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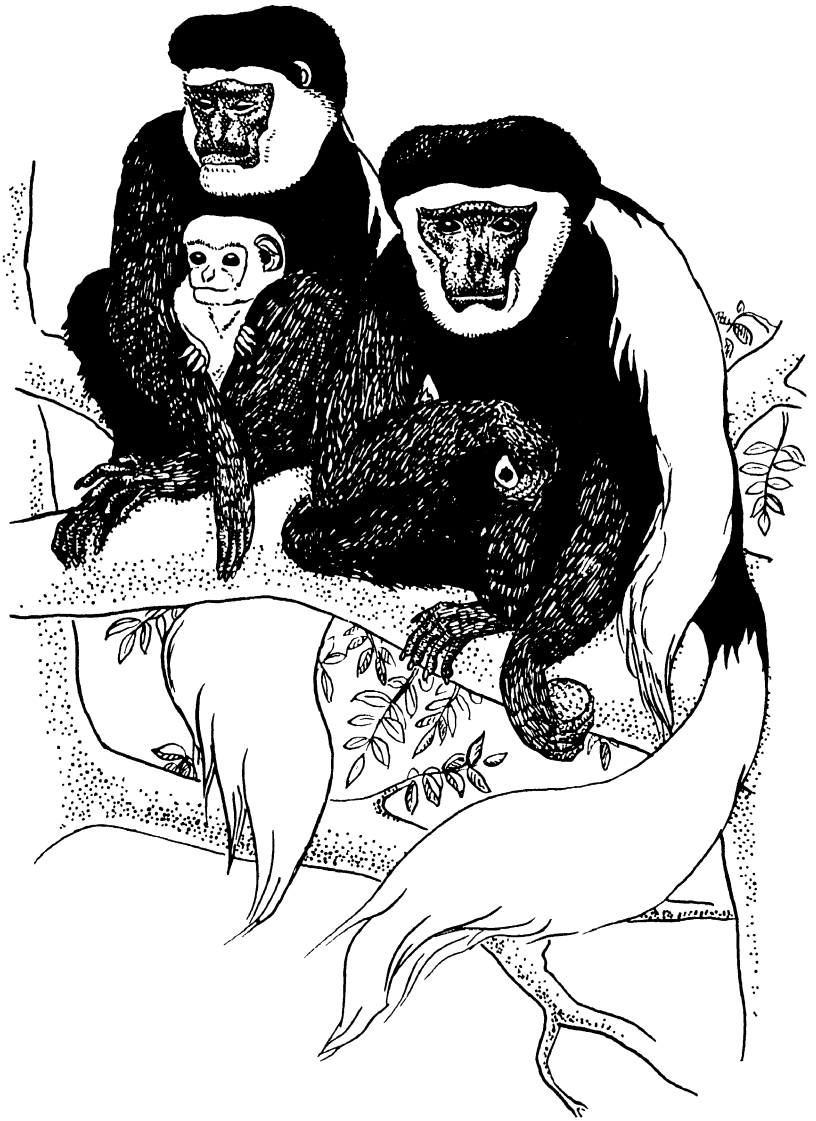

A family of East African colobus monkeys

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INFANCY IN ANIMALS

MAURICE BURTON
D.Sc.

drawings by Jane Burton

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PREFACE

THE young animal is always attractive. Not only the young animals themselves but also photographs or drawings are an irresistible snare for the emotions of most people. And we have only to listen to the chorus of exclamation when the picture of a young animal appears on the cinema screen to be assured of the place reserved in the average heart for infants, whether animal or human. The scientist is, in his studies at least, less demonstrative. Nevertheless there has been written a great deal on the young animal. There are numerous statistics on the sizes of eggs, the number of eggs in a clutch, how long they take to hatch, how long before the young animal is born, how quickly it grows, and so on, and so on, almost *ad nauseam*. The *Handbook of British Birds* contains a wealth of statistical details of the eggs and nestlings of the birds found in Britain. In *The History of British Mammals* we find similar statistics for the mammals living in Britain. Each country has such books, more or less complete, giving these details for the animals found within its borders. There is, also, much additional information to be found in the numerous scientific journals and periodicals. Very little attempt has been made, however, to summarize this information, and, in any case, it is not statistics that make a cinema audience coo with delight at the antics on the screen of a puppy or a kitten. Nor is it knowledge of growth-rates or of hereditary equipments that makes all the women stop and admire the tame fox cub when the little girl who owns it takes it for a walk on a string down the village street. In fact, despite our vast accumulation of knowledge of such things as gestation periods, of embryology, of comparative animal psychology and the rest, we still are not sure why cinema audiences coo or women—and men—pat a tame fox cub. Some people have proffered an answer to this problem and, later, we may have an opportunity of judging for ourselves whether the answer is correct or not.

The number of books written on the early days in lives of animals is small. One of the best known is *The Infancy of Animals*, by W. P. Pycraft, first published in 1912, and long out of print. In this, its author has sought to bring into some sort of order what was then known of the young animal. He has written a clear account of the different ways

animals bring up their families, the light shed by young animals on problems of evolution and, especially—and a high proportion of the chapters is devoted to this—on the significance of the colours in young animals. Pycraft, moreover, included in his account information about mammals and birds, reptiles and fishes, and also information about the early stages of crabs, insects and other less familiar members of the lower orders.

When Pycraft was writing, the Theory of Recapitulation still dominated very largely our biological ideas. This theory supposed that every animal in the course of its development recapitulated in shortened form the life-history of its race. It has been often expressed in the phrase: "During its life-history an animal climbs up its family tree." Our views have now been considerably altered, as shown by de Beer in his *Embryos and Ancestors*, published in 1940. In addition, we are less sure today about the meaning of colour, whether in the adult or the young, and especially in the young. Finally, Pycraft's excellent book also has the weakness of having included in it accounts of the life-histories of crabs, insects and other invertebrates. Whether this was, in fact, a weakness depends very much on what we mean by 'infant'. As we shall see, this word is by no means easy to define.

Another book on this same subject was *The Childhood of Animals*, by P. Chalmers Mitchell, also published in 1912. In this also a fair amount of space is devoted to colour and colour patterns and to the early stages in the life-histories of the invertebrates and the cold-blooded vertebrates. There is a chapter on play as well as chapters on how animals bring up their families.

Since the days when Pycraft and Mitchell were writing, even since 1940, when de Beer's book was first published, there has been an increasing attention given to the behaviour of animals, including the young animals. This does not mean that we no longer have any interest in other kinds of knowledge nor that other fields of research into the lives of young animals have been allowed to go fallow. On the contrary, the accumulation is such that it is not possible to cover all branches within a single book. In an endeavour to be in line with modern trends, therefore, the main emphasis in this book is on what young animals do and why they do it. I have deliberately avoided saying much about colour because the evidence is contradictory and anything like adequate treatment would take up almost the entire book. It must suffice on this point to say that some of the views held by previous authors have now been superseded and the question of the significance of colour in the

young animal largely thrown into the melting-pot. Little is said about play either, since that also is a subject for debate at the moment and should either be dealt with at length or left alone. My choice has been to give fairly detailed accounts of the early stages in the lives of a few selected birds and mammals. Then, using the information set forth in these, to examine the biological significance of infancy and the impact of offspring on the lives of the parents.

Experience has taught me that the biological orthodoxy of one decade runs a fair risk of being the discarded belief of the next decade. This has encouraged me at times to give way to a natural tendency to look for some other explanation than the one at present in vogue. I can only hope that, in addition, sufficient has been presented of current thought and ideas to enable the reader to enjoy that best of mental exercises, making up his own mind.

CHAPTER I

IRRESPONSIBLE AND RESPONSIBLE MOTHERS

THE word 'infant', as derived from its Latin root, means to be without the power of speech. The dictionary definition also implies that infancy includes the pre-natal period of growth together with the time during which the babe is being carried in the arms. This could be called perhaps the medical interpretation of infancy, with possibly the age of two years as the upper limit. In an educational sense, and possibly the legal, infancy extends to the age of seven, although according to another dictionary infancy, or the state of being an infant, ends legally at the age of twenty-one. Clearly, there is no rigid interpretation of the word, and since its use is so readily transferred to abstract things, such as the infancy of art or science, it can be taken to mean no more than the beginning or the early period of development. If the biologist uses the word it is in this last sense, but, in fact, only in so-called popularized science is its use at all general.

If we apply any of these meanings to the young of animals, we find that none is satisfactory. If we keep as close as possible to the Latin root, we must restrict the use of the word to human young, since man is the only animal capable of articulate speech. Again, in only a minority of animal species can we recognize, in the most exact sense, a pre-natal period, and the majority of these belong to the highest of the animal groups, the mammals. And there are few animals that carry their young in their arms. The monkeys and apes do so, as well as the sea-cows that gave rise to the mermaid stories. On the other hand, many others provide effective transport for their litters or broods, and this usually in the pick-a-back style, as in scorpions, opossums and the like. Yet, argue it as we will, there is a general concept, applicable to human beings and to animals, that infancy is that early part of life in which the individual is dependent upon the parents for food and protection. This means that we can speak of infancy only in those animal species showing a marked degree of parental care. With comparatively few exceptions, this limits the use of the word, even in its broad extended sense, to mammals and birds. Discussion has, therefore, been limited in the pages that follow to those two groups, with no more than passing reference to other groups.

Parental care is a term so generally used that although it is open to criticism by the scientifically fastidious it does express something which, in general terms, we all understand. It will be a convenience, therefore, to continue its use. It will make for a clearer understanding, however, if we attempt a more precise definition, in order to anticipate, for the moment, possible criticism of its use. One criticism could be, for example, that the word 'care' implies something of a conscious devotion or anxiety for the welfare of another, of the offspring in the case of parental care, and that in many instances of so-called parental care neither of these things can be proven. To meet such criticism, parental care can be expressed as a parent-offspring relationship in which the behaviour of both parent and offspring is directed towards the well-being of the offspring, and that this behaviour may or may not entail an emotional bond between the two parties. A good borderline case is seen in crocodiles.

The apparently lethargic and voiceless crocodile can, on occasion, give vent to loud bellowings, reminiscent of the roaring of a lion. This is especially noticeable in the breeding season, and, later, when the female is guarding her eggs. She lays her eggs in the sand, scraping a hole up to two feet deep and filling it up again after the eggs have been deposited in it. Then she stays in the vicinity of the nest, rushing at any intruder and at the same time giving tongue in a threatening bellow. When the eggs are about to hatch, the young crocodiles within begin to call. Their cries are heard by the mother, who digs down so that they are able to come to the surface. Having performed this service for her offspring, it is not long before she loses all interest in them, and any filial attachment they may have had to her rapidly and markedly declines. In a very short while, neither parent nor offspring shows any sign of recognition of their relationship to one another.

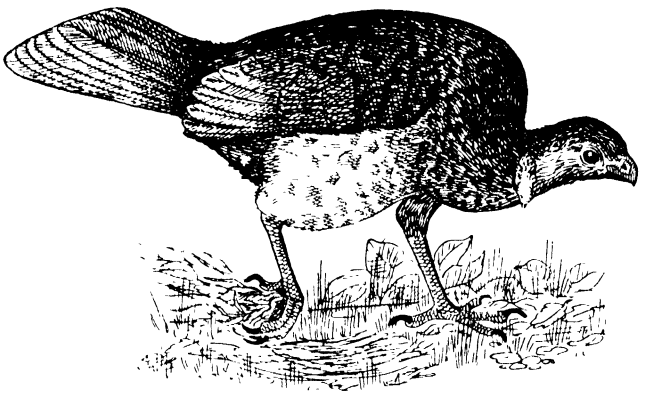
Although parental care is associated in our minds particularly with birds and, more especially, mammals, there are very few groups that do not contain examples of it. Only at the very lowest levels of organization, in the lower invertebrates, can it be said to be totally wanting. There are the beginnings of it in a few species of marine worms, although the great majority spawn at random and the larvae must take their chance of survival unaided by any intervention by the parents. In the starfishes, there are a few species in which the females have brood pouches where the young remain for some time, and from which, during that stay, they make brief excursions, returning periodically to the shelter of the pouch. Among the higher invertebrates there is little advance on this.

Young earwigs stay for a while with the mother; the female millipede makes a nest of mud and coils her body around it to protect her offspring within it; and there are a few instances of spiders sharing a common web with their numerous offspring, the young spiders even sharing the food caught by the parents. But to all intents and purposes the invertebrates display no concern for the next generation except—and this is a characteristic of many insects—to lay their eggs on the plant or in the animal upon which the larvae will feed.

In the vertebrates the amount of parental care increases noticeably with the increase in brain-power. In most fishes there is little sign of it, but in a small number of marine fishes, breeding in inshore waters or between tidemarks, and freshwater fishes, a nest of sorts is made and the young are protected in the early stages, usually by the male. Seahorses and pipefishes even have a pouch for the reception and sheltering of the young, as in kangaroos, except that it is carried by the male. The amphibia show little advance on the fishes in these matters. The newts, for example, lay their eggs in a pond. Later in the season, we see both the adults and the young newts living almost side by side in the same pond, but there is no bond between them. They behave as if wholly unrelated and brought together from different ponds. The young salamanders, close relatives of newts, are born alive. They at least have had the advantage of having spent the first stage of their lives within the maternal body and protected by it, but as soon as the young are born they are entirely independent of the parents and the parents show no concern for their welfare. Thus, in salamanders there is a parent-offspring relationship of sorts, directed towards the welfare of the young, in that the young are retained within the maternal body until a late stage. It is not parental care in the usually accepted sense, but it does represent a first step in the direction of a more thorough-going parental care.

Snakes show a slight advance on this. The smooth snake lays her eggs, 30 to 40 at a time, in a manure heap or a heap of rotting leaves. Having done so, she may leave them, or she may remain, with her body coiled round the mass of eggs, hissing and attempting to strike at an intruder. Young adders, on the other hand, are born alive. Instead of heaps of refuse, generating sufficient heat to hatch them, being used as a kind of foster-parent, the eggs are retained within the body of the mother and are there incubated. After the young are born, however, they stay with the mother for a period of days, although it is not known for certain how long this period may be. There is, therefore, even after

birth, a certain degree of parental care, amounting to little more than protection from enemies. It does not, so far as we can tell, amount to the young ones taking refuge in the mother's stomach when danger threatens, as the age-old legend would have it. Here, again, the wisdom of speaking of a parent-offspring relationship as opposed to a parental care is self-evident. At the same time, it is of interest to see that even at this incipient stage the parents' role is not merely passive. It has been found that pet snakes, normally quite tame, become morose and excited, hissing and striking savagely, as the time for egg-laying draws near, giving clear evidence of a physiological change reflected in the



Australian brush turkey

behaviour, the result of which makes for some protection of the offspring, especially if continued after the eggs are laid or the young born.

Birds, the next group of animals in ascending order, with few exceptions show a strong parental care. In some the burden falls almost entirely on one parent, either the hen or the cock, as the case may be. In the exceptional species there is little more parental care than in snakes. The brush turkeys of Australia kick together earth and dead leaves to form a mound up to 20 feet diameter. In this the hens lay their eggs and then depart. The chicks hatch, emerge from under the mound of leaves and are fully able, from the start, to fend for themselves. The cocks show a little more consideration in that, like the female crocodiles, they remain behind to help the chicks find their way out. To all intents and purposes, however, parents and offspring know

nothing of each other. There is, nevertheless, an anticipatory appreciation of the needs of the offspring, shown in the building of the mound, but since this precedes the laying of the eggs it can hardly qualify as a parent-offspring relationship. Yet it contains one of the ingredients necessary to the full development of a true parental care, such as reaches its peak in the highest class of the animal kingdom, namely, the mammals. That is, the foundations for the parental care that is to emerge are laid well before the offspring is conceived.

There is another side to this problem. As with all the primary processes of living, which reach their maximum in the highest levels of animal organization, parental care is foreshadowed at the lower levels and increases in intensity as we ascend the animal scale. The progression is, however, not regular but is marked with exceptions and deviations. It is not our purpose at this moment to study these, but to establish the point that we cannot draw a hard and fast line between those animals that show a parental care and those that do not, just as we cannot sharply demarcate the moment when parental care begins to function in any given individual.

Returning to those animals which obviously possess it, the instinct for parental care does not come into being only at the moment when an offspring first sees the light of day, but at some time previously to it. At conception, in the higher animals, an ovum within the body of the female is joined by a sperm, introduced into her body by a male. The ovum is then said to be fertilized. At the moment of union of ovum and sperm, there comes into being a single cell which differs markedly from every other cell within the bodies of both male and female parents. It is a new organism endowed with new potentialities for growth and for developing an individuality. In spite of its dependence upon the mother during the course of the next few weeks or months, during the period of gestation, as it is called when the offspring is born alive, and which varies from one species to another, it is a separate individual. Even while these changes are taking place in the parents, directing their attention to the needs of the future offspring, the offspring itself is following an independent path, at the same time clinging to the parent for help and also preparing to be independent. Infancy is then a state of parasitism. This is a theme to which we shall return later. It is a period of 'take' with little 'give'. But no study of a parasite is complete if we ignore that on which it is parasitic. So throughout any study of infancy we cannot ignore the parent. The makings of the parent are, however, already in the infant. In the

individual the parental instinct is present almost from the beginning, indiscernible at first, then barely discernible and finally reaching full fruition with maturity. The emergence of a parental care follows much this pattern as we travel up the animal kingdom.

What then is this fertilized ovum which gives rise to a new life? It differs from all other cells in the maternal body in that it contains substance derived from the body of the male; and it differs from every cell in the body of the father, in that it contains material from the maternal body. Further than this, the mixing of the ultra-microscopic elements from the cells of the two parents has endowed the fertilized ovum with potentialities differing in detail from those possessed at their inception by either parent. These potentialities differ, also, in a slight degree from those of any other individual of its generation, and probably from any other individual that has ever existed or is ever likely to exist.

A common interpretation of the word 'individuality', and the one most used in everyday speech, implies the ability to take an independent line of action and the possession of a character which marks its owner from his fellows. Although it is less obvious than in an adult, the fertilized ovum and the embryo into which it subsequently grows has an individuality. But whether in a fertilized ovum or in a mature individual, the variation from the normal, or average, must conform to certain well-defined limits. There are certain lines of conduct that must be followed, certain rules to be observed, if chaos for the individual, and for its fellows with whom it must live, is to be avoided. These rules are no less important as between parent and offspring, especially since, as we have seen, there is in the offspring a natural and growing tendency to achieve independence. There are, in fact, three disciplines necessary: that which binds the parent to the offspring, that which binds the offspring to the parent, and that which prepares the offspring for independence. And all these three must dovetail the one into the other.

To understand these things as well as our present imperfect knowledge will permit, we cannot do better than start once again from the beginning with the fertilized ovum. Soon after fertilization, the ovum divides into similar halves, so that two cells exist where there was formerly one. That is the normal process of cell-division. Then the two cells divide again, into four, and again, into eight, and so on, until a small mass of cells, all similar in appearance, comes into being. There comes a time, however, when, instead of dividing in this regular manner,

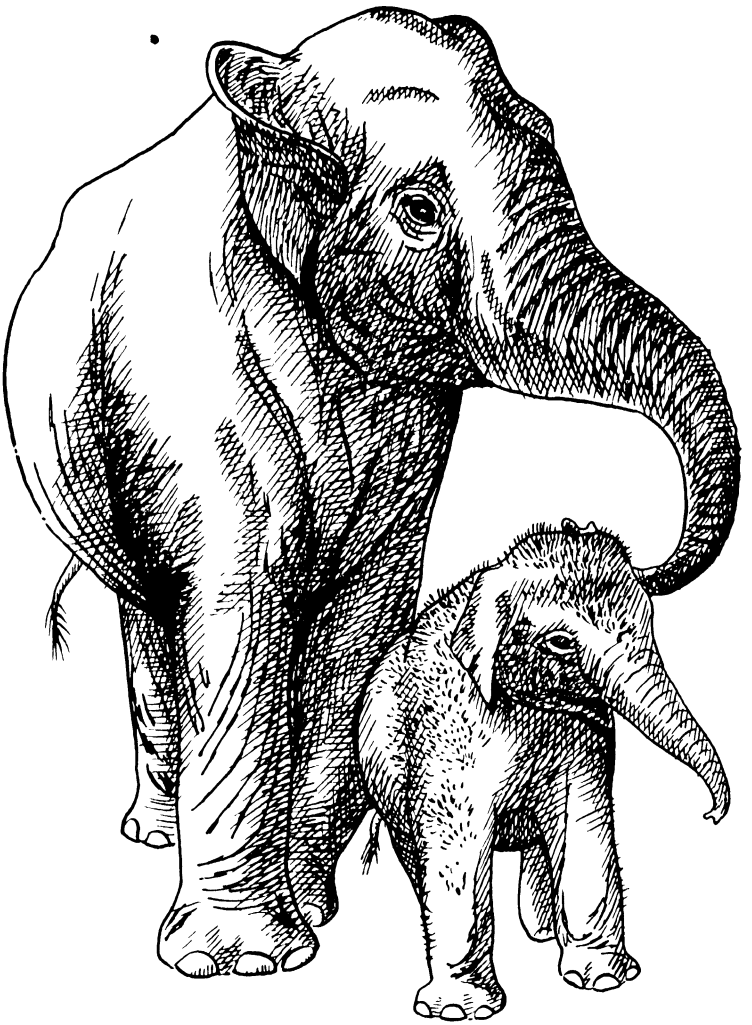
a differentiation takes place. The conduct of the individual cells, or of groups of cells, begins to differ, and recognizable tissues begin to form. An outer skin is laid down, as well as an inner tube, which eventually forms the gut, or food-canal. Other cells arise between these, destined to form the muscles and bones, among other things. One line of cells, along the back of the developing embryo, migrates inwards and comes to lie along the upper surface of the gut. This is the future spinal cord, which enlarges in front to form a brain and sends out branches to form the nerves. A heart comes into being and blood vessels begin to appear, radiating out from it. And there comes a time when the blood vessels are filled with cells lying freely, not connected as the cells of the other tissues have been with their fellows. These are the blood corpuscles. Finally, autonomously and automatically, the heart starts to beat rhythmically, and continues to do so throughout the lifetime of the new individual. At a later stage, towards the head end of the new individual, a pair of hollow bladders grow out from the wall of the gut, and later, at the right moment, neither too soon nor too late, these will begin spontaneously to expand and contract rhythmically, under the influence of the muscles. These hollow sacs are the lungs, which will take in air and expel the spent gases rhythmically throughout the lifetime of the individual.

It is obvious that each cell must behave in a definite and orderly manner, following a particular line of conduct, co-operating with its fellows and with all the other cells. Furthermore, all activities, whether it be the initiation of the division of a cell or the beating of the heart, must be self-starting. Then, again, there must be some form of communication between the separate cells. We are accustomed to the idea, in the mature animal, that the brain acts as the centre of control for all activities of the body. In general this is correct, but there is also a fair degree of purely local control. In the developing embryo, in which the brain is not yet recognizable and the nervous system has as yet barely come into being, this local control is even more necessary. Briefly, the cells communicate with each other by means of minute chemical messengers, and so do the organs as they come into being. In them, too, there is an interdependence combined with a growing independence. In them, too, is the need for disciplines to maintain order and harmony, and the governing forces are the chemical messengers. At a higher level a similar process is at work between the young animal and its parent, so that they are in effect, even if only by chemical means, talking to each other. And where there is a parental care they continue

doing so after the young one is born, but then it is no longer by chemical messengers. It may be objected that it is wholly wrong to use the word 'talk', for the very root of the word 'infancy' means to lack the power of speech. But 'talk', like most other words, has more than one meaning. It is not only used in the sense of uttering words but is used, according to the dictionary definition, 'to communicate by any means'.

Means of communication, or talking in this wide sense, may include both subtle and obvious means. And in respect to infancy they affect not merely the mother but may extend to other members of the colony or herd. For example, a writer has described how, in Africa, he was watching a herd of elephants. They were showing signs of excitement, and for security, in case there should be a stampede, he climbed into a tree. Then he describes how, after a while, three females detached themselves from the herd and walked slowly towards a thicket just beneath the tree in which he was sheltering. One of the three elephants went into the thicket, the other two remained outside, and drove off any of the herd that approached the thicket. After a while, the two outside made off and rejoined the herd. Very soon after this the third elephant emerged from the thicket, followed by a new-born calf, its hairy hide still wet. Without a doubt, the elephant had gone into the privacy of the thicket, aware that her calf was about to be born. What is more surprising is the conduct of the other two, who seemed to be behaving somewhat in the manner of midwives; and appeared to be aware that their services were needed even before the pregnant elephant left the herd.

The pet grass snake that becomes excited and ill-tempered is reacting to a physiological change occasioned by the imminence of egg-laying. The eggs, quite blindly of course, have communicated the fact of their maturity to the tissues of the oviduct. These in turn have set going other signals to which the snake responds by becoming ill-tempered. And being ill-tempered, the snake is in the best mood for protecting the eggs after they are laid. There is clearly a chain of communciation anticipating events to come and all directed to one end. The female crocodile is in like case. She anticipates the laying of the eggs by digging a hole for their reception. Having laid them, she fills the hole in, but, instead of wandering away, as we might have expected her to do, she stays in the vicinity of the nest, and, like the snake, vents her irritable mood on anything approaching her buried treasure. Finally, and this time it is a very obvious means of communication, she is made aware of the right moment for reopening the pit by the calling



Elephant and new-born young

of the newly hatched young, itself an automatic action, or, to use a word now going out of fashion, it is an instinctive action.

Our study of infancy, therefore, must be largely a study of those inherited disciplines which bind the parent to the young, which make the young cling to the parent and which prepare the young for independence and the full development of its individuality. Not all the details of this story are known, by a very long way. Many that are known require a knowledge of laboratory technique to comprehend. At best we can only deal with the subject superficially. Perhaps my best introduction will be to describe first some personal experiences.

CHAPTER II

YELLOW-HAMMER AT HOME

LAST summer I spent my holiday with my family on a narrow boat moored on the Oxford Canal. We drove the hundred miles or so, from Surrey to Warwickshire, in a steady downpour of rain. This ceased towards the end of the journey, but the skies still remained dismally leaden. The living quarters on the boat appeared at first sight more cramped than they were in fact. At the same time there was a chill in the air that was not conducive to optimism. Altogether the omens were unsatisfactory, but it has happened before with us that a holiday which promised so little at the start has led to an interesting, if not exciting, spell from home. It is probably always so if one's desires and ambitions are not too exacting.

In this instance, the first promising sign came in the late afternoon of the day of our arrival when the sun broke through the clouds for the first time that day and the atmosphere began to warm up. It was soon after this that we saw the hen yellow-hammer. In her beak she held three green caterpillars and was obviously anxious to enter her nest somewhere in the low brambles on the bank of the canal where we were standing. We moved away to let her go in. In a short while after she had flown away again we had located the nest. It was on the other side of the canal from where the boat was moored and was some fifty feet from our bows. Having located the nest, and having allowed the hen to depart on another foraging expedition, we proceeded carefully to inspect it. That is, we inspected it cautiously so as not to disturb the nestlings or to arouse the suspicions of the hen on her return.

At this point the canal was spanned by a small high brick bridge. On either side a ramp, flanked on both sides by a brick wall, led up to the bridge from the towpath. At the foot of each wall the earth was banked and overgrown. The nest was on the canal side of the wall. It was a rather untidy cup of grass, about four inches across, set on two diverging branches of a low bramble. Over it other straggling branches of bramble formed a protective cover, the leaves immediately above the nest forming an irregular but fairly complete canopy.

In the dim light in their shade little could be made out at the bottom

of the nest but a blackish indefinable smudge—until I tapped a branch of the bramble. Then two beings instantly sprang into life. The black smudge had resolved itself into two nestlings. The larger of the two had an almost naked body and any legs there may have been were hidden under it. The body was perhaps an inch long and from it stretched up a thin scraggy neck, nearly two inches long when fully extended. At its summit the beak opened wide revealing a flesh-coloured interior to mouth and throat, ornamented with three black spots, one in the middle and one either side, the whole margined with a

Yellow-hammers at nest: hen incubating

thin line of yellow. What had previously been a black head, with eyes still unopened and the edge of the beak marked with a thin line of bright yellow, was now transformed into a flesh-coloured diamond bordered with yellow and raised horizontally, presenting an unmistakable target for the maternal bill filled with food, and with recognition marks, the three black spots, to guide the hen in feeding her offspring.

