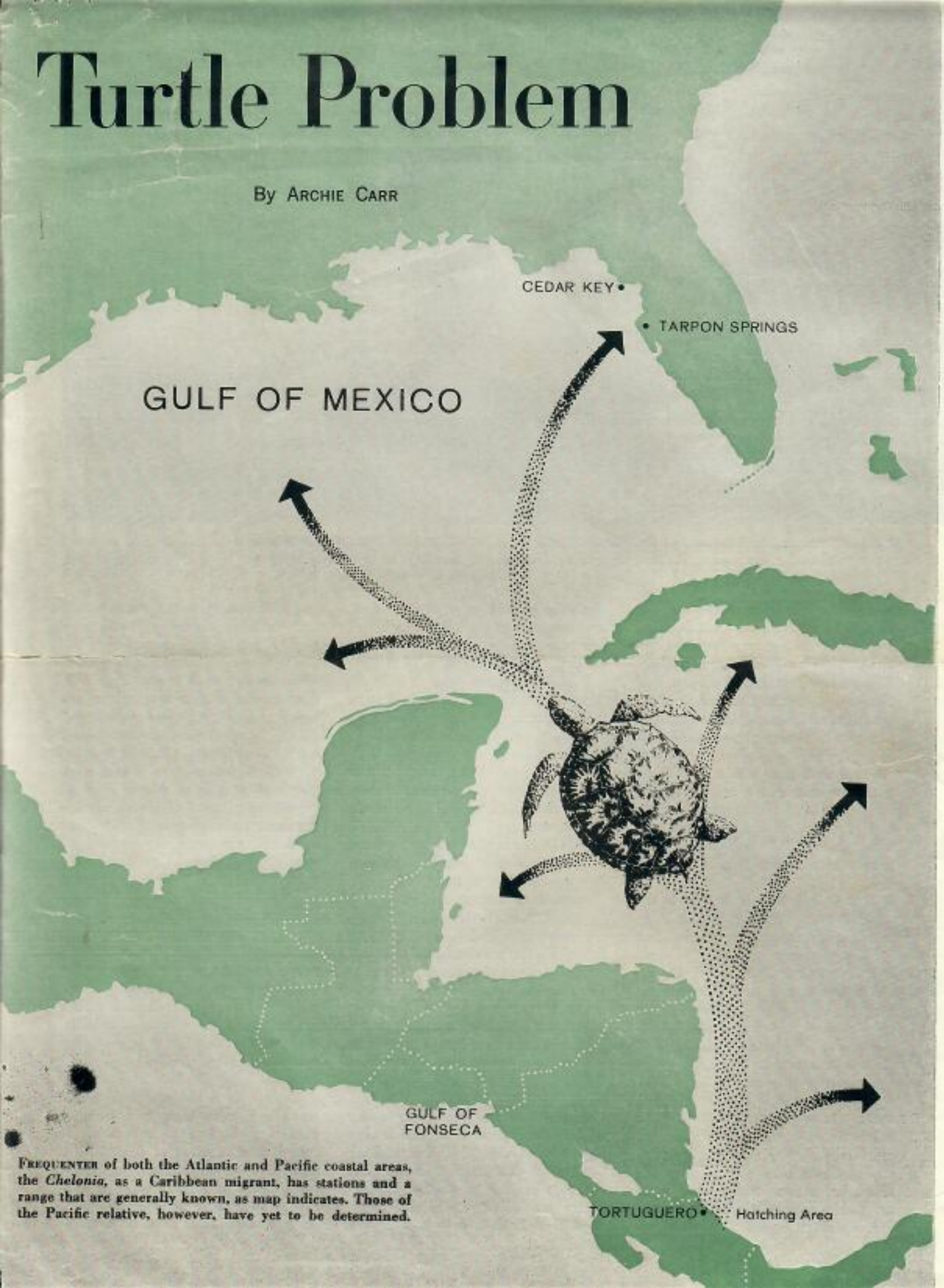
Mexico's coast yields information on a matter of melanism

When I was gathering information for my *Handbook of Turtles* ten years ago, I was struck by how little was known of the sea turtle fauna of the Pacific coast of the Americas. During the decade since that time a good deal has been learned about sea turtles in some areas, but the eastern Pacific has remained neglected territory. Even in Mexico, despite the seasonal immigration of zoologists from the United States, recorded observations are so scant and so rarely supported by good identifications, and specimens in museums are so few, that it has not been possible to tell which kinds of turtles nest on the coast, or even which kinds turn up as strays.

During the summer of 1960 I began to feel so uneasy about this that I set out to see what these neglected turtles were like. During August and September I took the hot road southward through Sonora and Sinaloa and on down into Nayarit, the states of Mexico that make up the eastern shore of the Gulf of California. I turned seaward whenever the way looked promising, and managed to reach the coast at the following places: Puerto Kino,

Turtle Problem

By Archie Carr



Frequenter of both the Atlantic and Pacific coastal areas, the *Chelonia*, as a Caribbean migrant, has stations and a range that are generally known, as map indicates. Those of the Pacific relative, however, have yet to be determined.

"BLACK" TURTLE, the *Chelonia* of the eastern Pacific, was photographed by the author at Kino Bay along Gulf of California. Note distinguishing melanism of this immature female—the dark coloration of head, flippers, and shell.

