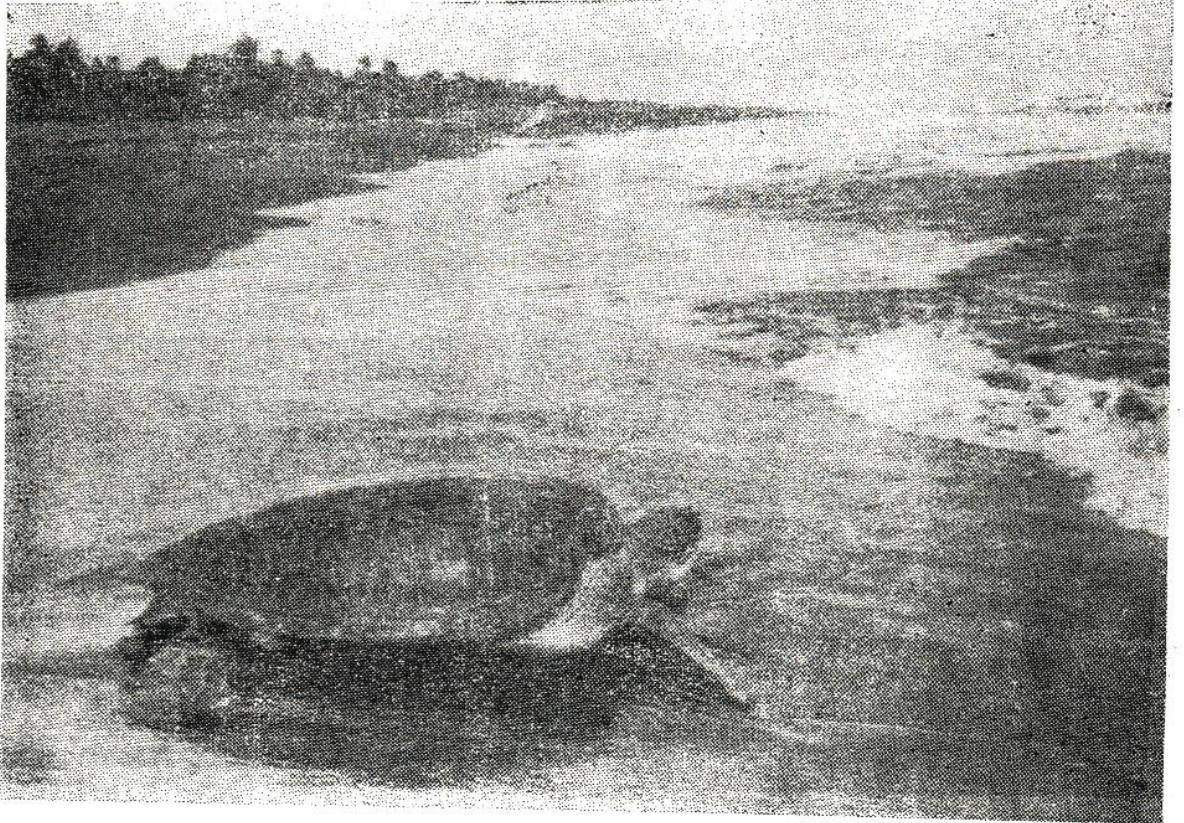


TURTLE TALES

BY DR. SIRI WICKREMASINGHE



Turtles, being familiar animals, we tend to forget that they are the oldest type of living reptile, more ancient in lineage than even the extinct dinosaurs, and the still extant Tuateras of New Zealand. Their shells, the most bizarre armour ever assumed by any land animal and their unchanging morphology over the ages would, if for not being so commonplace, evoke a sense of wonder. Truly, they deserve the much abused term, living fossils.

Turtles, tortoises and terrapins (Class Testudinata) originated in the Permian period of the Palaeozoic era (225 million years ago), probably from a flat-bodied cotylosaur ancestor named Eunosaurus. By the Triassic (180 million years), the Testudinates had assumed their familiar present day form. Aquatic modifications were completed by the Cretaceous (90 million years ago). Archelon, a giant marine turtle of this period, with a 11 ft carapace, differed little from present day forms, and was contemporary with the fearsome aquatic plesiosaurs, ichthyosaurs, Mosasaurs and the equally formidable terrestrial dinosaurs.

Present day marine turtles consist of 2 families, 5 genera and 7 species: namely 1. *Dermochelys coriacea* (Leathery, leatherback, or trunk back turtle). The most primitive yet the largest and best adapted aquatically. 2. *Chelonia mydas* (Green turtle). 3. *Chelonia depressa* (Flatback). 4. *Caretta caretta* (Loggerhead). 5. *Eretmochelys imbricata* (Hawksbill). 6. *Lepidochelys kemp* (Kemp's or Atlantic Ridley). 7. *Lepidochelys olivacea* (Pacific Ridley-formerly the olive loggerhead). All except the Atlantic Ridley, and perhaps the flatback, are found around the shores of Sri Lanka and nest on her beaches, Deraniyagala (1939, 1971). The Pacific Ridley (Olive Loggerhead) being the commonest species.

