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In 1971 he gave up his research career 'for ten years' in order to use his special skills to help indigenous Australians (aborigines and Torres Strait Islanders) achieve the sort of life which they themselves desire, and to be able to devote more time to conservation.

Jacket Photo: Kay watches Ruth mating

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up by patting her head, she noticed two raw areas of flesh and remembered that this was exactly where the male's thumb claws had been during copulation. She also noticed that the edges of the upper shell adjacent to these spots were slightly eroded, presumably as a result of cumulative matings. Kay had often noticed these raw areas on nesting turtles, indeed some emerged from the sea to lie with slight bleeding occurring there. Kay had wondered what caused them but would never have guessed that these wounds resulted from mating. Now, however, she knew for certain.

She sat with Ruth on the beach until the sun dropped towards the horizon. She was just starting to feel cold and thinking it was time she left when Ruth stretched, breathed, and started slowly down the beach towards the water. Another day had passed, night would soon come, and the male turtles would have to wait for another day. Leisurely Ruth dragged herself towards the sea, paused for a moment at the water's edge, and turned to look at Kay. Kay fancied she actually winked at her but she might merely have been removing sand from her eye. Ruth swam out towards the edge of the reef.

As Kay walked home many questions filtered through her mind. How old was Ruth? At what age do turtles start breeding? What is their lifespan? Little did she know that even the scientists cannot answer these questions. What a pity, Kay thought, that Ruth could not talk. There was so much that she could have told her about a turtle's life at sea.

CHAPTER SIX

Further meetings with Ruth ashore

*

KAY knew that Ruth was likely to nest several more times that season and kept a note of the date of the second nesting in the hope that she could be present again next time. It so happened that Kay went around to the other side of the island after only twelve days. It had been an exceptionally hot day and towards nightfall the slight breeze had disappeared making conditions intolerable for sleeping indoors. She had risen around midnight, sat on the step and then, attracted by the coolness outside compared to the temperature in her room, had decided to see what the turtles were doing.

She reached the beach where Ruth usually nested about 1 a.m. but of course did not expect to see her friend for several days yet. The tide was still not quite full but a number of turtles had beached and she wandered slowly along the edge of the vegetation looking at each turtle in turn. One was exceptionally large, she could not recall ever having seen one so big. Kay judged it must have measured all of four feet from the front to the rear of the upper shell. The upper shell was also extremely steeply arched making the turtle even larger. Undoubtedly it would have weighed in excess of four hundred pounds.

The next turtle had failed at its first nesting attempt and moved inland. Kay automatically followed the tracks which

twisted around a fallen pandanus palm and headed for a depression beside a clump of pandanus. As Kay crept beneath the low fronds of the bushy palms looking for the turtle, she saw that its second nesting attempt had also failed and that the track continued on and was lost from view behind a large messerschmidia bush. She followed the track and there at the other side of the bush, head facing in and near to the main trunk, was the turtle. It was Ruth! Not only was she a few days earlier than expected but she must have come ashore several hours before high tide – the tide was only now nearly full and reaching most of the way up the beach – in order to be at her third nesting attempt already. Kay reflected how lucky Ruth was that it had been an intolerable night for sleeping and that she had come out to watch the turtles. Otherwise, she probably would not have looked for Ruth until two nights later necessitating Ruth digging fruitlessly by herself for two whole nights. Kay felt strong compassion for Ruth and sat down at the rear of the body pit to help her. Ruth had just completed the preliminary excavation and was starting on the egg chamber. Kay worked consistently between Ruth's rear flipper actions taking special advantage of Ruth's rest periods. Kay wished she could have told Ruth to stop digging and rest as she could have prepared the egg chamber much more quickly working uninterrupted by herself. However, together they had soon completed the excavation. Ruth laid 170 eggs. Kay stayed with her friend until Ruth had completed filling in the nest and returned to the sea.

The fourth nesting was uneventful and occurred after an interval of fifteen days. Kay was there when Ruth came out of the water and they were together throughout the entire

process. This time Ruth laid 172 eggs. As soon as she saw Ruth, Kay knew that she was different in some way but Ruth was well up the beach before Kay detected what it was. Ruth had lost the large barnacle from the top of her head. Kay was not surprised because she often noticed marks on turtles' carapaces indicating where barnacles had been. In time the marks themselves disappeared.

Kay wondered how many more times, if any, Ruth would nest that season but kept watch again after fourteen days had elapsed. She visited the beach on two successive nights but Ruth did not appear. On the third night she went out towards sunset and took up a position on the nesting beach favoured by Ruth. Kay sat down just above the bank among the most seaward of the tall vegetation which consisted of messerschmidia and scaevola bushes.

It was a warm night and the air was almost motionless. Even the feather-like tops of the she-oaks some distance along the beach showed no movement. Cicadas kept up a deafening trilling noise in the she-oaks and a few silver gulls were lazily flapping over the tops of the trees trying to locate cicadas with their sharp eyes. Kay lay back and watched marvelling at the precise flight control of the gulls and thinking that if she were a cicada she would not suck the sap from the top of the she-oak where they were vulnerable to such deadly predators. As she watched, the three gulls captured and quickly swalled five cicadas.

As darkness fell the cicadas' call rose to an even higher pitch and then, following darkness, ceased altogether. The moon was already high and during the intervals when it was not cloud-covered, the scene was brightly illuminated. In the absence of the cicadas' trill Kay could now hear the dull

whirr of hawk moths' wings as they fed from the messerschmidia blooms suspended in mid-air like hummingbirds. During the illuminated intervals she could see the torpedo-shaped moths hovering motionless above the blooms, their long tongues fully extended to suck up the nectar. So motionless did the moths remain that their body form was clearly visible although the rapidly vibrating wings were just a blur. Suddenly, without warning, the moths would dart off to repeat the process above another bloom.

Mysterious 'plopping' noises attracted Kay's attention seawards but it being one of the dark intervals when heavy cloud obscured the moon, she could not see what was responsible. The cloud passed and during a brief, bright interval, Kay clearly saw the dark triangular fin of a shark cruising along parallel to the beach close inshore. Kay knew that although sharks were extremely common in the area – so as to definitely discourage swimming in deep water – here they did not generally venture onto the reef platform until after dark except during the turtle mating season. At this period of the year the presence of the mating turtles seemed to attract the sharks close inshore by day. During the night, however, it was commonplace to see large sharks only a couple of yards from the beach. Kay reflected that she had often wondered about the exact relationship between sharks and adult green turtles. There were so many sharks around the nesting beaches yet the turtles clearly survived. However, it was evident that sharks preyed upon the turtles since many of the breeding females were damaged – had rear flippers missing or large chunks bitten out of the shell. The exasperating fact was that virtually nothing was known about any of these encounters and it was impossible even to guess at how many of them

were fatal. Clearly one only saw evidence of attack from the lucky turtles that escaped with their lives.

The number of damaged female turtles had greatly surprised Kay when she had started to take a close interest in nesting turtles. Formerly she had always supposed that an animal as large as an adult green turtle was impervious to attack although she knew from films that the baby turtles were heavily preyed upon by birds, crabs and fish.

Two other shapes were now visible swimming shorewards, one almost directly in front of where Kay was sitting. The turtle to her left arrived first and sat in the shallows, the moonlight reflecting from its wet back. As a wave receded, it raised its head and looked around, its throat pulsating as it pumped air into its lungs. It must have liked what it saw because it made three forward lurching movements which brought it right to the water's edge. Meanwhile, the turtle directly in front of Kay had grounded and was still motionless. It had not yet poked its head out of the water. As she watched, it shuffled forwards so that between waves its head was clear of the sea even while resting on the sand. It raised its head to breathe and looked around, slowly and deliberately, then rested. It gave the impression of being loath to finally shake off its contact with the sea and, at intervals of several minutes, made two series of two or three forward movements interrupted by long rest periods. Each resting period was terminated by head elevation during which it breathed and looked carefully around. Kay knew that ashore, turtles have difficulty in breathing and pump air into their lungs by elevating their head and alternately relaxing and contracting the muscles of the floor of their mouth.

The turtle was now completely out of the water, only

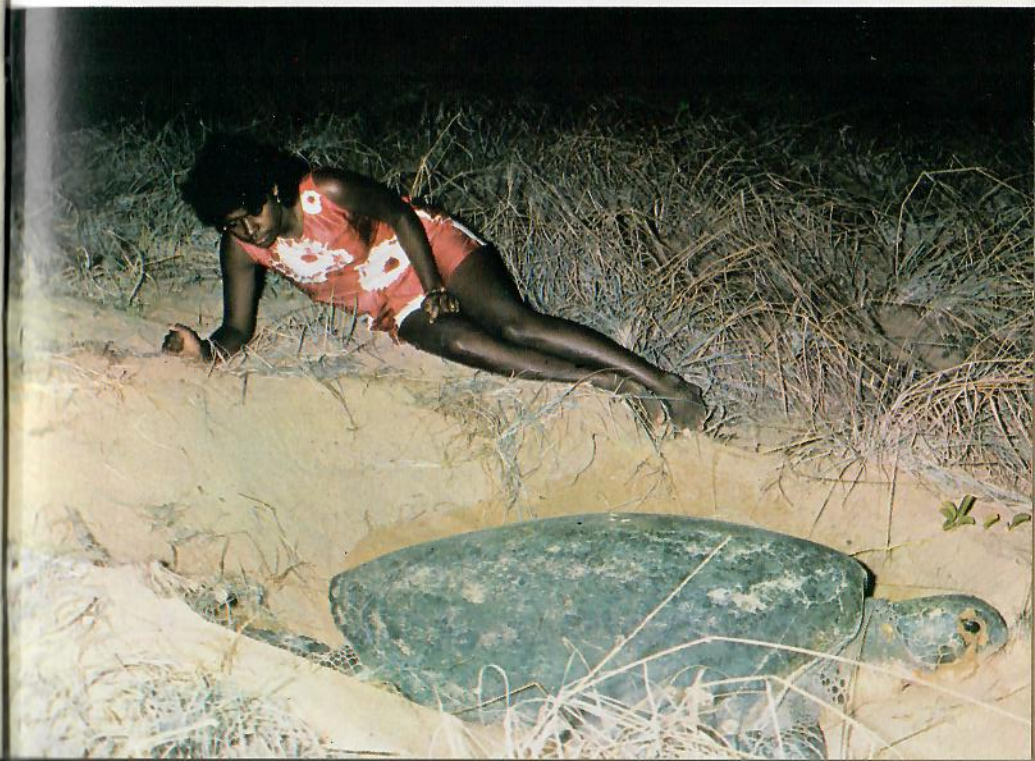
occasional strong waves buffeted the rear of its shell. She could see the large powerful front flippers resting on the sand, the small head, and the large wet shell reflecting the moonlight. The illumination was insufficient to detect colour. As Kay watched, the turtle raised its head to breathe and then started to move jerkily up the beach. As the turtle progressed further from the sea the rest periods became shorter, no longer did it look carefully around it at the end of each rest period and it made a greater number of forward movements between rests. There was a large log on the beach almost directly in the turtle's path and Kay noticed that it gave the log a very wide berth before returning to its original track which would bring it extremely close to her.