The smaller of the two nestlings reacted in a similar manner, showing the same colours and markings. But there was less vigour, and the height to which its beak was raised was noticeably less. The most remarkable thing in both nestlings was, however, the intensity of that upward thrusting of the open beak, especially so in the larger nestling. The tissues of its neck were stretched out until it seemed that

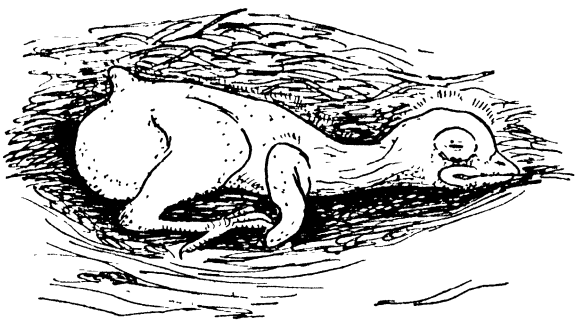
with a little more effort the neck might tear in the middle and head and body part company.

Slowly the fire of this endeavour died down, as if reluctantly. Almost indeed with an air of disappointment, if not of frustration, the two heads subsided and only the black smudge was left in the bottom of the nest. At this point it was necessary to retire from the nest, to allow the hen to come in to feed the nestlings. She carried another three green caterpillars in her beak.

Allowing several minutes to elapse, following the departure once more of the hen, I went back to the nest, judging that by this time the nestlings would be nearly ready for their feed. I did this deliberately for I wanted to test the reaction of the chicks when they were fully hungry. It was a trifle unkind, perhaps, but not too much so, I hope. I tapped the bramble once again. There was the same reaction as before on the part of the nestlings, and now I was ready to time its duration. The larger of the two held its head up for a full twenty-five seconds, straining vigorously upwards. It was not, however, an even action. At the end of the first fifteen seconds, the reaction started to die down slightly, but was followed by a visible and vigorous jerk upwards, as the nestling strove to keep its mouth up and open to the fullest extent. The same thing happened at the end of nineteen seconds. But at the end of the twenty-five seconds, the reaction died down completely. Meanwhile, the smaller nestling had behaved similarly but with a total duration of only seventeen seconds and without any of the upward jerks to impart a new effort into it. The interest in the behaviour of the larger chick is that the renewed effort at fifteen and nineteen seconds respectively was not the result of any stimulus from without. I was dead still all the time. Presumably there was some element of volition, however simple, some consciousness however elementary, that the purpose of the reaction had not been fulfilled and that more effort was needed.

There seemed something contradictory about the difference in the behaviour of the two chicks. The larger nestling was presumably the better fed yet it was showing the greater hunger reaction. We are usually told by those who study these things that the more hungry nestling shows the greater hunger reaction and stretches its head up the most, above the heads of its fellow nestlings. As a consequence it is usually assumed that this provides the parent with a ready means of spreading the feeding fairly among her brood. Thus, instead of having to remember which one she fed last, or which one is in greatest need, the

answers are automatically provided by the most hungry raising its mouth nearest to her as she comes to the nest, that one then standing the greatest chance of receiving the lion's share of the food she carries. Hence, it is argued, there is an automatic assurance of fair shares for all. This may in general be correct. On the face of it, it is logical that it should be so. One wonders, however, whether we have not to reckon with individual differences even at this early stage; whether one nestling in a brood may not be more greedy than the rest. Or to put it in the now fashionable scientific terms, whether the hunger reaction may not vary in its intensity from one individual to another. If this is so, can we then suppose that the hen shows some discrimination in the



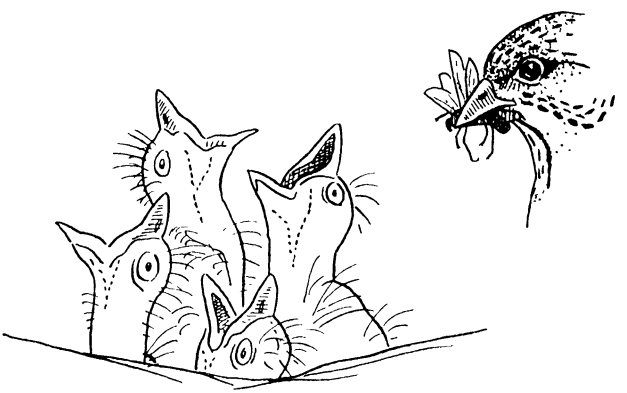
Newly hatched yellow-hammer

apportionment of the food? We can only guess the answer, and my guess would be that while there is this automatic device for aiding the hen in her task, it may not be beyond the bounds of possibility that she does also exercise some choice in the matter. If I could recognize a difference between the two nestlings is there any reason to suppose that the hen, much more familiar with them, cannot do so also? And I can see no reason for supposing that she is so complete an automaton as we are sometimes led to suppose, even if her behaviour is largely automatic.

At risk of disturbing the nestlings, and perhaps throwing out the routine of feeding, there was one more test I wanted to make. Immediately after the hen had departed from her next visit with food, I returned to the nest and repeated my experiment of tapping a bramble branch. I wanted to see what would happen when they were not fully hungry. This time, having just been fed, the nestlings responded noticeably less. This was to be expected. The smaller nestling did, indeed, make

no response at all; but the larger one thrust its open mouth upwards and held it there for five seconds.

There is another side to these reflex responses which is worth detailing. On the occasion of my first experiment with these two nestlings, when the one responded for twenty-five seconds and the other for seventeen, I tapped the bramble again as soon as both nestlings were finally settled back on the floor of the nest. That is, I wanted to see if the reaction could again be elicited immediately after it had died down from such a vigorous performance. On the second tap, the larger nestling responded for five seconds. A third tap, as soon as the reaction had died down, elicited a three-second response from the same



Vertical gape of nestling yellow-hammers

nestling, and a fourth tap gave a similar result. After this, the fifth and the sixth taps produced no result at all. As to the smaller nestling, this made no response whatever to the second tap, or to the third, or to any repetitions. As I have already mentioned, carrying out a similar series of repeated tappings immediately after the nestlings had been fed brought no response from the smaller, and from the larger nestling there was the five-second response to the first tap, a three-second response to the second tap, the same to the third tap, and after that no further response. Thus was demonstrated, what is indeed already well known, that a repetition of the same stimulus brings about a decreasing reaction to it.

It is useful to bear in mind this decreasing reaction to the repetition of a given stimulus. It is exemplified in the old story of 'crying wolf'. One practical application I can recall concerns a mother, otherwise

possessing many maternal virtues, who accompanied any admonition to her children by a tap on the head—punishment, 'to make them take notice'. In her, the action was a conditioned reflex. In the children there was also a conditioned reflex; to try quite automatically to dodge the anticipated blow. The stimulus, that is, the tap on the head, from frequent repetition, had ceased to evoke any other response.

To return to our hen and her two nestlings: although that first evening was fine it was not particularly warm and from the time we first located the nest, which was 5.46 p.m., until 6.11 p.m., she fed them only four times. She did not reappear after the last feed and brooded her offspring from then until it was too dark to inspect the nest without disturbing her.

The following day was more or less uniformly wet. The rain stopped at intervals, it is true, but only for short spells. Added to this we had shopping to do in the village over half a mile away, and other things to be attended to, with the result that the very existence of the nest went completely out of my mind. After all, it was not the first nest I had inspected. In fact, I have watched the progress of a number of broods over the preceding years. However, on the following morning, which again broke wet, with a steady and heavy downpouring of rain, it occurred to me to wonder how our hen was responding to this weather, which kept us under cover and made us disinclined to outdoor activity. There came the thought: Does a bird, in building its nest, anticipate the need for cover from the rain?

It is known, or suspected, that birds show great care in choosing the site of a nest. It would be difficult to say what processes are at work in their limited mentalities in choosing a nesting site, whether this choice is anything more than the combined effect of a number of automatic reactions like the gaping response of the nestling. The choice of site seems to have something to do with the points of the compass since the opening to the nest, when a nest has an opening on one side, is usually pointing east, and from this we might suppose that future weather conditions influence the choice. Having the entrance pointing east would avoid the full heat of the sun on the brood. The choice of site must also have something to do with the amount of food available in the vicinity. This can hardly be due to purely automatic behaviour but suggests at least some form of insight, intuition or what you will, on the part of the parent. One wonders also whether protection from predators is instinctively allowed for, and so on.

I wanted to see whether this hen yellow-hammer had selected the

site so that her nest was sheltered from the weather, and especially whether the bramble leaves over this particular nest formed an efficient protection from this downpour. The answer was readily obtained. The canopy of leaves did not protect the nest. On the contrary, some of the leaves when fully wet drooped and actually directed the water on to the nest, and there, in the pouring rain, the hen was brooding her chicks, her feathers noticeably bedraggled from the leaks in her roof.

She sat tight on the nest that day until the late afternoon, when the weather finally cleared. Then she started to feed her offspring. But that is not the whole story. Although the rain had stopped in the forenoon and was followed by a bright spell, the hen did not leave the nest, and surely enough, soon after this it rained again. We had several such spells, when the sun had broken through only to be followed by rain in a short while. In no instance did the sun tempt the hen yellow-hammer to leave her nest. Then, there did come a time, in the late afternoon, when a break in the clouds saw the hen leave the nest and return shortly with her beak filled with green caterpillars. She continued feeding her brood; and we had no more rain that day, until after sundown. It looked as if the hen was weather-wise.

The following morning did not look promising. The official weather forecast had promised overcast skies, with bright intervals and showers. Not at all holiday weather. The sky in the morning did not give even the meagre promise held out by the official forecast. But the hen was out early and, what is more, she continued feeding the chicks throughout the day until sunset. As it turned out, the day was fine throughout. There were, it is true, frequent threatening clouds but a good deal of sunshine broke through them, and all we had of rain was a few spots only, not even enough to make the grass damp, and by midday the atmosphere had warmed up considerably.

We also had made a decision for the day. We had decided early in the morning that because of the look of the sky coupled with the unpromising nature of the official forecast it was hopeless to plan anything that took us far afield. So we had decided to spend the day with the yellow-hammer and her brood. Accordingly, we settled down to a close and continuous watch, arranging to have at least two observers at a time, and to keep a full and detailed diary. There were few passers-by throughout the day. No doubt everyone else had been as misled about the weather as we had been. So there was no disturbance there and the hen seemed quite undisturbed by our presence in the bows, fifty feet from her nest. We not only watched the nest from this

short distance with binoculars but from time to time, once we had learned the intervals occupied by the hen's forays, we cautiously inspected the nest in her absence, to add more detailed notes to those obtained by observation through the binoculars.

The first thing our recorded time-table revealed, when we came to examine it at the end of the day, was that from 9 a.m. until 10.57 a.m., the hen had made two excursions for food, and on the second return she had stayed on the nest for a period of ten minutes. From then on we recorded that she had brooded for about ten minutes at the end of ten feeding forays. This happened three times, which brought us to 2.30 p.m. Now, we asked ourselves, did the hen spend these short intervals on the nest because she was tired and needed to rest, or was it to prevent the nestlings suffering from even slight exposure? The answer came, or so we think, in good time. From 9.30 a.m., when the air was somewhat chilly, until 2.30 p.m., the temperature had gradually risen. From 2.30 p.m. until sundown, the air was on the verge of being uncomfortably warm, and during this time the hen made one excursion after another without cessation. If she was not weather-wise she certainly made an excellent thermometer.

What we learned from a day of close observation is best summarized from our diary. Feeding finished soon after 8 p.m. We may reasonably assume, although we had not started our diary by then, that it started not later than 8 a.m. The working day for the hen was, therefore, at least twelve hours, and food was brought to the nest at a steady rate of one visit on the average every ten minutes. The minimum time for the foraging excursions was three minutes, the maximum was seventeen. She brooded during the first part of the day on six occasions, for a total of 56 minutes, the minimum period being six minutes, the maximum being 13. For each return to the nest we endeavoured to note what was in her beak. Usually it was green caterpillars, about one inch long and $\frac{3}{16}$ inch diameter, occasionally brown caterpillars of about the same size, the size being confirmed by our looking for samples among the vegetation and measuring them. Two, usually three, rarely four, were brought on each visit. Less frequently she brought crane-flies or harvest-men, and late in the day a large black earth beetle. The total over six hours' careful counting was ninety caterpillars and nine other insects.

These figures are given for a purpose, as with others that will be given later, since they help us to understand some of the things involved in bringing up a family of this kind. Thus, the cubic capacity of the

caterpillars brought to the nest in a full day's feeding represents, on a rough calculation, and after allowing for possible errors in our counting, and so on, at least twice the volume of the two nestlings put together. We know from numerous investigations that small mammals, such as shrews and moles, eat at least their own weight of food each twenty-four hours. These animals are always rightly described as restless and energetic, given to an habitual feverish activity. In the adult shrew or mole, most of the energy obtained from this large proportion of food is expended in bodily movements aimed at obtaining more food. It is something of a vicious circle, finding food to give the energy to find more food and so on to the end. In the infant, in this instance the nestling, there is a comparable heavy intake of food, but the bodily movement is comparatively little. Even the exertions in the gaping response count for little since they take place at intervals of ten minutes only. Under natural conditions of feeding, that is when there are no interfering humans prying into the nest in pursuit of so-called scientific research, the gaping reactions do not normally last more than a few seconds on each occasion. In between them the nestling sleeps; certainly it rests even if it is not actually sleeping. As a result, there must arise a large store of energy available for physical growth solely.

It could be claimed, of course, that the insects forming the food of the nestling contain only a small proportion of digestible matter. There is a hard outer skin, for example, and it could be that a high proportion of the food is waste. Here, however, we had a very easy means of checking. The indigestible parts of the food, together with the waste from the normal metabolism, is given off as excrement. In many nestlings, including those being studied, this is contained within a membrane, the whole being called the faecal pellet. When about to extrude such a pellet the nestling yellow-hammer gives by its actions a preliminary warning and the parent bird waits for the extrusion of the pellet, picks it up in the beak and flies with it to drop it at some distance from the site of the nest. The pellet in its white membranous envelope is very conspicuous when carried in the beak, so that it was possible to note every time one was carried away. It was also possible to follow the flight of the hen, note where the pellet was dropped and gain some fairly precise idea of its size. In our bird, the pellet was an oval of roughly half an inch length with a diameter at the equator of $\frac{3}{8}$ inch. One pellet was taken away from each nestling each hour. In fact, their removal was so regularly timed, when feeding was not interrupted by weather, that one came to know when to expect it.

This form of nest sanitation is, of course, very necessary to chicks so helpless during the first few days after hatching. It is a simple calculation to show from the figures already given that merely with these two nestlings, the pellets, if allowed to accumulate in the nest, would alone fill the cavity of the nest in two days or so. The advantages of an innate behaviour in the parent to recognize the signs, wait for the extrusion of the pellet and carry it clear of the nest, need no stressing.

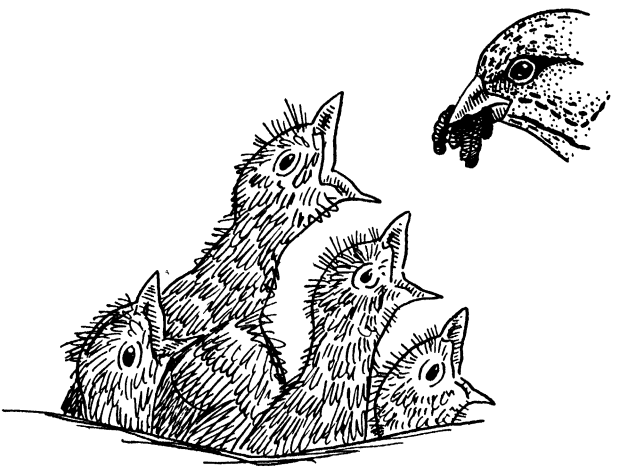
It is hardly necessary to say that the speed of development of the chicks is linked with the rate of feeding. We found that there was little change from the time we first inspected them until the evening of the second day following it, some forty-eight hours later. This period included one and a half days of more or less continuous rain, during which they received very little food. By the following morning a distinct change could be seen. The nestlings appeared hidden in a mist of blackish-grey down as they lay in the bottom of the nest. The legs also had grown visibly. But that was about all. By the next morning, however, after a day of twelve or more hours of continuous feeding, they were noticeably larger. The wings, now grown perceptibly larger, bore a layer of feather stumps. The down was restricted to the neck and head and the body bore three well-marked feather tracts, one down the middle line of the back and one running along each thigh. The legs were stronger and the nestlings now sat up and attempted to use the legs to gain height for the gaping reaction.

Two other changes had occurred. On the morning of the third day the eyes had opened. At first they appeared small, like two lead shots set in the sides of the head. The following morning they were more like normal eyes. The voice too had increased in intensity, from a low almost hiss-like sound when we first inspected the nest to a much louder *zee-zee*, uttered throughout the duration of the gaping reaction. Incidentally, by the following day the voice had improved to a call, the first syllable on a rising note, the second a falling note.

The opening of the eyes brought also a change in the gaping reaction. Apart from the increase in size, the gradual appearance of the plumage and such things, the one important sign of quickening life in the nestling is this reaction. It is, indeed, the most important thing for the chick at this stage. Put briefly and somewhat crudely, the nestling in the early stages of its life is little more than a bag for the reception of food and the one important action that transcends all others is that the mouth of the bag shall be fully open at the appropriate moment. At first, when the eyes are still unopened, when the other senses are

no doubt in their rudimentary stages, vibrations alone suffice to release the reaction. Tapping a twig or the edge of the nest, in imitation of the hen landing with food in her beak, will alone bring the chicks into action. When the eyes are fully opened tapping may bring forth the reaction but the more certain way to evoke it then is to present some moving object, such as a stick or the finger, about the level of the nest; that is, above the chick's eye-level.

The gaping reaction has been subject to a good deal of precise experiment. Over and above the responses listed already, it was found



Directed gape of nestling yellow-hammers

that if two circles of cardboard, one smaller than the other, and joined edge to edge, are presented to it the growing nestling would gape at the smaller. Thus, at an early age the chick will not only gape at any solid object presented above eye-level but will direct its open mouth at the smaller part of it, that is, at what would correspond to the parent's head—the place where the food will be. All these things mean no more than that the pattern of reactions in the growing chick is the most economical in the matter of obtaining food, to do so with the least fumbling and therefore the least loss of time. As we saw only too well, a spell of bad weather can interfere drastically with the rate of feeding. The loss of seconds at each feed, if there were not the maximum and most efficient co-operation between parent and offspring, could mean the difference, when all these seconds were added together,

between normal and abnormal development or even between the successful and unsuccessful rearing of a brood.

Making experiments with nestlings is in some ways one of the simplest and most satisfactory forms of research. The subject cannot move away. It is being attended by the parent bird, so that the experimenter does not have to worry about the conditions of the experiment or of the welfare of the subject to the experiment. And the responses are automatic. Moreover, tests can be repeated almost as often as one wishes without, provided care is taken, interfering unduly with the lives or well-being of parent or offspring, so upsetting the experiment. Indeed, it is the very simplicity of the experiment which is perhaps delusory. It tends perhaps to lead to the impression that the young birds, as well as the parents, are just purely and simply living automata. This in turn may conceivably lead us to overlook other vital factors. Thus, to recapitulate, in the first few days, before the eyes are open, we can show quite satisfactorily that by tapping an adjacent branch or the edge of the nest the nestling can be made to gape vertically. Then, when the eyes are open, the gaping response can be evoked by presenting a solid object before the eye of the nestling, the full gape being elicited if the solid object is moving and the gape being presented to whatever simulates the head of the parent.

Of course it is an automatic action, with a trigger-fine adjustment. And the more hungry the nestling the more trigger-like it tends to be. In fact, the whole organism is continually on the alert to this one end, gaping to obtain food. How much on the alert is shown by our silent inspection of the nestlings during the periods that the hen is away searching for food. They lie in the bottom of the nest, the body heaving rhythmically with the breathing, the legs twitching slightly as if life were waking more and more strongly within them. Yet, even while the eyes are closed, giving every appearance of complete sleep, the mouth is forever opening just slightly with a movement suggestive of the smacking of the lips in other animals, and at intervals, without even opening an eye, the beak opens halfway and closes again. Earlier in the chapter I implied that in these intervals between feeding the nestlings might be sleeping or they might only be resting. Probably, while not actually being brooded, resting is the better term, for in addition to the movements of the beak the eyes will open from time to time. Altogether, therefore, one has the impression that the gaping reaction is barely dormant, all the time on the verge of coming into play and merely awaiting the correct stimulus to touch it off.

That is an essential part of the story but it is not the whole story. Before concluding it, however, a word may not be out of place on the transition from the vertical gape to the gape directed towards the moving object. The break between the two is not as complete as the literature on the subject sometimes tends to lead us to believe. It is not a case that one day, with eyes unopened, the gape is vertical and that the next day, with the eyes opened, the gape is directed towards a solid body presented above eye-level. To begin with, the opening of the eyes themselves is gradual, as I have shown. And even when fully open, the vertical gape may still be used. That is, the change is not an abrupt substitution of one set of actions for another, but the emergence, alongside the vertical gape, of the directed gape.

To illustrate this, I will quote a typical instance when, shortly after the eyes were fully open, a tap on the bramble caused one nestling to raise its head, not quite vertically, but without moving the body. Since the nestling was lying so that its head was directly away from the point where the hen would normally land, the gape was directed in wholly the wrong direction. As soon as my finger was moved over the edge of the nest, however, the chick swung round and directed its gape at my finger-tip. Its fellow, the one I have already referred to as showing the feebler response, made no movement whatever. Try as I would, by tapping twigs, wagging the finger or other solid objects, even by cheeping, whistling, and making a variety of small sounds, I could evoke no response in the second chick. Moreover, even in the one that did respond, the reaction was feeble, not sustained and was not repeated. Yet a minute or so later, when the hen came to the nest, her arrival was greeted with a sustained *zee-zeeing* of both chicks, and in the few seconds she spent at the nest before departing it was very clear that she must have had a far greater success than I could achieve in calling her chicks into the appropriate action.

It should have been no surprise that these particular nestlings showed no response to sounds since the hen carries out the whole of her work of feeding them without, so far as we could judge, making any vocal sound. At the same time, it was worth trying the effect of sounds, however clumsily, because there is an individuality between broods as well as between different nestlings in a single brood. In broods of robins, for example, the gaping reaction can be called forth by tapping adjacent twigs or the edge of the nest. It can also be evoked by scraping the foot on the ground, when the nest is low down, snapping a dry twig a foot or more from the nest, or by whistling. I have reason

to suspect, however, that not all robin broods react equally to these same sound stimuli.

On the fourth day from the time we started observing the yellowhammer's nest, I inspected it in the evening and after trying all the orthodox tricks on the nestlings failed to get more than a feeble two-second response from one of them—presumably the 'greedy one'. A minute or two later the hen came in with a beakful of caterpillars and the moment she touched down there was a chorus of the most excited calling from the chicks, which ended just before she flew out again for more food.

It is quite impossible to see all that goes on in the nest on such occasions, but it is observations of this sort that convince me that while tapping twigs, waggling fingers, presenting cut-out cardboard and all the other tricks of the animal psychologist may reveal the major part of the story, it is not the whole story, especially when the chicks are beginning to develop. They may be very nearly pure automata in the earliest stages, but with their further growth there is more to it. The hen has ways and means of eliciting a response that are at present unknown to human beings, and can elicit those responses in less time than we take to obtain a second-best result. From this I would deduce that by this fourth day the chicks were becoming individuals in the wider sense of the word, were more aware of their surrounding world, were learning rapidly, and, most important of all, there was becoming established between them and the hen an understanding, based on minutiae of behaviour no doubt, which is past our analysing at present.

The following morning the two nestlings lay side by side in the nest with their heads drawn back into their shoulders and beaks pointing almost vertically upwards just under the rim of the nest where the hen habitually landed. They were in the best possible position for a quick intake of food, and throughout the day the hen came and went almost with the monotony of a swinging pendulum except when a passer-by caused her to pause or take evasive action until the way was once more clear. The chicks were larger, their wing feathers more pronounced, a stump of a tail had appeared and a colour-pattern was apparent on the top of the head, although down still hid them as in a partial mist. No amount of tapping twigs, presenting cut-out circles, wagging the fingers or putting an imitation hen on the edge of the nest evoked more than a feeble opening of the beak from one of them, the larger 'greedy' one, which seemed to be doing this from habit more than

anything else. Yet the moment the hen went in we could hear the excited clamour of their voices.

The tempo of events was rising. The hen was paying more visits to the nest. At intervals of three to five minutes she was carrying more food each visit, four to five caterpillars instead of two or three. Pellets were being taken away at more frequent intervals. The hen tended to forage nearer home, and when approaching the nest was more wary and yet spent less time in disguising her approach to it. It was no surprise, therefore, to find on the morning of the eighth day that the larger of the nestlings had lost its down, appeared fully feathered as it lay in the nest and showed much more yellow on throat and head. There was another significant change. Tapping a twig, waving a finger or showing a silhouette of the hen brought forth a feeble gaping response in the smaller nestling, which hitherto had shown no response, but as to the larger, every one of these signs merely caused it to crouch lower in the nest, drawing its head into its shoulders and almost flattening itself.

Now seemed the moment to have another photograph, as clearly the first chick was nearly ready to leave. Before the camera could be brought from fifty feet away, however, the newly-fledged chick had departed. Only one chick remained in the nest and search as we might, short of disturbing the surrounding vegetation beyond repair, we could see nothing of its fellow. Clearly, with its brownish colour, its habit of crouching low at the slightest sound or sight gave it the maximum chance of remaining concealed in this tangle of vegetation. But if we could not find it the hen had no difficulty for as soon as she landed on the wall, several feet away, the fledgling started calling.

Her task was now the heavier for having to feed a nestling as well as a fledgling in the undergrowth several feet away, and this continued for two days after which time the second chick was out of the nest and that phase of their lives was at an end. In the space of seven days, so far as the first chick was concerned, we had seen it grow from a helpless nestling, blind and all but naked, responding to the slightest tap on the branches by stretching up with open mouth, to a fledgling able to move about, that responded to the slightest disturbance by crouching low in cover. The rapid bodily changes were no more remarkable than those that had taken place in its psychology.

Two days later the second chick left the nest for the undergrowth and try as we would that was the last we saw of either. We watched the hen continuing to bring food. We could see movements of the vegetation

indicating where the chicks were, but no amount of peering between grass stems or bramble leaves gave us more than a fleeting sight of one of them. They, however, always greeted the hen vocally as soon as she touched down, so that she knew where to find them.

The nest was no longer used.

One of my earliest recollections is of seeing a card, illustrating a text, hanging on the wall in a country cottage. In the centre was a gaudy picture of a nest with five hungry nestlings gaping skywards. Around the picture were the words, "What is home without a mother?" I commend the text, but there was a fundamental error in the picture: Nest is not a home to birds, it is a place of incubation and brooding in the early stages only. Once the fledglings leave the nest there is no return.

CHAPTER III

BOND BETWEEN MOTHER AND CHILD

IN one sense, the story of the yellow-hammer's nestlings epitomizes the early days in the life of any animal. With the fertilization of the ovum a new individual is brought into being with one predominant need: food and yet more food to supply the energy needed for a miraculous growth and unfolding. At a later stage in its lifetime food is required mainly to repair wasted tissues or to replace energy expended. In infancy there is little loss of energy in terms of work done by muscular movement: the expenditure of energy is reckoned in terms of physical growth and in changes in personality or in the psyche—we have no convenient collective term for the sum of these other-than-bodily changes. Herein, it seems, lies the concept of infancy already mentioned, that it is the parasitical period of life, as contrasted with the adult or parasitized period. This is an over-simplified statement of a relationship in which the ratio of parasitism to parasitization varies from species to species, and from individual to individual within the species. It can be illustrated, however, by contrasting the activities of the hen yellow-hammer with those of her brood.

From the time the two nestlings are hatched the parent responds to those gaping throats by going in search of food. As we have seen, two to three caterpillars a time are collected, to the number of a hundred or so in a working day of over twelve hours when the weather is fine. In addition, the hen must feed herself. Those insects intended for the nestlings were, so far as we could see, carried from a distance averaging about a quarter of a mile. If we allow only half this distance then the total flown in search of food in a full day is some twenty miles. This takes no account, however, of any subsidiary movements. These can, in the course of a day, be considerable.There is, for example, the mere searching for the caterpillars.

We visited some of the spots where we had seen the hen go and we made an intensive search through the vegetation for the kinds of caterpillars we had seen her bring back. It was not at all easy to find them. In the first place, they were scattered on the plants and of a colour which made them harmonize with the foliage upon which they were living. Even if we grant that birds have keener sight than we have

and that they can creep in among the foliage, whereas we have to turn the foliage over, the foraging must still entail considerable searching. This is no more than should be expected from the fact that the journey from the nest to the foraging ground entails a flight of seconds only, yet a full ten minutes may elapse before the bird returns. In one instance she took seventeen minutes. On another occasion she took only three minutes, and we can reasonably assume that the difference between three and seventeen minutes merely represents what luck she was having. It may be due, on the other hand, to the amount of disturbance. With our hen this must have been little, since she was foraging where human passers-by were infrequent, This was not always so back at the nest, however, and disturbance must account for an appreciable loss of time and wastage of energy. Even without it, there is the normal evasive action which consumes both time and energy. This is something to which we paid some attention and several points arising from it are worth elaborating.