There are many lacunae in the natural history of turtles which have both puzzled and fascinated zoologists for a long time. Recent work by many scientists especially Robert Bustard on the Great Barrier Reef, Australia and Archie Carr on Tortuguero, Costa Rica and Ascension island have shed much light on the subject; although many enigmas remain. Some interesting aspects of these findings are discussed below.

The turtle as a long range sea-farer

That turtles perform periodic long range sea-voyages has been known for a long time. But the incredible distances covered and the pinpoint accuracy with which they navigate to their remote nesting beaches, have only recently been realised: the necessity for these odysseys is clear. Turtles often do not nest in proximity to their feeding grounds, as suitable feeding grounds and rookeries are situated far apart Carr (1973). Although, the Leatherback probably, undertakes longer voyages, tagging experiments have shown that the green turtle and the loggerhead are spectacular sea-farers. Nesting green turtles tagged on Ascension island in the south Atlantic have been recaptured off the coast of Brazil (their feeding ground) a distance of 1400 miles, and nesting Greens released from Tortuegero, Costa Rica, from various parts of the Caribbean over a thousand miles away, Carr (1973). Marked loggerheads from Bundaberg, Queensland, Australia at Papua New Guinea (1100 miles); Bustard and Limpus (1971). Hughes et al. (1967) reported recapture of a loggerhead tagged in Natal, S. Africa at a distance of 1650 miles. In some cases, the direction of travel was contrary to prevailing currents and the time required was short; e.g. in the last instance only 91 days. Furthermore, more tagged turtles return to the same or adjacent nesting beaches in 3-5 year cycles than could be explained by random chance Bustard (1972). Some of these off-visited rookeries are situated on remote islands such as Ascension island in the south Atlantic and Aves island in the eastern Caribbean.

How do turtles perform such extra-ordinary feats of navigation which entail voyaging out for over a thousand miles and returning to the same area? An achievement which would tax the skills of a trained sailor with modern navigational aids. Many explanations have been given. Among them are;

Chance finding

It is held by some that female turtles stumble upon suitable nesting beaches by pure chance. The possibility of a multitude of turtles, females and males (mating occurs in the sea adjacent to the nesting beaches prior to oviposition), upto 40,000 in the case of the arribada of the Kemp's Ridley (see below), repeatedly finding the same beach or tiny island at a particular time, travelling often against prevailing ocean currents seems very unlikely.

Odour or taste gradient

The utilisation of sophisticated landmarks such as smell or taste gradient is suggested by some. Turtles, perhaps, reach out to a spot whose characteristic smell or taste is imprinted on their senses.

There is no evidence however, that a land mass has any typical smell or taste. Furthermore, if olfaction ogustation is to be employed in this manner a turtle would have to continually sample and compare adjacent stretches of water to note a strenthening or weakening of the stimulous over a thousand miles. This would imply a continuous zig-zag trajectory at sea by travelling turtles. This has not been observed and this hypothesis appears unlikely.

Echo-location

It is well known that bats employ a system of radar to fly in the dark and locate its prey. Perhaps turtles utilise sea-bottom contours as guide posts by bouncing sound waves off them. No organs for sound emissions or echo location, however, have been found on them.

Utilisation of currents

Masses of water moving at different speeds from different sources may be utilised to guide animals in a certain direction. The Gulf Stream in the Atlantic for example, may be clearly distinguished from the adjacent water by its higher temperature and greater speed. This may apply to Ascension island (a favourite green turtle rookery), where the equatorial current sweeps past it westward, toward Brazil and may serve as a guide to turtles on their outward and return journeys. But turtles also nest in areas such as southern Yemen, Seychelles and remote islands in the Pacific and Indian oceans where such massive and well demarcated currents do not occur. It may however, be one of the guide posts utilised for locating nesting beaches in proximity to river mouths where outflows would be clearly demarcated.

Magnetic Land Marks

Variations in the Earth's magnetic field may be employed as guide posts for navigation. The sensory organs involved however are not known and no definite proof of this has been forthcoming.

Coriolis force

This term refers to the zonal speeds at which points on the surface of the earth are travelling through space at different latitudes. In the northern hemisphere, each shift southward or northward accelerates or decelerates one's eastward speed. The converse would apply in the southern hemisphere. A sensitive, built in, accelerometer would register changes in speed and indicate an animal's nautical position. The necessary anatomical structures for such sensitive recordings, however, have not been found.