Kino Nuevo and the shores of Kino Bay, Guaymas and adjacent beaches, in the State of Sonora; Topolobampo and the shores of Ohura Bay, Mazatlán, Sábalo, Los Serritos, Teacapán, and Tamboritos, in the State of Sinaloa; San Blas, and Matanchén, in the State of Nayarit. Although there is still a lot to be learned about West Coast turtles, at least I can speak of this fauna with more confidence, and a start has been made in tracing the travels of the local race of *Chelonia*—a handsome color phase called locally by Spanish names that all mean "black" turtle.

DURING previous short trips to the Mexican Pacific coast, the loose terminology the fishermen used had hindered my questioning the residents about sea turtles. *Caguama*, for instance, is evidently an old Carib name for the loggerhead—a term that in pre-Columbian times spread to the Pacific coast. In southern Mexico and Central America the word is now in general use for the ridley (*Lepidochelys*). North of Acapulco, however, it means simply "sea turtle." Thus, to ask if the *caguama* occurs in a given place is likely to produce little information on the kinds of turtles that actually live there. Having recognized this before my 1960 trip, I began asking fishermen to describe more precisely the kind of *caguama* they knew, and was able to work out this list of equivalent names:

carey, the rarely observed hawksbill (*Eretmochelys*);

galápago, the leatherback, known as a straggler (*Dermochelys*);

mestiza, exceptionally light-colored examples of the ridley (*Lepidochelys*) or of the "black" turtle (*Chelonia*), possibly also the loggerhead (*Caretta*), if it occurs in the region;

golfina (or in places where it alone occurs, simply *caguama*), the ridley (*Lepidochelys*);

caguama prieta or *tortuga negra*, the "black"—elsewhere, green—turtle (*Chelonia*).

In making this survey, I resorted to all possible means of collecting information. Besides systematically questioning local fishermen and turtle and egg hunters, I walked beaches, searched dumps for turtle shells and bones, visited markets, crawls, and docks where turtles were landed, and cruised 300 miles in offshore waters.

In the 650 miles from Kino to San Blas, including much of the eastern shore of the Gulf of California and the coast south of the mouth of the Gulf, only two kinds of sea turtles, *Lepidochelys* and *Chelonia*, seem to occur regularly. Of the live turtles I saw, and of the shells, bones, nests, tracks, and carcasses found in markets—a total of about 280 animals—all but one were either *Lepidochelys* or *Chelonia*. The exception was a half-grown, dead hawksbill that I found on the beach at Kino, two miles north of the village. Nowhere along the coast did I see the leatherback, although the people were acquainted with it as a straggler and at several places referred vaguely to distant leatherback nesting grounds. Although only the one dead hawksbill was seen, it was alleged nearly everywhere that hawksbills came ashore to nest once in a while. It was also said they arrived in fewer numbers than did ridleys, and favored either the same places as the ridley or "rockier places"—which presumably meant sections of beach bounded by rocky promontories. I had previously heard this same report at several localities along the Central American coast, particularly in the Gulf of Fonseca in Honduras and El Salvador, but have not been able to corroborate it.

The one sea turtle of which no sign was found, either directly or through verbal reports, was the loggerhead. In some places it seemed possible that the name *mestiza* might apply to a fifth turtle that would have had to be *Caretta*, but elsewhere exceptionally light-colored examples of *Chelonia* or *Lepi-*

dochelys were pointed out by fishermen as being *mestiza*'s. Thus, as I have said, the sea turtle fauna in the places visited consists essentially of the two genera, *Chelonia* and *Lepidochelys*. It is with the former that the observations below are concerned.

We first came upon the black turtle at Kino, sixty-five miles down a newly paved road from Hermosillo. There was a canoe landing on the beach at Kino village, and by the landing was a thatched, stick-walled pen. In the pen an old man was using a gourd to dip water from a bucket and wet down a broad spread of sea turtles that lay in the shade. The turtles looked familiar, but somehow a little wrong. They had the smooth, neat, unmistakable heads, long front flippers, and general air of the green turtles I know from Atlantic regions; but they were off-key in color, and the shells seemed too deep and straight-sided. I had just come from Costa Rica where I had seen a hundred or more Caribbean green turtles, and these at Kino made me feel unfocused. I asked the old man what kind of turtles they were.

"*Prieta*," he said. "Black turtles."

Most of the turtles were belly down on the sand, but twelve at one end were back down, in the traditional manner. He said the dozen on their backs had just arrived and were still "brave." Right-side-up, they would crawl about and rip out the palisade or cause confusion in the pen. After a day on their backs they became sad, he said, and would lie still, so they could be righted again. When I asked why he poured water on the turtles, he said it was to keep down their fever. When I asked what fever, he said the fever they get when one neglects to pour water on them.