The nest was situated, as I have said, in the branches of a bramble growing between the towpath and a low wall. This started at its lower end at ground level. At the point where the ramp joined the bridge the wall rose some ten feet from the ground. The wall on the other side of the ramp was for most of its length two to three feet higher than the one on the canal side. About midway along this near wall an ash seedling was growing, just above the position of the nest.

On returning from a foray the hen usually landed on this wall, and did so more or less regularly in one of three places: (*a*) just below the ash seedling; (*b*) two feet above it, and (*c*) six feet above it. Let me make it clear that her landings were not made with mathematical accuracy, but they were sufficiently close to one or other of these three points to make no matter. The one most often used was (*b*). From any one of these points her entry into the nest was relatively stereotyped along one of the three following lines. She might fly to a point on the towpath immediately below (*a*), then hop along the path to a point more or less opposite the nest. From there she would fly up and into the nest. The second variation was when she flew down to the towpath opposite (*b*), hopped to a point opposite the nest, and then flew up and in. The third variant was to fly straight into the nest from the wall. Although these methods were usual they were not invariable. Sometimes she would fly from the wall down to the other side, on to the ramp. From there she might fly over the wall on to the towpath and so into the nest, or merely skim the wall and fly straight into the nest.

On some occasions she would become positively expansive in her approach to the nest. She would land on the telegraph wires that ran overhead, or on the far wall of the ramp, or in a hawthorn growing at the foot of that wall. These were, however, only preliminaries, and the final approach to the nest would be made by landing on one or other of the three chosen points on the wall already mentioned, and from thence she would enter the nest by one of the three methods already described.

Apart from these rare and minor variations there were, as I have said, the three main points for landing on the wall, each with its three lines of approach to the nest, and to some extent, though not strictly so, these were used in rotation. Perhaps it is nearer the truth to say that, although she rang the changes on these nine combinations, they were sufficiently stereotyped to satisfy the most diehard behaviourist who wished to establish the sheer automatism of the bird's actions. Certainly there was sufficient ground for saying that the evasive action in returning to the nest was as automatic as the gaping reaction of the nestlings even if it was more varied.

Another point that should perhaps be stressed here is that the yellow-hammer used these nine combinations, or occasionally their variants, in the absence of any disturbing influences. She seemed very soon to be used to our presence in the bows of the narrow boat, but it was worth while taking a little trouble to test this, so on several occasions I kept watch through the window of the forward cabin, through the narrow slit between a pair of curtains. Thus, as far as it was humanly possible to be sure, one could assume that there was nothing in the vicinity to disturb her comings and goings. She continued in her customary regular pattern, putting an imaginary foe off her trail, so to speak, in order to keep hidden the actual position of the nest.

This question of the automatic behaviour, the innate behaviour patterns as they are called, interests me considerably. There is a tendency on the part of some students of animal behaviour to emphasize it to the exclusion of everything else. They point to the gaping reaction in nestlings, how it is vertical when the young bird is sightless, how it is directed towards the parent's beak when the nestlings' eyes are open, how it can be stimulated merely by twig-tappings, finger-waggings, and all the rest. They also show us how many aspects of the behaviour of the adults point in the same direction. And from this they resolve everything into automatic behaviour. One wonders, however, whether this is not misleading. If we take the trouble to note the daily habits of a

human being we can also make out a case for an appearance of automatism. We have our regular mealtimes, we go to work at the same time each day, we come home at the same time, we use the same routes to and from our work, or if we vary these routes it is in the same way as our hen varied her comings and goings when feeding her young. We grumble at the same things every day, find fault with the same people in the same way every day to such an extent that any observer on Mars, able to watch us without knowing our thoughts or understanding our language, would describe us as automatic, with our lives governed by innate behaviour patterns. Well, perhaps not quite, but surely the point is that inherited behaviour patterns with their automatic responses to given stimuli are an economy. In the young especially they offer the only hope of survival.

So my hen yellow-hammer was ordinarily automatic—or economical—in her comings and goings. But let there be any intrusion, such as a passer-by coming along the towpath, or somebody standing on the bridge, and immediately we saw a complete upsetting of the fixed paths of approach to the nest. Then she seldom repeated herself except as it was necessary to take advantage of the best cover. On these occasions one had an impression of originality and initiative, limited only by the resources of her surroundings.

Automatic behaviour, especially in the young, must to a greater or lesser extent make the ordinary processes of living supportable. To have to think about every action would be unendurable, even in ourselves with our greater brain power. To recognize this, however, is not to deny the possibility of initiative, resource, even powers of thought in some simple degree in at least some of the higher animals.

However, to return to our subject: while the stereotyped or automatic methods of approach to the nest constitute an economy they are also energy- and time-consuming, even when used as a normal routine. When, however, some disturbing presence caused apprehension on the part of the hen she might take as much as five minutes dodging from one point to another. Her sensitiveness to intruders or other foreign bodies was particularly well shown on one occasion when she took five minutes to enter the nest. I was watching this closely and could see no reason for it. Then I noticed that the dinghy had been tied to the forward mooring rope and was gently riding back and forth in front of our bows, out of my sight but not out of hers. I discovered this quite by accident and to test it took the dinghy out of sight, with as little fuss as possible. After its removal she entered the nest without further delay.

There was another occasion when somebody had walked up on to the bridge while the hen was away. He was at least fifty feet from the nearest of her customary landing places ; and no more than his head and shoulders showed 'bove the parapet of the bridge. Moreover, he stayed perfectly still gazing up the canal. On her return the hen took a full five minutes' evasive action before landing on the wall. Then for three more minutes she remained there, her head constantly moving as she looked all around her. There could be no doubt that the stranger on the bridge was the cause of her disquiet for, as he finally started to move away, she crouched low on the wall, her colours and her attitude making her look very like any one of the several cushions of moss growing on the wall. Then, as he receded further and further, she slowly came up from the crouching position until she had resumed the normal erect posture. It was a full three minutes more, however, from the time he had started to move away to the time she entered the nest. Then she did so following one of her customary lines, down on to the towpath, hop along and then up to the nest.

It was incidents of this sort that showed us how fully she had accepted our presence in the bows, for as long as we stayed there she showed no unusual evasive action. If one of us went on to the bridge, however, or if a stranger went by or a dinghy moved, her apprehensions were aroused.

There were certain things for which familiarity would never breed contempt. We saw one of these in action on the day the second youngster left the nest, when we heard the yellow-hammer for the first time utter a sound. She had returned to the wall as usual, both fledglings being now out of our sight in the tangle of vegetation beneath her, when she made a kind of low whistle. This can be best represented on paper by the word *zee*. In the air, a few hundred yards away, a kestrel was slowly gliding round. The hen crouched motionless. Only when the kestrel began to move further away did she slowly come up from this crouching position. She kept her eyes on him as he flew further and further away, and when he had gone far enough that he had dropped below her line of sight, she flew up on to the higher wall the other side of the ramp and watched him until he had completely disappeared from view.

All this may seem to have nothing to do with infancy, but in fact it has. This sensitiveness to intrusion by moving bodies must be a considerable burden on the hen. If she were not tied to the nest by her family responsibilities she would on such occasions take refuge in

flight. Feeding her young demanded more care than for her own safety, as well as an over-riding anxiety that she should not betray the whereabouts of the nest. Even if birds do not feel anxiety as we do, there must still be imposed some drain on their nervous energy at such moments. It is part and parcel of infancy that it makes these demands on the parents.

The disposal of the faecal pellets showed a stereotyped pattern similar to that of the approach to the nest. Its design was such that it avoided disclosing the site of the nest. Sometimes the hen would fly over a line of trees, dropping the pellets among them. There may have been other dropping places of this sort, but those most obvious to us were at various points on the bridge or on the walls leading up to it. These numbered five. She would land, drop the pellet on the brickwork and fly off. So at these five spaced-out points grew accumulations of the white patches but these were never in such quantity as to arouse suspicion of any adjacent nest or residence. Also, she rang the changes on the pellet-disposal in much the same way as she did her lines of approach to the nest.

The habits and methods of the hen discussed so far merely emphasize the burdens imposed by the brood on their parent. There was that other particular which caught our interest. As I have already indicated, it seemed to us that the hen yellow-hammer possessed a weather-wisdom, so we watched closely for further evidence of this. We found that not only did her behaviour vary in close anticipation of the general weather condition that subsequently obtained, but she also varied her procedure in a way that seemed aimed at protecting the nestlings from its immediate consequences.

Apart from the first few days, which I have already described, the weather was mainly fine until the young, still in the nest, were fledged, after which rain or fine the hen continued foraging. With their own feathers to protect them, the need now was for more food and still more food, whatever the weather. We did have occasional showers, sometimes heavy, and it was noticeable now that the hen would ignore the rain until such time as the water stood on the leaves in sufficient quantity to start dripping on to the nestlings. Then she would go in and brood them, letting her own back catch the drops and throw them into the rim of the nest. It was not easy to be precisely sure of what happened, but by watching other similar groups of leaves nearer to our observation point and taking careful note of the hen's action it did look as though she contrived always to return and shelter the

nestlings just before any considerable drip of water would be likely to fall on them.

Then there was the occasion when a thunderstorm threatened. Black clouds passed overhead and distant lightning and thunder presaged what was in store for us. A full hour passed, however, before the storm broke in our locality. Our hen foraged throughout this time but at precisely 7.55 p.m., the time when the rain started to come down, eventually falling in torrents, she returned to the nest and did not leave it until some time after the rain had finished falling.

There may have been no wisdom, as we understand it, in her actions on these occasions, but there seemed little doubt that she gave her brood the maximum shelter from the weather. If her actions were outside what is normally regarded as intelligent timing then she must have possessed a meteorological sense of such delicacy as to give the appearance of intelligence. One wonders whether birds normally give such attention—or, should we say, react so sensitively—to the weather or whether it is another of the results arising from the changes in a parent associated with the bearing of offspring.

We saw little of the yellow-hammer's mate. There was a cock with a bright yellow head that visited her from time to time. He may have had nothing to do with her present brood. The first time we saw him was when he flew in with her and landed on the wall beside her, literally dancing attendance on her. She seemed to be indifferent to his presence, but as she paused before flying into the nest he danced into the air several times around her, with wings half-open in display. She appeared to ignore him completely, and when she entered the nest with her load of caterpillars, he flew away.

On another occasion he came down to her just as she flew out of the nest. Both landed on the parapet of the bridge and this time she crouched low before him, spread her wings and opened her beak towards him, fluttering her wings at him in the way that fledglings have when the mother alights before them with food. It was the typical soliciting attitude, but for her it was symbolic only. Neither then, nor on the other infrequent visits, did the cock carry food in his beak. If he was indeed the father of her brood he was no more than a casually interested witness of their upbringing.

It is a familiar sight among many garden birds to see the hen soliciting from the cock in the same way as the young solicit food from the parent. It is especially a feature of the courtship ceremonies. It could be interpreted as the continuance into adult life of an infantile

trait, and so interpreted it would be in line with other female traits. In the yellow-hammer, for example, the plumage of the hen is less colourful than that of the cock and more like the plumage of the young bird. Like the juveniles the hen has no song, that being the prerogative of the male. It is such things as these that lead us to the general conclusion that there is, as a rule, a greater carry-over from infancy into the adult life of the female than in the male. Such a conclusion is partly true, but is subject to qualification; it may, nevertheless, have an important bearing on the general subject of infant welfare.

There is, however, another side to this, particularly well illustrated by the members of the thrush family. Among the species belonging to that family found in this country, we have the typical member, the song-thrush, in which the speckled breast is the most outstanding feature. This is equally well marked in both male and female. The speckling is also a marked feature of the juvenile plumage. In a nearly related species, the blackbird, the juvenile bears a fair amount of speckling. The female, with the brown colour of her plumage closely like that of the juvenile, also has the speckling on the throat although this varies from one individual to another. The adult male, by contrast, is a uniform black, with an orange bill, with no sign of speckled feathers. In robins there is no difference between the adult male and the adult female, but the young are speckled in a manner recalling the plumage of the young thrush and the young blackbird.

These three species present a graded series which is, in a way, representative of the birds as a whole. There are the less advanced species, represented here by the song-thrushes, in which the male and female are alike and not strikingly different from the juveniles. Then those species in which the male is more advanced in development than the female, as in blackbirds. At least we like to think that the male is the more highly developed, and that is how it seems. Finally, we have species, like the robins, with no difference between the adults of both sexes. Both are, superficially at least, equally advanced. There are, of course, numerous intermediates between the three.

It is usual to explain the condition found in the blackbird by saying that the hen, the more important for the continuation of the race, is thereby protected at her most vital and valuable period by her lack of conspicuous plumage. She remains inconspicuous, thereby standing the greater chance of preserving her offspring as well as herself. This may be a secondary effect, but to pretend that it is the primary significance of the difference between the male and female

plumages is to ignore the fact that such species as robins succeed just as well although the female has forgone the advantage of a more inconspicuous plumage.

So very frequently theory tends to be based upon certain examples which fit it and those that undermine it are subconsciously ignored. In this instance the theory of protection by inconspicuous plumage is supported also by outstanding examples, such as the ostriches and the phalaropes. The male ostrich has a black plumage and incubates by night, the female has a brownish plumage and incubates by day. So we have a pretty illustration of the theory: black is inconspicuous at night, the brown inconspicuous by day. In the phalaropes the hen does the courting, and is accordingly more brightly coloured. The male, inconspicuously coloured, as becomes a henpeck, does the incubating. In both these instances the colour is a subsidiary to the need for protection, for any bird incubating remains very still and this alone tends to ensure its being overlooked. The possible exception is white, which is why albinism in the wild is readily liquidated, except in species such as swans or polar bears that suffer little from predators, or where white is a protective colour, as in white winter coats.[1]

We find these same distinctions between the sexes in mammals. In some species there is no obvious difference between them except perhaps slightly in size. In others the males are decorated with horns, antlers, tusks, manes and the like, the female being without these and having an aspect much nearer the juvenile. There are other species in which both sexes carry adornments, those of the female being less well-developed. In the fallow deer, for example, the female is without antlers, the male carries them. In reindeer both sexes wear antlers, those of the female being less robust.

Whatever may be the scientific explanation of this, and it is no part of our present discussion to probe further into it, we can reasonably draw the generalization that the female tends to be closer to the juvenile in her physical characters. We could expect, therefore, that she would be nearer the juvenile in mentality. This is no more than it should be since it puts the female more *en rapport* with her offspring when they most need her services. With rare exceptions, therefore, as in the phalaropes, there should be quite naturally a stronger bond between the female and the offspring, quite apart from any bond arising from the need of caring for the offspring. We shall return to this point later.

[1] There is some evidence that the white coat of the baby harp seal is a protection against the absorption of heat from the sun as it lies on the ice.

CHAPTER IV

THE AUTOMATIC CHICK

A FRIEND of mine had a broody hen, so she placed a pair of artificial eggs under the hen and went off to buy some day-old chicks. The chicks duly arrived and were placed with the hen. Then ensued something in the nature of a pantomime. The hen sat tight on the useless eggs. The incubator-hatched chicks responded to her clucking sufficiently to keep them near her but their need for food was more insistent than the call of the hen. The chicks wandered around in her vicinity, pecking at this and that, every now and then executing a little shuffling dance with the feet, which is the way chicks have before they have learnt properly to scratch at the earth. Meanwhile, the hen, sitting fast on the nest containing the two eggs that would never hatch, craned her neck outwards, looked this way and that, clucked, craned her neck again, looked this way and that and clucked again. Clearly she was bewildered. Then someone had a bright idea. The eggs were removed; the hen instantly left the nest and with unrestrained clucking walked forth gathering her adopted chicks around her.

The hen had never had a brood of chicks before. The chicks had not previously known a mother's care. Yet once the eggs had been removed hen and brood were united to form a successful and harmonious family group. Before enquiring further into the reason for this let us examine the perplexity or disharmony that preceded it. We are prone to assume that the mother's tender care springs directly from the fact of her having borne the child—"flesh of my flesh, of my agonies born". The same idea tends to be applied also to the animal kingdom in general. In view of this the hen gathering her foster brood around her, and the foster brood, incubator-hatched, clustering around her should strike us as an unnatural situation. Yet we never regard it as such. Clearly such a contradiction should be enquired into a little more closely.

First of all, the call of the chicks tended to release or call forth a particular pattern of behaviour in the hen. This was the one that eventually came into play when finally she walked from the nest. The touch of the eggs on her breast, false though they were, tended to release in her another pattern of action which was contradictory to the

first, namely, to remain and brood these solid objects beneath her. The instinct to incubate the eggs and the instinct to mother the chicks warred within her. Neither eggs nor chicks belonged to her nor had formed any part of her at any time, yet each called to her, and did so in different ways, producing within her a struggle between conflicting instincts. The episode provides a good example of the basis of so much of animal behaviour, the innate reaction to an external stimulus. The earlier behaviour of the chicks furnishes further examples.

When the down-covered chick first emerges from the egg it is wet and helpless. It has but one ambition, if we may speak of it so, to nestle against something warm. It is the same whether the eggs are brooded by a natural mother or hatched in an incubator. Among other things, this is fortunate for the poultry farmer; the first needs of the young chick are readily met, merely by providing warmth. Although the chick has been able to struggle out of the egg, it is four to five hours after hatching before it is able to stand, support its own weight, hold up its head and make full acquaintance with the world around. This preliminary helplessness, and the way in which the chicks gradually gained possession of their faculties led to a perplexity among learned men a century ago. They could not decide whether the chick gained its independence so quickly as a result of rapid learning, or from instruction by the hen, or from something within the chick itself.

That a mere instinct, as this something came to be called, could account for so much was looked upon as impossible by most thinkers and they were inclined to look for some mystical explanation. Today, although the savants cannot agree upon the precise definition of instinct, they are no longer in doubt as to the principles underlying it. The early behaviour of the chick and, for that matter, of the hen towards her chicks, has now been fairly fully studied, and we know it is inherited, or innate. In all animals, no matter how low in the scale, there is some capacity for learning by experience and by trial and error, and this becomes progressively greater as we go up the scale. So in the domestic fowl there is superimposed on the innate behaviour patterns something that is derived from experience. In the fowl, it is, however, a relatively small part of the total, and in any case requires time to reach full expression, and a newly-hatched chick has not yet had time to learn.

The first essential for a chick to be independent from the time of hatching is that it must be capable of feeding itself. By the time we human beings are capable of conscious thought we have had so many

meals that feeding is taken for granted. A chick, unlike the many wild animals and birds that are fed at first by the parent, must not only be able to search for food, recognize it as food and perform the delicate operation of picking it up and swallowing it, but must be able to guard itself against the loss of the food and other things besides. Each of these separate components of the process we call feeding has been fully investigated in the domestic chick.

First then, the search for food; a chick from the start is able to judge distance and direction. Even if shielded from the light so that it has had no opportunity since hatching for exercising and developing the eye-muscles, a chick can judge both these things accurately. It never pecks at objects beyond its reach and invariably strikes them accurately,

Domestic chick one hour after hatching

or at most misses by no more than a hair's breadth, even when the object is no larger than the dot over an *i*. It will follow the movements of the human hand, at a distance of two feet or more, when the hand is moved backwards and forwards and all round it. It can follow the movements of crawling insects accurately. Indeed, a chick can use its eyes with a skill not perceptibly less than that of a full-grown bird. Moreover, a chick with one eye deficient or useless appears to suffer no handicap.

It might be suspected that moving objects make a noise, however small, and that the eyes might be guided to some extent by the ears, but it can be shown that hearing plays no part in this. Inanimate objects such as crumbs or particles of oatmeal will be picked up as readily and as accurately as moving insects. One chick which subsequently proved to be completely deaf at the time showed no less ability in using its eyes than its fellows that had their full powers of hearing. The ability to judge distance and direction comes out also in the way

the chick moves over rough ground, without mishap, as soon as it can stand. It will run round obstacles such as large stones, or jump on them and down the other side without making mistakes.

Although we speak of this ability to judge distance and direction as completely innate, that is, inherited and fully functional from the first, it may be necessary ultimately to add a slight qualification. The ability to stand is obviously innate. An incubator-hatched chick, even one hatched on its own so that at no time does it have sight of or any contact with other birds of any kind, will stand on its own feet within a few hours of hatching. It may be, however, that during this interval the muscles are not only gaining strength but learning co-ordination. This is something that is difficult to prove and is mentioned here merely because it needs to be borne in mind in later discussions.

The ability to recognize food is less clear-cut. It seems to consist of an innate tendency to distinguish between edible and inedible objects which improves with experience. A newly-hatched chick will recognize items of food and peck at them. It will also peck at the beaks of its fellow chicks. It will peck its own toes and will pick up its own droppings, rejecting them with apparent disgust and not repeating the performance after the first trial or two. The actual taking of food, the picking up and swallowing, requires the co-ordination and successful co-operation and timing of an intricate set of muscles. It is not surprising, then, that first attempts may sometimes be awkward or even fail completely. Success quite often attends the first attempt, but more often several pecks are necessary; and having picked the food up usually one or two attempts are needed before the food is actually swallowed. So here we have a situation in which the mere sight of food is a stimulus to peck. It is the result of an automatic or innate reaction to a simple stimulus. The pecking action, on the other hand, normally requires five or six attempts before the first success is achieved, and the swallowing of the food is not accomplished at first trial but requires the experience of at least one or two attempts.

In a sense, the whole machinery for feeding is innate, requiring only the stimulus of the sight of food to set it in motion. To this extent it resembles the workings of an automatic machine, requiring only the pressing of a button or the insertion of a coin to set it in motion. There is this difference, as we have seen, that not all the processes in the living machine will necessarily function properly at the first attempt. In some a modicum of learning is necessary, no matter how little. The act of swallowing requires normally one or two trial-and-error attempts,

picking up food requires five or six. Yet the tendency to do all these things is innate. There appears to be, therefore, no hard and fast line between an innate ability and the process of learning. Thus, in the domestic chick, the urge to feed itself is wholly innate. So far as we can see it functions instantly food comes within range of the eye. Swallowing works almost but not quite perfectly. Picking up food requires just a little more experience before perfection is reached. And for other actions necessary to life but not so immediately essential even more learning, or trial-and-error experience, is necessary.

The study of the domestic chick suggests a definition of learning: that it is the gaining of experience by the performance of certain acts or functions requiring a varying amount of repetition for its perfection. This may or may not be actuated or initiated by an innate tendency. It also teaches us that for a given species there are well-defined limits beyond which learning cannot proceed, and is borne out by a comparison between a chick of the domestic fowl and one of the turkey, both gamebirds and therefore closely related, both showing sufficiently marked differences in behaviour which no amount of learning can eradicate.

Douglas Spalding was one of the first to investigate the behaviour of the domestic chick. Writing in *Macmillan's Magazine* in 1873, he refers to the turkey's method of catching flies, "so remarkably clever that it cannot be witnessed without astonishment". Having noted that "chickens like flies no less than turkeys, and, though with less success, often try to catch them", he placed a newly-hatched chick with an eleven-day-old turkey. The two became constant companions but the chick never acquired the trick of catching flies, "wholly blind to the useful art that was for months practised before its eyes".

This contrasts with the instinctive fear of stinging insects, which Spalding noticed in both fowl and turkey chicks. The turkey chick on seeing a bee for the first time would stand with outstretched neck giving its characteristic alarm-call, after which it would turn and move away from it. The domestic chick also showed signs of an instinctive fear, both of bees and of swarming ants. It is not always possible to be sure that such things are innate, for a turkey or a chicken needs to peck but once at a bee to receive a lesson it will not forget. It could have been that when Spalding saw them show what he took to be their characteristic reactions it was not the first time they had met these troublesome insects. That this was not necessarily so, however, is suggested by the occasion when a young chick, soon after taking its first look on the world, caught a fly, later made a peck at its own toes, and several

minutes later seized a bee and threw it aside disabled. Presumably the bee had had no time to sting and the action by the chick was defensive.

The last of the components, listed a few pages back, for successful living was the ability to guard against the loss of the food once it has been acquired. Although I did not know it at the time I learned how this is done many years ago. One of my earliest memories, from about the age of three, is of wandering away with a biscuit in my hand to look at some poultry. Squatting down to have a closer look at the hens, the biscuit was snatched from my hand by a hen which instantly set off running at top speed followed closely by several others. As the thief hen passed the others her fellows made a peck at the biscuit or joined in the chase. Soon the chase ended in a general scrimmage, the biscuit passing from one beak to another, at first fairly whole, but later in pieces. What happened after this I cannot say. My vision must have been blurred by tears, for my memory of this early scientific experiment ends at that point. It is an experiment which I, in common doubtless with most people, have seen repeated many times.

I had always supposed, if I bothered to think about it at all, that when a hen picks up a particularly fat worm and immediately starts to run away the motive was an innate greed, an unwillingness to share with her fellows. Or else that it was a wisdom born of previous experience. The truth is otherwise. A young chick, first able to run, will, on picking up a morsel of food that cannot be instantly swallowed, turn round and run, as if pursued by an imaginary host intent on stealing. It will do this even when there are no other chicks present.

There are other ways in which a chick automatically takes care of itself, without previous learning or experience. One of these concerns defence against enemies, and in particular against hawks.

There may be an element of doubt about whether a chick, be it of domestic fowl or turkey, recognizes the uncomfortable properties of a stinging insect at first sight. There is none to its reaction to the even greater menace of a hawk. Poultry keepers are familiar with the immediate reaction of a hen with chicks to the presence of a hawk. The silhouette of a hawk high in the sky overhead or at a distance, even if far enough away to escape normal human notice, will draw from her a characteristic alarm-call. Very often the first intimation you have of a hawk in the vicinity is on hearing such an alarm-call, and, looking up and around, you discover the cause, sometimes almost unrecognizable by the human eye for what it is. To say that the bird is in no doubt is to mis-state the position. There is no process of thought such as is implied

by the use of the word 'doubt'. The image of the hawk's outline falling on the bird's retina automatically releases the alarm-call.

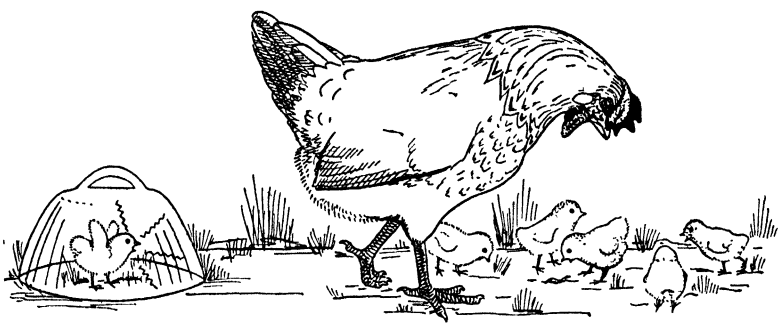
The effect on the chicks of the hawk alarm-call from the hen is that they immediately make for cover. If the ground is bare of vegetation they shelter under the hen, otherwise they make for grass or undergrowth. There is some variation in this according to circumstances. Nevertheless, there is one constant feature: the chicks make for cover and they do so instantly on hearing the call and without having had any previous experience of a hawk. Even an unhatched chick, cheeping in its shell prior to cracking it open to emerge, is said to go silent on hearing the hen's alarm-call. An incubator-hatched chick is also said to make for cover on hearing the cry of a hawk. If no cover is available it will freeze in a crouching position. A chick within its shell in an incubator is likewise said to cease its cheeping on hearing the call of a hawk.

There is no question but that the silhouette of a hawk alone has an immediate effect on chick and hen alike. Nor is there any question but that the reaction is innate. Perhaps the most remarkable thing is, however, that the shape of a hawk releases a similar innate reaction in such a wide diversity of birds. We have already noted what the yellowhammer did when the kestrel was overhead. The alarm-note of the parent and the responding behaviour of the chicks may differ according to the species, but all have this in common, that neither call nor response have to be learned, both belong to a fixed and inherited pattern of behaviour.

When a hen hatches a brood of chicks, parent and offspring are already talking to each other before the shell is broken. Under these natural conditions therefore the full significance of their calls cannot be appreciated. If, however, an incubator-hatched chick is placed on the ground, as soon as it can walk, in the vicinity of a hen clucking to her own brood it will make immediately for the hen. It will do so, moreover, if the hen is out of sight, provided she is giving the appropriate call. Conversely, the chirping of the chick will bring the hen to it. If a chick is taken from the hen and placed down at a distance from her it will call to her. Her response is to cease whatever she is doing and call in reply. This same call also brings the rest of her brood to her and keeps them following close to her as with neck upstretched she looks around to locate the lost chick. Once she sees it she advances towards it calling intermittently. So the mechanism for retrieving the lost chick and at the same time keeping the rest from straying is automatic on all sides. Even if the chick is placed down in tall vegetation so that it is hidden from

view these calls have the same result in the end: the hen retrieves the chick.