Inertial Guidance System

This is the general term given to the fantastically keen ability to perceive and record all changes of speed and direction throughout any journey, however long and tortuous it may be. A reversal of this process would take one back to the starting point. This however begs the question of what particular navigation system is employed.

Celestial Navigation and Compass Sense

A sailor, if requested to navigate in the open sea would need a compass, clock, sextant, nautical almanac, ocean charts, slide rule, a pair of dividers and a sound knowledge of mathematics to calculate his nautical position. The principle employed is that heavenly bodies have predictable shifting positions over particular spots on the earth.

The altitude of the sun or star above the horizon (Co-altitude) obtained with a sextant and the time would give the distance to the spot where these bodies would be directly overhead. Then with the aid of the nautical almanac, sea-charts and much mathematics, the latitude and longitude of this point could be obtained. The position of the sailor would be on a circle inscribed around this point with the co-altitude as radius. The point of intersection with a similar circle obtained from a different celestial object or the same object in a different position would pinpoint his position in terms of latitude and longitude. Altogether a very complex process.

That certain animals have a star or light compass sense is well established. Migratory birds are known to orientate themselves correctly for migratory travel by the position of moon, stars, and constellations in a planetarium; Bees and small salmon by taking alignments from the sun. But to steer to a certain point, animals would, have to measure celestial angles accurately

while in motion, day or night, remember it, and compare it with other angles and also utilise a built in biological clock. In addition, it must possess a star map, and earth sense map (the equivalent of the nautical almanac), that has taken man so long to accumulate, stored up in its nervous system.

However preposterous it may seem, and however incomplete the experimental evidence, it appears that turtles and birds have these faculties, and celestial navigation seems to be the method employed for sea navigation. Carr (1973).

Turtle Courtship and Mating

Courtship and mating usually occur in the sea adjacent to the nesting beaches. The male faces the female and nuzzles her head. He shifts his position and gently bites her hind flipper. If the female does not object, the male swims up and onto her back. It maintains its position by hooking the large thumb claws of its front flippers over the front of the female's carapace between the shoulder and neck region and by tucking the horny end of its elongated tail under the posterior marginals of the female's carapace. Copulation now ensues. Sometimes, the nuisance value of these hyper-sexed, promiscuous males is so great, that the females retreat to the beach or sheltered shallow bays to avoid their unwelcome attentions!

Nesting

Although slight species variations occur, nesting habits of all turtles are similar. Nesting occurs usually on high, surf built, beaches with a relatively obstacle free, deep water approach. It occurs usually at night and at high tide. The Kemp's Ridley nests exceptionally between 9 a.m.-1. p.m. on remote Mexican beaches (see below). Oviposition proceeds in stormy weather too and is considered to have survival value as nesting trails are obliterated.

The breeding season generally coincides with the rainy season over a six month period. Each gravid female lays 3-6 clutches per season at an average interval of 14 days. Mating generally precedes nesting, but may occur in between oviposition. Different species may nest on the same beach and at the same time, e.g. green turtles and loggeheads. There may be many exploratory beachings prior to actual nesting. At the height of the breeding season, there may be turtles of different species nesting on the same beach simultaneously.

Arribada

This is the term meaning arrival in Spanish, given to a phenomenon where an enormous number of turtles of a particular species nest on a particular beach, on one day of the year. The Atlantic Ridley (*Lepidochelys Kempfi*) is the classic example. Vast assemblages of male and female Ridley's congregate in the seas adjacent to the nesting beaches in April-June at a time of strong wind and heavy surf. Nesting en masse occurs on any one mile long beach of a ninety mile stretch on the Tamaulipas coast of Mexico, north of Tampico. Nesting always occurs during the day and is completed in 6-8 hours. Films taken by André Herrera at Rancho Nuevo Carr (1973), reveal that 40,000 female turtles nest simultaneously on that one mile stretch of beach so that one can cross from end to end on turtle backs without setting foot on the ground! An arribada, on a smaller scale occurs, with regard to the Pacific Ridley (*Lepidochelys olivaceae*) at Eilanti in French Guiana where over 700 turtles have been observed to nest simultaneously on a 200 yd beach. These Two species also nest in twos and threes like other species.

What is the reason for this extraordinary phenomenon? The high wind, tide, surf and rapid daytime nesting would obliterate the nesting trails and thwart predators especially the nocturnal coyote which abounds in that region. The arribada itself is also perhaps a way of combating predation;—To swamp and override predators (Land and sea), with a surfeit of prey by a process of "Flooding the market". If 40,000 turtles lay an average of 100 eggs each, there would be a total of 4,000,000 eggs. If 80% hatch, there will be 3 million turtles entering the sea about the same time,—surely sufficient to saturate all predator appetites and permit a considerable number to survive. The mass bunching of turtles has therefore a strong survival value. It would appear from this that perhaps only large scale, artificial turtle hatcheries will have any major impact on conservation.