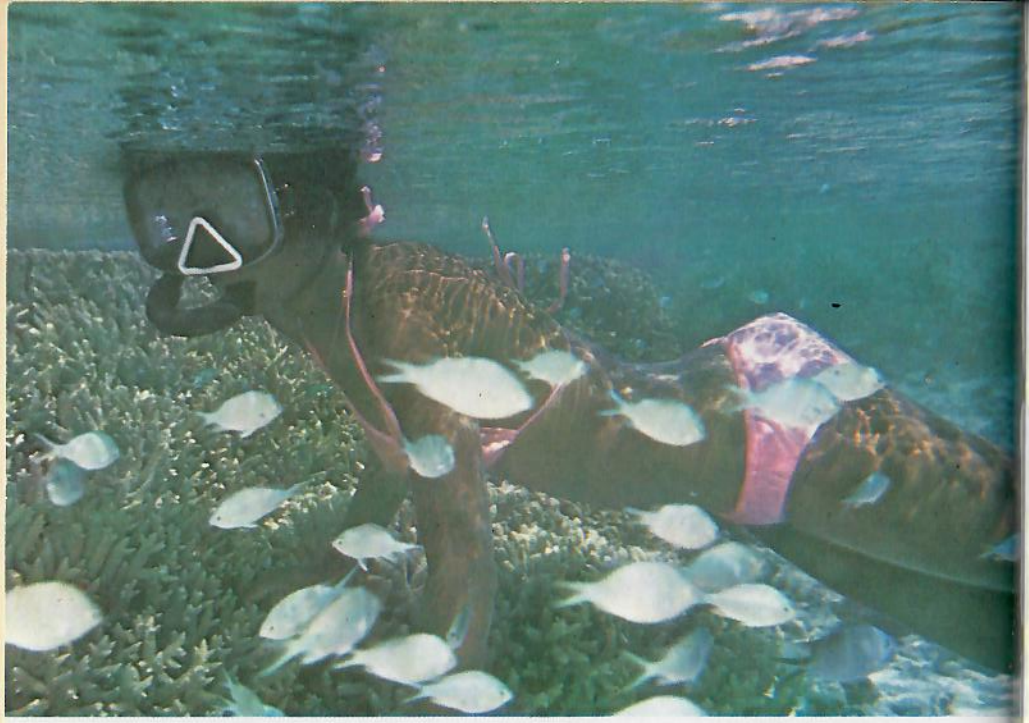
Kay knew that if she kept still it would probably not see her and continue past into the vegetation zone. The turtle was almost level with her feet which were stretched out in front of her, and had stopped to rest. After about a minute the turtle raised its head to breathe and Kay heard throaty grunting sounds as it pumped air into its lungs by three contractions of the throat region. The small bird-like brownish eyes seemed to look right through Kay yet showed no sign of recognition which Kay knew *should* have been there for she now recognized the turtle – it was Gemai! Kay peered closely at Gemai's face to see if she could detect any sign of recognition in the watery eyes bright from the reflected moonlight. Mucus 'tears' hung from each eye making Gemai look so sad. Lying there in the moonlight she had such an aged appearance that Kay felt acute concern for the amount of work that Gemai had to accomplish that night.

For a moment Kay thought that Gemai was about to walk over her and prepared to roll aside to let her pass to avoid

Kay watching Barry courting

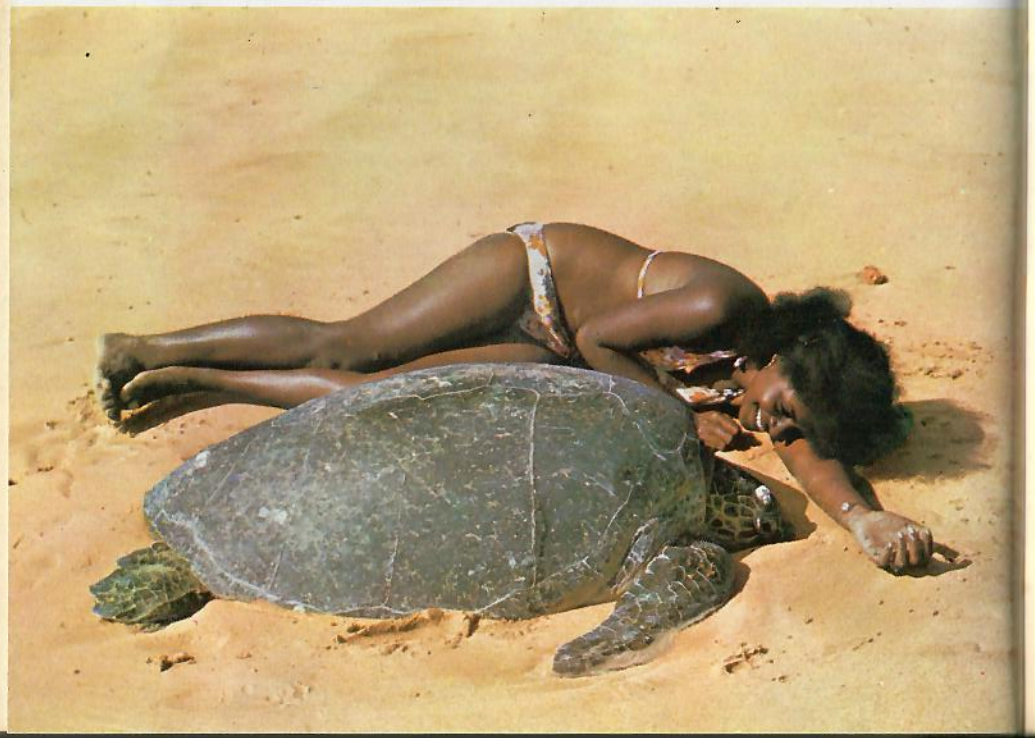
Gemai completing the egg chamber in dry sand





Kay in a coral pool surrounded by curious blue pullers and sergeant-majors

Kay and Ruth lazing in the heat of the day



being crushed by her great weight. However, Gemai moved slightly to the right and came abreast of her, the extremity of her left front flipper just touching her bare leg as if in recognition. Gemai rested again and then moved past Kay into the vegetation zone but not without a backward glance when she next stopped to breathe. Immediately in front of Kay the bank was ill-defined, nevertheless the sand was extremely soft and the incline fairly steep and Gemai obviously had some difficulty making progress up the bank. She now lay motionless for some minutes before making for a large messerschmidia bush under which she literally disappeared. Soon Kay heard the sound of dry sand showering against leaves and turning round saw that Gemai had commenced digging her nest. Kay had often noticed that green turtles seemed to like vegetation and most often nested under or close to it rather than on open areas of sand. She had never known green turtles to nest on developing cays which were little more than sandbanks and lacked vegetation other than grass and bindweed although she knew that some other kinds of turtles used these cays for nesting.

Kay watched Gemai. She was literally swimming into the sand with powerful synchronous movements of the front flippers which sent sand showering backwards for distances of several yards. As Kay watched, Gemai adopted a head downwards posture. A major purpose of the nesting process is to place the eggs in a suitable incubation environment at a depth in the sand where moisture is generally present even during dry spells, since turtle eggs have soft shells and rapidly dry out unless they are in a very humid atmosphere. The depth of the egg mass also ensures that the temperature is not subject to changes between day and night. The purpose of

the body pit, Kay thought, seemed to be to remove the surface layer of sand which was usually dry and 'fluffy' and impossible to dig an egg chamber in, and get down to a layer of sand which was usually somewhat moist and compacted and in which digging of a deep egg chamber of small cross-section was a feasible proposition. Of course, the body pit also results in the eggs being placed deeper in the sand than would be the case if the egg chamber was dug from the surface.

Meanwhile, Gemai continued digging into the sand sometimes using both front flippers together but at other times the left or the right flipper moved independently causing her to slew somewhat from side to side. The rear flippers pushed sand backwards. However, piles of sand tended to accumulate about half way along Gemai's sides. These were out of reach of the rear flippers when they stretched forwards to collect sand and push it backwards and resulted from intermittent less active digging movements of the front flippers.

After about half an hour Gemai was sitting in a depression about twelve inches deep and considerably larger than the size of her own body. The depression measured about five to six feet from front to back and four feet wide.

While Kay watched Gemai dug a near perfect egg chamber. The chamber completed to her satisfaction, Gemai removed both flippers from the hole and placed them flat on the sand to the sides of the chamber. Kay shone her torch down into the egg chamber. It was beautifully constructed both sides being perfectly symmetrical. The chamber was roughly pear-shaped with a well-defined neck region. At the surface it was almost square but below became rather more circular. The neck opened out into a very definite chamber which Kay knew would house all or most of the eggs depending on the

size of the clutch. At the surface the chamber was slightly wider than broad measuring about eight inches from left to right. By poking a twig down until it reached the bottom Kay judged the chamber to be about fifteen inches deep. She realized that in order to appreciate where the eggs would be located in relation to the sand surface, one had to approximately double this to allow for the depth of the body pit. As Kay watched, several contractions occurred in the cloacal region and some clear mucus dripped into the egg chamber. At the same time Gemai moved her rear flippers together so that they almost covered the hole. It was just possible to see what was happening by shining a torch down the small space between the flippers. Kay settled down to watch.

Several more contractions occurred accompanied by more mucus and then Gemai laid a single egg which fell down into the chamber. Gemai laid three more eggs singly and then two together and another two. Kay decided to keep count. Soon Gemai had laid forty eggs and eggs now regularly dropped two or three at a time. Kay leaned forwards and taking the right rear flipper in both hands moved it laterally until it was well clear of the hole. She held it there until she felt that the initial resistance from the turtle had ceased and slowly let go. The flipper remained where it was allowing a completely unobstructed view of the egg chamber. Gemai had made no visible response to Kay's action which did not surprise Kay in the least. She could have done this with almost any turtle. She knew that the one time a turtle forgot its fear of man was during actual egg laying and immediately thereafter. Once they have laid about forty eggs most turtles settle down and take little interest in the outside world. The worst that could happen, except with a very nervous turtle,

would be that the turtle would stop laying for a few minutes and then continue as before.

Gemai had laid sixty-four eggs. Kay leaned forward, reached into the hole and removed an egg. The egg was almost circular and was quite large – about two inches in diameter – with a soft shell which dented when pressure was placed on any part of it and then sprang back into shape as the pressure was removed. Not unexpectedly, in view of the mucus being extruded from the female's cloaca, the egg was extremely sticky to the touch. Kay carefully dropped the egg back into the hole.

Egg laying had now been in progress for over ten minutes. Kay thought that the first body pit had taken Gemai about half an hour whereas completion of the second had occupied no more than ten minutes. The first egg chamber had been almost complete when the sand had fallen in – after about fifteen minutes' digging – and the present egg chamber had been constructed in a somewhat shorter time, probably due to the slightly damp sand.

Kay wondered how many eggs Gemai would lay. She knew that an average clutch was just over one hundred. However, she had noticed that the larger turtles generally laid more eggs and a big old girl like Gemai could easily lay one hundred and fifty eggs or even more. She kept count. Kay remembered that the largest clutch she had counted consisted of exactly two hundred eggs and the smallest about sixty. Of course, she knew that when turtles were frightened during the early part of the egg laying process they often stopped laying and returned to the sea. However, such turtles came out the next night to lay the rest of the clutch so the first night's laying could not be considered a proper clutch.