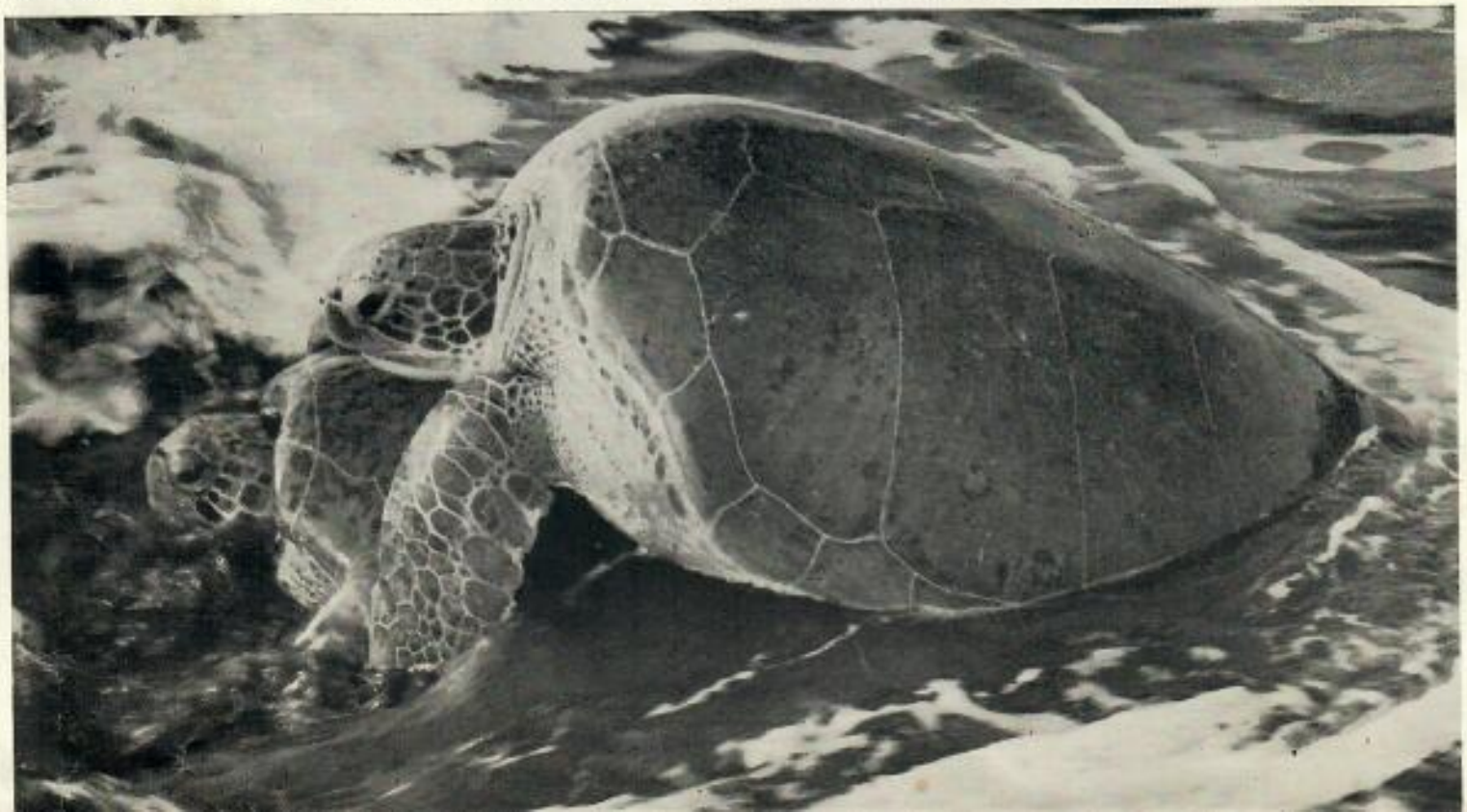
The turtles were being held for the arrival of trucks to take them to Tijuana, Mexicali, and San Diego, where their flesh is highly regarded as a food. They had been brought, and were being added to, by turtle fishermen coming in from little islands between Kino and Tiburon Island, which lies just within sight on a clear day. The turtles had all been harpooned at night on their feeding ground. They can be assumed to have been a typical sample of the population in the area.