To get back to the story of turtle nesting; The gravid female laboriously crawls up above the surf line, reaches the vegetation zone where rootlet binding lends firmness to the sand and commences digging its body pit. This is an ovoid, 15 inches deep hollow, slightly larger than the circumference of the animal, which it excavates by moving its front flippers forward and backwards. Then follows the egg chamber, a 16" deep flask shaped structure in which the eggs are deposited, dug at the posterior end of the body pit, with its hind flippers. The purpose of the body

pit is to (a) Prevent sand slippage into the egg chamber proper during construction and (b) To protect the eggs from heat and predation by giving additional depth to the egg chamber.

It is only rarely that successful nesting occurs at the first attempt. Sometimes, over 20 attempts precede a successful effort.

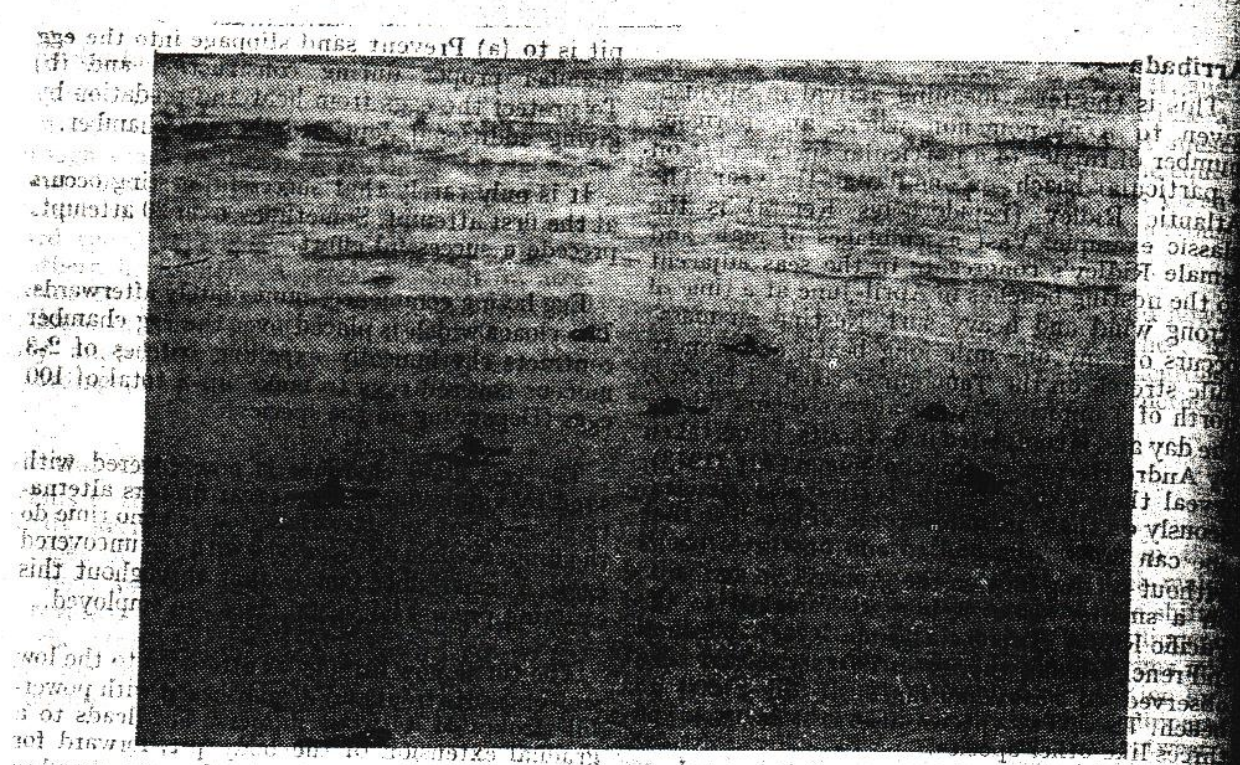
Egg laying commences immediately afterwards. The cloaca which is placed over the egg chamber contracts rhythmically expelling batches of 2-3 mucous covered eggs to make up a total of 100 eggs (Depending on the species).

The egg filled chamber is now covered with sand by employing the two rear flippers alternatively;—Great care is exercised since at no time do the flippers come into contact with the uncovered eggs. A remarkable fact is that throughout this exacting process no visual clues are employed.

The turtle now directs its attention to the low wall of sand in front and demolishes it with powerful strokes of its front flippers. This leads to a gradual extension of the body pit, forward for at least 3 yards anterior to the egg chamber and moves about a third of a ton of sand in the process. This flurry of activity disturbs the sand to such an extent that it is impossible to locate the exact site of the egg chamber. The body pit is now covered and the turtle slowly returns to the sea. The ingress and egress trails as may be seen, do not lead directly to the egg chamber and makes it difficult to locate by back tracking.