Kay knew that one of the most sensitive areas is the cloacal region but that most of the tail is sensitive. She had sometimes accidentally touched the tail region when egg collecting before the turtle had laid many eggs and noticed that it stopped laying. Although most females started laying again after a few minutes if there was no further disturbance, some ceased laying for that night. Of course, if you really disturbed the turtle such as by climbing on its back during egg-laying as Kay had heard some European kids did, it would certainly take fright and return to the sea. Whether or not it stopped to cover up the nest in such circumstances depended on the degree of fright which occurred. A turtle which had merely been seriously disturbed would be likely to stop laying and cover up in the normal way – just as if it had laid a normal clutch of eggs. However, when the turtle was really frightened, it would climb out of the body pit and head for the sea at a half 'gallop' without making any attempt to cover the nest. Occasionally such turtles seemed unable to stop egg laying and continued to drop eggs as they moved down the beach.

Gemai had now laid one hundred and seventy-one eggs and the rate of laying had decreased noticeably. As Kay watched, Gemai laid a single egg and after an interval, two more. It seemed that egg laying was almost at an end. After a further interval Gemai laid one further egg. Kay decided that must be the lot making a total of one hundred and seventy-four eggs.

Kay reflected that she found the end of egg-laying rather amusing as she always seemed to know when the turtle was finished laying before it realized this itself. Some sat for a long time before starting to cover the nest and she sometimes

used to hurry them up by nudging a rear flipper. They then commenced covering the nest at once.

Gemai sat motionless for about one minute and then she lifted her rear flippers well clear of the sand and moved them laterally, first the left and then the right flipper dragged sand towards the egg chamber and over the eggs. Kay noticed how delicate the action was when the flipper came close to the eggs. The alternate movement continued until a mound of sand had built up over the egg chamber when the action became more vigorous. Each flipper in turn drew sand in and slapped it against the pile. The tail seemed to act as location point, being buried in the middle of the pile of sand. After this action had continued for several minutes, Kay moved well to one side. Almost immediately, the front flippers sent a shower of sand across the area Kay had just vacated. The rear flipper action slowly gave way to powerful 'swimming' strokes of the front flippers. However, periodically the rear flippers continued their action of piling sand over the egg chamber.

After ten minutes the net effect seemed negligible as the turtle was still sitting in the body pit. However, Kay knew that the area where the eggs were laid had now been completely covered up. What the turtle had done was to continue the body pit forwards digging out in front and filling in behind as it went along. Green turtles usually continue this for several yards, slowly making a shallower excavation. Then suddenly they appear to tire of it and clamber out the front end and head for the sea.

Kay wondered what the purpose of this was. She doubted somehow the explanation that this behaviour served to disguise the exact site of the nest. Scientists said that if the

turtles did not do it there would be a set of tracks leading up to and away from the nest and it would be simple to pinpoint the location of the eggs. By continuing the body pit forwards, so the reasoning ran, the turtle moves a great mass of sand, disturbing a large area, and hence making it impossible to detect by sight where the eggs are located. However, this did not seem to Kay to have much real value for she knew that most of the egg predators – wild pigs, goannas, foxes, wild dogs – had an excellent sense of smell and did not require visual clues in order to detect the nest site. Furthermore, these large enemies did not occur on small coral cays. It seemed to Kay that the turtles undertook an enormous amount of work for very little gain. On the average, about two-thirds of the work took place after egg laying and the bulk of this was involved, supposedly, in camouflaging the nest site.

Gemai was still actively digging the body pit forwards. The pit was now noticeably shallower than when egg laying had taken place. Sometimes her two front flippers worked simultaneously, or one or other acted independently exactly as had occurred during the initial excavation. The digging activity was now extremely powerful. The front flippers ended their stroke with a resounding slap against her upper shell, a sound which could be heard in the still night air for a distance of a hundred yards or more. From similar sounds elsewhere on the beach Kay knew that other turtles must also have completed the nesting procedure and now be filling in and disguising the nesting site.

Finally, Gemai stopped work, looked up, breathed and climbed ponderously out of the body pit which had followed a semi-circular direction. She looked around and headed towards the bank. Kay gasped involuntarily as she saw the

very steep slope immediately in front of the turtle. However, she knew she had no need to worry as turtles rarely came to grief even on much steeper slopes than that. Sure enough, Gemai came to the edge of the bank and did not hesitate. For a moment, the front of the animal stuck out into space, the front flippers flapping the air unable to touch the ground, then the rear limbs gave a further push and old Gemai fell forwards and tobogganed down the slope on her smooth lower shell. She came to rest near the foot of the bank and almost immediately started seawards using the same pull-push movements with which she had progressed laboriously up the beach. Going down was, of course, easier and Gemai made a greater number of forward movements between rest periods. The rest periods also seemed to be of shorter duration.

There were no obstructions and Gemai had soon traversed the beach and had only to cross a flat area of sand to reach the sea. She accomplished this without incident and then rested head down, right at the water's edge. After breathing she dragged her weight into the shallow water and soon, being extremely buoyant from the air in her lungs, was able to float free from the bottom and start swimming. The first few strokes were clumsy and created much turbulence at the water's surface. She breathed out, sank further into the water and swam out to sea the water lapping against a pile of sand still lying on her shell from the nesting activity. Soon she dived and after about half a minute, surfaced briefly for air, dived, and was not seen again by the lone watcher on the beach.

Kay wondered why green turtles nested only under cover of darkness. She had noticed that they generally came ashore at or around the time of high tide. That darkness was a cue

could be clearly seen on days when a high tide fell in the hours immediately preceding nightfall. Many turtles came in over the reef edge and could be seen cruising up and down off the nesting beaches but until darkness fell, they did not come ashore. Synchronization with tide cycles made sense to Kay. Like many sea creatures, the tide cycles and the moon which controls them, play an important role in the Islanders' lives.

The Island people have known for generations that the same turtle returns to nest after an interval of about fourteen days. In areas where turtles are not so numerous this information is used to the turtle's downfall. When a freshly laid nest is located, the people take the eggs but are sure to be back a fortnight later to take the turtle also. This seldom fails although they might have to watch the beach for several evenings to get the turtle. Kay knew that peak turtle nesting occurred at the time of the full and the new moon.

She had thought about this business of returning fourteen days later to take the turtle the next time it laid. Surely this only held good if the turtle returned to the same beach to lay her eggs. Here was strong evidence that turtles do return to the same beach each time to lay.

Kay did not know how they did this – how they found their way back – but she had often watched turtles swimming parallel to the beach several yards offshore for considerable distances before suddenly swinging at right angles to the beach and coming ashore. At such times they seldom raised their heads above the water, except for occasional quick respirations, so presumably they used under water cues to find their way about. That they were able to do this did not surprise Kay at all.

Kay had heard from the older Island people that they believed turtles did not nest every year but that when they did re-nest they came back to the same island that they had nested on before. Kay did not know if this was true or not but her grandfather had told her that they had seen turtles, which they could recognize for sure because of certain deformities or damage, back at the island several years after first seeing them.

On the way home, Kay stopped, remembering that she wanted to look for a turtle which had been trapped by a steep area of bank. She approached the bank, took off her cardigan, and lay down on the sand. After excavating a few handfuls of sand she found that the turtle was still there. She grabbed its tail and twisted and the mound of bank heaved in the bright moonlight. The turtle had been unable to climb that very steep portion of bank so had started nesting right at the foot. As it dug its body pit, it had undermined part of the bank which had caused a landslide burying the turtle. At this stage, the turtle, using its great strength, could easily have backed out but turtles were always very loth to move backwards. Instead, therefore, it had merely tunnelled deeper into the sand and would stay there until it died unless Kay helped it to get free. It had been there for two days already. Kay had thought of returning by day with her brother with shovels and digging it out but she had a better idea which she wanted to try first. Digging could always be done later on as a last resort. Kay thought that if the turtle could only see the light it would dig towards it. If she could combine its tremendous strength with her superior reasoning power she should be able to get it out now.

Kay climbed the bank and looked down among a mass of

pandanus roots from the top. She decided that if she dug down here she might be able to locate its head since these roots formed a sort of small cave. If she could do this then by going back to the foot of the bank and tweaking its tail she could get it to climb out the top. Certainly the turtle was strong enough to shift the several feet of sand lying on its back.

After five minutes' digging sand with her hands, Kay saw that her surmise was correct as she could now see the turtle's head. She jumped down the bank and gave its tail a series of hard pulls. The bank heaved each time and the turtle moved upwards a few inches. Kay climbed the bank again to direct it towards the left otherwise the turtle would become hopelessly entangled in some she-oak roots and Kay would have to axe these to free it. Kay directed the turtle to the left by slapping the right front flipper. The turtle responded at once and when it had angled itself sufficiently towards the left Kay jumped down the bank, buried her arm in the sand well above her elbow, found the tail, and gave it a violent tug. The turtle jerked forward, the bank heaving as it did so. The turtle made at least six inches that time and Kay kept going.

Twice Kay had to go up the bank to keep the turtle moving towards the left.

In a further five minutes the turtle's head and shoulders appeared from the sand and soon it had completely emerged. By continuing to slap the right flipper Kay got it to turn round in its tracks. She then moved clear so as not to frighten the turtle and it slid down the bank and very slowly started to drag itself seawards.

After a brief glance at the turtle Kay moved homewards.

She knew that it would be all right now. It was just a little tired after its ordeal and the effort she had forced it to make to break free. What never failed to amaze Kay was the knowledge that it would never have done that itself. It had given up and would have just lain there until it died. That was not too surprising in the present case but turtles which have wandered far inland so that they cannot orientate themselves towards the sea also just lie there until they die. After about a day they make no further attempts to find the sea. Yet these turtles are perfectly healthy and strong. This puzzled Kay. When she found them she could always get them back to the sea under their own power. She provided the direction to the sea by slapping a front flipper to make the turtle go to the left or right as necessary, and got the turtle moving by tickling its tail with her foot. Once she got it to the beach it took over itself.

Kay had now returned home, still deep in thought, her head buzzing with ideas. However, she was ready for bed, it being after two o'clock. With that delightful feeling of physical tiredness and well-being which this gives one she soon fell into a deep sleep. The last sounds she heard were the familiar high-pitched squeaks of some flying foxes as they fought over the ripe fruit on a nearby paw-paw tree.

The next night Kay again looked for Ruth but Ruth did not appear. She decided that Ruth must have completed her nesting cycle and afterwards could never pin-point what made her return to the beach for yet a fourth night, making an interval of seventeen days since Ruth's fourth nesting. Kay went to the back of the island during the day so she could see the mass of tracks resulting from nocturnal activity on the beach. Since she had been up much of the night for

the preceding three nights, she slept until at least lunch-time. This left little time for day visiting of the turtle beach as she had to be back there in the evening to look for Ruth.

She set out in the late afternoon and arrived at the bay where she had been watching for Ruth by night just as the sun was fast falling towards the horizon. It was the first time for ages that Kay had seen the bay in daylight. It appeared as if a line of tractors had moved up and down the beach, from the sea to the vegetation, and as she walked along there seemed scarcely space for another track. Such was the density of green turtle nesting where man, the dominant species in the world today, had not altered the balance firmly against the turtles. Kay thought she recalled reading that in many parts of the world there are now no turtles or only a few stragglers, though in former times they were every bit as numerous as here. Hunting has wiped them out. Adult turtles have so few natural enemies that they are very vulnerable to large-scale human predation which she had been told resulted from the demand for turtle soup and the new craze for turtle oil cosmetics and turtle leather.