It is regrettable that so charming a scene of devoted poultry motherhood has to be so completely shattered by the findings of scientific investigation. But science goes even further in this devastating disillusion. For example, one scientist had the bright idea of placing a glass cover, the sort of thing you find covering sandwiches and cakes in a refreshment bar, over a chick that had wandered from the rest of the brood. Imprisoned in this way the chick could cheep its heart out but nobody could hear it, not even its own mother—or foster-mother. So, although the hen could see the chick, because she could not hear its voice she wandered off as if nothing were amiss. However, as soon



Domestic hen ignoring chick she cannot hear

as the experimenter lifted the glass cover so that the chick's calls could be heard the scene changed completely. The hen answered the chick call for call and continued doing so, advancing all the time towards the chick until it had joined the rest of the brood.

There may perhaps be those who consider it unfair to play such a trick on a hen, arguing that, since under natural circumstances such a thing is unlikely to occur, there is little point in an experiment that can yield so little information. In fact, a similar situation has been known to occur and for this we must go to the black-headed gulls that have taken to nesting on a sewage farm near London. What we find there emphasizes the limitations and disadvantages of the fixed behaviour pattern just as the chick under the glass cover does. On this sewage farm are areas of drying sludge, giving a firm mud interspersed with wet 'quicksands' so to speak. Many scores of gulls nest there, building their nests on the firm mud.

It often happens that a young gull will run from the nest, especially at the approach of a human intruder, and will stray on to the 'quicksand'. The feet sink in and the chick can take no further step. At first it may struggle and the other gulls will appear puzzled by this, and even seek to attack it. As the sinking continues the wings are held to the sides of the body, so that struggling is no longer possible. There is no appropriate call in the innate vocabulary of the gull chick for such a situation. As a consequence there is no reaction from the parents, certainly nothing to bring a rescue attempt from them. In the later days of the breeding season one may see a number of chicks at various stages of sinking beneath the mud while the parents go about their everyday business unaware of the high rate of infant mortality in this artificial environment.

It is easy from this to see one drawback to fixed behaviour patterns. A species could readily become extinct with a radical change of environment, merely by reason of a steep increase in infant mortality.

Although we speak of these things as innate, or inborn, the particular pattern appropriate to the care of the chicks does not emerge in the hen—certainly not in its strongly marked form—except under the influence of physiological change. How far it is latent and how long it is before being called forth is not easy to say. One thing we do know is that it comes out in its fullest expression following changes in the reproductive glands, and especially following a period of broodiness. Under wholly natural circumstances a hen bird comes into breeding condition after having been courted, after having mated, laid and incubated the eggs, felt the eggs under her breast and finally having seen her chicks emerge. Each step brings its physiological changes. What happens in this respect in the domestic hen may not be a fully reliable guide, for we are dealing with a bird in which the whole sequence has been altered by man's interference. On the other hand, the fact that the domestic hen can be used as a foster-parent even when she has not experienced the preliminaries to parenthood shows how parental instincts or patterns of behaviour are latent and can emerge even in the absence of these preliminaries, as the following story also suggests.

It is the story of the bitch which, before ever she had puppies of her own, would wait until the cat had left her kittens for a spell, when she would creep in and coil herself around the kittens. It took all the maternal belligerence of the returning cat to eject her from them. The same thing happened with each litter of kittens even after the bitch had had her own litters. It may be difficult to separate a fixed pattern from

the impulse underlying it. In principle they are the same, and this suggests that instincts, fixed patterns of behaviour and all such things which are apparently transitory, merely serving the purpose of the moment, are in fact part of a total inherited pattern from which appropriate parts may be called forth or suppressed as circumstances demand.

Many of the fixed behaviour patterns of the infant are, on the contrary, of temporary duration. They serve the needs of the infant and, incidentally, characterize the period of infancy. Furthermore, their impermanent nature is shown by the fact that a chick of the domestic fowl that had no contact with other chicks or with a hen prior to the age of four to ten days will have nothing to do with a hen. The calls from the hen, no matter how insistent, make no impression on the chick and nothing will induce it to stay with her. Instead it makes every endeavour to go back to the place it has occupied since hatching and which is for it the nearest thing to home a bird ever knows. Or else it returns to the human being that has tended it and who for the chick is mother. The fixed behaviour pattern has these disadvantages that it can lead to unnatural fixations. The young of the grey lag goose is said to become fixated on the first moving object it sees, human or otherwise. To a lesser degree the same is true of ducklings and chicken. This does, of course, make adoption easy thereby solving some of the poultry farmer's problems, but it also suggests that the fixed infancy pattern, unlike those of later life, has a limited duration in the lifetime of its possessor. But we return to this later.

CHAPTER V

SUMMARY OF INFANCY IN BIRDS

THERE is much evidence for the generally accepted theory that modern birds are descended from a reptilian ancestor. Modern birds differ from reptiles, living or extinct, in being warm-blooded, in having the body covered with feathers instead of scales and in a number of other features, but most of all in their behaviour towards their offspring. Most reptiles lay eggs, a few give birth to live young, but there is little in the way of parental care. Birds, on the other hand, always lay eggs, and except in rare instances not only provide a nest and incubate their eggs with the warmth from their own bodies, but tend the young for a varying length of time. The fossil history of birds is woefully incomplete. We know little enough therefore of what the adult birds were like in bygone days, and nothing at all of their breeding habits or the way they treated their young. What we know of birds now living can shed little that is reliable on the past, but we might as well start with one of the more, if not the most, ancient of living birds, the kiwi.

At one time it seemed as if the kiwis might be in danger of extinction, but now they are protected absolutely by law. In addition to this, some are kept in captivity at the game farm of the Hawke's Bay Acclimatization Society, at Greenmeadows, near Napier, New Zealand. In the wild, the kiwi is difficult to study. It comes out at night to feed, and by day lies up completely hidden in a hollow, between the roots of a large tree, under a fallen tree or in a hole in a soft bank. In such places also the nest is made. The result is that although their nests are often found not a great deal is known about their nesting habits. At Greenmeadows it has been possible to study their habits, in the nesting-boxes provided in the kiwis' aviary.

The birds do not begin to lay, it seems, until the age of five or six years; the life-span of a kiwi is something over twenty-five years. The male builds the nest and takes over the care of the eggs a few days after the first one is laid. The strength of the parental urge within him can be gauged by two things at least: that every time he enters the nest he takes building materials, leaves or dried grass, in his bill; and during the incubation period of 75 days he alters his habits considerably. For

weeks on end he will not leave the nest, fasting for these long periods and spending most of his time sleeping, even at night when normally he would be most active.

The kiwi's egg is unusually large and it weighs from 13½ to 15½ ounces, just under a quarter of the total weight of the bird that lays it. Ian Harman, writing in *Zoo Life*, tells us that:

> "When [the male] has only one egg to incubate he keeps it longways, in the hollow between his legs; the second egg he keeps up nearer the neck. When there are three in a clutch they are arranged in a row, one in front of the other, sometimes end to end, sometimes side by side. Under such conditions, the bird cannot tuck his head under his back feathers to sleep, but is forced to keep it stretched out in front, covering the third egg. A curious point observed by Mr. Robson [the curator at Greenmeadows] is that the male nearly always sits facing south."

There may be variations in the way the male kiwi arranges the eggs when incubating; it could be that he does not always face south. We do not know enough about it to say whether this is so or not, yet from this little we do know it is very clear that the whole business of incubating is anything but haphazard. The presence of the eggs in the nest causes the male kiwi to behave in a particular way towards them. They convey to him a stimulus which evokes a particular pattern of behaviour, and this, moreover, cannot be called forth by anything not having the shape of an egg in a nest.

At the actual hatching, most young birds peck a series of small holes round the inside of the egg so that ultimately that part of the shell within the line of holes comes off like a cap. The kiwi chick breaks off pieces about ½ inch across to form a hole about an inch in diameter. Into this hole it puts a claw and wrenches the shell apart. The whole action is one that the chick has never performed before and will never do again. It is instinctive; the behaviour pattern necessary to its performance is part of the inherited mechanism stored up somewhere within its brain.

The newly-hatched kiwi chick is nearly black, its eyes are open and it is fully feathered, but the feathers are covered with a slime which does not disappear until four or five days have passed. The legs are weak so that the chick cannot stand until the fourth day, nor does it make any attempt to feed until the sixth day. The male kiwi behaves as

though this were fully known to him. As soon as the chicks hatch he eats the shell to clear the nest. He also barricades the entrance to the nest, and he does not break down the barricade until the sixth day, when the chicks are ready to leave. At no time does either of the parents feed the chicks, which as soon as they emerge from the nest drive their bills into the soft earth for worms. Everything goes according to a plan passed on from generation to generation.

Although the chicks can feed themselves from the sixth day onwards, and can run about rapidly at a fortnight old, the male does not relinquish his duties. He will attack anything coming near the chicks, will drive them back into the nest for greater security and in every way, apart from feeding them, is concerned for their welfare. The chicks respond by showing complete confidence in him. The mother approaches them at some peril, for they strike at her with their strong feet if she comes too close to them.

This does not mean that the hen, having laid her eggs, is thenceforth without any bond with her offspring, for a few days prior to the eggs hatching she behaves in a singular manner, according to what was seen in the aviary at Greenmeadows. There she came to the nesting-box and tapped all round it with her beak. The male inside tapped back. When a chick hatched she was seen to tap the box about every two and half minutes throughout the night. No explanation has yet been offered for this, so far as I am aware, and one can only note for future reference this curious 'liaison' between maternal parent and offspring. Or perhaps the tappings convey messages between cock and hen the meaning of which is as yet unknown to us.

Kiwis are related to ostriches and it will be of interest to see therefore how their breeding behaviour differs. The story of the breeding of ostriches is one of many which help to explain why I am at times apt to show myself heterodox in my views. It is one that tends to undermine faith in opinions generally held. According to all the standard works, with an occasional exception, ostriches are polygamous, the male having a harem of several hens that share a single nest. This appears, however, to be wholly incorrect and based upon ostriches under domestication. There, although the sexes are evenly balanced in the broods, the males fight so much as a result of being in close contact that by the time they reach the age for breeding their numbers have become drastically reduced. The result is that they are outnumbered by the females and the nesting behaviour is seriously distorted. It is the cock ostrich that makes the nest, squatting on his breast and kicking

the earth outwards with his feet, to scrape a saucer-shaped depression in the earth. The polygamy resulting from captivity means that several hens endeavour to share the one nest.

The hen ostrich lays one egg each day. On an average she lays a total of 15 eggs. With several hens sharing a nest it comes to hold 50 or 70, the highest number recorded from one nest being 150. Contrary to accepted opinion, also, the ostrich does not leave her eggs by day to be incubated by the heat of the sun. In the wild she occupies the nest from 8 to 9 a.m. until about 4 p.m., the cock taking over from then until the following morning. Unattached hens may sometimes lay in the nest of the mated hen, even in the wild, but these eggs would be infertile. They are more probably laid in the vicinity of the nest and so have given rise to the story that a few eggs are laid outside the nest for the chicks to feed on when first hatched.

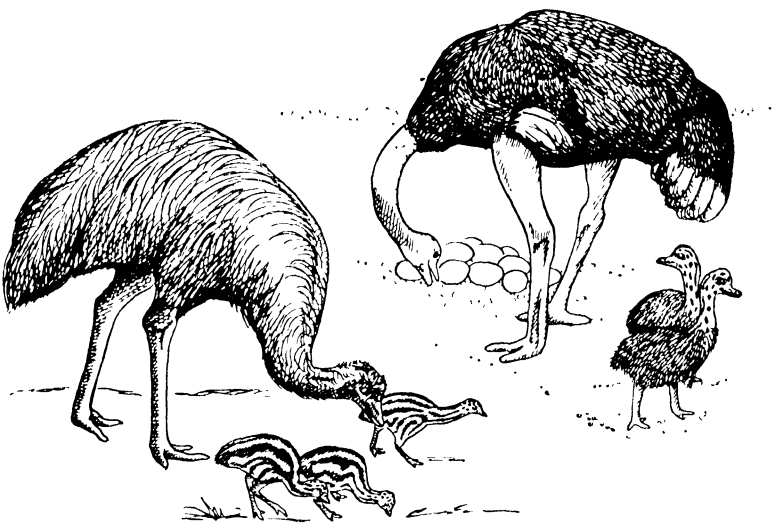
On the ostrich farms a hen ostrich occupying a nest has several other broody hens standing or squatting nearby. Whenever she rises there is a scramble to take her place, eggs are broken, one or more fresh eggs are added. Some eggs are rolled out, old ones previously rolled out may be retrieved, and so it comes about that the same lot of eggs is seldom in the nest for more than a few days at a time. It can happen also that in the end no chicks are hatched, eggs are addled or broken, the nest becomes a trampled ruin and is abandoned before the full period of incubation has run. Clearly any knowledge of the natural history of ostriches obtained from the domesticated birds must be viewed with suspicion.

All this was pointed out by Cronwright Schreiner in the *Zoologist* as far back as 1897, yet his writings have been ignored for over fifty years except, as far as I can find, by the late W. P. Pycraft, who carefully summarized Schreiner's results in the *Standard Natural History*. Schreiner pointed out that for all its size the ostrich nest is not easy to find, especially in the wild. He was of the opinion that the birds are naturally monogamous, that they shared the duties of incubation and brooding and also those associated with the care of the chicks. He also disposed of the notion, held even by authoritative writers, that the cock helps the chick out of the egg by cracking it with its breast. Like all other chicks, young ostriches peck their way out, but it is not impossible that occasionally the 300-lb of parental bulk may accidentally assist the chick in its task.

The pattern of behaviour seems to be, so far as we can tell, very similar to that of the ground-nesting game-birds, including the jungle

fowl from which our domestic fowls have been derived. If we are to expect a stereotyped pattern in any animal it should be in a 300-lb bird with a head the size of an orange and a brain not much bigger than a walnut. Unfortunately, apart from the injury-feigning of the parents, and the freezing of the chicks in moments of danger, the best we can say of this very familiar bird is that we know next-to-nothing of its infancy. Its study should be very rewarding.

We know only a little more of the emu, which has about the same mental capacity as the ostrich. The emu has been deliberately killed off



Emu and chicks (*left*) and ostrich and chicks

by the hundred thousand in parts of Australia because its presence clashed with human interests. But there seems to have been little attempt to study it. Around it, too, misconceptions have been perpetuated. For example, it had usually been assumed that the hen was larger than the cock, until David Fleay, as recently as 1936, pointed out that the cock is larger and slightly thicker-set than the hen. Apart from this there are only slight differences between the two sexes. The irides of the eyes are a rich brown in the male as against the yellowish irides of the hen, and the skin of his head and neck is brighter in colour. Only when a cock and a hen are together can such distinctions have much value. The best distinction lies in the voice, the hen using booming or drumming notes, the cock muttering or using guttural notes. It was the confusion in the

identification of the sexes that obscured for a long time the details of the emu's breeding habits.

In the breeding season the emus gather in flocks, the hens doing the courting. This is not consistent with our general ideas, that if the hen does the courting she wears the brighter colours. At all events, mating having taken place, the hen lays her eggs in a nest fairly well hidden in the vegetation. There is a difference of opinion on the time occupied in the incubation. Some writers say it is eight weeks, others that it is three months. When the first egg is laid the hen covers it with vegetation and leaves it. This protects it from the direct rays of the sun and also conceals it. As each egg is laid, the same protective measure is used. Then the male takes over to brood the clutch, which he does before the last egg is laid.

Once egg-laying is finished, the cock takes over entirely. In captivity, should the hen wander near the nest, she is promptly chased away. In the wild she probably keeps away, having more room to wander. The cock sits close, with body depressed over the eggs and head lowered, or with the neck drawn back into the back feathers. The brooding emu is not readily seen, therefore, which, with the covering-up of the eggs every time he leaves the nest, accounts for so few nests having been observed. So he sits tight, taking little or no food, occasionally stepping off the nest to drink or rising to turn the eggs. Only if approached closely will he move off and then he indulges in injury-feigning. Barton has described how he found a brooding emu and what took place. "Upon cracking some sticks, the long neck lifted gently, one glance toward me, and the emu rose, and moved off. . . . It had the gait of a drunken man, and several times staggered against a tree."

The young, which are striped dark on a light ground, have the same kind of call when in distress or lost, and it is answered by the parent in a similar way to that with which we are more familiar in ground-nesting birds or, better still, the domestic hen. One observer has described how, if disturbed with its chicks when they have left the nest, the cock makes off, preceded by the chicks. The cock has his head lowered but his eye is on the intruder. This observer claims that the low notes from the parent caused the chicks to turn left or right or go straight ahead, the parent guiding them with vocal signals as a drill-sergeant directs a platoon. It would be interesting if this could be confirmed. But the parent emu can fight as well as retreat, the threat display consisting, in the female, of a booming note, with the neck straight and ruffled and the wings slightly extended, ending, if necessary,

with a raking forward-kick accompanied by a hiss. The display of the male appears to be similar, except that the guttural notes replace the booming.

There are some 8,000[1] different species of birds living today and in no two of them is the story of infancy precisely the same, and the extremes of variation are very wide. These 8,000 can be divided into two main groups: the ostrich-like birds and the rest. The first of these, known also as the Ratites, includes the emu, cassowaries, rheas and kiwis, in addition to ostriches, and consists of some 30 species at most. All are completely flightless and, because of the strength of their legs and the feebleness of their wings, could well be called the running birds. Opinion is divided on whether they or their ancestors ever did fly, or whether their remote ancestors did have the power of flight which their descendants have lost. Incidentally, and to show the difficulty of putting animals and the things they do into watertight compartments, we have the fact that the tinamous are also included in the Ratites although they can fly and are much more like the game-birds. Their inclusion with the ostrich-like birds is anomalous, to say the least.

The second group, the Carinates or true flying birds, comprising nearly all of the 8,000, also includes some that do not fly. These last, we have more reason to believe, are descended from ancestors that did fly and have lost the power of flight secondarily. The extinct dodo, or flightless pigeon of Mauritius, is the classic example of a completely flightless bird. Penguins, of course, do not fly but use their wings as paddles for swimming, and here again it is not impossible that they are more nearly related to the Ratites than the Carinates.

The Carinates show a wide range of nesting-sites: on the ground or in burrows in the ground, in trees or bushes, on cliffs or in hollow trees, by water or on the water, and many have taken to building habitually on or in houses. Some make no nest worth speaking of, like the nightjar which broods its own eggs, and some none at all, like the cuckoo that leaves other birds to do the work. Thrushes build a cup-shaped nest, the long-tailed tit builds a domed nest. The tailor-bird sews its nest to a large leaf, some humming-birds build their tiny nests under broad leaves for protection. Martins and swallows use mud, the cave-dwelling swifts use their own saliva. Wood-pigeons build a platform of twigs so flimsy that, looking up from below, one may see the eggs

[1] Estimates of the number of species of birds vary. The figure given here may be conservative, but it is a recent estimate.

beneath the brooding parent. Contrasting with this are the huge nests of sticks built by storks, or those of some jackdaws, who will build in an old chimney filling it with a cartload of sticks to reach the requisite height for the nest. Weaver birds build their nests as a community, forming what can only be called tenement nests. The black ani, of the West Indies, related to the cuckoos, build a communal nest in which many of their number combine to lay a pile of eggs. The frogmouth, relative of the nightjar, builds a nest of spiders' webs, a kingfisher makes a tunnel in the bank and builds the 'nest', if such it can be called, at the inner end of the tunnel, of a layer of fish-bones. Some birds always use the same type of situation, as the swallow, while others choose almost any situation, like the robin.

There are some birds that build habitually near to the nests of wasps or bees, thereby gaining some immunity from interference. Others build among the spine-covered leaves of cacti. Security is sought by the grebes not only in building among reeds well away from the bank, but by the brooding parent quickly covering the eggs with vegetation and slipping silently and rapidly off the nest and under the water. Partridges cover their eggs with dry foliage when they leave them, and some tropical birds kick earth over the eggs. Eider duck cover their eggs with down from their own breasts. The collection of this for the commercial eiderdown has often been accompanied by the taking of the eggs. In this way two ends are gained. Robbed of its eggs the eider lays a further clutch and covers these with a fresh layer of down, providing a further supply of food and the saleable eiderdown. This laying of a second clutch is by no means exceptional. Many birds respond to the loss of eggs or young by laying again. Others will lay only one clutch whatever happens.

For the moment, however, let us take another side to this matter of nest-building. Not only do the 8,000 different birds use a variety of different kinds of nesting-sites, build different kinds of nests and seek different ways of gaining security for their young, they also have different methods of obtaining the materials with which to build. A sparrow will scavenge any pieces of grass, hay or straw lying about or caught up in the bushes. It will pull the ends of a clothes-line to pieces and take the strands of hemp. It will take string or paper. It will chase feathers or thistledown flying in the breeze. There is little in the way of soft materials it cannot use. A pigeon gathers sticks lying on the ground, but a rook will break off twigs from the trees with its beak and an eagle will crash-land on a branch to break it off.

In these few paragraphs we have merely dealt with a few chosen examples. The full range of choice of site, architecture of the nest, type of material chosen and the manner in which it is collected would need several volumes to describe adequately. And on top of this there are the differences in the relations between the sexes during nest-building, incubation and the rearing of the young. Some birds are monogamous, some are polygamous, some are promiscuous. Some mate for life, some for the season and some, in species producing several clutches in a season, the hen has a different mate for each clutch. In most birds the male is the dominant partner. He it is who usually wears the bright colours, does the obvious part of the courting and leaves the hen to bear the brunt of family affairs. In others the male is truly 'henpecked', the hen usually wearing the bright colours and leaving the cock to do the incubating. The emu, as we have seen, is an exception to this wearing of the brighter colours.

On the whole, the sexes manage a fairly equitable distribution of the parental duties. The cock chooses the nesting-site, the hen building the nest; the cock helps at least by collecting materials; the hen lays the eggs, the cock takes his turn with the incubating or feeds the hen; the hen looks after the chicks with the cock helping to feed them and acting mainly in the capacity of protector. But this represents only the average. There are all variations from that in which the cock does little more than fertilize the eggs to that in which the cock and hen show the greatest attachment to each other from the time the site for the nest is chosen to the time the young birds disperse as fully independent individuals.

Every species then has its pattern of behaviour. This may bear some similarity between related species, but even in such instances the details at least vary. Let us take a single example from some members of the thrush family, those belonging to a single genus *Turdus*.

The fieldfare nests in colonies in low trees with a nest of grass having a layer of mud beneath the inner lining. The five to six eggs, variable in colour, from bright blue to heavily blotched and capped with red-brown, are laid in April or May, the hen doing most, if not all, of the incubating, which lasts from 13 to 14 days, both sexes feeding the young for a similar period.

The mistle thrush builds solitary (i.e. each pair at a distance from their fellows), high up in a large tree, in a fork or out on a bough, the nest being built by the hen alone, of bents, roots and moss consolidated with earth, lined with grass and decorated with lichens, wool, feathers,

Members of thrush family : song thrushes and young (*top left*), mistle thrushes (*top right*), blackbirds (*centre*), fieldfares (*bottom*)

rags and so on. The four eggs, cream to greenish-blue blotched and spotted with lilac and brown, are laid in early April, the hen incubating for 13 to 14 days, leaving the nest only to feed, the cock often guarding it in her absence. The young are fed by both parents for 14 to 16 days.

The song thrush builds solitary in trees, bushes, hedgerows, in ivy, on a bank or in buildings, the nest built by the hen alone being of grass and roots, even moss, leaves and twigs, consolidated with earth and lined with rotten wood or dung. The four to five eggs, blue with a greenish tinge, scantily spotted with black or red-brown, are laid in early April, the hen incubating for 13 to 14 days, both parents feeding the young for a similar period.

The blackbird builds solitary in bushes, hedgerows, in trees from a few feet off the ground to high up, in ivy, on banks, in sheds or on buildings. The nest, of grass, roots and moss, consolidated with mud and lined with it, has an inner lining of dry grass. The hen does the building and the cock sometimes collects materials. The four to five eggs, bluish-green freckled with brown, are laid in early April, are incubated by the hen, the cock sometimes taking part, for 13 to 14 days, and the young are fed by both parents for a similar period.

In these four species, closely related in bodily structure as well as in outward appearance—this applies particularly, of course, to the first three—there is a general similarity in the habits of the parents and in the eggs, and yet in no two is the pattern the same. All differ sufficiently that the nests on their own are recognizable, so are the eggs; within slightly less strict limits the nesting-sites also are typical, especially to the experienced field-naturalist.

If, without going outside the thrush family, we choose a member of another genus, *Oenanthe*, the wheatear, a further interesting comparison can be made. The true thrushes, that is the members of the genus *Turdus*, are mainly recognizable by their speckled breasts. This does not hold for the blackbird, yet even there the young show this character markedly and so does the adult female to some extent, which has given rise to the story of thrushes and blackbirds mating. The wheatear, a somewhat smaller bird, although having the speckled breast in the young, is dapper, short-tailed, ground-living and an inhabitant of the open country away from trees and bushes. It nests on bare hillsides, on commons, on the sea-shore, in holes on the ground or under rocks, in old walls, in drain-pipes, or in anything giving similar shelter, such as an old kettle, empty tin and the like. In these last the wheatear

recalls strongly the habits of another member of the thrush family, the robin. In plumage, the adult male wheatear is french-grey on the back, sandy-buff on the breast, has blackish wings, white and black tail, the head marked with a grey top, buff throat and a prominent black stripe along the side of the head bordered above with white.

At first glance, one would hardly suspect a close relationship between a wheatear and, say, a song thrush. If we look now at the nesting habits we find that, in addition to the differences in the nesting-site, the cock takes a large share in building the nest of moss lined with grass, hair, feathers or wool. The six eggs are pale blue, laid in May, take 14 days to incubate, the cock taking his share of this operation. As with the plumage, so with their habits, typical thrushes and wheat-ears show marked differences, but in the nesting habits these differences are less emphatic and do show still a family likeness. And this is seen particularly in the young, for whatever may be the colours of the adults in the thrush family the young all show the speckled breast.

These brief descriptions serve to underline two principles. One is that, as already stated, a brief summary even of the infancy of birds is impossible, for just as the nesting-sites, nests and eggs differ even in related species, so does the behaviour and development of the chicks hatching from the eggs. Nevertheless, there are features in common, similar trends and outstanding characteristics as we pass from one to the other. These we can concentrate on, and especially in so far as they illuminate our main theme. The second principle is a very obvious one, that the patterns shown by each species in turn is inheritable. It is obvious when we stop to consider the matter, yet no apology is needed for stressing it.

Underlying the whole of wild nature—and indeed civilized human nature—is an orderliness and, up to a certain point, a predestination. A song thrush can no more help building a nest of grass and roots consolidated with earth and lined with rotten wood and dung than a blackbird can help making one of grass, roots and moss, consolidated with mud. The whole mechanism in each case is fixed, inherited and unlearned. Canaries born in captivity, wild birds taken early from the nest and reared by hand, wild or domesticated birds reared by foster-parents, hatched in a nest unnatural to their species, will still build a nest on the pattern of all members of their species. Nest-building therefore represents the unfolding of a behaviour pattern which is innate or inborn, laid down in ultramicroscopic particles within the fertilized ovum and carried on from generation to generation. It is these

inheritable patterns that for the most part determine the orderliness of nature.

In the same way, the male song thrush can no more help leaving the female to do all the incubating than the cock wheatear can help taking his turn with his hen. It is not a question of morals, of one shirking his responsibilities and the other being more virtuous and taking his turn in this domestic task. The pattern is fixed before ever the birds themselves are born and comes to fruition as they themselves become parents. The point is stressed here for it is a temptation to speak of this bird as idle, that as industrious, another as shirking responsibilities, and so on when writing for lay audiences. It is a dialectical convenience, often carried to excess, which can make for easy and entertaining reading. The danger is that it can also lead to lack of understanding, even to a distorted perspective. Wild animals know no virtue and practise no vice.

Another aspect of the onset of parenthood, which not only leads us on to the subject of infancy but assists our understanding of it, is that it follows a pattern contrasting with the normal behaviour of the animal. The tremendous change in behaviour is controlled by the action of glands, and the action of these in turn is linked with climatic and meteorological conditions. It is necessary to make this distinction for climatic conditions, in the broad sense, that is, the seasonal droughts or rainfall, cold or warmth, determine approximately the season, but prevailing meteorological conditions influence the exact date of the breeding season, putting it forward or back. The lives of wild animals are so adjusted that in any given locality or region they bring forth their young at a time when food is abundant and conditions generally are such as to afford the maximum chances of their survival. Whereas the broad climatic changes influence the survival of the species, the day-to-day weather conditions influence the survival of individuals; but whereas the first is effective through the behaviour of the parents, the impact of the latter is apt to be direct on the young.