The average period of nesting for a green turtle is about 3 hours (Less for loggerheads and other species) and longer for leatherbacks. Turtles, whose flippers are damaged may take much longer. The whole process is an extremely arduous procedure for a turtle without the buoyancy of its natural aquatic environment and some are known to perish in the process apparently of cardiac failure. Throughout the nesting process, turtles appear to be shedding tears, weeping it is said by the sentimental minded for the progeny it will never know or due to the physical torture it endures, but is really the product of internal environment controlling, salt excreting glands which open to the exterior near the lacrimal ducts.

Competition for suitable nesting sites on one beach may be severe and often result in egg chambers being dug up by late nesting turtles with consequent destruction of incubating eggs. At Tortuegero or Aves island in the eastern Carribean, where green turtles nest almost ex-



A MAD SCRAMBLE FOR THE OCEAN

clusively, the intra-species destruction may be considerable. Even where nesting habits are different, as in the case of greens and loggerheads on Heron island, Great Barrier Reef, egg destruction may be appreciable.

Loggerheads nest much nearer the surf than green turtles and do not adversely affect the nests of the latter. The greens, however, in their exploratory beachings, dig abortive egg chambers at a level lower than their final nests and destroy a proportion of loggerhead nests, and thus affects the latter population adversely Bustard (1972). In both instances, the destruction is proportional to the population density.

The reason for this phenomenon is not known. Perhaps it is a form of natural population control. This factor, however, would have to operate at a population level above that required for survival of the species.

The eggs and young

(a) *Biology of the egg mass*
Clutchsize varies from an average of 50 (flatback), to 110 (green turtle); From 40 mm diameter and 40gm (loggerhead), to over 52mm and 78gm (green turtle). The trunkback lays even larger eggs. The incubation period of green turtle eggs vary from 6-12 weeks (av. 8) and is somewhat shorter for other species. The temperature required for successful hatching ranges from 25°C-33°C.

The hatching rate under natural conditions is about 85%. Under optimal artificial conditions where the eggs are collected and reburied quickly with minimum trauma, the maximum emergence rate is about 65-67%. Bustard (1972). The difference is probably due to the fact that rapid development of the embryo occurs immediately after laying and even slight trauma would be detrimental to further development.

The averages and temperature at the depth of the egg chamber is about 26°C. Carr and Hirth (1961), measured the temperature of developing nests by inserting thermometers into them and found that the temperature was increased by as much as 5°C. This would be expected due to the heat liberated by the metabolism of the egg mass. This has an interesting implication. It has been shown by Bustard and Greenham (1968), that the incubation period is inversely proportional (within limits) to the temperature. For example in the case of the green turtle, hatching occurs in 80 days (normal) at 27°C. At 30°C, -55 days. At 32°C-48 days. This shortening of the incubation period would have survival value, as nest predation would be proportionately reduced.

Another interesting fact was observed by the above workers. Thermometers inserted in different areas of the egg mass, recorded a temperature gradient of about 5°C between the centre and

periphery of the mass. This poses an intriguing problem. It is known that a difference of 5°C would vary the hatching period by as much as 32 days (see above). How is it that all hatchlings (in the centre and periphery) emerge from a nest at the same time? To answer this question an experiment was set up by Bustard (1972):—A clutch of eggs was divided into three equal portions. One set was incubated at the temperature of the middle of a natural nest and the other two kept in an incubator at a temperature of the periphery of the egg mass. One of the latter was stimulated by a mechanical prodder at hourly intervals commencing 10 days prior to the anticipated time of hatching. The other served as control. Eggs incubated at the temperature of the centre of the egg mass and those prodded hatched on the same day, whereas the undisturbed control group took 5-10 days longer. It appears, therefore, that movements of the developing turtles at the advanced centre communicates itself to the advanced periphery of the egg mass, stimulating the latter to catch up, so that all emerge simultaneously.

Resistance to desiccation

The eggs on laying are flaccid and as the shell porous, they can absorb several ml of water and increase in weight by about a third. If conditions are adverse however, an egg can lose 7-8% of water and still develop satisfactorily.

Egg and hatchling aberration

Abnormalities of eggs and hatchlings are not uncommon. Eggs may be pyriform, bifid or umbell-shaped. These are usually infertile (Saranivayala 1939). Total albinism of hatchlings is rare, and is usually accompanied by other defects inimical to life. Partial hypopigmentation is less uncommon, especially among green turtles and Pacific Ridelys. Carapace abnormalities also occur and are thought to be due to excessive desiccation.