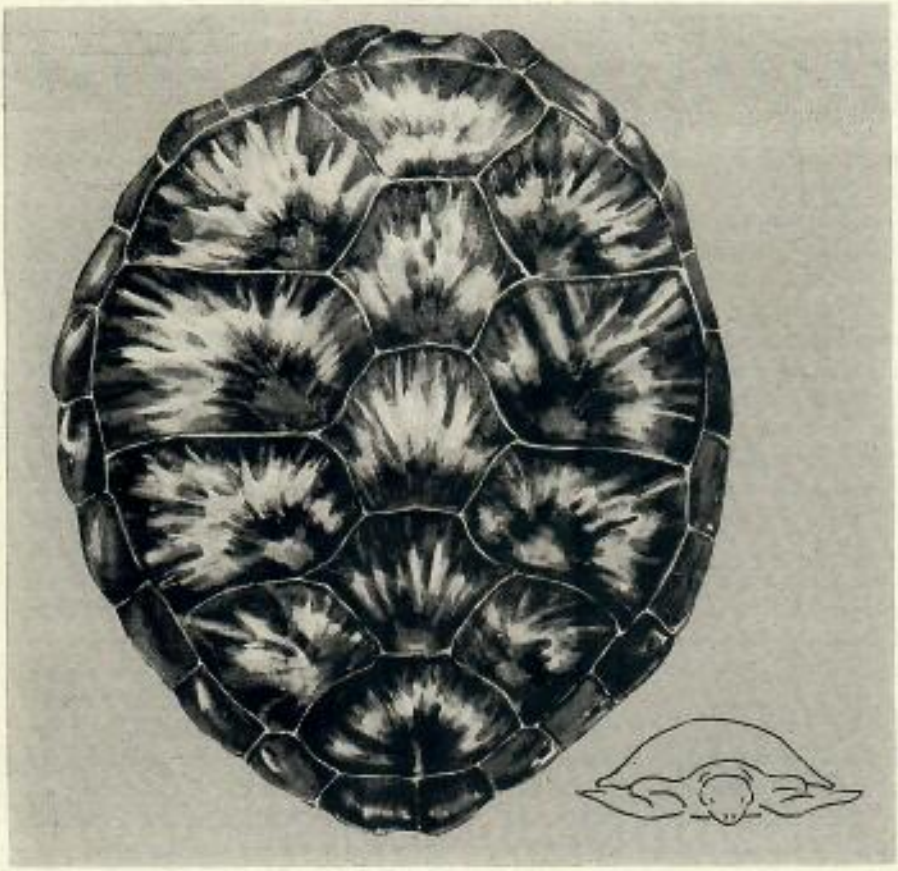
THERE were fifty-three turtles in this lot—forty-nine females and four males. The range in their size was from 17¾ inches to 30½ inches, the average being 23 inches. The largest was a male; the next largest was a female 30¼ inches long. The four males were adolescent, although all showed secondary sex structure, and the largest was evidently close to maturity. Most of the females were below minimum breeding size for the Atlantic green turtle. Their immaturity was borne out by the fact that none had mating scars on the fore-margin of the shell. This was also confirmed by local fishermen, who said that none of the females caught there is ever found to have shelled eggs in the oviduct.

I took a sample of stomach contents from a refuse heap where several of the turtles had been butchered. The sample consisted wholly of two kinds of algae, one called locally *sargasso*, the other *lechuga*. Both turtle fishermen and turtle slaughterers told me that such algae, growing in beds about the islands where the turtles were taken, were almost the only food of local *prieta*. The men apparently knew nothing of any marine spermatophyte plants such as eel-grass, turtle-grass, or manatee-grass, which are the main foods of the Atlantic green turtle.

This sample, then, clearly represented a non-breeding colony similar to that at a comparable latitude on the west coast of peninsular Florida. It was thus no surprise when the keeper of the crawl and other local people spoke of the strong seasonality of the Kino-Tiburon black turtles, because the Florida green turtles are seasonal, too. All reports indicate that the black turtle begins to thin out in October, disappears in late November, is gone throughout the winter, and comes back again in March and April. This

GREEN TURTLE, the *Chelonia* of the Caribbean and Gulf of Mexico, is identified by its sparse dark markings on light ground color that varies from brown to olive. This pair was photographed at Tortuguero, on the coast of Costa Rica.





TYPICAL CARAPACE of Atlantic green turtle, *above*, is slightly curved and has light ground color. When blotched, marks tend to form radiating patterns.

DARK CARAPACE of the Pacific "black" turtle, together with the steep profile of its shell, *below*, distinguish this *Chelonia* from its Atlantic relative.

schedule is strikingly like that on the turtle-grass flats between the Suwannee River mouth and Tarpon Springs, Florida, and is what one expects of a colony of young animals, born in some distant place and destined to return there to breed in some future period.

The only known center of group nesting by Pacific *Chelonia* in Mexico is considerably farther south—at Maruata Bay, on the coast of the State of Michoacan. This colony has been described by Dr. James Peters in *The Biologist*. It is probably the main breeding assemblage for a great extent of the east Pacific shore—possibly for all that north of Michoacan. The more accurate and articulate informants from Kino to the coast of Nayarit agreed that the main nesting grounds of *caguama prieta* or *negra* (*Chelonia*) lay "somewhere to the south."

That the Maruata Bay assemblage may be unique is also suggested by the attention given it in the account of the seventeenth-century explorer William Dampier and that of his mate, William Funnell, writing in the eighteenth century. I have not yet been able to visit Maruata. Although Dr. Peters said nothing about the coloration or shape of the shell of the nesting turtles he observed there, it seems possible that they may be the parents of the immature black turtles that turn up as summer residents in the Gulf waters.

NOWHERE were there found stages in weight between the approximately 15-pound minimum of the Kino series, and the hatchlings and breeding adults at Maruata Bay. This, too, brings to mind the situation in the Caribbean and Gulf of Mexico. Young green turtles weighing 10 to 80 pounds are seasonally common in Florida, while only breeding adults and new hatchlings are found in Costa Rican waters. Nothing is known of the fate of the hatchlings or of the origin of the itinerant Florida population. The parallels with the situation on the Pacific coast suggest that the life cycles of the two colonies involve similar patterns of developmental migration.