In studying the actions of the hen yellow-hammer we had the suspicion that she possessed a weather sense. Certainly many birds show what looks like a highly developed time sense. In the change-over at the nest it is the cock ostrich that appears to control the time-table. We shall see, later, in dealing with penguins, an even more pronounced illustration of a time sense. If birds can have a time sense why not a weather sense? Certainly swifts seem to have it to a marked degree. In spring swifts travel north from their winter quarters in South Africa to nest during the summer months in Europe, from the shores of the

Mediterranean northwards to Scandinavia and Finland, even to Siberia. This movement is annual and is linked with the scarcity of winged insects in the north in winter and their abundance in spring and summer. One effect of the weather, during their sojourn in the north, has been investigated during recent years. In Finland it was noticed that prior to the arrival of cyclonic storms all the adult swifts disappeared. Heavy rains accompanying such storms would beat down all flying insects making normal feeding impossible, so the birds fly hundreds of miles to the south or south-west, against the wind, to appear suddenly in numbers in a fresh locality. Because their movements precede stormy weather, anticipating the cyclone when it is as much as 800 miles away, the swifts have been called storm-swallows, or rain-swallows.

The nestling period of the young swift is unusually long for so small a bird, and lasts for some six weeks. The chances of the parents retreating before a storm and staying away for five or six days at some time during the nestling period are therefore high. To meet this, the young are capable of a form of hibernation.

The body temperature of an adult swift is 104°F., that of the young is several degrees lower and is moreover variable with the temperature of the surroundings, as in the cold-blooded animals. When left by its parents, therefore, the nestling swift, instead of succumbing to the cold as might the nestling thrush or blackbird, sinks into a torpor as a snake or lizard will, with a drop in temperature. Its breathing drops to a very slow rate and the young bird feeds on its accumulated fat, the weight of its body dropping ultimately by 50 per cent.

When the storm has passed and conditions are again normal, the parents return and pick up where they left off. The young are fed, resume their growth and quickly the family is back to normal. One thing only remains to be stressed, that although the parents journey hundreds of miles away from their young they nevertheless come back to them, an excellent example of the strong bond between parent and offspring.

The behaviour of swifts in the face of approaching storms represents a tremendous upheaval in behaviour which is sporadic and dependent upon the vagaries of weather. Even more tremendous upheavals occur with the approach of the breeding season in all animals; but this is cyclic and its rhythm is determined by the behaviour of the ductless glands working through the reproductive organs. The following example will help to illustrate the change. Throughout most of the year

the jackdaws spend the day foraging on the arable land nearly a mile down the road from my house. Occasionally a group of them may fly overhead but we see little of them from the house, except in spring. In March the flocks have disintegrated and, for the most part, the jackdaws are in pairs scattered over this part of the countryside, prospecting for nests. One may see such a pair investigating an old tree with a trunk that is beginning to show cavities in its substance. These the daws search with a concentration and assiduity that is quite remarkable. Each member of the pair will, in turn, leave its perch on a neighbouring bough and scramble up and down the trunk investigating each hole. If there is a deep cavity, each in turn will explore it to the depths, often two or three feet down, with barely room to squeeze the body down. What happens inside we are left to conjecture, but we can see that the ascent can only be made by the bird struggling up again using half-opened wings and feet, pressed against the sides of the cavity, to reach its exit. Day after day they will re-explore the same sites until they have chosen one of them.

Other instances may be seen in the activities of some of our commoner birds. The nuthatch will nest in a hole in the trunk or a branch of a tree, in a hole in the wall, in an old sand martin's nest or a nesting-box. It fills up any crevices and reduces the entrance to the appropriate size by plastering with hard mud and then lines the cavity with chips of fir or birch-bark or of dried leaves, up to the number of 6,000 or more. The long-tailed tit builds a domed nest, large externally, in proportion to the size of the builder, its thick wall pierced at the side with a small hole, and will line the inside with 2,000 feathers or more gathered from the surrounding countryside. Anyone who has tried collecting small feathers, to the number of 2,000, even without having to trip backwards and forwards to a nest, will appreciate the labour involved merely in collecting the lining to the nest.

Intense labour as well as a marked change of habit are seen in the nesting activities of the male sparrowhawk, who does not collect sticks from the ground but like the golden eagle will break them off by crashing on them. If this does not detach a selected branch, the hawk will hang on it upside down flapping its wings until the weakened wood gives way.

There is a tremendous activity, the appearance of a desperate urge; there is the departure from the normal habit, the taking of risks, and all the concomitant actions of selecting a place to build a nest. And it is all done in anticipation of eggs yet to be laid. The eggs are there, however,

and it is their maturation within the ovary of the hen—and of the sperms within the testis of the male—that have set in action the minute quantities of biochemicals, and these in turn result in fundamental changes in the working of both the body and brain of the birds. Each year the reproductive glands mature and swell prior to the breeding season ; each late summer and autumn these same glands regress. With their waxing and waning go the changes from normal (i.e. non-breeding) to breeding behaviour, and the trigger to set them off is provided by secretions from a minute gland, the pituitary, lying under the brain, which receives its stimuli through the animal's sense-organs from the outside world. The pituitary contains a master-key which is turned largely by forces external to the body although it unlocks a mechanism within the body. This, indeed, epitomizes the mechanics of life : it is the result of an interplay between tendencies inherited by the organism and changing conditions in the surrounding world. This makes the action (that is, the behaviour) of an animal at any given moment so difficult to analyse.

Above all, we have constantly to keep in mind that these changes in the behaviour of the parents, as those in the offspring, are anticipatory.

CHAPTER VI

ECONOMICS OF POUCH BIRTH

A WELL-KNOWN ornithologist once made the remark that if birds had not adopted the habit of laying eggs they could not have made such a success of flying. I wonder if he is right. After all, female bats do not lay eggs but carry their young. In this country young bats are born between late May and early July. At first they are naked and uncoloured and at birth are delivered into that part of the flying membrane that stretches between the hind-legs of the mother. From this natural pouch—we might almost call it a cradle—the newly born bat, after having been licked clean by the mother, must at a later date find its way to the teats on the maternal breast. This it does by clinging to the mother's fur, which it does all the time, whether the mother is resting or flying, until it has reached a size too large to be carried about. That is, just before it is weaned.

Although bats carry their young both before and after birth it is hardly just to compare them with birds. For one thing, bats have fewer offspring. In Britain a single young is the rule, twins being very rare. Related bats elsewhere show a greater tendency to twins, but nowhere do we find the large families that are usual with birds. Another argument in favour of the ornithologist's remark is that all birds, without exception, lay eggs. None brings forth its young alive, not even birds like the kiwi and ostrich that do not fly. This is more significant than it may appear at first sight. In all other groups of animals there are some species that lay eggs and others that bear their young alive. Even among mammals, a group characterized by the fact that the females suckle their young, there are a few species that lay eggs, as we shall shortly see. In birds, however, egg-laying is the rule. One result of this can be seen in our adventures with the yellow-hammer.

Although in our second chapter I have described with, I hope, enthusiasm watching the yellow-hammer day after day, the actual watching was not always free of its tedious moments. The clock-like monotony of her journeys to and from the nest became at times somewhat boring. It was almost as if some giant hidden in the sky held the bird at the end of an invisible wire and swung her backwards and forwards between the nest and the feeding-ground. Indeed, it often

required persistence on our part to continue watching it hour after hour and day after day. One could not help thinking that if only she could go off, catch the insects, concentrate the vital substances from their bodies, rejecting the indigestible matter, and bring only that concentrate back to the nestlings, far fewer visits would be necessary and there would be a great saving of time and labour. This, in a way, is what the birds of prey have achieved. They bring back to their nestlings the larger, more nourishing bodies of small birds and mammals, in which quantities of vegetable food have been converted into animal protein. This entails fewer journeys to and from the nests. Even so, it entails greater search, longer journeys and more time than if they could take their nestlings with them wherever they went. This, of course, is what the mammals have done.

Our yellow-hammer was unfortunate in having to do all the work without the aid of the father of her brood, which, incidentally, is not normal with yellow-hammers. But even when both parents undertake the feeding jointly it can amount to a considerable labour. It has been reckoned that a pair of robins will take something like 10,000 insects to feed their brood. Even if they carry more than three or four insects at a time and do not travel as far in search of them as our yellow-hammer did this still represents a considerable labour. The birds of prey have found only a partial solution to this problem. Cuckoos, on the other hand, have completely solved the problem by laying their eggs in the nests of other birds, leaving the foster-parents to shoulder the full burden of bringing up a youngster not their own and very much larger than themselves. This is not particularly to the credit of the cuckoos. They are able to do it only because of the exaggerated maternal tendencies which as we shall see in a later chapter seem to lie dormant in all animals and are so easily provoked.

Cuckoos are not alone in this. The cow-birds, quite unrelated to them, have also adopted the parasitic habit. So has the blackheaded duck of South America, which distributes its eggs in the nests of night herons, ibises and coots. Even insects have descended to it, for some humble bees play cuckoo in the nests of other humble bees. Yet, on the whole, this kind of parasitism, as a solution to a domestic problem, seems to have achieved little more than to save the individuals practising it from a heavy labour. To the species there can have been little success or the animals using it would be far more numerous than they are. The way mothers tend their young does nothing to influence the size of the population. Cuckoos are no more numerous because they make light

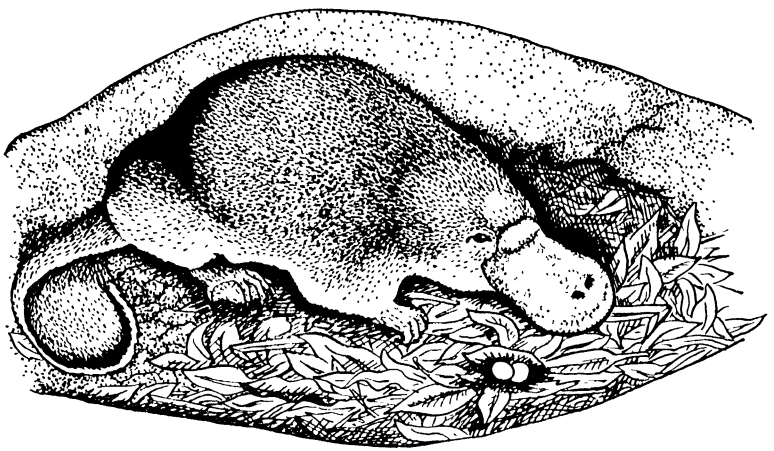
of their maternal responsibilities, and yellow-hammers are no less numerous because they toil all day to raise a brood.

Perhaps we may digress further here to comment upon one sidelight on the behaviour of cuckoos, that is the ease with which parents of another species can be prevailed upon to adopt infants other than their own. It is all very well to talk of stereotyped behaviour patterns, as between an animal and its own offspring, but these cannot be so rigid as we are at times apt to think. There must be a fair elasticity in the behaviour of a pair of meadow pipits, for example, when faced with the task of bringing up the cuckoo foundling larger than themselves. Feeding one young bird may be very like feeding any other young bird, yet the trend of modern behaviour studies is to show how each species has its own fixed pattern. The studies also tend to show how restricted is a bird's capacity, ordinarily, to cope with new situations; yet birds and other beasts manage to vary the patterns of their behaviour and enlarge their capacity under the urge of an appeal from a helpless infant. Moreover, adoption is not always enforced. It is by no means unknown for a pair of birds, in the wild, to adopt the orphaned brood of another species, or even for parents of one species to feed the young of another species while their parents are away from the nest. And among mammals there are many stories of strange foster-parents, including the bitch that sought out young rabbits in the fields to bring them home to mother them. More recently, a boxer bitch living near us, before having puppies of her own, has developed the habit of visiting a nearby poultry farm and bringing home one half-grown bird after another, carrying them in her mouth without the slightest sign of injury.

It may be, as I have suggested, that the way mothers rear their offspring has little to do with the rise and fall of populations. On the other hand, the manner of birth and early infancy may be all-important to the success or otherwise of the species. There is reason to believe, for example, that the mammals, like the birds, were descended from reptilian ancestors. From this we may reasonably assume that the first mammals laid eggs. We can only assume it because the fossils of extinct mammals have little to tell us on this point. There is, however, living in Australia today an animal with its body covered with hair. This is one of the hallmarks of a mammal. Many of its bones are, however, distinctly reptilian. And it also lays eggs. This animal is the duckbill or platypus. It makes a burrow in the river-bank and in it constructs a nest; and therein the two eggs are laid. The fact that it is mammal with

reptilian affinities does strongly suggest that the earliest mammals did lay eggs, but we can learn little from the platypus how the transition from egg-laying to bearing the young alive was brought about. One thing we can surmise, however, is that since all but a very few of the egg-laying mammals have died out, and since mammals have now become dominant on the earth, the act of bearing the young alive, combined no doubt with other changes, as in the capacity of the brain, has brought tangible advantages.

Unfortunately, we can learn little from platypus of how an egg-



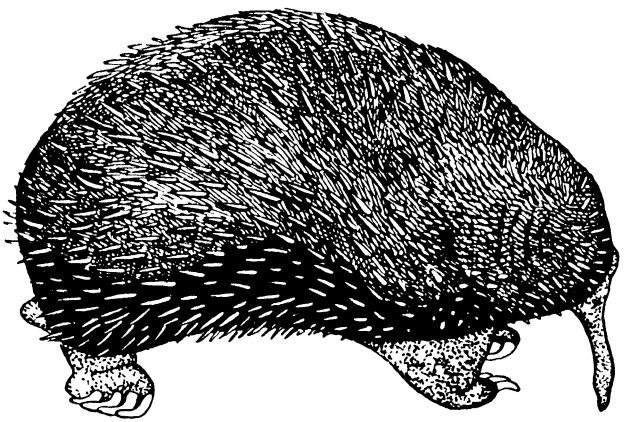
Platypus on nest, with eggs

laying mammal behaves towards its offspring. It is by no means easy to keep a platypus nest under observation. The parent does not 'sit' on the eggs but cuddles her body to them, curling her tail over them. The eggs themselves are nearly spherical, white changing later to a yellowish-white or brown, with a parchment-like shell as in reptile eggs. When the young hatch they are barely half-an-inch long, very small by comparison with the two-foot length of the mother. For a few days they remain firmly attached to the maternal skin, the platypus having no pouch. Then they attempt to suckle, if that word is permissible, for the mother has no teats, merely slit-like openings through which the milk exudes.

The young duckbill grows rapidly, reaching a foot in length in six weeks, and by that time its fur is well grown. At 11 weeks its eyes have opened and the duck-like bill has appeared, and the platypus is able

to move about the burrow, which it does not leave even for short excursions until nearly four months old. At the end of about six weeks the mother leaves the burrow for the first time, to feed ravenously, as well she might since much of her substance must have been used up in feeding the rapidly-growing young. At least, therefore, the female platypus has solved the problem of avoiding the numerous journeys in search of food which are so marked a feature of the yellow-hammer's task. Moreover, the mother is always with the young, for their comfort and protection.

The echidna, or spiny anteater, of Australia and also New Guinea,



Echidna or spiny anteater

closely related to the platypus, has taken matters a step further. It, like the platypus, has a number of decidedly reptilian features, especially in its skeleton. From it also we may glean, dimly, something of the transition that may have taken place in ancestral mammals. The female echidna has a pouch in which her single egg is deposited ; and there it is hatched. In the pouch, too, the young is carried about for some weeks, while being suckled. After this, the mother leaves it in a safe place to rest and grow before making its own way into the world. Although platypus and echidna are superficially unlike they are structurally so close as to be included in a single group, known as the monotremes, yet their methods of dealing with the infant young differ radically. This is merely one of the many reminders that, to speak metaphorically, Nature is always trying out new methods. In a way the bats also illustrate this, for there

is a similarity between the way the female bat treats her young and the way the echidna treats hers. Yet there is little doubt that bats arrived at the method by a different route.

Another experiment, so to speak, which must have started early in the history of the mammals is that found in the marsupials, also known as the pouched mammals. These include the kangaroos, opossums, wombats and others. Although the various marsupials differ somewhat in outward appearance all agree in using the pouch birth. And all agree in being undoubted mammals which yet retain some reptilian features in their anatomy. The best-known marsupial is, of course, the kangaroo, which has a capacious pouch with its opening in front, that is towards the animal's head. The same is true of the related marsupials known as the phalangers, which include the koalas, or Australian teddy bears, the cuscuses and the so-called flying phalangers, which live in trees. In fact, all the marsupials that are more or less bipedal or live in trees have the pouch opening forwards. There would obviously be a disadvantage if it opened backwards. In those marsupials that customarily move across the ground on all fours the pouch opens backwards. There are, however, a few exceptions to these two generalizations, in those marsupials that have no pouch at all.

Marsupials are also found in America, including the cat-sized common opossum and a number of South American species no larger than rats and mice. All the small marsupials here have no pouch, and even in some of the Australian marsupials there is no fully-formed pouch, only two flaps of skin that do duty for it. This suggests that the pouch-bearing habit could have been developed from ancestors similar to platypus and echidna, the one having no pouch, the other a pouch for eggs. But the intermediate stages have to be left to the imagination.

Incidentally, among other oddities of marsupial infancy may be mentioned the native cat and some of the bandicoots of Australia. The native cat has only six teats yet may have as many as 24 young at a birth. Some of the bandicoots, by contrast, have only two to four young at a birth and eight teats to feed them. If nothing else these two scraps of information serve to emphasize that nothing in the living world proceeds along straight lines nor conforms to hard-and-fast rules.

For nearly three centuries there was considerable argument on how the newly-born kangaroo found its way into the pouch. And apart from anything else, the history of the solution of the problem illustrates the difficulty of finding out all we would like to know about animal infancy. The newly-born kangaroo, like the young platypus, is of very small

size. Even in a large kangaroo it will be less than an inch long and is born at a very early stage of development. The first people to study kangaroos could find the young ones in the pouch easily enough by putting a hand in and feeling for them. It was a very different thing finding out how the young kangaroo found its way there.

We have been a very long time getting to know the truth about the birth of a kangaroo and in the process all kinds of wild ideas have been put forward. Some held that conception took place in the pouch. Others that it took place in the normal way and that afterwards a teat grew out from the womb through the body-wall and into the pouch carrying the young kangaroo with it. Then there was the suggestion that the newly-born animal was catapulted, so to speak, into the pouch from the birth-canal. More rational suggestions were that the mother picked up the newly-born with her mouth or with her fore-paws and placed it on a teat in the pouch.

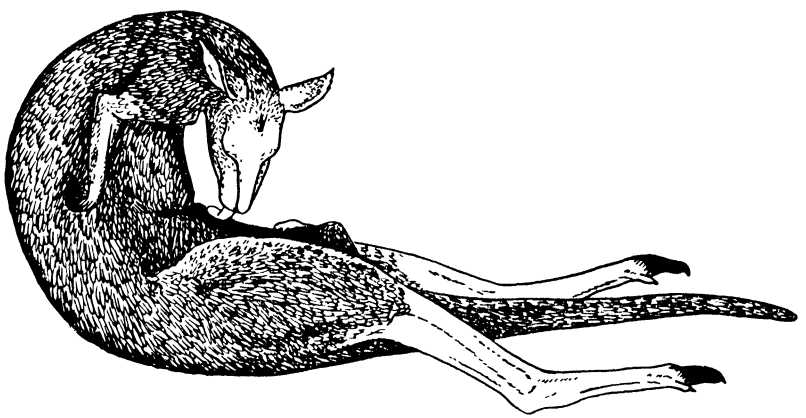
In fact, the truth about kangaroo birth was established as early as 1832, by a naval surgeon, and it was reiterated by several laymen mainly in letters to the Press in the succeeding years. Yet the true story was not finally accepted by scientists for nearly a century, when the matter was put beyond all doubt. Indeed, the history of this episode serves to emphasize that it is not sufficient merely to demonstrate or expose the truth, one must also overcome human prejudices to ensure its acceptance.

The leading scientists of the last century probably found it difficult to believe that a kangaroo could be capable of handling so small and delicate an object with its lips or fore-paws. It was probably even more difficult to suppose that it could carry out the delicate task of both opening the mouth of the pouch and at the same time placing the youngster, no bigger than a haricot bean, on a teat. But what were they to believe? To them it was inconceivable that so small an embryo, as yet bearing little resemblance to a kangaroo and having a brain that had hardly begun to take shape, could possibly climb into the pouch on its own. It amounted almost to asking them to believe that an animated haricot bean could climb through the fur of the abdomen, make its way into the pouch and find its way to a teat so small as to be nearly invisible among the hair lining the pouch. Yet that is what happens. And the fact that the newly-born kangaroo does so provides an important clue to the mechanism of inborn behaviour.

The story of the birth of a kangaroo, as we now know it, is as follows. As the time for the birth draws near, the female kangaroo takes

up a resting position, which is almost a sitting or reclining posture. In this the hind legs are stretched out at full length in front with the tail stretched between them. This brings the exit from the birth-canal into a position where it is directed upwards towards the pouch. In this position, the mother kangaroo grooms the interior of the pouch. Having cleaned it out, she then licks a path in her fur from the exit of the birth-canal to the entrance of the pouch.

As the foetus leaves the birth-canal the mother bends her head to lick it free of the delicate membranes surrounding it. Once free the foetus follows the path licked in the fur, using an overarm movement of



Female kangaroo preparing for birth of young

the front legs, which, contrary to what we see in the adult animal, are longer than the hind legs. Throughout the journey the foetus moves its head from side to side in what appears to be a searching movement. Having reached the mouth of the pouch, the newly-born mite enters and travels over the inner wall until its searching mouth touches a nipple. This it grasps and remains attached, suckling until large enough to move about on its own. The shape of the teat is such that it takes quite a fair amount of pressure to move the foetus from its position. Should the young kangaroo become detached from the nipple, however, for any reason, during the suckling period, it will start climbing and searching until it can take hold once more. Even when old enough to make excursions from the pouch, it always returns rapidly when alarmed or when tired, and continues this until it is quite a fair size.

The story of kangaroo birth is very important for our study. I have repeatedly referred to the newly-born kangaroo as a foetus. That is, it is an animal at a very early stage of development. Its brain has only just begun to take form. It is without functional eyes and ears, and it probably has little sense of smell. It has no previous knowledge of its destination, nor of the direction it must travel. Yet it can find its way unaided into the pouch. The whole process must therefore depend on an inborn pattern of behaviour, possibly aided by a sense of touch. Herein is the proof, therefore, that innate reactions spring from a very low mental level. Their origins must be set in the first traces of the brain, at least, and some may even be independent of the brain. Study of the young kangaroo does not tell us very much about their origins, it is true, but even this little is highly important. That is why a greater knowledge of the small-brained ostrich would be so valuable, as a means of comparison.

The discovery of the way in which the young of the common opossum of America are born has a remarkably similar history to that of the kangaroo. In both the truth has been re-discovered within comparatively recent times after long years of disbelief. The details of each corroborated those of the other. Since they were arrived at independently there can no longer be any doubt in the matter. Furthermore, it has been possible to make at least one test with the opossum, because of its small size, which would have been difficult with a kangaroo. When the mother opossum, while giving birth, is moved into different positions, it is seen that the newly-born animal always travels upwards. If therefore the mother is held upside down, as she can be without harm, her offspring travel in the wrong direction, away from the pouch.

So it is possible to establish a further point, that although it is usual to say that the newly-born kangaroo or opossum makes its way unaided to the pouch, the mother does in fact assist it. She anticipates the birth by grooming the pouch, she licks a path for the guidance of her offspring, then licks it free of its enclosing membranes, and she so disposes herself that when the infant follows the natural impulse to climb upwards the journey brings it to its correct destination. Yet the mother's co-operation is not as complete as all that. It appears to be, so to speak, an impersonal co-operation rather than the result of any maternal emotion, using the words in the sense of sentiment. It arises purely from a fixed behaviour pattern. On several occasions, a mother kangaroo has been seen to flick the young off her fur with her paw, just

as she might a tick or other vermin. This is the more serious for, contrary to what is sometimes set forth in popular writings, a kangaroo does not have a litter, with the first to reach the pouch as the one fortunate survivor. There is only one young at birth, twins being very rare.

One other thing we learn from our study of these lowly mammals. It can be stated in this way: that if the things animals do had been specially designed to make their study difficult, matters could hardly have been arranged differently. We have seen that platypus and echidna, the one by laying eggs and suckling the newly-hatched young and the other by carrying its egg in a pouch, can dispense with the slave-like labours that burden the parent birds. Both these animals are justifiably placed low in the mammalian scale not only for the reptilian features in their general anatomy but for the lowly structure of their brain. From this it is reasonable to argue that ancestral mammals solved the problem in a similar way and that their descendants, as represented by the true mammals, went on to perfect the process by carrying the young about with them during the early stages of development. On the other hand, birds having started at approximately the same point have specialized in making themselves slaves to the egg and the nest. Even the most intelligent or advanced have failed to avoid it, with one possible exception, namely, the penguins. These are generally acknowledged to be fairly low in the bird-scale, yet some species among them have achieved something akin to the pouch birth of early mammals. And with this they have also developed social structures which challenge comparison with those of certain of the more intelligent mammals.

A leading authority on the study of penguins in the wild state, Dr. William Sladen, has recently stated that:

> "the more one studies these interesting birds . . . the more one is impressed by the orderliness of their social structure, a structure based on many attributes which are taken for granted in human behaviour, but which might be thought incredible in such a lowly animal."

Penguins recognize each other as individuals, and pairs once mated come together again after the winter and together they return to their old nesting-site. The birds not only live in colonies but have a crèche system for the protection and welfare of the young.

Some penguins build nests for their eggs and, like so many other

birds, both parents take part in the incubation. On the other hand, king penguins and emperor penguins build no nest, the single egg being placed in a fold of skin, a sort of pouch in front of the body. There, among the down feathers it remains warm, when the air temperature is well below zero, supported on the parent's feet. Here also after hatching the chick remains, protected until able to stand the cold on its own. More significant, however, is the way in which the incubation and care of the young is shared, a feature not unknown in other penguins.

Thus, in the Adélie penguins the female, having laid her eggs, departs for the sea, there to feed for some 14 days, leaving the male to incubate the eggs—and fast. Since the male has stood by the female throughout the period of egg-laying prior to her departure, this means he has to fast for a total of some 40 days. It is only when she returns that he can leave for a fortnight's feeding. So, turn and turn about, the parents alternately incubate (and fast) and depart to feed, until just before the eggs are due to hatch. There may be hardship in this, but there is also an economy of effort.

The feeding of the chicks, too, shows a fair degree of economy. It takes place at intervals of one to 10 days, the chick's stomach being capable of holding a large quantity of food, which is regurgitated in a partly-digested condition by the parents.

The emperor penguins also use this same sharing of the duties of incubation. The male takes the first turn and in doing so fasts for 60 days. The female departs to the feeding-ground a long distance away, yet faithfully returns at the appointed time to release her spouse for his turn at the feeding ground. We may comment on this, according to taste, in terms of wonder or in matter-of-fact tones, that it is due to an innate behaviour pattern. It is, no doubt, true that this coming and going is in no sense the responsibility of the birds carrying it out. Even so there is a remarkable time-sense shown, no matter how it is controlled. And there is a remarkable attachment to the needs of the offspring, no matter how we attempt to explain it. If these things can obtain in a bird with a comparatively low mental capacity, we should expect something even better in the higher mammals with their greater volume of brain.

Unfortunately it is not possible to say more about these particular habits of penguins. The brief details given here of penguins' behaviour are of recent discovery, and they are the result of extensive observation of marked birds. This alone suggests that there are vast fields in animal behaviour still awaiting exploration and that when this is carried out it

may alter considerably our approach to many problems. The same could be said of the relations between the kangaroo and its young. Although such well-known animals, relatively little is known about their natural history. This is partly because they are mainly active at night. Our knowledge of their infancy is small indeed; such as it is, however, it points mainly to two things, the parasitism of the young on the mother and the low level of maternal devotion. Yet we cannot be sure that this represents the sum of all there is to learn.

Up to the end of the first six weeks of life the young kangaroo is as complete a parasite as it is possible to imagine. In a sense it is as much so as the ticks that infest wild kangaroos. After that time it is able to leave the pouch for short journeys, returning as we have seen for shelter or rest. It also returns for feeding, but this does not necessarily entail re-entry into the pouch, for in the later stages the growing infant will merely push its head into the pouch to feed. During all this time the mother's main contribution to infant welfare, apart from supplying food, appears to lie in keeping the pouch clean, grooming the inside with her front paws or with the tongue. When the young kangaroo is capable of moving about on its own legs the mother appears unceremoniously to bundle it out of the pouch in order to groom the inside. But is the liaison between them so impersonal?

As we have seen, in moments of alarm the growing infant will leap into its mother's pouch to be carried to safety. Surely she must make some co-operative effort in this. Then again, should the mother take refuge in flight before her offspring can reach her, it will lie perfectly still in the undergrowth. This 'freezing' is not, therefore, a peculiarity of young birds, as we shall see from other examples to be given later. So we may argue that jumping into the maternal pouch, freezing and the like are merely the obvious manifestations of a bond between parent and offspring. If ever kangaroos are extensively studied as penguins are being studied we may become aware of personal or social qualities in kangaroos that are at present hidden from us.