Emergence

When ready to emerge, baby turtles slit the shell employing the egg tooth at the tip of the snout. Having done this, the young remain quiescent within the shell for about 24 hours, during which time, the balance yolk is absorbed. On leaving the shell, the hatchlings are about 10 cm long, 1 cm wide, and complete emergence from the sand takes several days. Group effort (Social facilitation) is very important for satisfactory emergence. The movement of one hatchling stimulates a flurry of activity in all. The turtles at the top literally bring the roof down, the animals below, trample the sand underfoot and the whole mass moves upward.

Baby turtles rarely emerge during the day. This makes sense as (a) Bird predation is maximal during the day (b) Heat exposure would rapidly kill the turtles. But how is this nocturnal nest departure controlled?

Hendrickson (1958) and others have shown that baby turtles move upward day and night from their nests. Activity, however, ceases when the topmost turtles reach a temperature of 30°C. The sluggishness of the turtles at the top have a dampening effect on the activity of the turtles below and act as a stopper in a bottle. With the advent of nightfall or rain, waves of activity spread through the whole mass and emergence is completed in under a minute.

Sea orientation of baby turtles

Baby turtles enter a hostile world determined to devour them. They are immediately assailed on all sides by a formidable array of aerial, terrestrial and later aquatic predators. They have to go fast and direct to the ocean or be destroyed. This amazing ability to always do so, constitutes one of the great marvels of turtle biology.

The nest may be situated on an unobstructed beach sloping to the sea which is clearly visible or more often it is on a declivity below the tidal margin and inclined away from the sea. The sea itself may be completely obstructed by rocks or vegetation. After a few false starts, the turtles begin to crawl steadily and almost immediately align themselves in the direction of the sea. They move around, through, or over obstacles, go up and down slopes with supreme confidence. They can find the sea in day light or night-time, with the sun or moon shining brightly or hidden, in all weather except heavy rain. Rarely, they may be misled by artificial light or a specially intense source of natural light such as a break in the cloud cover.

Certain facts are established concerning sea orientation: (a) Baby turtles need their eyes to find the sea;—Blindfolded hatchlings get hopelessly disorientated. (b) It is not based on compass sense:—The surf is reached whether it lies north, south, east or west. (c) It is not dependant on the downward slope of the beach, as nestlings may travel up a bank before descending to the sea. (d) Not sound dependant:—A cacophony of sound which obliterates the noise of the breakers does not disorientate them. Furthermore, hearing is poorly developed as turtles like other reptiles lack an external ear and the ear drum is covered by ordinary skin which greatly reduces its sen-

sitivity. (d) This sea finding sense is also found in adult females (and probably males) as shown by the unfailing return to the sea of the former after nesting.

Sea finding experiments on baby turtles employing spectacles with various filters have shown that they respond to green and blue light equally well, as to white light, but not to red light, Ehrenfeld, quoted by Carr (1973). Trials with artificial light of different hues have also shown this preference. Polarised light, however made no difference.

A question that arises is whether it is the quality of light over the sea or the silhouette of the horizon that guides turtles to the sea. To clarify this Ehrenfeld, quoted by Carr (1973), performed the following experiment:—A circular area 42 ft in diameter was selected near the shore and an 18 inch wall was constructed around it. Palms were planted at regular intervals around its circumference thus breaking up the beach horizon but not blocking the light. A spectrophotometer showed no consistent difference between the light from the sky over the land and sea. Released hatchlings showed marked disorientation: When the wall and palm trees were removed, the baby turtles sped towards the sea with no hesitation.

These experiments seem to indicate that: (1) It is some ill-defined quality of the light horizon that orientates baby turtles seaward. (2) The guidepost lies low over the horizon. (3) It is associated with the blue-green part of the spectrum. In a natural situation, the light horizon is always sea-ward as the ocean acts as a gigantic mirror, reflecting available sun, moon, and starlight.

Besides this basic light response, there may be subsidiary stimuli. Foamy breakers in bright moonlight and phosphorescent surf leads to accelerated effort, as does firm, moist, sand. Wet sand leads to abortive swimming strokes. Turtles also align themselves at right-angles to the direction of the ebb and flow of the waves. But nothing alters the basic response to some quality of the light horizon.

The importance of group behaviour in survival

The importance of group behaviour in survival of hatchlings is noteworthy. If a single egg is buried at normal nest level, its fate is dismal. Of 22 eggs that were buried singly by Carr (1973), only 6 emerged and none entered the water. The jostling of the bunched turtles keeps the group moving: The pauses are fewer, and any straying is promptly corrected. The fanning out of the hatchlings from the point of emergence would distract the attention of the predators, so that at least some of them would survive.

Where do little turtles go?