This evening, the fourth consecutive night Kay had looked for Ruth, she was rewarded, Ruth being among the first of the turtles to appear. She started nesting beside and partly under a large clump of pandanus.

While Ruth was completing the body pit, large dark rain clouds moved over the island and Kay resigned herself to getting wet. When it rained, usually after nightfall at this time of the year, it poured. Only people who have lived in the tropics can imagine these quick tropical downpours which may be over in about an hour after producing one or two inches of rain.

The first large drops started to fall and the rain quickly gathered momentum until, looking out from under the shelter of the pandanus all one could see was a solid sheet of water. Even with a powerful torch it would have been impossible to see beyond fifty feet.

The pandanus were soon completely soaked and without warning the long leaves bent over under the weight of water lying along their main ribs. It was like sitting under a series of taps, and as the water poured down Kay's neck and ran from her bottom onto the ground as she crouched hunched up to minimize the area of her body in contact with the water, she felt grateful that it had been another warm night and she was wearing only a cotton shift. She did not mind getting wet herself, this being no hardship in the tropics, but she did dislike soaking wet clothes sticking to her body.

As the water continued to pour down her back and run in rivulets down her legs and arms, she was interested to see the effects of all this rain on Ruth. Ruth looked a sorry sight with wet sand sticking to her flippers and body. There was no question but that the rain had impeded her progress though she had continued digging throughout. Kay, who couldn't have been much wetter, moved forwards to help. While they were digging the egg chamber the rain stopped. Kay and Ruth rapidly completed the egg chamber and Kay watched Ruth deposit 159 eggs in her fifth clutch for the season. She did not wait to watch Ruth complete the filling in process and return to the sea because she was still very wet. However, as on previous occasions, she carefully noted the exact location of the egg chamber so that she could subsequently watch for signs that the baby turtles were about to emerge and perhaps be fortunate enough to watch the hatch-

ing. Kay's mind was very much on baby turtles tonight as Ruth's fifth laying was the reminder that her second clutch of eggs was about to hatch thereby providing Kay with her first chance to see Ruth's babies.

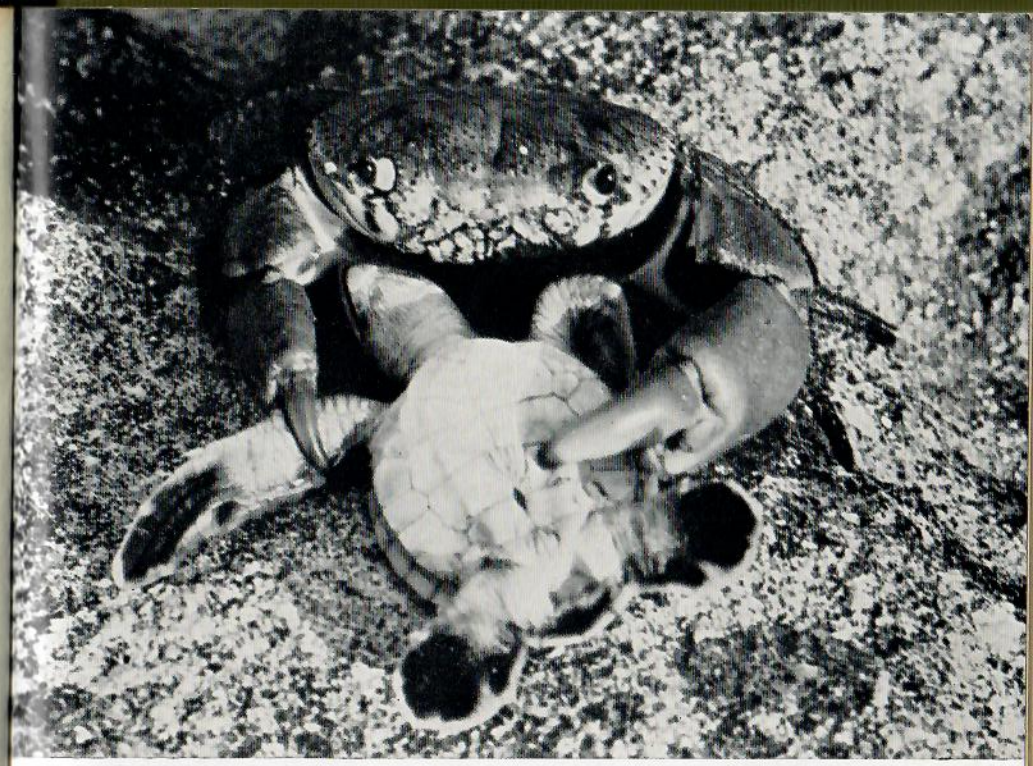
Ruth returned and nested for a sixth time after a further interval of fourteen days. Kay had come to look for her for the first time in that nesting cycle that night and both Kay and Ruth arrived at the beach simultaneously. At her sixth nesting Ruth laid 161 eggs. The chief event that remained in Kay's mind that night was the extreme clumsiness of turtles when they were forced to move backwards. After filling in and disguising the nest site – Ruth never spent too much effort on the latter which to Kay was a sign of her superior intelligence – Ruth toboganned down the steeply inclined bank and came to rest partly under a mass of she-oak roots. These had been exposed by erosion combined with digging activities at the foot of the bank by previous nesting turtles. Since the sea lay on the other side of the roots, Ruth without hesitation crawled further into the tangle and once completely inside tried to push her way through on the seaward side using her great strength. Unfortunately, her strength was insufficient to break she-oak roots. Had they been pandanus they would have ruptured or come out of the sand and allowed the turtle to continue on its way. Ruth spent considerable time and energy in an attempt to break through but eventually she realized that it was useless.

The obvious thing to do now was to back out and then continue down the beach. Being extremely reticent about moving backwards on land, like all turtles, Ruth decided after a prolonged rest and 'think' period to try to turn around in the confined space. In the course of this, one front flipper

got hooked over a strong rootlet which came out of the sand and projected several inches in an elongated loop before re-entering the sand at the edge of the bank. Ruth could not progress forwards over this obstruction but succeeded in manœuvring herself into a position from which she could not retreat either. The root trapped her beneath the shoulder so that she was quite unable to move the left front flipper in either direction. After a few abortive attempts she remained motionless apparently having given up attempting to get out.

Ruth was very lucky to have Kay to help for the second time that evening. It was a simple matter for Kay to work out that in order to get free Ruth must pull her head in and move forward a few inches using all her strength to push back the roots in front of her. She would then be in a position to lift her left front flipper clear of the obstructing root and then, with Kay's help, bring it backwards to clear the root. Putting this into effect in the confined space was quite another matter! However, Ruth now knew Kay well and was an extremely placid turtle. In fact, it passed through Kay's mind that perhaps she was just sitting there letting Kay work it all out in the knowledge that she would then come and help her out of her impasse!

Straddling Ruth, Kay encouraged her to move forward. Ruth strained against the roots but did not move forward sufficiently and Kay, who was virtually doing the splits and had hard roots digging into her ribs and breasts, exhorted her to greater efforts. As soon as Ruth had managed to push the roots back a key couple of inches further, Kay leaned forward and grabbed her left front flipper in her left hand. She clambered onto Ruth's back and grasping the flipper with both hands so that it cleared the obstructing root, encouraged



A red-eyed crab holds a hatchling green turtle in its vice-like grip at the edge of its beach-rock shelter

A ghost crab holds a struggling baby turtle in its greatly enlarged left claw while with its right claw it picks out and eats the turtle's eye

A land hermit crab stretching out of its shell 'house' to right itself after Kay has placed it upside down on the sand

Kay finally located Ruth (*in front and to the left*) after walking half way round the island

Ruth to move backwards so that she could let the flipper down behind the root obstruction. Ruth clearly did not like this manœuvre but after token resistance did as Kay wished. Kay now jumped from her back, the way being clear for Ruth to clamber free from the roots and proceed down the beach to the sea. Kay's body was tingling from the exertion of maintaining a most difficult position for a lengthy period of time while she encouraged Ruth to make the right moves and she wiped perspiration from her face. Soon Ruth was back in the sea and yet another nesting was over.

Kay did not know if she could expect Ruth to return to nest again but had thought this on previous occasions so a fortnight later went out to look for Ruth. On the second night, fifteen days after the sixth nesting, Ruth came ashore to lay her seventh clutch of eggs. This nesting was interesting in that it occurred on one of several evenings of dry storms. Sheet lightning vividly illuminated the moonless sky at frequent intervals virtually turning the scene to day. She was most interested to note that this made Ruth very frightened. For the first time she was clearly nervous and on edge throughout the whole of her time ashore. This night she laid 140 eggs.

Fourteen days later Kay was unable to visit the beach. She was vexed but knew that if Ruth did show up again she would not be able to lay without her help so would return the following night. When Kay went to the beach the following evening Ruth did not appear. However, she was back again the next evening, sixteen days after her seventh nesting. This night there had been a big rain storm earlier in the evening and following similar storms on the two previous evenings the sand was very wet. Kay was fascinated to discover that this put Ruth off course. When she came to the usual nesting

area just over the bank she continued inland after only a few cursory digging movements and then proceeded to wander rather than settle down and start an excavation. Kay left Ruth for a few minutes to inspect the other turtles on the beach and found that they were all behaving similarly. It occurred to her that perhaps dry, powdery sand was one of the cues necessary to release the digging urge, and that being in the vegetation zone above the bank was not sufficient in itself. Then she remembered the magic effect that a head-downward inclination usually had. She looked round and found a deep crater resulting from a previous nesting and by slapping the left flipper, with occasional remedial 'steering' actions on the right flipper, she directed Ruth to this. It worked! As soon as Ruth fell into it she started digging and once properly started she continued with vigorous actions of her front flippers.

The two 'girls' dug the egg chamber as a co-operative effort as before and Ruth started laying. Kay was surprised that Ruth stopped laying after only 98 eggs. She thought she must have paused during the egg laying process and Kay twitched a rear flipper to hurry her up. Instead of starting to lay again, Ruth began covering the egg chamber. Kay did not know that the last nesting of the season is often much smaller than those which precede it. Had she known this she would have realized that Ruth with the eighth nesting had now completed her nesting for that year and would not be seen again until she was ready for another nesting cycle in three or four years' time.

In ignorance of this, Kay kept a careful watch for Ruth after fourteen days and maintained this on three subsequent nights but to her disappointment Ruth did not reappear.

The parting was doubly sad as Ruth had not been ashore during the day for more than six weeks now. Her daytime beachings had ceased once the mating season had finished and hence nocturnal nesting activity had been Kay's last contact with her just as it had been her first.

Kay brightened somewhat at the thought that two clutches of Ruth's eggs still remained to hatch. The sixth clutch had hatched the previous evening but the seventh and eighth clutches had still to hatch. Hence she would have some feeling of contact with Ruth for another month. The hatchlings she had taken from the second brood of the year were growing well and Kay decided to take two also from the eighth nest when that hatched. That would give her four of Ruth's progeny with a time interval of three months between their hatching. Now at eight weeks old the first two which she had named Deba and Florie weighed six and five ounces having increased their weight almost seven and exactly eight-fold respectively from the three-quarters of an ounce each had weighed the day after Kay had brought them home.