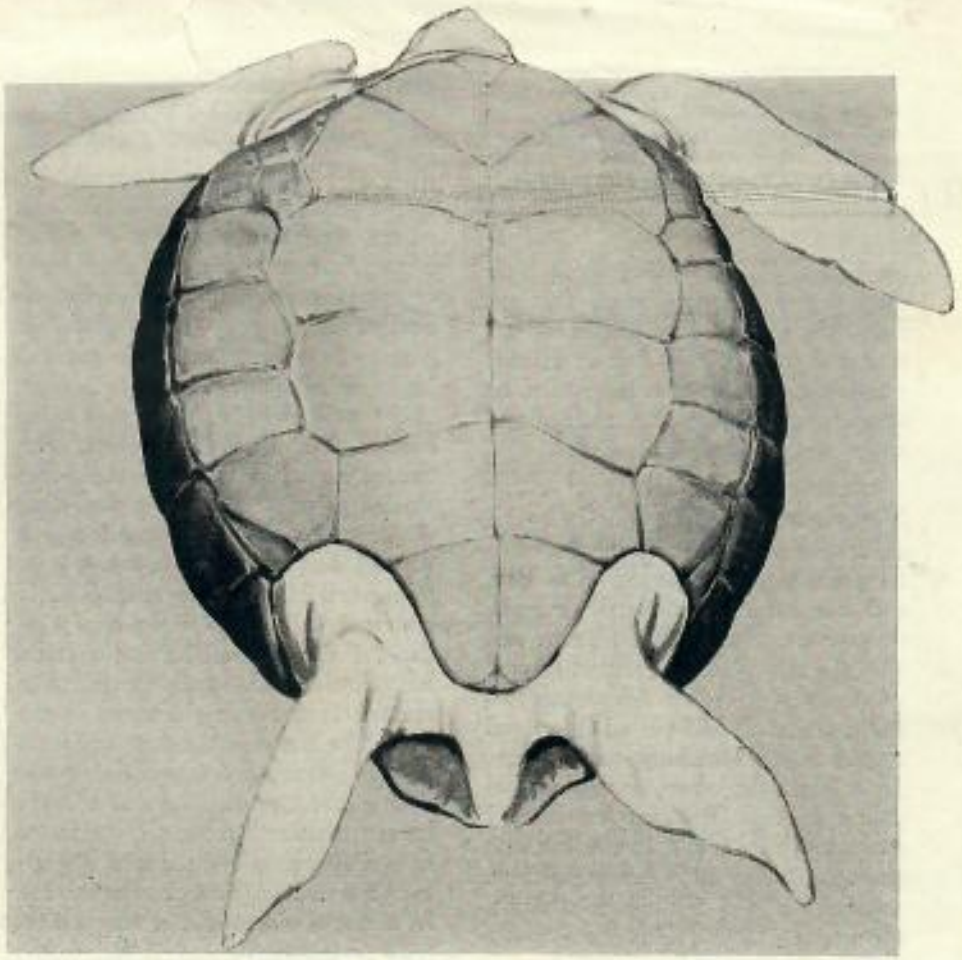
Both the immaturity of the black turtles at Kino and the curiously unbalanced sex ratio were duplicated farther south at Topolobampo, where the shells of 115 *Chelonia*, caught near the little islands in spectacular Ohura Bay, were examined. In about a third of these, sex could not be determined; in the rest, males made up only 4 or 5

per cent. Melanism, the pronounced dark pigmentation noted in the Kino turtles, was evident in these also, and the shells of the females had the same steep, flat slope we observed at Kino.

At Mazatlan, Tamboritos, and Teacapán, no evidence of the occurrence of the black turtle was found, although the ridley was obviously common. The next appearance of *Chelonia* on our trip south was at San Blas where, among numerous shells and bones of ridleys, I found the carapace of a single freakish black turtle, evidently an adolescent male. It was 27½ inches in length, as dark as a Kino turtle, and peculiar in having five laterals—the big scales along either side of the shell—on the left side, and the normal four on the right. Having heard much talk of the *mestiza* here, I carried the carapace and that of a female ridley to a fisherman who had impressed me as both sensible and familiar with the local turtles, and asked him what they were. The ridley he called *golfina*, and the other, the odd *Chelonia*, he said was *prieta*. I asked him what sort of turtle *mestiza* was. He searched along the shore among ridley shells, chose one a little lighter in color than the rest, and told me that was *mestiza*. When I objected that in Sonora and Sinaloa *mestiza* seemed to be the name for a color phase of *prieta*, the man admitted that the term is loosely used. It seems probable, then, that along the Mexican coast the term *mestiza*, which means crossbreed, is not restricted to any one kind of turtle but is simply used for any specimen that looks strange or exceptional.