After they leave their natal shore, baby turtles are lost sight of for one year. The ocean adjacent to their nesting beaches are in general, most insalubrious for them. The currents are strong, predation by birds and fish is heavy, and food is scarce. Exhaustive search has failed to locate them close to the shore. When they next surface, they are 10-50 lbs. in weight and probably 1 year old. The intervening period called "The lost year" is almost a total blank. It is known that for the first year, most turtles are carnivorous and are unable to manipulate their food below 4 ft. of water. They have to congregate therefore where animal food is abundant and can be devoured above that depth. Carr (1973), believes that Costa Rica hatched turtles spend their first year in the Sargossa Sea; where the floating weeds and the diverse fauna of small creatures associated with them provide the necessary buoyancy and animal food required for survival. The location of a similar site for Indian baby turtles (if any) is not known. It is likely that they swim and drift with the currents till a suitable spot is found.

Turtle predation and defense mechanisms

The survival of turtles over a period of a hundred million years is the greatest miracle of them all, when one considers the number and variety of animals that prey on them. The odds against any turtle surviving are formidable. The eggs are dug up and eaten by jackals, coyotes, dogs, opossums, pigs, mongooses, monitor lizards, buzzards and even by leopards and tigers. The hatchlings in their short journey to the sea are attacked among others, by the ghost crab, red-eyed crab, and birds such as gulls, reef-herons, sea eagles and terns. Once in the water, their problems are by no means over. The young are most vulnerable when they are crossing the reef-flats. In addition to the gulls and terns, carnivorous fish such as jack and kingfish and other mackerel, snook, bass and shark take a heavy toll. Bustard (1972), records a case of a fifty-seven inch black-tipped shark whose stomach contained 14 green turtle hatchlings. It is estimated that no more than 2-4 hatchlings per thousand survive to adulthood.

Adult turtles are relatively safe since they outgrow most predators. The rate of growth of immature turtles is increased appreciably by their habit of basking on the surface of the sea, which raises the body temperature and enables digestion to proceed faster. They are not totally immune, however; Shark and barracuda attack on adult turtle are recorded and turtles with flippers lost after predator attack are not unknown.

Some of the turtle defense mechanisms have been discussed before:— The selection of remote lands and beaches as rookeries, nesting in stormy weather, high tide and night-time. The complicated nesting procedure which obliterates the site of the egg chamber. The elevated temperature of the incubating eggs which shortens the period of hatching. The night emergence of baby turtles and their rapid progress to the sea. The massive simultaneous nesting, especially the "tribada" which "floods the market" with baby turtles and their rapid growth in size. All these mechanisms trend to counter predation to some extent. Baby turtles in addition are not totally helpless. The black carapace and light plastron (especially of the green turtles and leatherback bliferative colouring) camouflages them from aerial and aquatic predators. Baby turtles (and even adults) instinctively dive when a shadow passes over them:— A protective device against aerial predators. Turtles swim normally with a lift like motion of their front flippers, while the hind flippers serve as balancing organs. Baby turtles, however, can accelerate 5-10 times their normal speed by bringing their hind flippers together dolphin fashion; a manouever that would hopelessly outflank all but the speediest of game fish. The very fact that turtles have been around for over a hundred million years testifies to their very successful way of life.

But the advent of modern man has tilted the balance drastically against them. The uninterrupted plunder of eggs and the capture of turtles for food calipee (used for turtle soup) and tortoiseshell, on their feeding grounds, nesting beaches and migratory routes have greatly reduced their numbers. Turtles were mercilessly exploited by the navies of the early European sea-faring nations as a ready source of live protein and Vitamin C (to ward off Scurvy) on long voyages. The practice of turning over gravid females on the nesting beaches, even before they could lay, was particularly disastrous.

The greatest danger, however, to turtle survival is the sheer pressure of human population. Traditional nesting beaches are being encroached upon for human habitation as well as highways, tourist complexes, industry etc. Even where the beach itself is not interfered with, lights on coastal highways confuse nesting turtles and attract emerging hatchling away from the sea to be crushed in great numbers on the highways, Carr (1952).

The present distribution (International and local) and survival status of sea turtles is given below and makes gloomy reading.

Green turtle

Main nesting sites are Tortuguero, Costa Rica; Aves island in the eastern Caribbean; Trinidad; Surinam; Ascension island; South Yemen; Turkey Western Australia Northern territories and Queensland; Small numbers nest on the Andaman and Laccadive islands, Seychelles, Maldives and Sri Lanka. In Sri Lanka, occasional nesting occurs on the west, south and south-east coast ranging from Kalpitiya to Palatupana. The reptile Red Data Book of the International Union for the Conservation of Nature and Natural Resources (I.U.C.N.), comments:— "Depleted. Although occurring in numbers adequate for survival, has been heavily depleted and continues to decline at a rate substantially greater than can be sustained".

The Flatback

Limited geographic distribution in Queensland, Northern territories and Western Australia. potentially extremely vulnerable due to restricted range. The main threat is land alienation for commercial exploitation of its nesting beaches.