CHAPTER VII

SQUIRREL GROWS UP

IT is perhaps unfair to lay too much stress on the impersonal nature of the mother kangaroo's devotions towards her young. Whatever she does, or does not do, her attentions are sufficient to give her babies the necessary start in life. Her behaviour is more a measure of the progress made by the more specialized mammals. Some of those that give birth to young at a later stage of development behave little better than the kangaroos, and if we may judge from the young squirrel there are faults on both sides.

My daughter once had a young grey squirrel. A lady walking in the woods was adopted by the squirrel, which climbed into her pocket. She tried to restore it to the tree in which she supposed its nest to be but the young rodent resolutely refused to be deprived of its new home. The story would sound improbable except that this particular lady was always adopting or being adopted by some wild stray, waif or orphan. She rarely returned from a walk without one in her pocket.

It would be difficult to say with any degree of certainty the age of this squirrel. Somebody suggested that it was about three weeks old and in default of other evidence this was officially adopted as its age. That it was juvenile could be judged from the general proportions of the body as well as its total size. That it was very young seemed certain from the fact that it slept all the night and most of the day, waking only at long intervals during the day and screaming to be fed. A little exercise was taken after each feed before it returned to sleep.

Soon after being brought in from the woods the squirrel had access, quite fortuitously, to some coconut, which it ate greedily. This led to the idea that it might be already weaned. But having made this one onslaught on solid food it refused to take anything but milk for the next two weeks. At first it was fed with an eye-dropper but soon a spoon was found to be sufficient, the squirrel taking the milk greedily, noisily and in a most untidy way, holding the rim of the spoon with both fore-feet. Since full weaning was not achieved for about a fortnight, it can only be supposed that eating the coconut represented desperate hunger or a precocious flash-in-the-pan, for during the fortnight that succeeded, a variety of nuts, cereals and green vegetation was offered it, all of which it stubbornly declined. Towards the end of the

fortnight it began to eat a little solid food although prior to this it might nibble the occasional nut rejecting most if not all the fragments gnawed from the solid. It was as if it was merely practising the art of chewing.

We may therefore accept this as a very young squirrel which could have had little experience of the world, and which could have had little time to learn either by example or instruction from its parent or from others of its kind. The age of this squirrel is, however, not important, except to recognize it as a very young squirrel for, as it turned out, the most interesting things we learned from it did not demand a critical knowledge of its history prior to its coming to live with us.

From the very beginning this young rodent stood out in sharp contrast to, say, a young rabbit. A sleeping rabbit merely crouches and shuts its eyes and a very young rabbit, even when it is awake, does little more than crouch and open its eyes. At the most it moves in a gentle lolloping manner, leisurely sniffing at the objects it meets. Young rabbits are calm, too, and gentle creatures. A young squirrel, by contrast, is a creature of extremes. When it sleeps it composes its limbs and body into a compact ball, laying its tail round itself in the manner of a blanket. Once awake, on the other hand, it is noisy until fed, alert, and moving with seemingly restless jerks. There is nothing leisurely about a squirrel, nothing smooth. Everything is done in this jerky manner.

There was a time when rabbits were classified along with squirrels as rodents. Today rabbits and hares are placed in a separate order, the Lagomorpha. This was done primarily on anatomical grounds, but it could as well have been based on their conduct. A young rabbit may show some ability to climb a wire fence but this is nothing beside the skill in climbing seen from a very early age in a squirrel. During the first few days, when it was not sleeping, our squirrel would climb on to the top of its nesting-box and move about on all fours, awkwardly. One reason for this was the tendency to turn the hind feet so that the toes were directed almost completely backwards. Should one of us hold out a hand or stand near the box, we saw the awkwardness vanish and we saw the purpose of those turned-back hind-legs.

A squirrel is by nature a climber. All its reflexes are those of a tree-dweller. When our young squirrel climbed on one of us, that person became, for the squirrel, a tree, a natural mistake seeing that both possess a trunk and limbs. And as the squirrel darted up and down and around the person it had chosen for its spell of exercise it was for ever seeking out the nooks and crannies, climbing into pockets, up sleeves and inside the jacket.

The reflexes that serve an arboreal animal so well were, however, best demonstrated when the squirrel was moving about on the top of the box, on the surface of which its sharp curved claws, so valuable in climbing, were more of a hindrance. On such a limited surface, its jerky movements resulted again and again in moments when its hindquarters would swing round and momentarily hang in space. With lightning speed came the reflex; the front half of the body, and especially the front legs, would lunge forward dragging the hindquarters on to a firm surface. If it were the forequarters that hung over the precipice, then would come the flash-like reflex in the hinder part of the body.

It was of interest also to feel the tail being used. In appearance this was not the magnificent bushy affair one normally associates with squirrels in the abstract. Rather it was a rat's tail with a few straggling long hairs ornamenting it. When the squirrel was on your hand, the tail would suddenly be flattened against your skin so tightly as to leave no doubt that the animal was holding on by it. When this happened the separate vertebrae could be felt, and even the hairs pressing against the skin seemed to have a holding power.

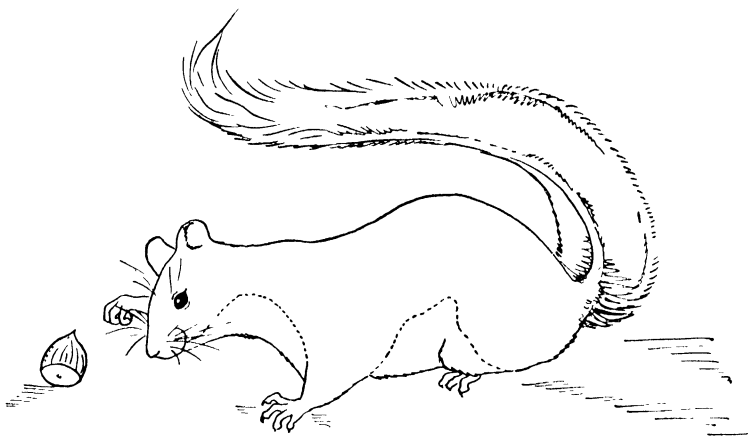
The trick of moving bodily sideways, to left or to right, in quick nervous jumps was not immediately apparent but its purpose soon came into evidence. It is the natural movement round a tree-trunk, of which more is said later. To say the animal jumped sideways is perhaps to give the wrong impression. Its movements were rather those of a table on well-oiled castors moving in any direction with an easy gliding movement at the slightest touch.

All the time baby squirrel was on the move it was investigating the world immediately around it. The eyes did not move, the lids seldom blinked, so that each eye had a static, almost stupid, glare. But then there was no need for movement. The eyes are prominent and set in prominent cheeks, so that the field of vision must be in every direction at once, backwards and forwards, upwards and downwards. The nostrils and the whiskers, on the other hand, were constantly in action. Every fresh object the squirrel met was investigated with the nose, and usually with the teeth. When running over you his teeth investigated the material of your clothing as well as your fingers, ears, hair and skin.

As the young squirrel clambered up and down the curtains there were occasions, especially in the early days, when it missed its footing. Like a flash all four legs were extended and usually one or more of the needle-like claws found their mark, holding sufficiently long for the other legs or the tail, or all together, to obtain a further grip. Even so,

the animal did occasionally take tumbles, righting itself immediately after a fall, standing on all fours and for a moment taking stock before darting off again, or standing with one front paw drawn up under the chest in the manner typical of its kind.

When very young, the squirrel hesitated before jumping, and the jump attempted was no more than a few inches. It appeared to be assessing the distance before taking off, looking before it leapt. With each day the length of the jumps increased and the pause before jumping became less noticeable, and before it was weaned it would



Squirrel bowling a hazel nut in play

jump a foot or two from a curtain to land on the shoulder of the nearest person.

My daughter fed the squirrel and put it to bed. It was her pet, yet the animal showed no more tendency to go to her or to jump on to her than could be explained by its greater familiarity with her. There was, in fact, an impersonal quality about its approaches, an absence of anything which could be construed as affection or attachment to one person. There was more evidence of attachment in the baby rabbit which shared its sleeping-quarters and was also being hand-fed. That at least showed a slightly greater preference for the hand that fed it. The reason for this impersonal quality, or what I take to be the reason, occurred to me one day when the squirrel was climbing over my elder son.

For some years now I have made particular observations of squirrels in the wild, and especially of their ability to play hide-and-seek with you round a tree. Using every trick of movement which our pet taught

us to know so well, a squirrel can move around a tree keeping the trunk between itself and a human observer. So it is possible that you may walk round and round a tree on which you know quite well there is a squirrel and see nothing of it, or at most catch only the fleeting glimpse of a paw or the tip of the nose. This is something I have grown to know so well that as I walked towards my son, while the squirrel was on him, I realized suddenly that it was playing hide-and-seek with me, in the way with which I was so familiar in wild squirrels. To the squirrel my son was a tree.

Once that idea has occurred to you then all becomes obvious. The impersonal attitude of even a pet baby squirrel is explained. When it leaps from a chair on to the shoulder of the nearest person at the approach of a cat or a dog it is not rushing to you as a person for succour. You, the tall object rising up from the ground, are the equivalent of a tree, the natural refuge of a grey squirrel. The creeping into one's pocket, up the sleeve or under the jacket is no more than a natural investigation of the holes and crannies in trees, suitable for retreat or shelter. The gentle biting of one's ear, hair, finger and skin with the needle-like baby incisors is a natural means of learning the texture of the parts of the tree, which doubtless lead later to the squirrel eating bark, leaves and buds.

We had further evidence of this by contrast with the behaviour of its companion, the young rabbit. This escaped one day into the lounge and ran behind a settee. My son endeavoured to coax it out by talking to it in soothing tones and extending his hand gently towards where the rabbit peeped out from between the wall and the back of the settee. At each advance the rabbit would retreat backwards to greater safety. Then my son, more to have a better view of the rabbit than from any reasoned action, lay prone on the ground and spoke soothingly, at the same time extending his hand. With little hesitation the rabbit came out and allowed itself to be captured.

Lorenz had, of course, anticipated my son's discovery and published, several years before, his account of making friends with his ducklings by bringing himself down to their eye-level. Even so, there was the thrill of new discovery in this and, moreover, it drew attention to the contrast in the squirrel. Approach a squirrel on all fours when it is on the ground and it will as likely as not bolt from you. Extend a limb down to it, in other words, behave like a tree and its natural impulse is to climb on to you.

There came the time when it was deemed better that the squirrel,

now that it was taking solid food, should be housed in a large aviary in the garden. Small branches were put in to make the animal feel at home and a new nesting-box with clean straw was perched high up in one of the branches. When first transferred to the aviary, the squirrel spent its time running over the branches and over the wire. This was to be expected. It was making acquaintance with its new world and we confidently expected its appealing cries would die down as it grew accustomed to this new world. This did not happen, however, until my daughter had the bright idea of putting its old nesting-box in the aviary. Trees were well enough, whether human trees or branches in an aviary, but there was an evident attachment to 'home', as represented by the familiar sleeping-box.

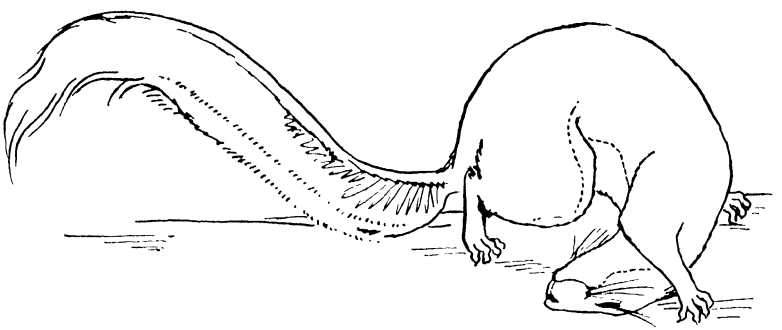
The attachment to 'home' was evidenced later in another way. Squirrel was now eating solid food and refusing milk even when offered as an occasional drink. But for some reason it was not feeding well. To begin with it had no idea of opening a nut. It would chew one readily when shelled for it, but even the relatively soft shell of a peanut presented insuperable difficulties. And although it chewed a shelled nut, dropping pieces all over the ground below, it appeared to be eating very little. Perhaps we were giving it the wrong food, so in the hope that it knew better how to feed itself than we did, the squirrel was given spells of freedom outside the aviary. Always its impulse was to climb a tree, to the top. It was not possible to see whether it fed but presumably it did. That is not, however, the point at issue.

At first its love of running about in the tree-top gave cause for anxiety; but we need not have feared it would hurt itself. It was fully at home in the tree. Its natural endowment of reflexes ensured that. Rather it was our fear that the call of the wild would be too great and we should lose it. There need not have been this anxiety, either. We soon found that when it had had sufficient exercise, it would come down, jump on to my daughter's back with what sounded like an appealing cry, allow itself to be taken in the hand and put into its nesting-box, where it nestled down to sleep. The door of the aviary was shut, and it had recognized its inability to enter unaided. Or perhaps it was force of habit, since it had always been placed in the aviary by hand. At all events, and this is the main point, it recognized 'home'.

There was another point that emerged during these attempts to feed the squirrel. For a while, when fed with nuts, it would gnaw them to pieces and let the pieces drop on to the ground. Then it was given a biscuit. It ate all round the edge, sitting up on the bough holding the

biscuit in its forefeet in the usual way. When it had had enough it dropped to the ground, ran to a corner of the aviary, lifted a piece of turf and pushed the biscuit underneath. This was the first time it had buried anything in the typical squirrel fashion.

The time came when squirrel seemed to have blossomed suddenly into a different being. The changes must have occupied several days, of course. But just as you realize, all of a sudden it seems, that the daughter you have known as a girl for years is suddenly a young woman, so the baby squirrel of yesterday seemed suddenly to have acquired a new personality. To begin with the tail was now a magnificent brush. As if aware of this, the animal was markedly more prone to sit with its tail curled over its back in the picture-book style. Further than this



Young squirrel somersaulting in play

it would be difficult to put into precise terms the nature of the changes that had taken place.

There was one marked change, however, which can be readily described. Although it had all the trees in the garden a squirrel could wish for, including oak, ash, hornbeam and conifer, and while spending plenty of time in these, it would re-visit its old trees—ourselves. It may still have treated us as trees, it is impossible to know a squirrel's mind. Now, however, there was a difference. As it ran from one shoulder to the other it would utter low pleasant sounds. They would have passed almost unheard except that they were uttered near one's ear. When it nipped the ear with its incisors the bite was firmer but more gentle. It was also more playful, a gentle tweak followed by a scampering away, quite different from the testing bite of the same teeth a short while before. The feel of the bite was no longer redolent of curiosity and exploration, it smacked almost of companionship.

It could be, of course, that this was pure fancy, of imagination reinforced with our growing affection for the squirrel. But if a human being can grow fond of a squirrel, must we suppose that the reverse cannot take place? These things cannot be tested experimentally or described and analysed in the cold language of science. That does not mean they cannot exist.

It is true that we had experience of one squirrel only and it is always risky to draw conclusions from too little evidence. However, from all I can glean our squirrel was fairly normal. And although it was little enough we did glean from it of infancy in squirrels it was enough to justify a summary of the early development in this one species. To recapitulate, therefore, we have first of all the helpless nestling doing little more than sleep and feed. Naked at birth except for a few whiskers, its organs of touch around the mouth, with eyes and ears closed, the claws, so essential to the equipment of a squirrel, are already there. So it remains with relatively little change for the next two to three weeks except that the hair, which started to grow at about 10 days, now covers the body with a short fur, and the lower incisors have begun to break through. At the end of a month, or as much as five weeks in some, the eyes open, and since solid food is taken at about seven weeks our squirrel must have been about five weeks old when we first acquired it. We did not know these things at the time or we should have known that our estimate of three weeks for its age was incorrect. These statistics did not, however, affect the things we were able to learn from our foundling.

Very certainly our pet squirrel must have been taking almost its first peeps on to the world and must, as I have suggested, mistaken our friend for a tree and her pocket for a cosy retreat. Its confidence in moving about must have been due to the equipment of reflexes which guard it from the dangers ever-present even at that early age, of a fall through space from the edge of the nest or a tumble from a missed foothold. This indicates that these reflexes are wholly hereditary and innate, entirely unlearned, which should indeed be the strict definition of a reflex. As we shall see, however, it is not always possible to draw a hard-and-fast line between the various facets of animal behaviour. For example, climbing comes natural to a squirrel, as we saw, but although its origins were innate there was improvement with practice, so that it partakes of the nature of an emergent skill. It would seem, nevertheless, to be a skill that was easily acquired. Or it may be that prior to weaning the animal is unhampered by, for example, the need to search for food,

and so all its nervous energy can be devoted to improving such skills, and also in the learning about the world immediately around.

In earlier chapters we have dealt with the scientific findings on the reactions of young birds. These tend to reduce the conduct of birds and, by implication, of all young animals to an almost purely mechanistic basis. It does no harm therefore to introduce here a mild antidote to a view that could be misleading. I would therefore stress one particular change. As I have said earlier, the first days of our acquaintance with the squirrel were marked by an, apparently, very impersonal attitude on the animal's part. If this had continued it would have been no more than we were expecting. It would have occasioned no surprise. And for this reason I feel we were not mistaken when we supposed that the squirrel was developing a new approach, something almost of affection towards its human neighbours—even although it might still be regarding us as benevolent trees. The change from the first of these stages to the second was most marked.

This marked change may, perhaps, be explained in the following manner. As skill in movement and a knowledge of the world around mature, more of the nervous flow is available for learning how to feed. The tendency to hide surplus food, on the other hand, seems to be an instinct which is complete from the start and is therefore truly innate. It has an obvious advantage in ensuring reserves of food. Opening nuts and acorns also is innate in origin but requires practice, or learning, and leads with the increase in skill to a wider selection of food to draw upon. Then, as the inherited reflexes are reinforced by learning and memory, so that ordinary living becomes largely automatic, nervous energy later becomes available for purely emotional behaviour, expressed in play and companionship.

Perhaps we can with profit now recall the comparison made earlier between the characteristics of the squirrel and the young rabbit which, while differing in appearance, differed even more in behaviour. There are in the world three kinds of squirrels: the true or tree-dwelling squirrels, the ground squirrels and also the flying squirrels, which do not fly but glide. In their bodily structure and appearance all are recognizable as squirrels even while they differ in their habits and in the habitats they occupy. The young of each of these groups have also sufficient in common that we should not fail to recognize them as young squirrels. In the same way, hares and rabbits are close relatives. They differ, however, in habits, as well as in appearance and in bodily structure. The uninitiated would be unable to tell whether a young animal placed

before him was an infant hare or rabbit. At first, of course, there is a difference. The young rabbit is born helpless while the hare is born in a more advanced condition, but fundamentally their behaviour is closely similar, and at a certain stage so is their appearance.

From the structure of the adult animal, relationships can be deduced and this in turn enables us to classify them. Conversely, this classification helps us to know what to expect in the way of habits : we do not expect a rabbit to behave like a squirrel, simply because they are unrelated. The pattern of infancy in related animals shows, if anything, even more similarity than is found in the behaviour of the adults. This brings one great advantage for it enables us to generalize about groups of animals from what is known of one or a few species representative of each group. That is why, in discussing the infancy of animals generally, the method chosen is to study a few typical examples, rather than try to deal with all species. There will, of course, always be the exceptions and these are often highly illuminating. They are, however, no more than complementary to our study of the general pattern. If then we can establish, with some confidence, that the summary given for the emergence of personality in the young squirrel is likely to be general for mammals, then we may gain some idea of what to expect higher up in the scale of the furred animals.

The rest of the story of our pet squirrel can be told briefly. In course of time it showed more and more the characteristics of its race, in the way it collected materials, in the way it made its nest, in its restless activity, its manner of feeding and so on. Then came the inevitable day when it escaped. We made no attempt to stop it. It was at an age when all young squirrels leave home. It was no longer a baby, although still juvenile, and as with all youth the pioneering spirit, the spirit of adventure, had emerged. It, too, is innate but the pattern is not so fixed as some of the earlier patterns.

For a while the squirrel stayed in the trees in the garden, but within a few hours there was nothing more to be seen of it. Had it fallen in with another squirrel and wandered off to explore the world ? Or had it fallen victim to a cat ? The danger in such pets escaping is that they enter the hard world trustingly. We had our answer to these questions later for every now and then, always in a different place around the neighbouring field, a squirrel would come towards us at my daughter's call. It would come towards us but no more. The wild had claimed it but something of its childhood still lingered on in its memory. Was it affection or mere force of habit ?

CHAPTER VIII

WOOD RATS AT HOME

WITH our young squirrel we have been able to deal in generalities only, combined with a good deal of speculation on the meaning of infancy and some of the problems arising from it. We have always to remember, also, that the animal was not truly wild while it was in our care, and that alone might be misleading. More definite information can perhaps be found in the results of a ten-years' study of a single species, the North American wood rat.

Wood rats are found over most of southern and western North America and also in some of the eastern states of the U.S.A. Very much like the common or garden rat in general appearance, they are coloured various shades of brown or buff, with pale underparts. Their special feature is that they build houses, variously called dens, huts or nests, but the name 'house' is much more appropriate. Constructed of sticks or other vegetation, a house comprises a recognizable body and a roof, with several entrances, sometimes on two levels, opening into passageways. The passages open into various chambers which serve as nests, food stores or middens. Two American naturalists spent ten years studying the habits of one species, the dusky-footed wood rat. The results so obtained are embodied in a book, published in recent years, of nearly 300,000 words, of which a sixth was devoted to the breeding habits and infancy of the rats. Yet these two investigators feel constrained to remark that the evidence they had been able to collect on the behaviour of this one species of wood rat is still insufficient to enable them to give a complete account of its normal behaviour. Nothing could better illustrate the difficulty of filling in the story of the private lives of animals, nor better demonstrate how much remains to be learned.

One of the first difficulties these two naturalists encountered, a familiar one where mammals are concerned, is that the wood rat works mainly at night. If active during the day it seeks the shadows and shuns the light. Even on moonlit nights, when the human observer has a better chance of seeing nocturnal animals, the wood rat is apt to stay at home and sleep; and an electric torch used on a dark night did little more than scare the rats as they wandered abroad. Painstakingly they

live-trapped the rats, marked them, released them and watched which house each rat went into. Numbering the houses with labels stuck into the ground they watched and listened, noting every detail and slowly piecing together their evidence. Sometimes by good fortune a trapped female would give birth while in the trap and the two observers could collect information on how the mother behaved towards the young ones, and what, in their turn, the young ones did. And when the family had been restored to its house they were able to see what happened to the father.

In writing their book, the two naturalists did no more than put down what they had observed, making no attempt to embellish it or fashion a consecutive story. Their results are used here because of the completeness of the survey, and it can only be hoped that in turning them into a narrative justice will have been done to this fine piece of investigation.

We can start our story with each male and each female wood rat in their separate houses, coming out at night to forage, sleeping for most of the day. On the occasions when two rats meet, on their journeys abroad, the likelihood is that they will not just pass each other by, for although of solitary habits they maintain a fair degree of sociability. On meeting, they will stop at a short distance from each other and, with noses pointed, each will sniff at the other's nose. Then, coming closer, the noses meet, the rats lick each other's lips and 'mouth' the face and head.

At the breeding time, a male wood rat will mate with the female in the house nearest his own. He will take up residence in her house and remain there until gestation begins, after which the female becomes intolerant of her partner and drives him out. He makes no resistance to her attacks and, if he should show a disposition to stay in spite of these, she will do him serious injury. Raising her head and fore-feet, she lunges at him furiously, striking forward and down, biting his ears, face, legs or breast. After the first attack she will disengage, turn about and launch herself in a fresh attack, again and again; and although the wounds themselves are not immediately troublesome, they readily inflame, producing suppurating swellings, which are eventually fatal. Her behaviour seems comparable with the ill-temper of a snake when she has eggs.

Those males sufficiently prudent to go at the first persuasions will wander about the area seeking further mates. So it transpires that the male is a wanderer occupying one house after another, either a fresh

one during his periods of celibacy, or the house of his mate for the time being. The females also change houses for each litter, so although the word 'house' is appropriate to describe these dwellings, and 'home' may sometimes be used to denote an occupied house, there is something in the nature of communal ownership. Yet paradoxically, as we shall see, the young do show an attachment to the house in which they are born.

We know from the researches of recent years how widespread is the territorial instinct in birds and mammals and how great is its importance for the welfare of the young. It is, strictly speaking, no part of our present story but it will do no harm to recall the general principles. Suppose we take the chaffinch as an example. In autumn and winter chaffinches live in flocks, usually the hens in one flock and the cocks in another. As spring approaches the sociability of the cocks begins to break down. At first it is no more than a tendency for individual birds to perch alone in a tree or bush and sing for a short while, after which he rejoins his fellows. As the days pass he spends more and more time alone singing, not from the one tree alone. He has a number of singing posts, as they are called, and the area of ground marked by them is his territory. Somewhere within this territory the nest will be built. In this area the cock will sing until a hen joins him. From this area he will drive off all intruding chaffinches. And the one point that interests us here is that this area will be the territory from which the chaffinches, when their brood is hatched, will gather the food to feed their offspring.

There are many variations on this theme, in both birds and mammals. In one way or another they have, like human beings, this strong sense of property, and whether it is temporary, for the breeding season only as in so many birds, or permanent, as in many mammals, it represents a feeding-ground. In the wood rats we have a rather unusual situation, but something of the usual territorial instinct is seen even in them. For example, although a male will submit to the attacks of the female when he is in her house he will retaliate if she tries to molest him when he is in his own house. There seems also to be the same unwritten law about respecting the territory of another. This is best seen when a rat goes house-hunting.

A wood rat looking for a new home approaches a house and smells round it. That examination completed it approaches one of the entrances and smells that more carefully. Presumably a rat in residence, even if temporarily absent, leaves signs of occupation in the form of its

own scent, and the newcomer can detect the signs, freshness of the odour and so on. The smelling ritual finished the prospecting rat rattles its tail. If the owner is at home it will rattle its tail in reply, and for a few seconds a 'conversation' is carried on by this means, the exact significance of which is not clear.

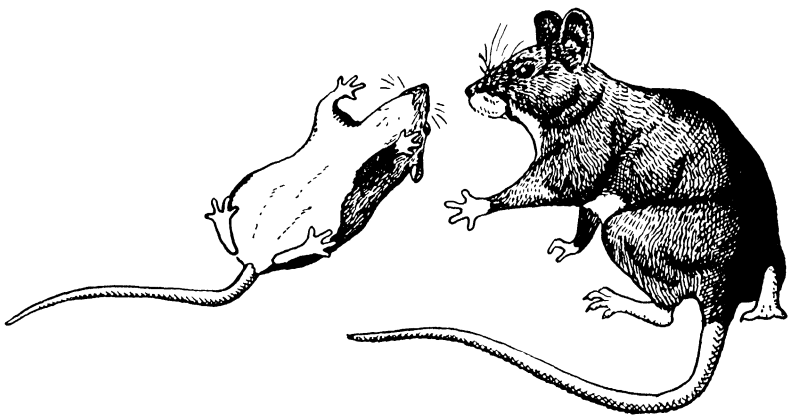
Tail-rattling is caused by the rat swinging the outer half of the tail in an oval, the rattling being caused by the tail hitting the dry leaves in the lower part of the swing.

Perhaps the best way of interpreting the territorial instinct in the wood rat is by viewing it as a nomadism, with attachment for one particular house while occupying it. This looser kind of territorialism makes it possible for a female readily to take up residence in another house for her next litter. Another consequence of this, in turn, is that she leaves the young rats of her previous litter in the house in which they were born, thus increasing their chances of survival. They do not have to wander into the world at too early an age to seek a new site, nor do they need to build a fresh home at a time when their abilities to do so are not fully developed. The action of the mother in leaving the house of their birth ensures the young adequate shelter and protection in the days of their later infancy and must be regarded as part of a pattern of parental care, even if it means the mother ostensibly forsaking the young to accomplish it. Whether or not as a result of this, it seems certain that young wood rats retain a memory of their ancestral house even when they are no longer living in it.

It is not surprising that the two investigators did not actually witness the birth of the young wood rat, for it seems from their observations that this usually takes place at night. They did see the young, however, within a short while of actual birth. These are born naked except for a few sparse hairs on the back. The eyes are closed. The skin of the upper parts of body and head is grey, the ears, legs, tail, nose and the mustacial pads—whence the whiskers later grow out—are pink. Presumably the mother eats the afterbirth, as is usual, and licks the newborn infants clean. In view of what we have later to deduce, these efforts at sanitation must be regarded as purely instinctive actions, that is, indicating no measure of affection as the term is normally understood. Finally, as to the first reactions of the infants themselves, within an hour of birth they begin to squeak and seek the underparts of the mother where they eventually grasp the teats and hang on to them with their mouths.