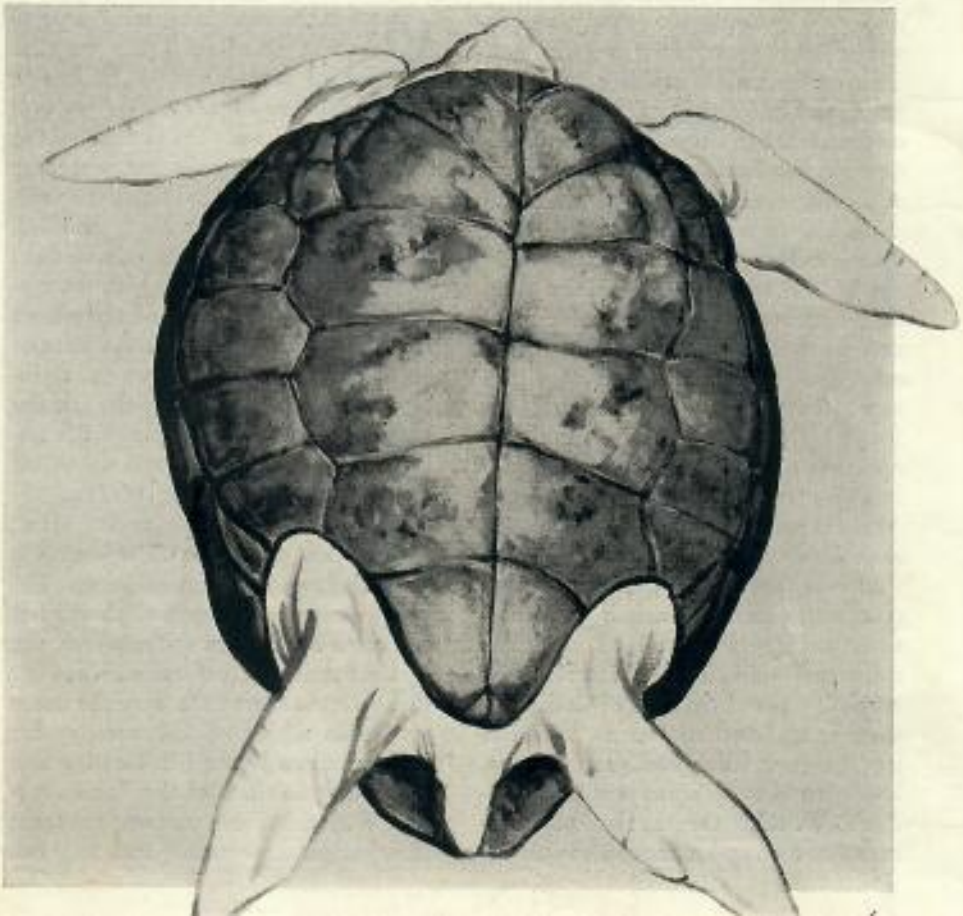
After going home and meditating on the black turtle, I began to see how tantalizingly incomplete the summer's observations were. There was the coast of Colima, for instance—a big gap between the southernmost locality I had visited and the one known nesting ground at Maruata Bay. There was also the recurrent talk I had heard of masses of sea turtles round La Paz, which is in the state of Baja California, on the opposite coast of the "Sea of Cortes" from that I had visited. I decided to go back to Mexico to piece out something more of the story.

At Manzanillo, the chief port of Colima, only about fifty miles north of the Maruata rookery, fishermen knew the black turtle well, but said they caught it only rarely. The turtle they were bringing to the local market was



TYPICAL PLASTRON of Atlantic green turtle, *above*, is clean greenish white. As with all coloring described, there is much variation among individuals.

PLASTRON of the "black" turtle, *below*, found along Pacific coast of Mexico, is distinguished by blue cast that is caused by deeply placed black pigment.



A University of Florida Professor, Dr. Carr is author of many popular and scientific books. The work he relates in this article was supported by funds from the National Science Foundation.

the ridley. My scratching about local dumps and garbage heaps substantiated the word of local turtle experts that, although *prieta* is an occasional visitor there, it is much less abundant at all seasons than the ridley, and never nests on nearby beaches.

From Manzanillo I crossed to La Paz. Here the situation proved to be precisely like that at Kino Bay, with black turtles sufficiently common to support a small local fishery, and with the ridley, at least at that season, sparingly represented. The black turtles there graze on beds of algae, and are taken with both harpoons and nets. As at Kino, the colony is made up of young turtles. Of twenty-one that I measured, the range in shell length was from 17 to 32½ inches, with an average of 24¼ inches. The largest specimens of both sexes were apparently not quite mature.

When I asked turtle fishermen about nesting grounds, some looked vague and said, "*¿Quien sabe?*" Others made directionless gestures in the air and said maybe they nest in Sonora or Sinaloa, or in other places in which I was pretty sure they did not.

As on the mainland side of the Gulf, the Baja California turtles are readily distinguishable from Atlantic *Chelonia* on the basis of color and of the shell shape of the nearly grown female. The head and the forelimbs are much darker—often a nearly solid black. The upper shell is either deep black or heavily blotched with separate sooty markings, while the plastron is clouded with deep-seated pigment that shows blue through the horny belly scales. I should say that a complete novice in turtle study would be able to separate 95 to 98 per cent of a mixed lot of *Chelonia* from La Paz and Cedar Key. The confusing ones would be occasional individuals that completely lack the strong pigmentation, and are too small to show the steep shell-sides. It is of interest that on both sides of the Gulf of California these exceptional specimens, which to my eye look like good green turtles, are referred to by some people as *mestiza*'s. Whether they are simply variants that turn up among more typically pigmented brothers and sisters, or are waifs brought in by currents from some distant place, only breeding experiments will be able to reveal.