Kemp's (Atlantic) Ridley

Very restricted distribution. Nesting occurs on the east coast of America from Massachusetts to Mexico, predominantly in a very small area:— Rancho Nuevo, Tamaulipas, Mexico. The Red Data Book includes it in category 1. "Endangered. Actively threatened with extinction. Continued survival unlikely without the implementation of special protective measures".

The Pacific Ridley (Olive Loggerhead)

Occurs in certain areas of the Indian, Pacific and Atlantic oceans; namely China, Japan, Northern Australia, Seychelles, India, Sri Lanka, the Philippines, the Gurneas and Mexico. It is the commonest Ceylon species, being found off Mannar, Karaitivu, Arippu, Marichakuddi, Kalpitiya and Chilaw. Nests have been discovered on beaches ranging from Negombo to Hambantota. The Red Data Book states "Rare. Not under immediate threat of extinction but occurring in such small numbers and/or in such a restricted or specialised habitat, that it could quickly disappear. Requires careful watching".

The Loggerhead

Found mainly in Northern Australia, Natal, S. Africa and South-eastern United States. Occurs in smaller numbers in the Maldives, Sri

Lanka, Malaysia and the Parcel islands in the South China sea. Largest concentrations nest on continental beaches and are thus vulnerable to predation and land alienation. Survival status as for the green turtle.

The Hawksbill

Nests in small numbers on the Caribbean islands, Gulf of Mexico, West Africa, South China, Seychelles, Sri Lanka, Malaysia, China New Guinea, Fiji and islands on the Torres straits, North-Australia. It is known to nest locally in-Talaimanar, Karaitivu, Talawila, Udappu, Bentota and Amaduva and is relentlessly hunted for its prized tortoise shell, although its flesh is occasionally poisonous. The Red Data Book includes it in category 1. (The highest priority category) as the Kemp's Ridley.

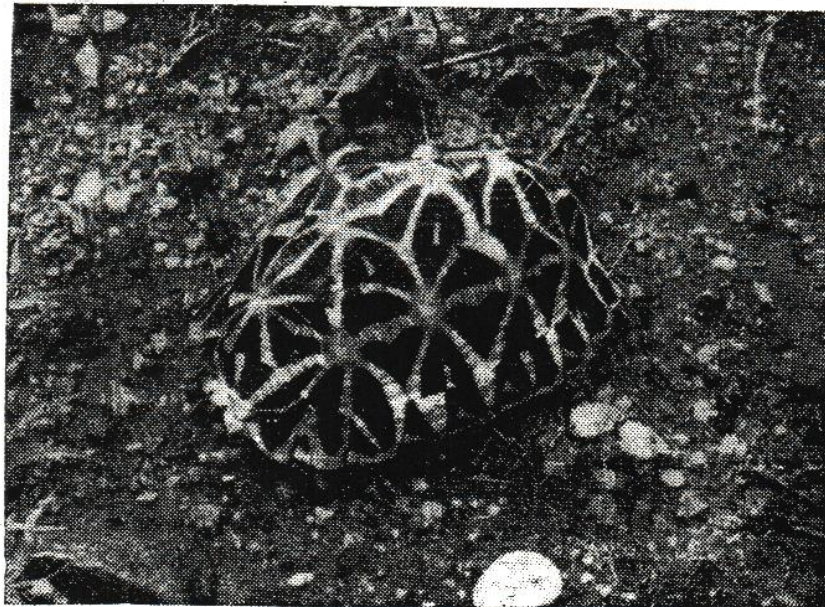
The Leathery Turtle

The leatherback is the most pelagic of sea turtles with a wide ranging circumtropical distribution. Its principal nesting beaches are in Trengannu in eastern Malaysia; French Guiana and Fiji. Smaller numbers are known to nest in Costa Rica, Mexico, Surinam, East Indies, Australia, West Africa, S. Africa and Sri Lanka.

Nests have been located in Sri Lanka at Lunawai, Wadduwa, Bentota, Paiyagalla, Maggona, Welgama and Hambantota. The leatherback is the only species (Among sea turtles) given star listing in the Reptile Red Data Book, signifying that it is critically endangered.

The present distribution of sea turtles, in the words of Professor Archie Carr (1952) "Is a ghostly outline of their primitive range, except where they have been completely extirpated".

As our experience in Sri Lanka has shown, enlightened and well-meaning legislation is not sufficient to ensure survival. Rigid enforcement of existing laws and constant publicity concerning the uniqueness of turtles is essential. Artificial turtle hatcheries on a massive scale and turtle farms (which would not parasitise the wild population and have its own breeding stock) are a necessary adjuvant to assuage increasing world demand for turtle products. Unless these measures are adopted, it will not be long before sea turtles follow the passenger pigeon, the dodo and numerous other species to extinction, and the incredible saga of the turtle, one of the last links with the age of reptiles would have been ended forever.



A STAR TORTOISE