CHAPTER SEVEN

The hatching of Ruth's babies

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KAY had often seen broods of baby green turtles scampering down the beach to the sea in the hour or two following nightfall. She had been entranced by the way they rushed seawards in a completely single-minded fashion like over-wound clockwork toys which could know no rest until they had released the pressure on their main spring. When they reached the water they swam steadily out to sea and were soon lost to sight. Little did she know that they maintained this frenzied activity for several days after leaving the nest, and that it was thought that this enabled them to get well clear of the reefs which harbour many predators and out into deep water. Once in the deep sea, floating at the surface, their black dorsal coloration disguises them from the watchful eyes of seabirds flying overhead, as the mass of the sea looks blackish from above, and their immaculate white undersides make it difficult for fish beneath to spot them since the sea's surface appears silvery white from below due to the sky's reflection on the water.

Occasionally Kay had watched the actual emergence process and she knew that in the day or so prior to emergence the nest site took on a slight depression indicating that the baby turtles would soon come out. Kay did not know that the turtlets broke their egg-shells, using a special egg-tooth

on the snout, which was later lost, a full three days before their emergence from the sand. For the first day they sit in their egg-shells and 'unbend' for in the egg their bodies are curved to fit into the confined space. During this period they absorb their yolk-sac – the remains of the yolk that has nourished them during development – and this ensures that for the first four or five days of life in the sea they do not need to worry about finding food.

After their yolk-sacs are fully absorbed into their abdomens, the baby turtles show signs of activity and this quickly spreads through the whole mass of turtlets. Instinctively they direct their efforts upwards. The chance of one or a few turtlets managing to escape from that depth in the sand is remote, but working together, it is no problem for the brood. The uppermost turtles dig into the roof over the eggs and as this caves in it is trampled down by the multitude below. In this way the whole brood slowly moves upwards rather like an elevator slowly making its way up a lift-shaft. The analogy is particularly apt as the emerging turtles do in fact move up the neck of the original egg chamber. Kay was well aware of this for she had occasionally excavated nests after the emergence of the young to see if any were left inside the nest as sometimes happened. Working with her bare hands she had found it extremely easy to trace the exact outlines of the egg chamber even after a lapse of two months. The surrounding sand was more consolidated, likely to contain rootlets which bound the sand together, whereas the sand in the neck of the egg chamber was much looser and easier to remove. When one's hands touched the limits of the egg chamber one was at once aware of this.

Kay also knew that the baby turtles hatched in a specially

contrived chamber under the sand. When collecting eggs the day after they had been laid she had discovered – initially to her surprise – that the eggs were not imprisoned in a solid mass of sand but loosely covered with many air spaces between the eggs into which sand had not penetrated. This was a surprising find as, watching the female turtle cover up the eggs, one could be excused for thinking that the sand would be pushed down very firmly over and around the eggs. The next time Kay saw a nesting green turtle she watched most carefully when it started to cover the eggs and noticed that the main effort was directed towards bringing sand in from the sides and that at no time did the turtle actually ram the sand down over the nest. What happened was that the eggs were covered by a loose mass of sand which somehow settled to form a ceiling to the egg chamber without pressing down on, and falling between, the eggs.

Kay also knew that baby turtles almost all emerge in the hour or two following nightfall. She had never given this much thought, merely accepted it. She would have been most surprised if she had known how this was brought about. The baby turtles digging upwards in the dark may come close to the surface at any time of the day or night. However, if sand temperatures near the surface exceed a certain level (which they generally do during the day), the hatchlings become torpid and remain so until temperatures drop off in the early evening. This means that all the broods of hatchlings which reach the upper sand levels during the day lie in wait until falling temperatures in the evening cause them to become active again. Hence there is a spectacular burst of emergences in the hours immediately following nightfall.

Several times Kay had noticed one or two heads or flippers

poking out of egg chamber depressions as she walked along the beach at sunset. She did not know that these were the forerunners of a brood waiting for cooler temperatures to activate them, and hence the rest of the brood was lying in deeper levels in the sand. One evening when she saw this she bent down and gently pulled out two baby turtles, parts of which were protruding from the sand. The effect was like removing a champagne cork! The sand heaved, baby turtles 'bubbled' out of it, and in under a minute more than one hundred baby turtles had fought their way out of the ground to go scampering down the beach. Kay had unwittingly provided the emergence cue by activating the two hatchlings at the surface and the disturbance had been transmitted down through those immediately below to the whole brood which had then emerged. As they scampered down the beach, seagulls appeared from nowhere to dive on the babies and soon five silver gulls each held a baby turtle in its jaws despite Kay's best attempts to protect the brood. The gulls landed at once at the water's edge some distance away from Kay and tried to swallow the turtlets which was quite arduous. However, all succeeded, and two in time to take a second straggler from the beach. The remaining three gulls took off and each soon swooped on a baby turtle swimming through the shallow water on the reef flat while Kay watched impotent on the beach, and winged shorewards to devour their prey. Kay was forcefully reminded of the advantage for the baby turtles of waiting for nightfall before emerging. The gulls were almost exclusively diurnal, although occasionally they patrolled the tide mark on nights around full moon.

The first time Kay had watched a turtle brood rushing down the beach she had been saddened to see three large ghost

crabs each descend on a hatchling and start to drag it towards its burrow. Although the hatchlings beat the air wildly with their flippers they seemed utterly powerless to defend themselves from the crabs which held them by their necks with their big claws. Kay quickly ended the unequal contest in the turtlets' favour by giving each crab a kick, causing it to release the baby turtle and to run sideways for the protection of the sea while the baby turtles, unharmed, continued their rapid jerky progression down the beach to the sea and the dangers they would meet on the reef flat.

Later the same night Kay had come upon several ghost crabs sitting near the mouth of their burrows eating baby turtles. In two instances the turtles were clearly dead, their limbs hanging limp, but in the remaining three cases they were very much alive. Kay rescued the latter hatchlings to find that two had had their brains eaten into by the crabs while they were still alive and the third had had one eye completely picked out. She quickly put them out of their misery and went on her way with a shudder. From that time on Kay disliked ghost crabs and usually aimed a kick at patrolling members of the species – which invariably missed – as they scuttled away from her across the sand. People often accuse reptiles of being cold and efficient but to Kay the baby turtles had an endearing charm while the crabs were cold, characterless, automatons which were, alas for the turtlets, extremely efficient hunters. When one crab secured a baby turtle, somehow the information was transmitted to the other crabs on the beach and, unless the turtle was a straggler, all crabs rushed hither and thither until they too encountered a hatchling and then all settled down to enjoy their meal.

However, the turtles were lucky on this island, Kay reflected. On the rocky, mountainous islands, monitor lizards, known to Kay as goannas, often occurred in huge numbers. These large lizards patrolled the beaches detecting the presence of turtle nests with their acutely developed sense of smell. The monitors crawled across the sand by day with their peculiar gait in which the long body twisted from side to side and the limbs splayed out sidewards. The long tail dragged along the ground leaving a well marked furrow in the sand. As they crawled the monitors continuously extruded and retracted their long forked tongue the tips of which just brushed the sand before being withdrawn. Each time the tongue was retracted the tips were pushed into paired organs in the roof of the monitor's mouth which were the sites of a remarkably acute sense of smell. Tiny particles from the tips of the tongue were wafted into these organs and gave the monitor very detailed information about its surroundings. The mechanism served to 'concentrate smell' so to speak, in that tiny particles possessing sensory (smell) cues were collected by the tongue and intruded into the smell organ. In this way the monitor knew precisely when it was over a turtle nest and using its powerful front limbs, equipped with sharp claws, could rapidly dig down to the level of the eggs. As many chicken farmers know, monitors have a great fondness for eggs. When visiting uninhabited mountainous islands, Kay had often seen the beach literally criss-crossed with monitor tracks and had noted the remains of nests where several monitors had fed in turn until, gorged with eggs, they had retreated to sleep off the meal in their lair among the rocks. However, on this small cay there were no monitors. Nor did the turtles here have to face the deadly predators introduced to the

mainland by the white man – pigs, foxes and dogs – or the dingo, probably brought to Australia by the aborigines.

When Ruth had laid her second clutch of eggs, Kay had been careful to mark the exact spot in her mind. This was not difficult for her as Island people have a much better sense of geography and an awareness of their surroundings than Europeans who somewhere along the way have lost this sensitivity. She knew that they would hatch in about six weeks and made a mental note to investigate the site regularly from a few days before Ruth was due to lay her fifth clutch of eggs.

Ruth had nested for the fifth time the day before yesterday and the next afternoon Kay had noticed a slight but definite depression over the site of her second egg chamber. She decided to return late the next afternoon to see if anything happened. Somehow she felt that she shared these hatchlings with Ruth and was eager to watch them emerge and to try to see that no harm came to them, at least until they entered the sea.

Kay arrived at the nest site shortly after five o'clock – a good hour before sunset. She had come early, partly from a feeling of impatience, but partly also subconsciously from good sense. The site was shaded from mid-afternoon so would cool off much more quickly than an average spot on that beach.

As soon as she arrived Kay noticed a difference from the previous day. Now three small black heads, each complete with pointed egg-tooth, protruded from the sand and two front flippers also poked out. Remembering her previous experience Kay determined to be patient and to await happenings without interfering. For about an hour nothing

happened and then, just as the last glimmerings of the dying sun were fading on the still waters of the bay, Kay detected a slight movement and then another. She craned forward to watch exactly what happened and saw that the turtlet in the centre of the three was moving its head slowly from side to side. As she watched, it dragged one front flipper from the sand and laid it on top of the adjacent hatchling. This turtlet at once responded and started to drag itself upwards as did the third member of the trio. In a moment two other heads appeared from below and the mass of sand moved, presumably as other turtlets fought their way upwards through the neck of the egg chamber. The scene now changed very rapidly. One minute there were seven hatchlings all struggling to release themselves from the sand and each stimulating the others to more activity. Scarcely a minute later, these first turtlets to emerge were fanning out followed by the next wave and the mouth of the egg chamber was a seething mass of struggling turtles rather like the struggling mass of humanity one would expect to find in a cinema exit after someone had shouted 'fire'. Similarly, the hatchlings were propelled upwards as much by the pressure of those below as by their own efforts to free themselves from the others and the sand. Kay had determined to keep count but realized that this was quite impossible. She knew she could check this later by excavating the nest. She had counted the eggs as Ruth had laid them and it would be a fairly straightforward matter to dig up the nest, count any hatchlings still present, unhatched eggs, and apportion the egg-shells to turtlets.