The green turtle of the Pacific coast of the Americas was first described from Guatemala by the nineteenth-century French zoologist Bocourt, who named the new species *agassizi* in honor of the great American naturalist, Louis Agassiz of Harvard. Bocourt said nothing of his new turtle's being blacker than usual. Through the past twenty years I have seen several dozen Pacific green turtles along the coasts of Central and South America, and while I had previously observed the steep shell of the young female (I illustrated it in my *Handbook of Turtles*), I don't recall having particularly noticed any such heavily pigmented look as the Mexican turtles have. The limits of the territory occupied by *caguama prieta* remain to be determined. Eventually, it must also be known whether its curious coloration is hereditary or is produced directly by some factor in the environment—by the diet of algae, for instance. If the trait is inherited, and if the turtles showing it are confined to the upper Pacific coast of Mexico, there is a good probability that someone will give the population a new scientific name.

One of the most interesting aspects of the situation is the way the few known facts seem to fit into a world pattern of sea turtle natural history. So far, only the outlines of the pattern have emerged; but wherever good information is available the indications are that the half-grown *Chelonia* lives in places distant from both the feeding grounds on which the mature turtles spend most of their lives and the beaches to which the females go at three-year (rarely two-year) intervals to nest. Where baby turtles stay during their first year of life nobody knows; and the travels of all stages are almost wholly hidden.

Meanwhile, the most useful result of the recent observations in Mexico is pinning down the common names. The terms are misued here and there; but not often by the real *conocedores*, not by the sound old turtle men. Knowing these names clears the way for more profitable sifting of folk zoology for leads that can be used in locating and separating habitats of the Pacific turtles. With this done, we can then trace their migratory routes and stations.

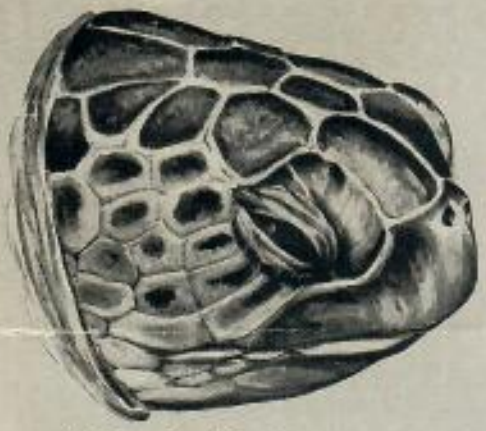
***Eretmochelys*, easily identified by its English common name, hawksbill, is called *carey* by Mexicans.**

These close-ups of five common sea turtles reveal main distinguishing head features. Factors of age and sex, however, may result in considerable deviation in individuals, so exact identification of particular turtles depends on clues other than heads.

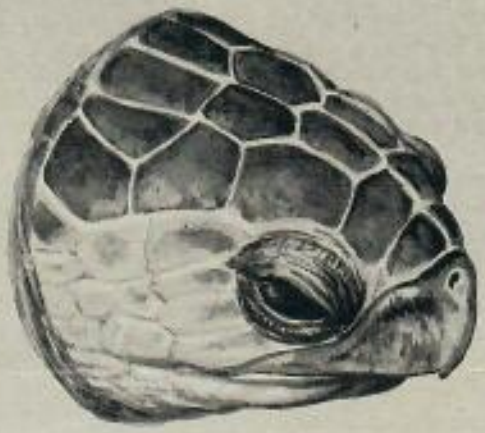
Illustrations by
Matthew Kalmenoff

FAMILY
CHELONIIDAE

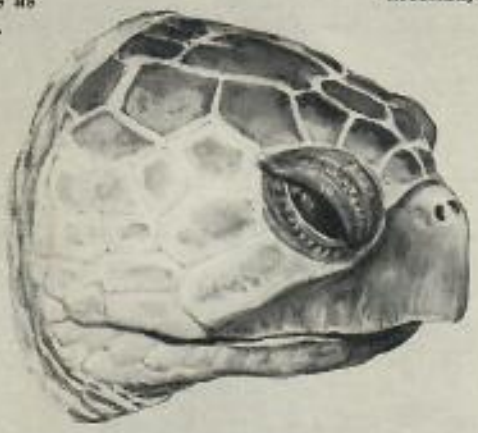
FAMILY
DERMOCHELYIDAE



Chelonia, the Atlantic green turtle, has same facial features as relative, Pacific "black" turtle.



Lepidochelys, known by Mexicans as *golfina*, *caguama*, or *mestiza*, is the ridley.



Caretta, known in English as loggerhead, was only species not found along Pacific coast.

Dermochelys, a straggler along Mexican coast, where it is called *galápago*, is the leatherback in English.

YOUNG SCIENTIST

A study of the role of the pineal system in amphibian behavior

By William M. Adkins III

Extensive research into the nature of the pineal system and its functional significance in animal groups, from lamprey to man, is experiencing a new revival. This tiny series of connected outgrowths from the forebrain (diencephalon) has fascinated men ever since Galen. Speculation as to the nature of the pineal system has passed through several stages. Descartes, for example, thought of the system as the "seat of the soul." Today, the pineal is considered to be tissue of *uncertain* function.

Recently the pineal system in the lower vertebrates—fish, amphibians, and reptiles—has received particular attention. Certain pineal outgrowths in these animals lie under a layer of translucent skin above the brain, or in or beneath a light-transmitting region of the skull. These apparent specializations for light reception suggest a sensory role with respect to solar radiation.

In 1958, Stebbins and Eakin published their studies of the photoreceptive capacity of this "third eye" in reptiles. When the pineal element was removed or shielded in four species of lizards, striking behavioral and metabolic changes were noted. It was found, among other things, that treated lizards spend a greater amount of time in high-intensity illumination and are also poorer at surviving when deprived of food.