The relationship between parent and infant wood rat may be

expressed briefly as an obvious parasitism on the part of the young and an automatic acceptance of the duties of host by the mother, the attachment of the mother for the young being, apparently, at every step the result of an attempt to satisfy a particular instinct. If anything in the nature of a bond of affection does arise it would seem to be on the part of the infant for the parent and this only in the later stages of infancy. Such an analysis may appear harsh but it is at least consistent with the mother leaving the maternal house. It is underlined by the fact that the young normally remain in the house of their birth, although



Female wood rat chastising young

they may sometimes follow the mother when she moves to a new residence.

Point is also given to this summing up by the several observations made on a young rat on the threshold of maturity. On meeting its mother again it endeavoured to mouth her head, or in other ways show signs of a recognition and of a bond between them. In all cases observed, where it was tolerably certain that the two rats were parent and offspring, it was the young rat that took the initiative, the parent tolerating the demonstration for a short while and then breaking away. This picture of the devoted infant is, however, somewhat marred by the observation that sometimes the young rat would try to push its head under the maternal abdomen, the implication being that any affection shown may be mere cupboard love, or at least a relic of the days of active suckling.

Soon after birth, as we have seen, when the eyes and ears are still

closed, the young rat begins to squeal and to squirm towards the mother. If she is away from the nest the young rat spends its time squealing, lying on its back and pushing upwards with its feet. When the mother is present these actions are effective in enabling the youngster to push its way under her abdomen and seize one of the teats. Once it can do this it holds on tenaciously, remaining attached most of the day, even when it is not sucking, and one cannot help making a passing comparison with the young kangaroo in the pouch. With captive rats it is not uncommon to see the parent moving about with two youngsters firmly holding and being dragged unceremoniously across the floor of the cage. Whether it ever happens under natural circumstances cannot be said for certain, but it has sometimes happened that an adult rat so burdened, when allowed the opportunity to return to her house, has dragged one young attached to her while carrying the other in her mouth. It has been seen in other rats in the wild, however. At other times the mother wood rat has carried one away in her mouth leaving the other youngster on the ground to be fetched later.

In all cases it was noted that should the mother need to disembarrass herself of her living burdens the most strenuous efforts were needed to accomplish this, although the operation is carried out swiftly and to all appearances easily once it is started. To detach the baby the mother mouths it roughly on the back and shoulders, appearing to bite it. Once she has obtained a firm grip she pulls upwards until the young rat loses its hold, the whole vigorous operation takes about three seconds. The human foster-parent found the same difficulties when hand-feeding orphaned wood rats with milk from an eye-dropper. The young rat held this as firmly as it would have done the maternal teat.

The secret of this tenacious grip lies in the shape of the juvenile incisors. Instead of lying close together as in the adult, the lower pair curve strongly outward to either side. The upper pair are also divergent but not so strongly curved and their function is to press the teat into the crotch formed by the lower pair. The grip may also be aided by suction for it was found that a hand-fed young rat would extract milk from the eye-dropper even when the rubber bulb was not being pressed. Presumably therefore the baby rat actively sucks.

The gripping reaction can also be independent of actual hunger. On occasion a young rat has been seen to seize the base of the maternal tail and hang on to this as tenaciously as it would to a teat. And while doing so it did not squeal. There is therefore a simple formula: with

something in the mouth to grip there is no squealing, with nothing to grip there are squeals.

What the comparable maternal reactions may be is not clear. On occasion the mother rat has been seen to respond to her squirming babes by crawling over them, clearly allowing them by this action to become attached to her. It was also noted at other times that, when searching for the teats, the young rats made clicking noises with their incisors. These may take the form of a releaser stimulus to the mother causing her to take up position to give the youngsters the opportunity to take hold of her. This last is purely conjecture, however, but assuming it to be true then we have three sounds made by the young rat, which appear to be the full extent of its vocabulary. The clicking; the squealing which could then be interpreted as a more urgent signal but directed to the same end as the clicking; and finally a prolonged and high-pitched squeal indicative of physical pain. For example, in order to study more closely the behaviour of the young rats, the investigators would mark one of the pair. The only satisfactory method, and the least painful, was to make a small incision into one of its toes. On such occasions, as well as under other more natural conditions of injury, pain, or fear, the high-pitched squeal was evoked.

It may be interpolated here that all the time the rats were being watched variations in temperament were noted in both adults and young. One individual would show every evidence of fear on the slightest provocation; another would submit to handling, even to being marked, with the greatest calmness and patience. Similar variations were found in other particulars, in their responses to the human observer as well as of young rats towards the mother.

The simple reactions of the young already noted were paralleled by equally simple reactions of the mother. Indeed, there seemed to be throughout the period of nursing an automatic, almost an objective or impersonal attitude on her part. Thus, when picking up her baby, the mother would put both of her fore-feet on it, one on the head and one on the left thigh, so that the baby's feet were directed away from her mouth. Then she would mouth it, moving her mouth backwards and forwards and from side to side, in such a way that, combined with the ruthless pressure of the feet, there was every appearance that she might be going to eat the youngster. She seemed to recognize no feeling in the baby rat and was merely impelled by an instinct to pick it up, which she did finally by the left middle back.

It is of interest to note that throughout the operation, and when

being carried, a young rat does not squeal, even although it has nothing to grip in its own mouth.

The instinct to carry her young back to the nest, to allow them to become attached to her teats, and an occasional licking of a foot or a flank were all that could be observed of parental devotion. But presumably this is adequate. Throughout infancy the young wood rats enjoy the protection of a house, and so are protected from enemies except for small predators or those prepared to go to a lot of trouble to pull the house to pieces for the sake of a meal. The need for parental protection is thus reduced to a minimum. In other words, the usual security measures are not demanded of wood rats, or not called for to the same degree as in, say, nest-building birds with their helpless

Female wood rat retrieving young

young. In any case, a wood rat, even with two young attached, can still run swiftly away.

To what degree the mother licks the young for the purpose of cleaning it is not known, but it was noticed that at an early age the young rat showed signs of cleaning itself.

It would be wrong to give the impression that this is the sum total of the wood rat's attention to her young, although the reactions so far enumerated must represent something near the total. It does seem, however, from scattered observations that she may occasionally chastise her offspring. To what end is a matter for speculation. Thus the observers noted on one occasion that a young male, released from the trap before his mother, went to the end of a log and there crouched. When the mother was released she rushed directly at him and hit him, so that he fell three feet on to a pile of leaves. He made no sound following this rough treatment and three minutes later was seen following his

mother, who ignored him but tolerated him. The observers interpreted this as a failure by the mother to recognize her own offspring, but there may be more to it than that.

For example, another observation made on a number of occasions by the two American naturalists is of the young wood rat following directly behind its mother when, at a later stage in infancy, the two left the house to move abroad. The same thing would happen when the two were released after being in captivity. There are obvious advantages in this and it would not be surprising to find that it represented a fixed behaviour pattern. It may also explain why the mother chastised her youngster. All animals are to some extent upset by departures from the normal, and usually respond by taking aggressive action of some sort. It would ensue then that if a young rat failed to follow its parent even this small departure from the normal would cause her to chastise it and to continue to do so until it came into line with normal practice. This does not necessarily mean that she is aware of the advantages of having her young one following directly behind her, although the end result is the same. The appearance would be that she was punishing her offspring "for not doing as it was told" and to this extent challenges comparison with human behaviour.

These speculations may be open to question, but I have seen something similar in a young water vole swimming behind its mother. Suddenly it swam obliquely from the course she was following. The mother turned, there was a flurry of water and every sign of chastisement after which the two swam on, the young one following directly behind the mother. It is worthy of note, in this connexion, that within the otherwise scrupulously objective account by the two American writers they do occasionally offer observations in more homely terms. One of these is appropriate here. They described the reunion of parent and offspring and noted how the latter lowered its head and crouched as if expecting chastisement.

One more remark that occurs several times in the book is that when reunited after being parted, or even on other occasions, the mother rat seemed to ignore but tolerate her offspring. On the other hand, and here again the more homely terms are used, a young rat would appear to show delight or pleasure on meeting its parent. This difference between the attitude of parent and offspring may be apparent rather than real or it might be accounted for by the cynical comment that a young rat can have only one mother but a mother rat can have several litters. It may also be that, as with ourselves, the

young are more demonstrative than the adult. These things cannot be assessed accurately and are subjects for speculation only.

Observations on the behaviour of young rats when they first leave home, at the age of about 25 days, are more definite. The two naturalists remark how closely their mannerisms resemble those of adults. On emerging from the house the young rat takes up a fixed position, with head pointed straight forward, body stretched to its fullest length, whiskers still, eyes protruding and ears laid back on top of the head in the best position to catch sounds from any direction. The left hind-leg is extended backwards as far as possible with only the toes in contact with the ground, the right hind-leg being brought up so as to be almost touching the body. In this statuesque pose the animal has all the senses alert and the muscles poised for an instant get-away should the need arise.

Another point of similarity between the young and adult was noticed as a result of trapping. After the rat had been trapped and taken away for weighing and other such observations it was taken back, still in the trap, and released more or less at the point of capture. Young or old, the captives would start running backwards and forwards in the trap as soon as they recognized their home ground. This recognition of 'home' is apparently very strongly marked and will be referred to again later.

There were, however, ways in which the young differed from the parents. A small but instructive feature was in the movement of the vibrissae or whiskers. A grown rat when alarmed moves them so rapidly that they are almost blurred. A young rat when alarmed can only move them slowly backwards and forwards as if the action of the muscles controlling them is not yet fully co-ordinated. Not only is there this apparent lack of co-ordination but the young are less careful in their movements. A young rat trying to escape will leap from a height greater than that from which an adult will venture.

At the beginning of the chapter a very brief description was given of the wood rat's 'house'. The architecture of these dwelling-places has little to do with infancy but the stages leading to their construction and uses have. If no more they shed light on the underlying instincts and their emergence in the young rat. To understand these a few more details about the houses themselves must be given. As already stated, the house is a pile of sticks or other vegetation with a recognizable body and roof. At the same time, while there is some constancy in design there is also a considerable variability in the placing as well as in the

construction. This variability is related it seems to a variability in temperament of the builders themselves, who may be energetic or lethargic, friendly or surly, as well as being large or small and physically strong or weak. Even this is not the whole story for there remains the matter of choice of a site. The house may be in a crotch in a tree, at the base of a tree, on a bank or in a bush. The materials of which the house is made are, naturally, those most readily available. The end result is, however, that some houses are better built than others. Those with steeply peaked roofs are the more resistant to rain, those with flat roofs tending to become sodden inside.

Generally speaking, the plan of the tunnels within the house and of the various chambers bears a superficial resemblance at least to that of so many rodents burrowing underground. In other words, the wood rat produces in different materials and above ground much the same result as is achieved by so many small rodents, or even other mammals not closely related, such as the mole. It is a fair assumption therefore that any conclusions reached on the behaviour of wood rats may be regarded in general terms as applicable to a wide range of rodents. I have already made this point in another way in regard to squirrels.

Before proceeding further with this point, we should see what the two American observers have to say on the use made of the houses. They found that when the young rats leave the maternal roof they tend to occupy the nearest vacant house. In a litter of two or more the smallest moves farthest away, but all tend to move once or twice before finally settling down. From then on, as we have seen, they tend to move about from one house to another, most noticeably in the case of the pregnant females which are apt to change house with each litter. Each new occupant tends to add to or improve the house, or to rebuild one that is dilapidated. The question naturally arises: Who builds the houses in the first place? This is not known for certain but it is assumed to be always the old rats, and there were several instances in which a new house was observed under construction. In these instances, the building was commenced either on the site used previously for the deposition of faeces, or on a natural pile of sticks.

A house occupied by a recently weaned rat is recognizable as a rule by its having a freshly cut twig laid on the top. Slightly older but still young rats may lay several twigs on the roof. This seems to suggest an innate tendency to cut twigs and lay them in a pile. To some extent this is connected with feeding, for a mature rat living in a well-constructed house will accumulate within it stores of acorns and also of

freshly cut twigs. Even if the accumulation of twigs be regarded as an offshoot of a feeding pattern, the building instinct can still be regarded as a separate pattern of behaviour since the twigs must be arranged to form a body and a roof and to leave passages and chambers within the body of the house. Moreover, earth is often used and a house built on the ground will have tunnels in the earth beneath giving entrance to the house. Where this happens the earth removed in making the tunnels may be used to strengthen the foundations and to shore up the insecure places in the pile of sticks itself.

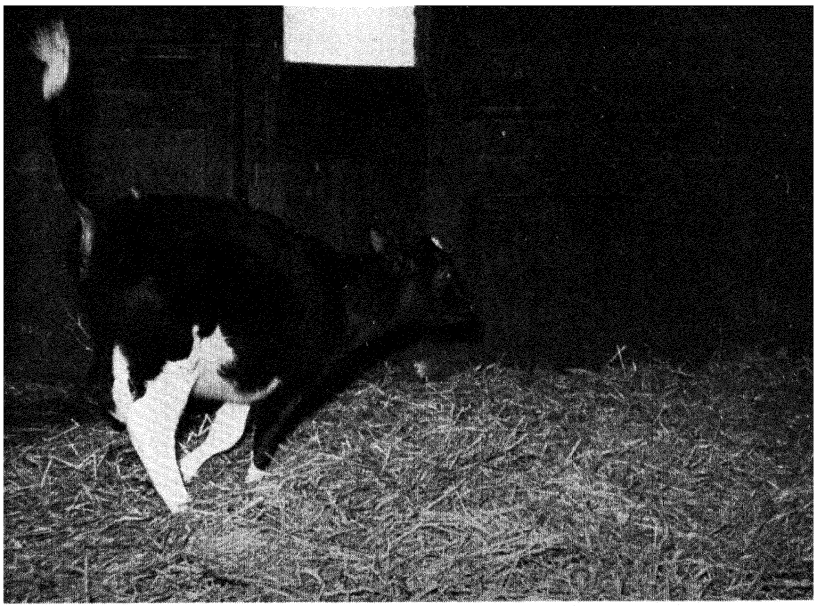
A young robin or thrush does not attempt to build until it is mature and in a condition to breed. Its first attempt then to build does not fall noticeably short of that of a bird that has had three or four years' experience. It is true that in some species of birds there may be several abortive attempts at nest-building before the final nest is achieved, but these first efforts are abortive largely in the sense that they remain uncompleted and unused. Such nests, as far as they go, are still recognizable as nests and conform to the pattern for the species. In other words, they result from a pattern of behaviour that is justifiably termed fixed. Even more so is the web-building of spiders. The first web built by a young spider is as perfect as the last one it will build, and the pattern is the same for each successive web even if the size is increased. The whole process of web-building emerges as a fixed pattern. It is innate and therefore totally unlearned.

The nest-building of birds is very like the web-building of spiders, with slightly more individual variation, but not sufficient to overthrow the idea that it is, with possible rare exceptions, dependent upon a fixed and inherited pattern of behaviour. The best-known exception is found in bower-birds. These do not breed until three or four years of age. Yet each year in its early life the male bower-bird will build a bower. In the first year the bower will consist of no more than a few sticks laid on the ground. The next year more sticks will be used and the result will more nearly resemble a bower, and so on until, when sexually mature, it builds the complete bower. It is a very moot point, in these instances, whether we should look upon this as successive stages in a fixed pattern of behaviour or as an emergent skill in which practice and learning play a part.

In the wood rat we have something rather like that in bower-birds. The house-building, like the nest-building of birds and web-spinning of spiders, is quite obviously unlearned. The young take over houses already built. The rats themselves are sufficiently solitary that any

appreciable learning by example or by copying the actions of older rats can be reasonably eliminated. Instead we have the process of building emerging by degrees. First the single twig laid on a house already built, later a few twigs, and, at the end, the ability to construct a nest from the start, together with sufficient appreciation of the mechanics of sound construction to make the improvement from a flat roof to a peaked roof, to shore up foundations, to construct a terrace giving maximum advantages of a look-out, to make additional entrances and chambers and all the other refinements found in the best wood rat houses.

Little is known of the way in which the young of other mammals derive their skill or gain their experience in building shelters, largely because they work underground or, as in beavers, under water. Wood rats are exceptional in working above ground and in a manner which makes their working moderately easily seen. Even so, many gaps remain although these can be filled in fairly confidently. Since the end result is so similar in many other mammals we may suppose that the steps leading to it are also similar. From this we may draw the general conclusion that mammals are endowed not so much with a fixed pattern of nest- or house-building but an emergent skill which follows a more or less well-defined course, varies with the individual, and, above all, is developed by stages and improved upon by experience.

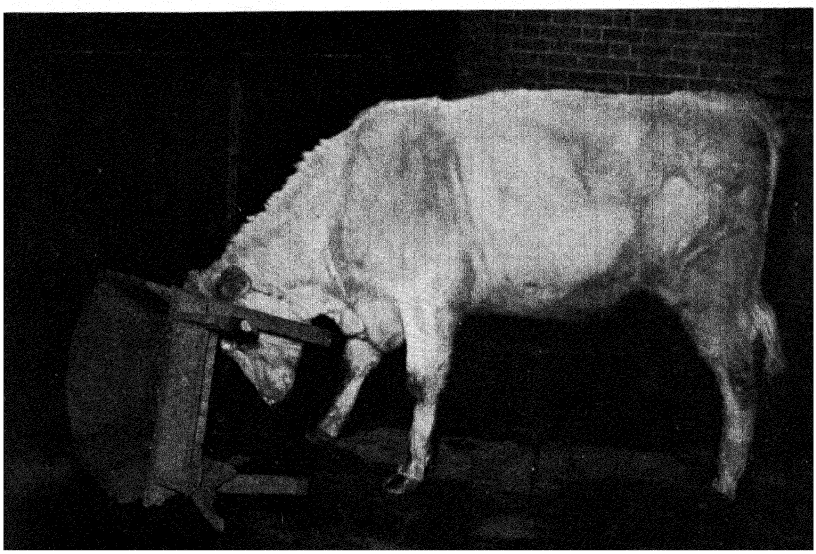


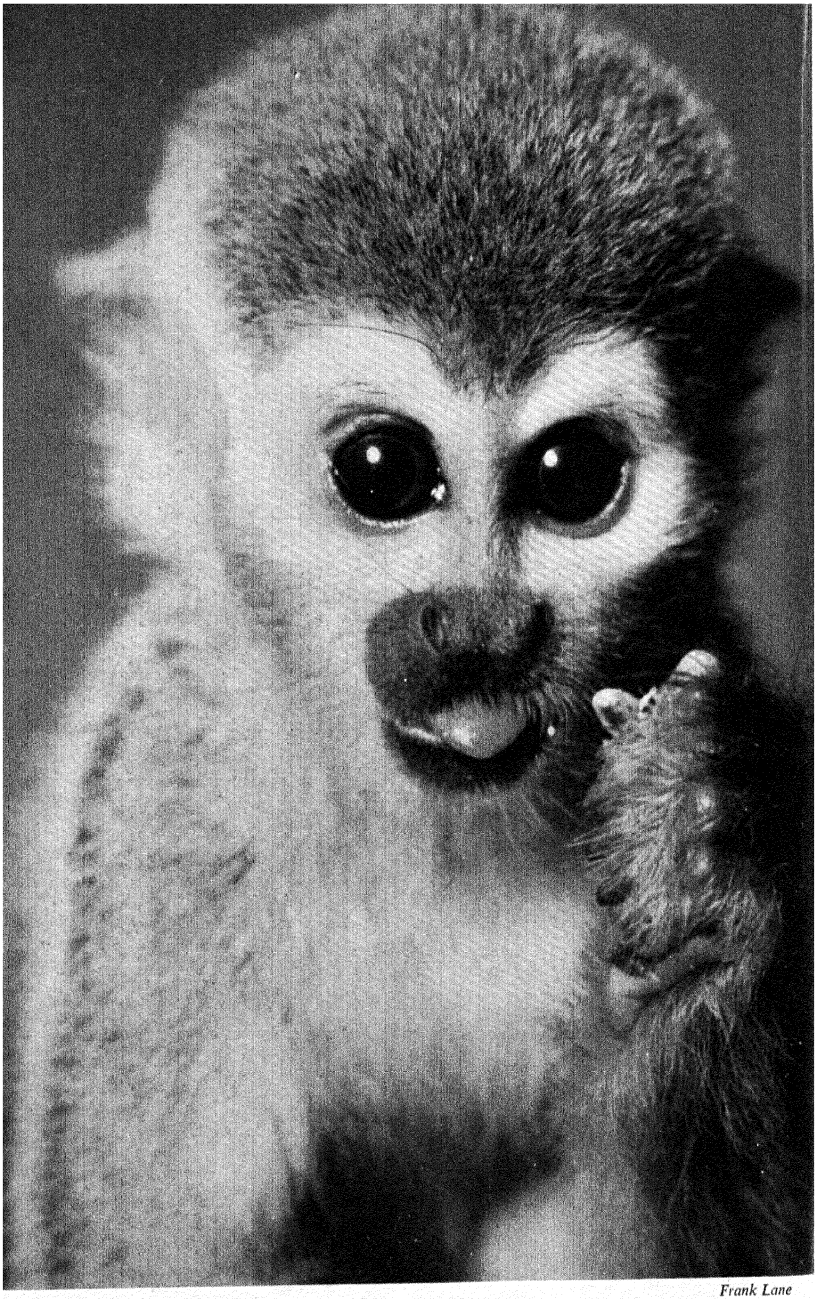
A favourite pastime of calves is galloping with the tail held at an angle to the body

1. PLAY IN DOMESTIC CATTLE

Mr. A. Brownlee and th
British Veterinary Journa

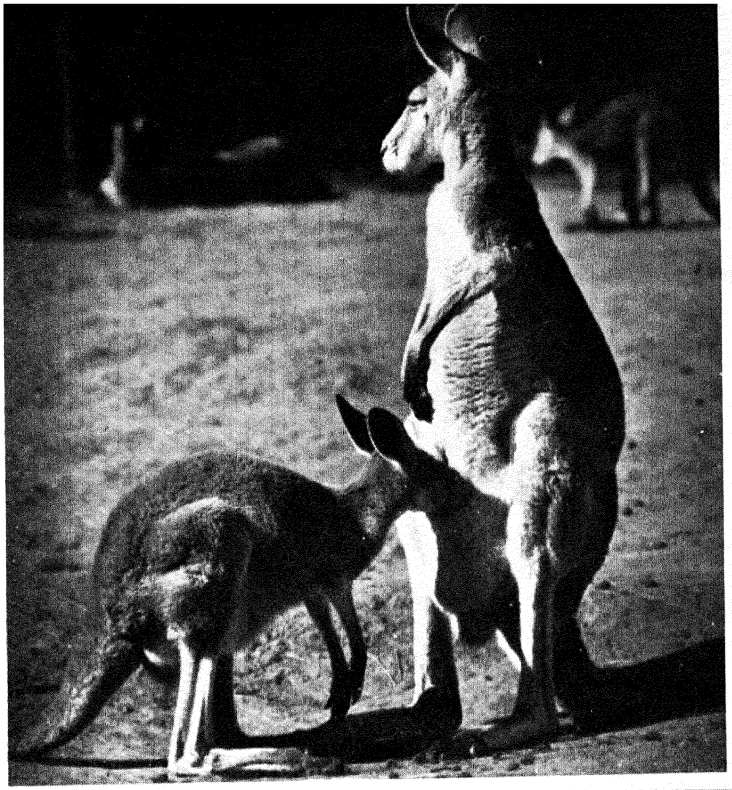
Young cattle will butt any loose object, a bucket, a bale of straw or a wheelbarrow





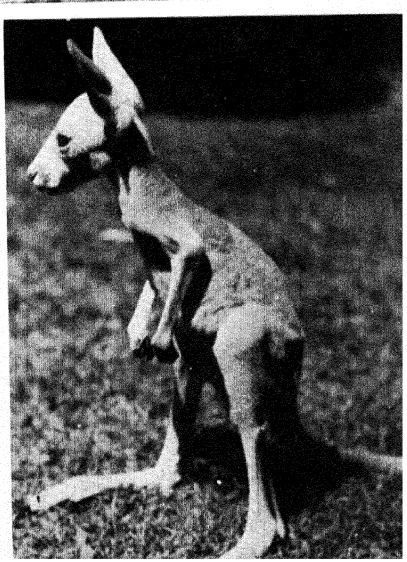
Frank Lane

2. A young spider monkey from South America



Frank Lane

3. The young kangaroo lives in the mother's pouch until able to run about on its own. Even then it will return to feed and to seek shelter and rest in the pouch

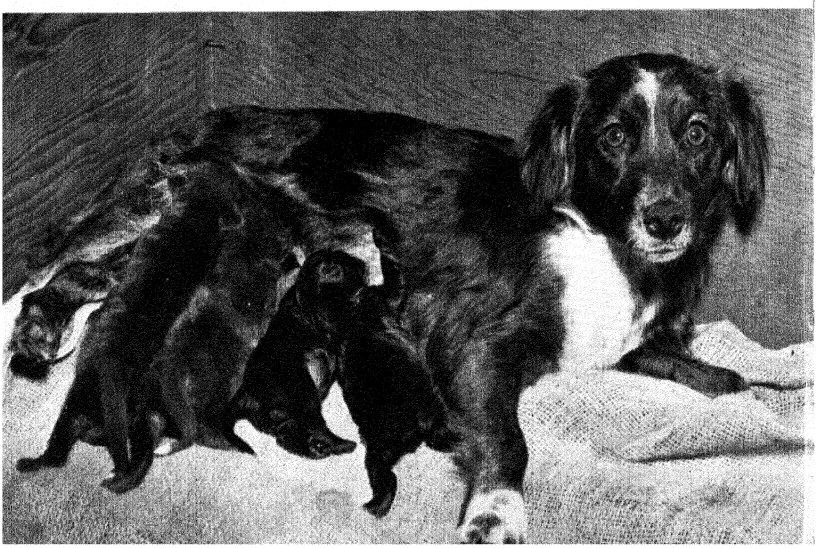


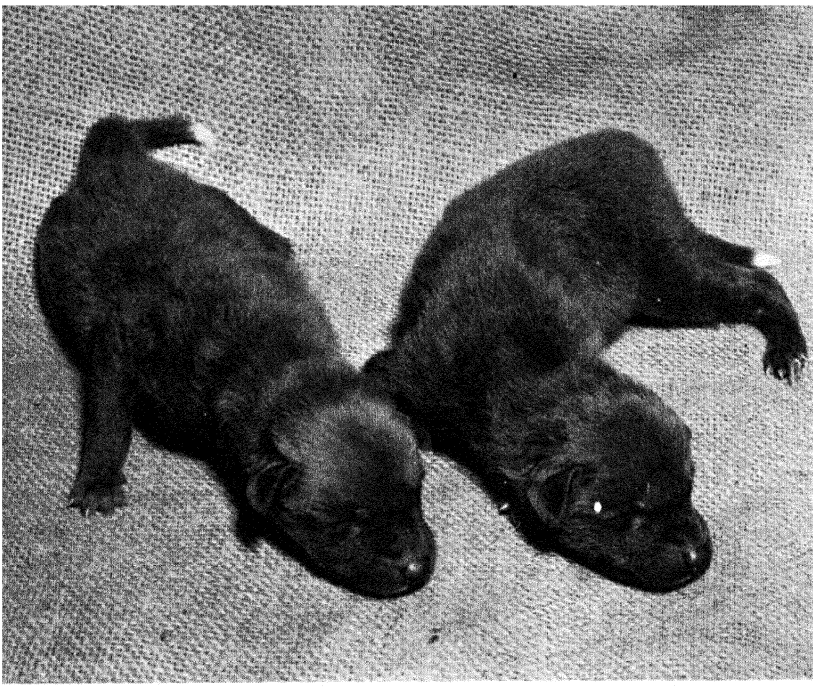
4. A young kangaroo soon after it has left the pouch for the first time. The hing legs are disproportionately long and even at this early age it can run rapidly and is a fairly good jumper

5. A slow loris with its young. Adult and young are alike in appearance and proportions, infancy being denoted by the texture of the coat and the expression of the face

Zoological Society of San Diego

6. A collie bitch nursing two of her own puppies and two puppies from a maned wolf





Zoological Society of San Diego

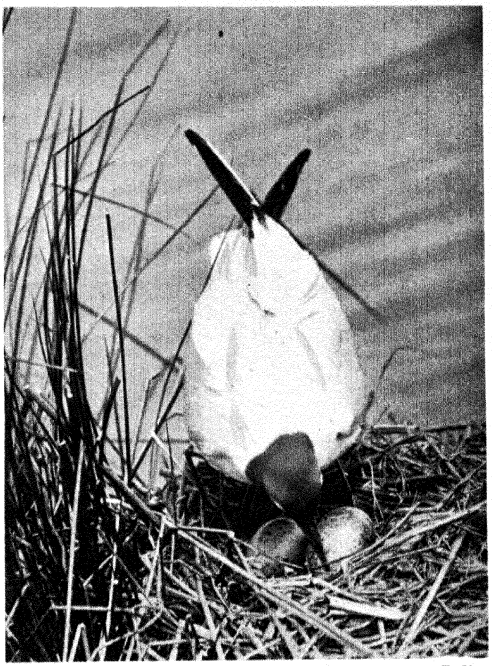
7. A young maned wolf still with eyes unopened, ears not yet functioning and with no hint of the long legs yet to come