The nest was situated over the bank so that in order to reach the sea the baby turtles had first to climb upwards, to

the top of the bank. From the nest site the sea was not visible. There were a number of small bushes seawards from the nest and behind the nest site was a mass of vegetation which appeared like a black wall in the last moments of twilight. Kay watched the fore-runners of the hatchlings. Following emergence, they sometimes seemed to circle the nest but then set off unerringly towards the sea. Most hatchlings as soon as they popped from the sand unhesitatingly headed seawards. Kay wondered how they did this. Most nests, of course, were laid in situations where the baby turtles would reach the sea by simply moving downhill or in locations where the sea was visible from the nest. Kay did not know that baby turtles find the sea by moving towards the light horizon and that they possess a remarkable ability to discriminate small differences in light intensity. The surface of the sea acts like a huge mirror reflecting available light. Even on the darkest night when the moon is not up and the stars are cloud-covered, there is always sufficient light to illuminate the sea very slightly. Kay *did* know that baby turtles move towards light. On several occasions when she had shone a torch on the beach she had suddenly become surrounded by a brood of hatchlings which had urgently tried to climb up her body towards the torch. The first time this had happened had been on a particularly dark night when she was collecting eggs and was using a small torch to see what she was doing. Without warning, a couple of hatchlings appeared out of the night and dropped into the egg chamber, illuminated by the torchlight. Almost before she realized what had happened, several dozen baby turtles had appeared and, crawling around the body pit, fell among the eggs and caused so much confusion that the laying turtle stopped laying. In the confusion,

while Kay was picking the hatchlings out of the egg chamber, the torch fell in among the eggs and went out. Shortly thereafter Kay no longer felt the tickling sensation of baby turtles trying to climb her bare legs. They had all headed for the light horizon – the sea. On a subsequent occasion, Kay found that she could attract baby turtles running down the beach back up if she shone a torch on the sand.

Kay rose and followed the bulk of the hatchlings down towards the water. Once they reached the bank they made rapid progress sliding down the slope and banging into each other. A few fell on their backs but quickly righted themselves, unlike adults which once turned over, are completely unable to right themselves. In the scuttle to the sea the baby turtles moved in the normal four-legged animal manner, not by simultaneous pushes of all four limbs like adult green turtles. Kay had never noticed that trait before.

Soon the forerunners of the brood were at the water's edge and Kay noticed that as soon as they struck wet sand their limb actions changed to a swimming motion. The baby turtles were extremely buoyant but unhesitatingly headed towards the deep sea and set off with powerful strokes of their large front flippers. They swam several feet or yards and then dog-paddled on the surface while they breathed and then were gone again. Some appeared much more accomplished swimmers than the rest and right from the water's edge skimmed seawards below the surface with only occasional surfacings for breathing. Kay had seen that no ghost crabs attacked any of this brood of turtles and impulsively as the main column of turtles reached the water, bent down and picked up two particularly active turtles. She determined to take these home and rear them in captivity, at least for a

while. These would be two members of the brood not eaten by sharks or other predaceous reef fish within minutes of emerging from the nest. As Kay had these thoughts, she heard the first plopping noises and then several swirling sounds as fish jumped out of the sea. The plopping noises were fish surfacing to take a baby turtle. As Kay stood on the beach in ankle-deep water she wondered what was happening out there and how many of the brood of hatchlings would reach the edge of the reef let alone survive their first week of life.

The next afternoon she returned to excavate the nest. This she did quickly, the sand being particularly soft in the neck of the egg chamber. She encountered no turtlets as she dug down into the chamber and was soon at the level of the nest and began to pull out egg-shells which she placed in one pile. She touched something moving and pulled out a baby turtle and then a second one. She wondered why they had not emerged with the rest of the brood and placed them on the sand. The first one had a deformed flipper which resulted in its being able to move only in tight circles. The other individual appeared very weak and had a badly deformed upper shell. Kay took them both down to the water to see if they could swim but realized that neither would be able to survive. In the absence of anything with which to put them out of their misery, she threw them to a circling seagull in the knowledge that they would be dead in minutes, and returned to the nest just in time to chase off two gulls which were approaching expectantly.

Kay knew that Ruth had laid 166 eggs. She counted twenty-four which had not hatched and, from their discoloured shells and the fact that several were shrunken, she judged that they

were either infertile or that the embryos had died during development. In addition there had been the two deformed hatchlings. She made a rough check of the number of egg-shells and came up with at least 138 hence checking that the nest had not been excavated by another turtle in the intervening period. There had, therefore, been 140 hatchlings in the mass that had rushed down to the sea the previous evening. Little wonder that she had been unable to keep count!

It occurred to Kay that turtles were remarkably productive animals and must have to undergo terrible juvenile predation otherwise the sea would be teeming with turtles. She did a quick calculation. Ruth had laid her fifth clutch three days previously so had laid a total of 821 eggs already that season. Ruth was a large turtle but that was a colossal number. She wondered if Ruth would lay any more clutches that summer.

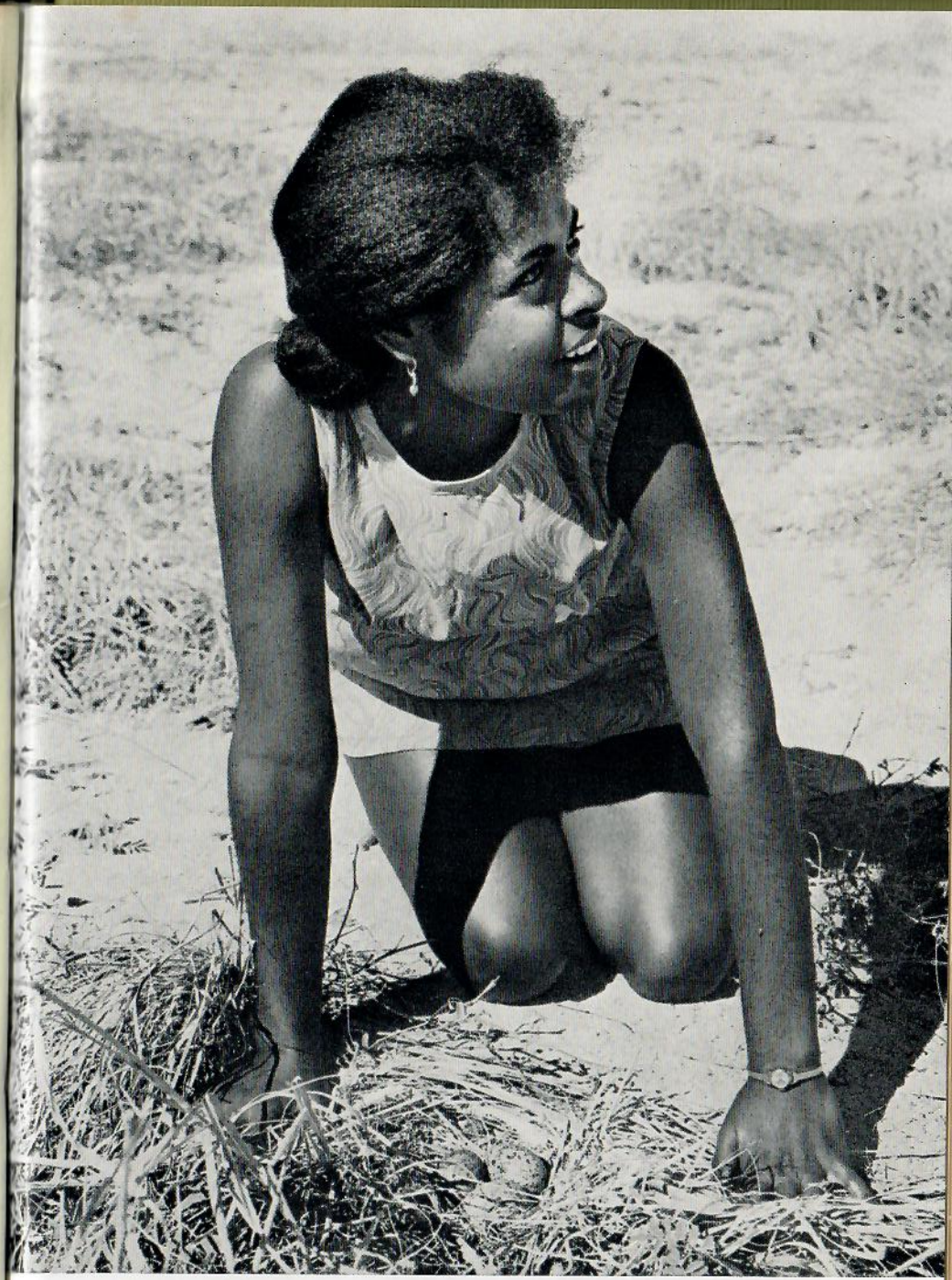
Kay sat down on the beach and was idly following the progress of the first of that evening's hatchlings across the calm sunlit waters of the reef flat when she saw one of the eagles soaring into the sun. The cay, like most in the neighbourhood, supported one breeding pair of white-breasted sea eagles which were seldom seen except at times like this, but particularly in the early morning, soaring effortlessly off the beaches at a height of several hundred feet. Now as she watched, the eagle circled over the bay losing height slowly and then to her surprise, skimmed over the water's surface and caught something in its talons. It was most unusual actually to see an eagle fishing and Kay wondered what it had caught. As it rose against the pale sky she was able to see without any doubt that it was a baby green turtle.

The seventh nest had been laid at the edge of a grassy patch and though, naturally, any grass roots in the path of the

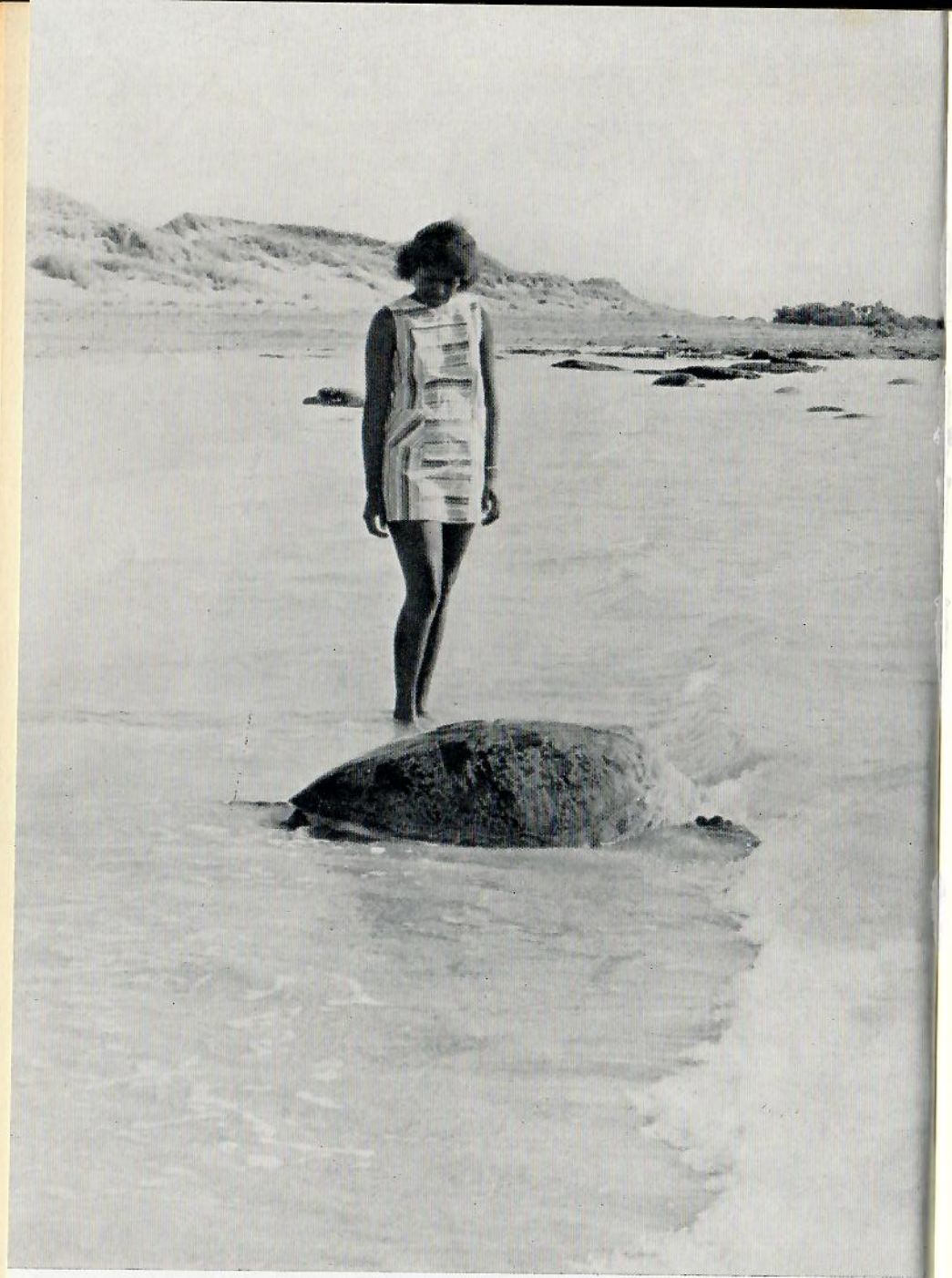
egg chamber had been removed by Ruth during the excavation, runners had apparently criss-crossed the area in the intervening six weeks although there was little indication of this at the surface. When the emergence took place only about fifty babies came out and even they were spaced over a much longer period than usual. As soon as they had all entered the sea Kay returned to investigate. Ruth had laid one hundred and forty eggs and fifty hatchlings seemed a very poor dividend. As she dug down she soon came upon the grass runners forming a virtual net across the neck of the egg chamber and saw a mass of baby turtles caught in it. As she tore the runners away, the turtlets pushed upwards and more emerged than had come out previously, rushing down to the sea like their predecessors who were probably out over the edge of the reef by now – at least, *the survivors should be*, Kay thought