This study applies Stebbins and Eakin's general techniques with reptiles to the amphibians, instead. Pineal interference was achieved by blocking the influence of light on this system of brain tissues in two species of the Amphibia: the leopard frog *Rana pipiens* and the southern toad *Bufo terrestris*.

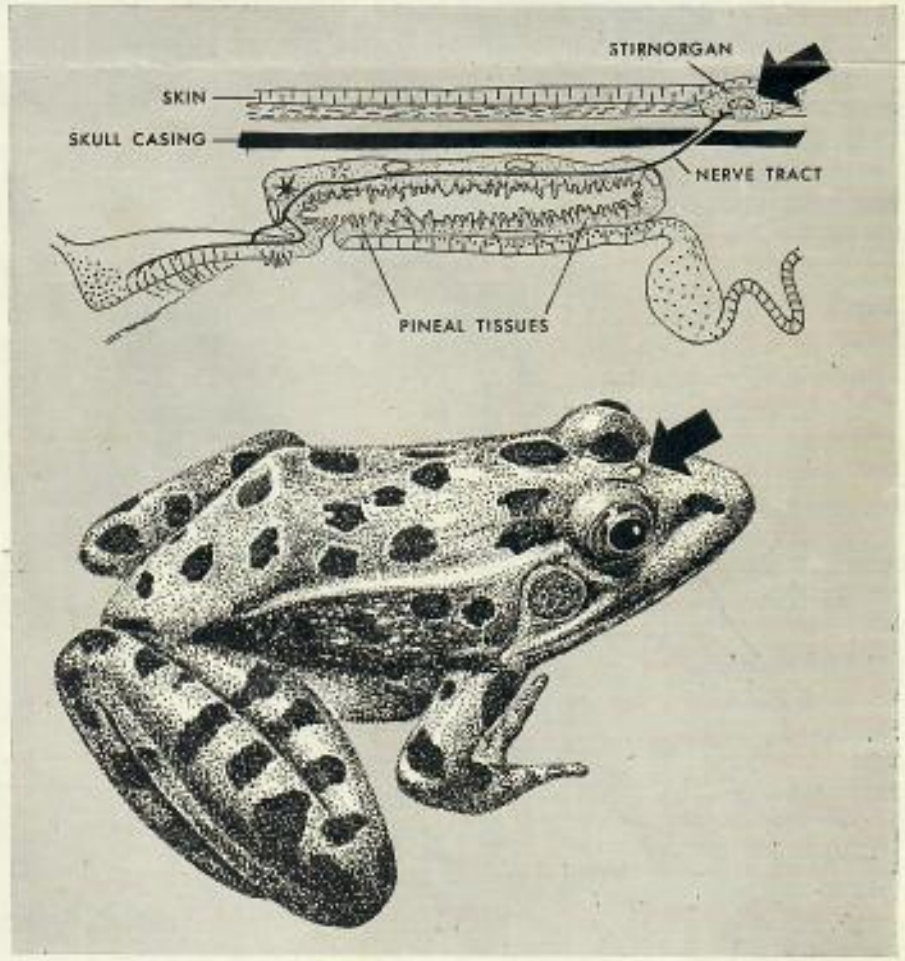
Several fine studies, notably those of Kelly (1960), have been published on the histological and histochemical features of the pineal system in European amphibians. The most conspicuous element of the system is a small saclike piece of tissue, the stirnorgan, which lies beneath a translucent spot in the skin between the eyes. Studies of this element in *Rana pipiens* show it to be connected by a stalk that pierces the skull through a minute opening, drawing at right.

Kelly has shown that such stalks enclose a nerve tract connecting the stirnorgan with the remaining pineal tissues in the skull. Pineal function in the leopard frogs was investigated by means of removing the stirnorgan. This was done by cutting out an area of skin, 2 mm. square, in which the stirnorgan was embedded, from each of the frogs. Within a week, the wounded area had healed. As a matter of control, a 2 mm. square area of skin was removed from the right hind legs of other frogs. Such animals were referred to as "sham-operated."

In southern toads, all pineal elements are evidently positioned *within* the skull casing, no stirnorgan being present. Any solar radiation that might affect this pineal system would have to penetrate both the skin and the brain casing.

Since surgical removal of any portion of the pineal in the toads might cause damage to the brain, an alternative method of study was devised. Petrolatum (as a skin protector) was smeared over the skull between and on the cranial crests. Then a non-drying putty compound was pressed on the skull in such a way that no light could enter between this putty shielding and the skin. Application of the putty had no apparent irritating effect on the molting cycles of the shielded toads and, for this reason, no sham-operation was conducted on the control toads.

Rana pipiens were obtained from Oshkosh, Wisconsin, where they were collected during the fall months and stored in spring-water holding pens. Upon arrival at the laboratory, they were either immediately put into an experimental run or stored in a refrigerator at 10° C. until needed. *Bufo terrestris* were collected from fields in the Melbourne, Florida, area during heavy "hurricane"



Stirnorgan, indicated by arrows, is most conspicuous part of frog's pineal system, which lies under a thin layer of skin above brain in light-transmitting region of skull.