For a number of reasons Kay was particularly anxious not to miss the emergence of the eighth nest. First, this would be the end of turtles for this season. Although Ruth had been among the first turtles to start nesting, she had laid more clutches than most with the result that by now there were few unhatched nests on the island. Equally, if not more important, Kay wanted to take two babies from the eighth nest to rear in captivity. She had taken two from the second clutch but had deliberately waited for the last nest to hatch so as to space them as far apart as possible. She had worked out that when the last of Ruth's nests hatched, the babies from the second clutch would be about three months old, and so it worked out. Both had done exceptionally well (see Chapter 8) and at three months weighed 12½ and 11½ ounces apiece.

As it happened, she had no difficulty in seeing the emergence



Kay at a silver gull's nest, watching a swooping and irate parent



Ruth re-entering the sea after a day spent ashore

of the eighth brood. About six weeks from the time of egg laying, Kay examined the nest regularly for the tell-tale slight depression in the sand. On the fourth visit she detected a slight depression over the egg chamber and the next evening the young emerged at about nine o'clock. The tide was well out and the baby turtles had to cross an area of beach-rock before they reached the sea. This made for the most exciting evening of all for quite small ledges, about four inches high, presented mountaineering tasks to the hatchling turtles. Their approach was the very antithesis of the adults, Kay thought, as full of optimism they tackled the most impossible climbs. What they lacked in size and realism was amply compensated for, however, in energy. This boundless energy was essential in situations such as this where, broadly speaking, they had to climb three major 'steps' in the beach-rock before the rock angled downwards towards the sea. In some places there were crevices below the rock so hatchlings had to move sideways to find an area to climb. Red-eyed crabs lurked in these crevices and Kay reflected that it was fortunate that these were extremely slow-moving crabs and that the hatchlings avoided dark areas in their quest for the 'illuminated' sea. Taking no risks, she had reached the beach-rock ahead of the mass of turtles and quickly searched it for foraging red-eyed crabs. She found three, each of which she picked up at the rear of the shell where the threatening big claws could not reach her fingers, and flung sideways and seawards so that they landed on the soft mud well clear of the area that the hatchlings would traverse. She then took up a central position on the beach-rock where she could observe the 'army' scale the 'mountains' and give help where necessary.

In general the sheer activity of the hatchlings made help

impossible. They had no sooner tumbled backwards and landed upside down than they had righted themselves and were off again. However, Kay noticed two gory encounters where a second's hesitation at the edge of a crevice proved fatal. In both instances, a red-eyed crab which must have been lurking just under cover, moved imperceptibly, its huge claws shot out and firmly imprisoned the baby turtle in its vice-like grasp. The crab then slid back into its dark, damp crevice to devour its meal at leisure. Kay felt sure that other hatchlings met a similar death unnoticed by her as it was quite impossible to watch more than a fraction of the brood which was moving in a series of waves across the beach-rock. The advance party had now reached the seaward slopes and were slipping and sliding across a thin layer of mud to the water.

Kay remembered that she wanted to take two hatchlings to keep so stationed herself on the seaward crest of the beach-rock and picked up two which to her eye appeared particularly vigorous as, having completed the last climb, they scuttled towards the sea. She waited until all visible hatchlings had taken to the water then walked landwards and then along the beach-rock where she located three hatchlings that were trapped by exceptionally difficult terrain. She deposited these on the seaward slope and then, her two babies squirming and flapping incessantly in her hands as they tried to break loose, set out for home.

The next day Kay returned to the site of nest eight and excavated it to find out how many hatchlings had left the nest. She added this to her previous total and found that the seven nests which had been allowed to hatch naturally had produced eight hundred and ninety-four hatchlings. Although she had not seen clutches three and five emerge she was able

to keep complete hatchling totals, as in the other instances, from an examination of the egg chamber after hatching had taken place.

During the routine examination of the third egg chamber she had found nineteen hatchlings dead in the nest. Most had occurred in the lower portion of the neck region of the chamber. This was the first time she had come across such an occurrence and Kay wondered if the torrential rain of the few days preceding emergence might have had something to do with it.

In another egg chamber Kay came across a find unique in her experience. It was a white turtle, or rather, a pinky-white turtle as it lacked all pigment and the blood gave the thin areas of the flippers a pinky hue. It also had pink eyes. It was a pure albino. Unfortunately it seemed very weak. Kay had found it at the foot of the nest among the shells and unhatched eggs. She took it home but it died during the night.

During excavation of another nest her hands detected movement and then one finger was given a sharp nip. She looked down the hole and there was one of the small land-dwelling ghost crabs. It must have tunnelled into the nest.

This had been a most eventful summer for Kay and she was left with many new things to think over. She felt sad that it had come to an end.

CHAPTER EIGHT

Kay's pet turtles

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WHEN Kay brought home the two hatchlings from Ruth's second clutch of eggs, everyone expected her to keep them in a five gallon kerosene drum cut in half horizontally to make it shallower. When an Islander decided to rear a baby turtle, as happened from time to time, this was how they housed it. Occasionally it might be kept in a plastic washing-up bowl. Kay had other ideas. She was also inundated with advice about how to feed and rear the babies to which she only gave half her attention as she wanted to explore the possibilities herself with an open mind. This was to be an adventure, and these turtles were to be real pets, not just animals stuck in a basin and thrown food from time to time when memory jogged the nominal owner or a member of the family. Of course Kay could not say this to her friends.

The morning following her return with the two turtlets, she sought out her grandfather when he was alone and asked him if she might borrow one of his dinghies. He at once wondered what she wanted it for and Kay explained that it was to house her two baby turtles. This appeared a novel idea to her grandfather but he was an 'easy touch' to Kay who had a way not only with animals but with people – most people were as Plasticine between her fingers and gave way in response to her direct approach, fluent tongue and

shy smile. He reflected that he had three dinghies and could easily let her use one for the turtles.

As soon as he agreed, Kay went to the dinghy which was full of dead leaves and other debris and cleaned it out. She then placed empty kerosene drums on both sides and several pieces of wood to ensure that it would stand upright. She then called her brother and together they went down to the sea and started carrying up buckets of salt water. They added these to the dinghy until the central area was about four inches deep. Kay then added the two baby turtles, which had been in a wash basin overnight, and took up a position on an upturned drum to watch them. She had expected the baby turtles, which she had named Deba and Florie after her brother and sister, to swim eagerly around their new home so was extremely disappointed when instead, they swam to the sides of the dinghy and continued swimming against the side as if trying to climb out. Soon they both congregated at the seaward side although, of course, from their position it was not possible to see the sea which, furthermore, was screened from them by a coconut windbreak erected along the top of the beach.

Kay next turned her thoughts to food and went inside to cut off a small piece from half a fish which would be cooked for lunch. Having chopped this into tiny fragments Kay returned and offered it to the baby turtles from her fingers. They showed absolutely no interest in the fish and kept swimming against the side of the dinghy. Kay thought that perhaps they could not see the fish against her fingers so she selected the fine mid-rib of a coconut leaf and used it as a skewer on which she placed a piece of fish and dangled this in front of each turtle in turn. Again there was no response.

Kay decided to leave the turtlets to settle down into their new home for several hours and then try again. She got her brother to help her drag several sheets of corrugated asbestos over to the dinghy and used these to cover it to prevent cats from catching her babies. The dinghy was located partly under a coconut shelter so there was no question of the baby turtles being overheated by the sun during the heat of the day.

Kay had the same lack of success at several subsequent feeding attempts that day and throughout the following day. The second and third days Kay went out and collected oysters and offered the turtles small pieces of oyster. She also caught some sardines. Both were ignored by the babies.

Kay did not know that when baby green turtles hatch from the egg they still have a considerable amount of residual yolk. As this is absorbed into the abdomen before they emerge from the sand they do not need to feed for the first four or five days.

By the fourth day Kay was almost frantic. However, despite their lack of feeding – which seemed quite unnatural to Kay as the only babies she knew seemed to feed almost continuously – they appeared well.

On the morning of the fifth day Kay yet again offered them small pieces of sardine and to her delight, after a few minutes' hesitation, Deba made a few clumsy attempts to grasp the fish in his jaws, closing on the water. At the fourth attempt, Deba bit the coconut skewer instead of the fish but the fifth time he took the piece of fish in his jaws only to let it fall to the bottom while trying to manœuvre it into a position for swallowing. Kay, however, was thrilled. Here was clear evidence of interest in food at last, and quickly placing another fragment of sardine on the coconut skewer

she offered it to Deba again. This time he took it at the second attempt and swallowed it and then was clearly on the look-out for more. In the next fifteen minutes Deba took four more pieces of sardine and then ignored the sixth piece offered to him.

Kay turned her attention to Florie who, to her delight, also showed an interest in food this morning. She likewise showed the same clumsiness in securing the fish as her brother had shown a few minutes previously. However, with Kay's help she ate four pieces before, obviously sated, she declined any more. Kay sat watching Deba and Florie for some time, happy now that they had started to feed.

Later in the morning she returned to the turtles and offered them more fish. Both eagerly accepted it. Feeding, however, was a slow and extremely laborious business and required a great deal of patience and time. It occupied most of Kay's free time on the first day. Each turtle took four feeds of fish that day and that became the pattern. When she woke in the morning Kay went out and fed the turtles. They were given a second feed in the late morning, another in the mid-afternoon and a fourth and final feed just before nightfall.

After a few days, Kay dispensed with the coconut skewer as she found that Deba and Florie would come to her hands and take the pieces of fish from her fingers.

At this stage they were being fed almost exclusively on sardines which Kay caught with a throw-net, a circular drop net edged with lead sinkers. One carried this over one arm and went down to the shallows where large shoals of sardines usually patrolled and with an expert throwing action, which to the observer appeared effortless, threw this over the sardines. At least, this was how it was in theory. Considerable skill

was involved as some people consistently caught many sardines while others worked hard and achieved minimal success. Having caught the sardines Kay scaled them and cut them into little pieces. Without thinking, she fed all the sardine – intestines, heart, liver, kidneys – to the baby turtles and then threw away the head, backbone and tail. In this way the turtles were given an excellent, balanced and extremely nutritious diet.

Towards the end of the first week Kay was spearing fish in her father's fish trap. The Island people build low walls of stone and coral boulders just like Scots build dry stone dykes, but out on the reef flat, not on the land, and much lower than walls needed to contain farm animals. As with the dry stone dykes, the interspaces between the larger stones are filled in with rubble and expertly placed smaller stones. The wall curves round in a wide semi-circle so that when the tide goes out, any fish feeding on that area of reef flat are trapped. The Islanders say the best way to obtain a really large catch is to build up your fence but leave a well-defined gap through which the fish can pass as the tide drops. Then after several days when the fish have become used to entering and leaving the area, and at a time coinciding with really high tides, you close the gap in the fence and visit the fish trap as the tide falls and in this way you should secure very large catches for several days. Of course, the fences require periodic mending, without which they do not operate well, but on most tides some fish are caught in the trap. Turtles are often caught in the fish traps also, generally not adults, but immature ones some three years old, sometimes as many as three or four being trapped on a single tide.

As Kay walked along just inside the fence spearing fish in

the trap, she saw numerous small oysters on the walls of the trap and remembered that she wanted to try them again on her turtles. She collected a dozen before she returned home with the fish.

As soon as she got home she went at once to the turtles, and lifting the cover off the dinghy, sat down to feed them. Both came swimming over to her side of the dinghy and she deftly broke the flesh of a small rock oyster into several pieces with her finger nail and offered it to the baby turtlets. They went crazy, swimming so frantically to nudge each other aside and so secure the next piece that they appeared to be trying to climb up her hand! In no time all twelve oysters had disappeared. Kay had found a baby turtle delicacy. It seemed rather strange as they would never get oysters as wild babies.

Very little is known about baby turtles once they leave the beach immediately after emerging from the nest. Indeed, knowledge is nonexistent until they are at least a year old when they appear in shallow coastal waters in beds of 'turtle grass' and around reefs. No one knows where they go during this year, what they do, or what they feed on. Since the hatchlings are very buoyant and it is assumed they remain in deep water, scientists assume they feed on plankton – small animals floating in the surface waters of the sea.

Kay noticed, again to her surprise, that Deba and Florie spent long periods of time out of the water. They would climb up the sides of the dinghy and sit for hours right out of the water. Deba particularly favoured the secluded area where the rear seat met the stern of the dinghy. Unknown to Kay, scientists had several times found them resting on floating masses of sargasso weed. The trait could be a means

of minimizing the risk of predation by larger sea animals.

Kay cleaned out the dinghy and added fresh sea water each morning. She was soon able to tell when they had eaten a big meal. On lifting them up she could literally feel their full stomachs pressing against and extending the lower shell as at birth, both the upper and lower shells are quite soft to the touch. Just before a meal time, especially if it had been delayed, one could feel a concave area where the stomach was. Kay was amazed just how much food they were getting through by the time they were two weeks old and even she, though she saw them every day, was able to see that they had grown considerably even though they had only been feeding for just over one week. Deba's growth rate was especially impressive.

Between the age of two and three weeks they became much more proficient at diving. At first when they dropped a piece of food, they ignored it completely although it was only a few inches below them. Later on they would look down at it and Deba would often make some half-hearted attempts at diving towards it. These were never sufficiently vigorous or sustained, however, to enable him to reach it. Then, when diving became more vigorous, their aim was often defective and it took quite a few days before they seemed to be able to co-ordinate strong diving movements with correct aiming. Deba proved to be the more adventuresome turtlet and usually developed new traits before Florie. When they overcame these problems, Kay found she could drop the food into the dinghy and let them feed themselves. She added food until it was all eaten but did not allow any uneaten food to remain to foul the water. Of course, she still often fed them from her hands and they remained exceptionally tame.

The baby turtles were thoroughly spoilt by Kay's mother, an extremely industrious person who still found time to visit the turtles several times a day and chase Kay up if she overslept, or was in her mother's opinion slow to feed Deba and Florie or change the water. Other members of the family showed a passing interest but it was Kay and her mother who became really fascinated by the turtles and were to remain that way.

After one month, Kay cut the feeds down to three per day and at two months to two feeds each day. The turtles were now very much larger and able to eat much more at one time rather than little and often. At six weeks they weighed just over five ounces compared to their weight of three-quarters of an ounce at birth. This was a weight increase of seven times their birth weight in six weeks!

As the turtles grew, sardines became too small in that most of the effort went into scaling and cutting off the small amounts of meat on each fish. Kay now either speared fish in the fish traps or on the reef flat or went fishing with her grandfather in his dinghy. There was an abundance of fish on the reef so providing food for the turtles was no problem. It would have been a simple matter to feed several hundred as well as just two.

Even at two months old, the young turtles – they were no longer babies – had become much lighter in dorsal shell coloration. Areas of brown had appeared on each carapace shield and by three months this progressive change was much more noticeable and areas of streaked markings, such as characterize the immature turtles seen on the reef flats, were starting to make their appearance at the rear of each shield.

It was not until Ruth's eighth clutch of eggs hatched and

Kay brought back two more hatchlings, that she realized just how much her two three-month-old turtles had grown. She had forgotten just how tiny the bodies of newly-hatched turtles were with their proportionately absurdly large flippers. Deba and Florie now weighing 12½ and 11½ ounces respectively or approximately sixteen times their weight at birth, appeared enormous beside them. Kay wondered if she dare put the new babies in with them. She decided to put them in and keep a close watch for a while to see what happened. As soon as they were in the dinghy, the two newcomers started up a mad swimming frenzy which kept them paddling against the side of the dinghy just as Deba and Florie had done three months before. Kay recalled that this had lasted for several days before they had started to settle down. Now this never happened, and Deba and Florie swam effortlessly around the dinghy, swimming on the surface or under water and diving for food with expertly directed, and apparently effortless, flipper strokes.

The ceaseless activity of the newcomers soon attracted the attention of Florie and Deba who swam over to see what was going on. However, they proved merely extremely curious and made no attempt to bite or in any way interfere with the two new hatchlings which Kay named Harry and Ettikai after her grandfather and father. Kay, therefore, decided that all four turtles could stay together. This time she made no attempt to feed the newcomers for four days. When Kay offered Harry and Ettikai food, they settled down to feed after several clumsy attempts, just like Deba and Florie three months earlier.

It was about this time that Kay's grandfather suggested she offer Deba and Florie some of the turtle grass which grew

so abundantly in the bay outside their house. That afternoon Kay brought some of the thin, grasslike, green blades home and put them in the dinghy. The two larger turtles at once showed interest and had soon devoured almost all the grass. Harry and Ettikai however, showed no interest in the grass but eagerly accepted pieces of sardine from Kay's fingers.

Kay wondered how to tell the sex of the turtles. She did not know that Deba was a boy and Florie a girl turtle. She had puzzled about this several times when she had only Deba and Florie but being unable to see any differences between them, she decided that perhaps she had either two boy or two girl turtles. However, now that she had four, she thought the chance of their all being the same sex was very small and spent considerable time looking for clues to their sex, or even differences between the four, but without success. Kay was not to know that even scientists cannot sex baby turtles or even small juveniles from their external appearance. Until the tail of the young males starts to elongate at several years of age, both sexes appear similar.

Epilogue

READERS may wonder what has become of Kay. They will be delighted to learn that this story has had an exceptionally happy ending. Kay has been able to put her keen interest in wild animals, and turtles in particular, to practical use. The Commonwealth Government of Australia, Office of Aboriginal Affairs, provided funds for me to initiate pilot turtle farming schemes at a research level in the Torres Strait. The aim of the scheme is to build up the turtle stocks of the area to full holding capacity and cull a specified number each year under strict scientific management. Not only will this scheme ensure the survival of large turtle populations in the area but, most importantly, it will also offer very considerable employment to the people of the Torres Strait – on their own islands.

The demand for turtles is enormous – for traditional uses like turtle soup – and also for more recent uses including steaks for the gourmet tourist trade, skins for the leather industry, and oil as a base for cosmetics. This has led to gross over-exploitation of turtles in most parts of the world and caused great concern among conservationists. The green turtle, and indeed most of the seven species of sea turtle, are rapidly decreasing in numbers and face certain extinction unless something is done to reverse the trend.

Queensland holds a key position in turtle conservation. Firstly, it is an enormous State mostly situated within the tropics and having large stocks of sea turtles. Six of the world's

seven species occur in Queensland waters and five are known to breed there. Secondly, Queensland has been in the van of marine turtle conservation following the pioneer work of a Queensland Government Fisheries Biologist (F. W. Moorhouse) at Heron Island in 1929–30. Following our own work, initiated at Heron Island in 1964, Queensland applied total protection to the green turtle and its eggs throughout the whole of the State and extended this protection to all other species of sea turtle. This legislation is bettered nowhere else in the world. It is of very great international conservation importance due to the huge area involved. Queensland has a coastline of 3250 miles and also includes the 1250-mile-long Great Barrier Reef (a turtles' paradise) and the islands of the Torres Strait.

To return to Kay – Kay was offered a six month training period at the Australian National University in Canberra after which she returned home where she started rearing newly-hatched green turtles. Not two or four, as happened with Ruth's progeny, but two hundred and fifty in one batch! In nature baby green turtles undergo tremendous mortality during the first hours, days and weeks of life and by keeping them in confinement for one year and then liberating them on the reefs, scientists have considered that their survival chances may be increased between fifty and one hundred-fold over babies leaving the natural nest.

The turtle farming scheme in the Torres Strait will investigate this situation by aiming to obtain detailed quantitative information on survival of captive raised hatchlings following their release. It will also fully investigate battery-rearing techniques to grow turtles to a commercial size. At present our eggs come from wild rookeries. However, these are taken

under strict scientific management (my own) and a very adequate supply of yearlings will be released to offset the very small numbers of eggs being taken at this stage. Once the survival rate of these yearlings is known, there is no reason whatsoever why natural eggs should not be used, and be fully compensated for, by subsequent release of yearlings. Free range farming of this type has much to recommend it in areas like the Torres Strait and there are no conservation draw-backs whatsoever so long as it is under scientific management so that it can be adequately policed.

Kay is extremely happy in her job and is now raising several hundred, very rapidly growing, baby green turtles.

KAY'S TURTLES

Robert Bustard

COLLINS