8. The maned wolf, one of the several members of the dog family living in South America

9. A nesting colony of black-headed gulls

F. Vear

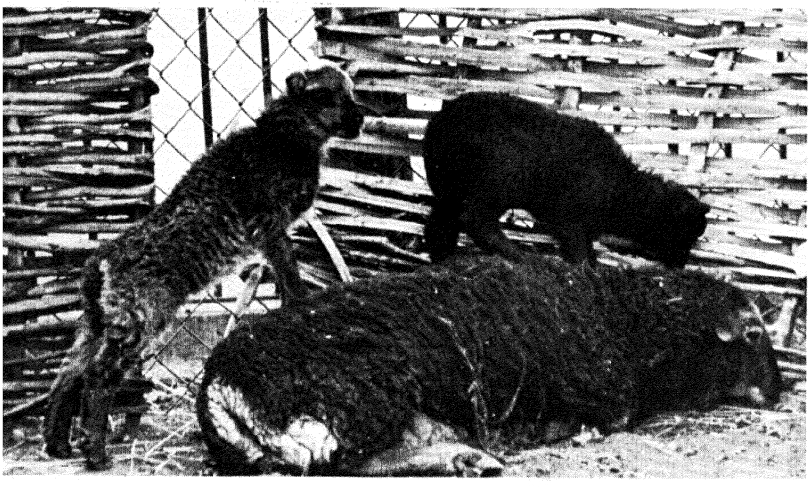
10. BLACK-HEADED GULLS



Turning the eggs

Mother and chick, showing the marked contrast in the pattern of plumage from adult to chick

F. Vear



11. Domestic sheep with lambs in the London Zoo. The ancestors of the domestic sheep inhabited rocky crags and the lambs of their domestic descendants seem to choose high places on which to play

Neave Parker

Neave Parker

12. A young fox cub

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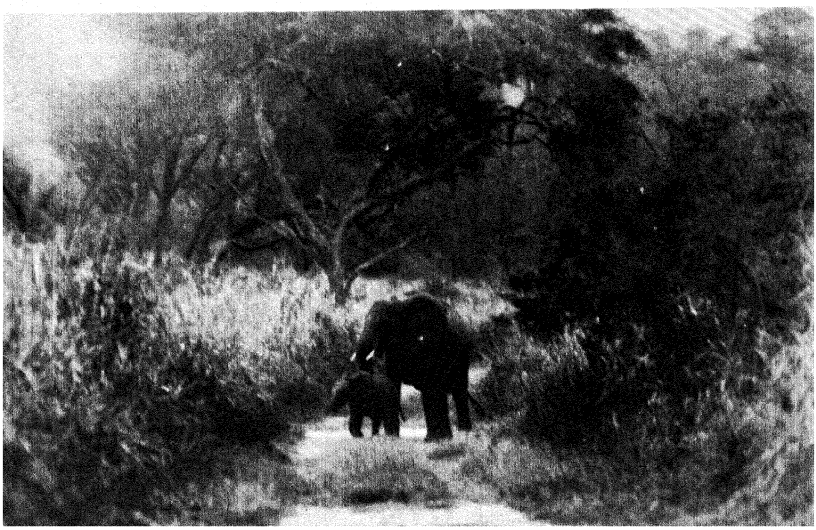
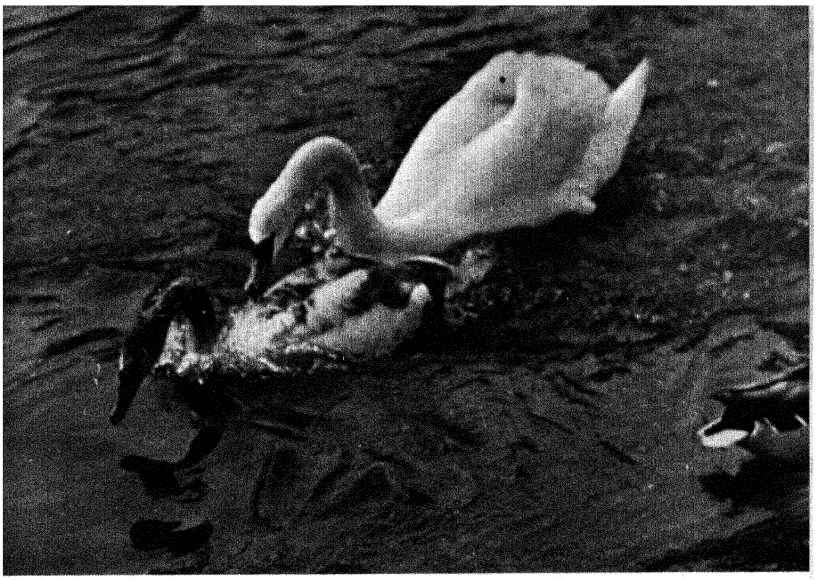
Hippo mother going to pasture leaves her young one in the care of another female

13 DOMESTIC LIFE IN THE WILDS OF THE CONGO
L'Institut des Parcs Nationaux du Congo Belge

The mother elephant guides her offspring through the Bush





The cygnet being driven from the home territory when it is old enough to fend for itself

14. TWO STAGES IN THE LIFE-HISTORY OF A SWAN *Neave Parker*

The young cygnets sheltering under the parent's body

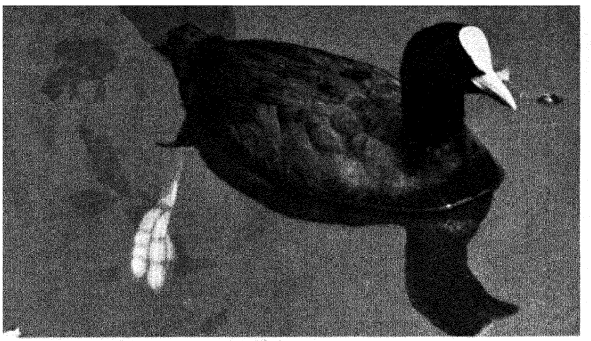
15. A puma in infancy and (*above*) fully grown. The face of the young puma has very much the proportions of the adult but the expression is totally different. It is probably the lack of aggressive expression, among other things, which makes young animals so attractive

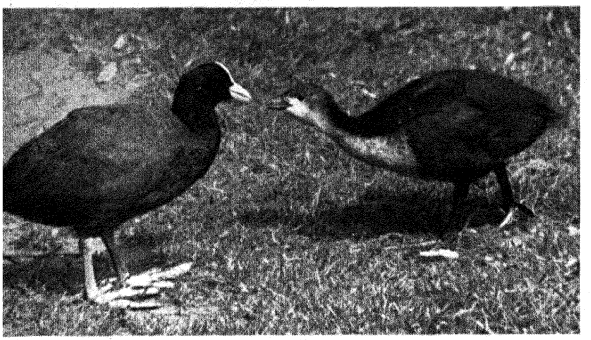
Neave Parker

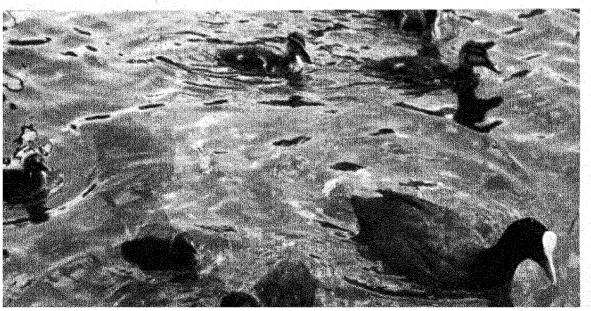
The mere sight of food causes the crow to gape and call out

16. FEEDING A YOUNG CROW *Neave Parker*

As the food nears the mouth the young crow goes into a soliciting attitude spreading its wings and lowering the body still keeping the mouth agape







17. FOUR STAGES IN THE LIFE OF A COOT

The well-known form of the coot seen on lakes and ornamental ponds

Three scenes in the life of a mother coot with her chicks. Recent studies have shown that it is a little while after they are first hatched before the coot parent recognizes its own chicks, but when it does so it can distinguish them from chicks from a neighbouring brood that to the human eye look almost identical

Neave Parker

18. Moorhen on nest. While incubating, nesting material is added. Here the cock is approaching the nest with a piece of stick in his beak which he offers to the hen

Neave Parker

Jean-Marie Bautle

19. A young three-toed sloth of South America cradled by its mother's body and clinging by its claws to her hair with an arm around her neck.

CHAPTER IX

YOUNG RABBITS AWAY FROM HOME

THE studies of wood rats were on a number of animals living under natural conditions, supplemented by observation of captive animals trapped for that purpose. Our study of the grey squirrel was of an animal normally solitary isolated in captivity. Both the grey squirrel and the wood rat are rodents in the strict sense. It may not be inappropriate then to follow with a story of rabbits. As already explained these are no longer classified as rodents. In addition to giving us another type of animal, we also have one that enjoys community life of a sort. Moreover, it is the story of a litter of wild rabbits adopted and hand-fed from an early age, and at no time unduly restricted in their movements.

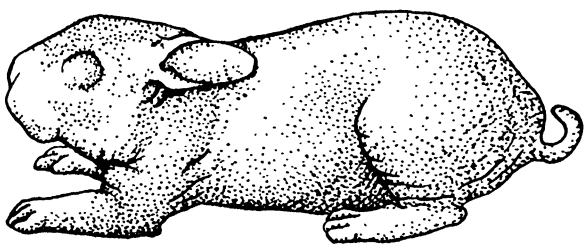
The story of their adventures may be prefaced with a brief summary of the chief stages in the infancy of a rabbit. As the doe feels for the first time the new life quicken within her she does something she has never done before. On the margins of the warren in which she lives she digs a shallow burrow, known according to taste as a stop or stab, a tunnel about two feet long, with a single entrance, and no more than a few inches below the surface at its further end. In the slight chamber formed at this blind end she builds a nest of dried grass, lining it with down plucked with the mouth from her own breast. Quite often the stop may be at a distance from the warren, in the middle of a field.

The young are born naked, blind, deaf and not able to walk. The doe leaves them in the stop and returns to them only at night to suckle them. On leaving her newly-born litter she stops up the entrance to the burrow with earth, and continues to do this after each visit and as long as the young are in the burrow. A doe has been known to gather hay from a nearby stook to scatter over the bare earth stopping the entrance, further to hide the whereabouts of her litter. These are not the only precautions taken. As the young rabbits draw near to the time of independence, that is, when they begin to take their first walks abroad, the doe, in stopping the entrance, leaves a hole in the earth-plug just sufficiently large to allow the young ones through, and increases the size of the hole as they grow in size.

It is said that the purpose of these precautions is partly to protect

the young from predators. This seems unlikely, for in such a burrow a badger or a fox has no difficulty in locating them and digging them out. Even a domesticated dog, with its instincts and senses dulled or partly suppressed by selective breeding and secure conditions of living, will do so. Further, even a small opening left in the earth stopping the entrance will allow a stoat easy access to the burrow. It seems safe to assume that the precautions are wholly against the aggressiveness of the buck. This is suggested by the behaviour of a doe who, as sometimes happens, has her litter in the main warren. In this event she guards them day and night, apart presumably from short excursions from the warren for feeding.

Whatever be the case, the significance of the actions in relation to our present discussion is not affected. This is, that as the result of



Newly born rabbit

certain physiological changes within her body, consequent upon her pregnancy, the doe follows a definite and for her a wholly new line of behaviour. Not only does this line of action anticipate the needs of the young but the timing of the changes in behaviour keeps pace with their changing needs. Thus, in leaving a bigger and bigger exit, as time passes, her action is linked with the increasing girth of the young rabbits' bodies. Nobody could suppose a rabbit capable of appreciating, much less estimating, this increase in girth. So we are justified in assuming that it results from a fixed behaviour pattern, the mechanism for which is inherited, and released at the appropriate moment. The same must be true of the precautions for the safety of the young ones against the aggressiveness of the buck.

Yet while we speak of a fixed and inherited pattern of behaviour, it must be admitted that the pattern is not inflexible. Thus not all does camouflage the entrance to the stop with grass. And we have seen that some does have their litters in the warren, necessitating a markedly

different pattern of behaviour. The best explanation we can offer, and the only feasible one we can arrive at from the available evidence, is that if the doe did not do these things, few of the young rabbits would survive. As matters stand, a close study made by H. N. Southern of the wild rabbit in England showed that of 280 young born of 36 does, and living long enough to be weaned and start independent feeding, 252 had disappeared by the end of the first season. He also found that rabbits do not move far from their own warren although a few young ones may migrate to neighbouring warrens. It may be assumed therefore that most of the 252 were killed by predators or died from some other natural cause. In other words, in spite of all the mother's precautions, there is less than a ten per cent survival beyond the first season. If she did not take such elaborate precautions the survival rate would be considerably lessened. Thus we arrive at the conclusion that, to use the current terminology, wild rabbits have been selected out for this particular behaviour in the doe. This means that any strain in which the inherited behaviour pattern did not include precautions by the doe for the safety of her litters would tend rapidly to die out, while a strain showing the converse would tend to survive. It is a simple illustration of the process known as natural selection.

We may extend the argument in this way. The number of does that have their litters in the warren itself would appear to be relatively small. This we should expect since the chances of survival of litters so produced must be much smaller than the percentage of survival elsewhere. As a result the number of rabbits inheriting this pattern of behaviour should be correspondingly small.

It would be instructive to go into further details of the mechanism of inheritance and the results of natural selection. The subject is, however, a wide and complex one and to pursue it would lead to an inconvenient digression. Sufficient has been said to justify the view that seemingly intelligent behaviour in animals is, in the main, no more than the working of a fixed and inherited pattern selected out by natural circumstances. The means whereby a particular pattern should first have come into being to be acted upon by natural selection is, however, another story.

The pattern of events so far as the doe is concerned is paralleled by a changing sequence in the young themselves. From being naked and helpless, blind and deaf, they become independent of the mother in three to four weeks from birth. The body soon becomes clothed with a soft fur. The limbs, at first moved in an unco-ordinated and feeble

manner, begin to strengthen and function in concert until the young rabbit can first get on to its feet and later walk. The ears gain the power of movement at about the tenth day; on the twelfth day they are completely open and by the thirteenth day they can be erected. The eyes open about the eleventh day and towards the end of a fortnight from birth the youngsters begin to make short excursions from the burrow in which they were born. Even then the proportions of the body are still juvenile. The head is relatively large, the ears are small, the tail small and inconspicuous and the legs relatively stout, the fore-legs being not so short in relation to the hind legs as in the adult.

Judged by these criteria the litter of young rabbits mentioned earlier in the chapter were thirteen days or so old when my daughter first acquired them. It was in the course of the usual morning walk through the woods that our dog dug them out of a stop in the bracken well away from the warren. The dog showed more interest in playing with the nest than in the rabbits, tossing the mass of grass and down into the air and chasing it. This enabled my daughter to pick up the five young rabbits and bring them home cuddled inside her coat. It was then early April and the weather cold, and adopting the rabbits seemed the only alternative to leaving them to die in the bleak wind.

The events immediately succeeding the moment when the dog dug the rabbits out are not without significance, particularly in view of what will be later said about the analysis of the maternal instinct. Wild rabbits are vermin to the farmer and the forester. To some people their flesh is palatable, but few would care to hand-rear a litter of wild rabbits and then fatten them for the table. In any case the prevailing view is that it is difficult, if not impossible, to rear young wild rabbits in captivity. Certainly to do so means devoting much time to their care and, so far as my daughter was concerned, it would mean absenting herself for a time from the art school she was then attending. Yet it is clear that her first and immediate impulse was to save these juvenile—but very charming—vermin from the dog's attentions; and the second was to bring them home and care for them. It is equally clear that this was impulsive, or instinctive, with no reasoned thought for the consequences. To quote her own words, "My maternal instincts were stronger than my artistic ambitions." As it turned out, not only were the rabbits successfully reared but they provided a useful means of study.

Two things only were necessary for the successful rearing of the litter, the provision of warmth and food. As to the first of these, the

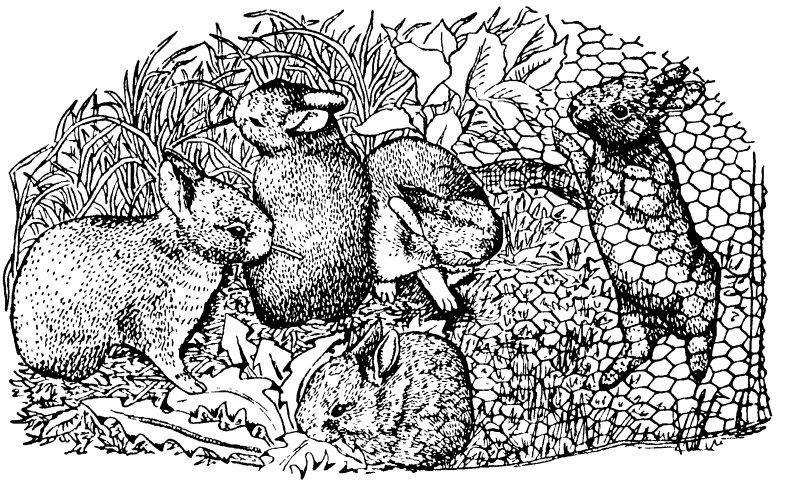
weather being cold, my daughter housed the rabbits in a corner of her bedroom, behind a wire screen, where they slept in the folds of a piece of blanket. The food was cow's milk diluted with water, offered from an eye-dropper. It was not for some days that the first and only casualty in the nine weeks they were with us was sustained. One of the young rabbits, which was apparently in good health in the evening, was found dead in the morning from no obvious cause.

Having had the rabbits from an early age and, as we believe, soon after their eyes had first opened, and having them segregated from all but human contacts we could be tolerably certain that any behaviour manifest must be innate. The first noteworthy point is that three days after their capture and four days before they took solid food they gave evidence of an incipient attempt at burrowing. While my daughter nursed them in her lap, one by one, to persuade them to take milk from the glass nozzle, there would occur from time to time a movement of the paws wholly reminiscent of the adult burrowing action. Neither vigorous nor sustained it was nevertheless recognizable.

Here is a subsidiary point of interest. It has been suggested more than once, and by those who have made a special study of the European rabbit, that it is not naturally a burrowing animal. This is based especially upon two considerations. The rabbit is said to have originated from south-west Europe and to have spread north-east within the historic period. The burrowing habit has been supposed, by a few of the older authors as well as by some modern authorities, to have developed in response to the predators encountered in the course of that spread. Certain it is that rabbits living in localities away from human habitations and where there are no foxes have their litters in nests on the surface and do not burrow for day-to-day shelter. I have not seen this myself, but the number and reliability of those who have told me of having seen it, together with the references in the literature, make it highly probable. It is true, on the other hand, that domesticated rabbits kept in hutches from birth will dig vigorously almost the moment they escape into a garden. It seems possible therefore that a piece of behaviour can be inborn, become highly developed in response to circumstances, yet remain dormant in other circumstances.

The next point of interest lay in the light we obtained on the weaning, which seems to be voluntary. On the third day of their captivity our young rabbits began to chew grass but not to swallow it. After chewing for a while it would be ejected from the mouth, chewed but not masticated, if this distinction can be made. Like the squirrel,

the rabbits seemed to be practising chewing. The opportunity to do so arose because my daughter had included behind the wire screen, probably to satisfy her own aesthetic tastes, a large clump of grass. It was not until the seventh day of captivity that one of them actually ate grass and at the same time refused utterly to take milk ; and by the end of the next 24 hours hand-feeding had ceased. The course of events may have been influenced by the unnatural diet of cow's milk, but the abruptness of the change from liquid to solid food should not perhaps be unexpected.



Young rabbits in wire pen

When first placed in the garden in a wired-in enclosure, on the day after they had taken to eating grass, the young rabbits although relatively tame showed a marked tendency to 'freeze' if anyone approached. That is, they remained perfectly still for a while. The freezing did not last long, but while it lasted the attitude of immobility was very definite. In wholly wild rabbits it may be more marked, but it is necessary to emphasize here that no attempt was made consciously to tame these rabbits. They grew tolerably used to being handled by my daughter who petted them no more than the doe might have done. That is, she did little more than stroke them behind the ears. Since, as we shall see later, their quarters were never cramped they retained something approaching a natural freedom of action and showed little sign of

being fixated, as they say, on human beings. Indeed, the fact that there were five (later, four) of them probably helped to keep their reactions as near natural as could be desired.

As is well known, rabbits use definite latrines, often the flat upper surface of a tree-stump or of an old ant-hill, but often on a piece of bare level ground. These accumulations of droppings are, of course, a characteristic feature wherever rabbits abound. At first our rabbits scattered their droppings indiscriminately, but about a fortnight after weaning we became aware that groups of droppings two to three inches in diameter were beginning to take shape at three points in their enclosure, and from then on all the rabbits took to using these regularly, but not necessarily exclusively. While on the subject of sanitation and hygiene, it can be remarked that at no time was it necessary to clean the young rabbits yet their fur remained unsullied and we early noted their efforts to clean themselves, at first awkward but rapidly improving with experience.

If what is written upon the feeding habits of wild rabbits is true, that the doe suckles her young at night, our litter had had their time-table upset, for they were fed by day. Certainly they had a last feed in the late evening but there were several feeds also during the day. They slept through most of the day but at night were apt to be active, and because she found her nights being disturbed my daughter, on the ninth day after she had started her adoption scheme, transferred them to a large cage in the garden. Prior to this, however, she had acclimatized them to an outdoor life by giving them spells in the temporary wire enclosure on the lawn, already mentioned, during several days before their final banishment from the house. It was during one of these spells that two of them tried several times to climb the wire, reaching a point one and a half feet from the ground and returning to earth by the simple process of falling backwards, an action which looked like a chosen method of returning to ground.

The superficial area covered by the wire screen in the bedroom was little more than a foot square, that of the temporary enclosure for acclimatization was about a yard square. In both, apart from the climbing episodes, there seemed no suggestion that they might have wandered further had they been given the opportunity, or that if they had they would not have returned to their shelter in the blanket to sleep. In the yard-square enclosure, for example, and again excepting the climbing, they did not for most of the time use the full extent of the enclosure.

The permanent outdoor home consisted of a box frame of 1 inch by 1 inch quartering covered on all sides, including the base, with wire netting of ½-inch mesh, the whole measuring 3 feet by 3 feet by 6 feet long. The wire-enclosed base was covered with turf. In one corner was placed a fair-sized tussock of grass so arranged that the rabbits had an archway, with each end draped with grass, which they could run through or shelter in. To make them feel more at home, and in case bark was needed in their diet, two boughs were placed each diagonally and slanting in opposite directions. It was soon after their transfer to this enclosure that the casualty already referred to occurred. Otherwise the litter readily settled down and showed by their play that they were content. Two quickly learned to climb nimbly up and down the boughs and when a nesting-box was placed at the summit of one bough, that is three feet from the ground, these two soon took most of their rest during the day in it. Again, and apart from the climbing, there was nothing to show that they felt any undue restriction, and all slept for part of the night in the nesting-box at ground level.

It would be unwise to assume that, given complete freedom, the rabbits would not now have wandered over a greater area than that allowed by the dimensions of this wire cage. For one thing their food was brought to them, which reduced the need to wander. Indeed, the fact that two should have clambered about the boughs and used the upper nesting-box suggested the urge, in at least two of them, to wander further afield. Incidentally, they were still not tame in the usual sense although they would advance and examine a finger inserted through the wire. This, doubtless, was associated with the arrival of food. Any further advances were, however, met with attempts to elude or escape possible capture. It is important to stress this, in order to emphasize that their development and their reactions were likely to be very nearly those of truly wild rabbits.

It may be remarked in passing that the latrines were sited in corners of the enclosure farthest away from the shelters. This suggests that in the wild they might have moved further out than their enclosure permitted for this particular purpose. It also shows how strong is the instinct for correct sanitation.

The next move was to a larger cage, on the same design as the first but measuring 10 feet long by 4 feet high by 5 feet across. The bottom of this cage was also bounded by wire-netting under a layer of turf. It contained a fair-sized hutch and their first and familiar nesting-box was placed beside this, to lessen the possible disturbance from the

change of quarters. For several days everything went well. The four rabbits settled in their sleeping-box and seemed fully content. Then, on a Sunday, it was noticed that there were only three in the cage. A few minutes later the fourth was discovered cropping wild parsley in the hedge some 15 feet from its cage. It was caught with little difficulty and returned to the cage.

An hour or so later, there were again only three in the cage. Again the truant was found eating the wild parsley and again caught with relatively little trouble, although slightly more than on the first occasion. This time, however, at first quiet in the hand, it lashed out with its hind legs in a most savage attempt to escape being put back into the cage once it recognized that this was to be its fate.

The puzzling feature of these two prison-breaks was to know how they were done. The cage was enclosed in wire-netting of $1\frac{1}{2}$-inch mesh to a height of three feet, and from there and over the top of the cage was netting of 2-inch mesh. Although the rabbits were now growing fast and assuming the form of the adult rabbit, it transpired that the escape was actually made by squeezing through at the lower edge of the 2-inch wire. To do this the escapee jumped on to the nesting-box, thence on to the hutch and by standing on its hind legs could reach the lowest parts of the larger (i.e. 2-inch meshed) wire. These it squeezed through and reached the ground by the simple process of tumbling the three feet from the top of the cage. We know this because we watched it escape the third time and make for the parsley. However, this time we intercepted it. Finding its way to the parsley blocked, it ran back to the cage and sought frantically for a way in.

Now came the question, how to keep this rabbit in without having to build a new cage. As a temporary measure, a board was put on the top of the hutch flat against the wire-netting, to prevent access to the netting, and this was held in position by another board slanted against it. For a while we watched the thwarted escapee mount on to the hutch, search every inch of the vertical board and then wander, apparently disconsolately, around the top of the hutch. Satisfied that escape was no longer possible we resumed our interrupted gardening only to find, a few minutes later, that two rabbits were now missing. There can be no alternative explanation than that escapee number one had climbed the sloping board which held the vertical board in place, had emerged through the 2-inch mesh forming the roof of the cage and had jumped thence to the ground four feet below. Moreover, its example had been followed by escapee number two, and both were feeding on the parsley.

With considerable difficulty one was captured and returned to the cage. We then turned our attention to number two, which was still at large. In a matter of seconds almost, number one was out again. What was worse, it took shelter under a pile of brushwood bordering the kitchen garden, where presently it was joined by number two. There was no doubt by this time that both the escapees had gone completely wild. If they ventured from the shelter of the brushwood they did so cautiously, inspecting each obstacle they passed, and no matter how cautiously we moved they would allow us to approach within four feet of them and no more, before dashing into the brushwood at lightning speed.

There is little need to pursue the narrative. Our consternation, even our dilemma, can be imagined. It was not so much the loss of our pets, of which we had grown fairly fond, nor the abrupt termination of our scientific study—if it can be so glorified. It was those two youngsters with lusty appetites hiding under the mountainous pile of brushwood, with rows of young carrots and other green vegetables hard by, that began to obscure all other considerations. The best we could hope for, since all our attempts at recapture were vain, was that they would escape to the woods beyond the garden. This they probably did, for we never saw them again.

So we will draw a veil over the rest of the story and see what we had learned from our temporary guests. We had seen, with qualifications and some parts of the picture missing or slightly distorted by the unnatural conditions, something of what probably takes place in the wild. Thus, some members of the litter were more venturesome than others. They may have been males, we do not know. Certainly they were the more venturesome. We had already seen an increasing need for more living-space, which was to some extent supplied first by the wire enclosure on the lawn, then the cage, then the larger cage. Then we arrive at the point where the wanderlust had exploded in the attempts at escape at all costs and in the face of obstacles one would have thought insurmountable. There was the return 'home' on one occasion, when 'home' spelt security from pursuit. There was the learning by the second rabbit from the example of the first, and the escape of two of them. It is possible, though of this we cannot be certain, that these were the same two that climbed the wire-netting when first put out on the lawn. They may have been the same two that later climbed the branches in the large cage. Finally, we reach the point where anything they may have learnt or acquired by contact with human

beings has been entirely lost and the hand-reared rabbits have gone completely wild.

Another lesson learned was the speed with which the total behaviour could change. From docile, if semi-wild, rabbits playing contentedly in a cage and showing none of the wiles of the truly wild animal, there emerged in a matter of short hours, and as the result of repeated escape and recapture, the full range of cautious behaviour, alertness for every sound and movement, and speed in escape reactions. All were lying dormant to be called forth at the time of need.

To revert to a point raised earlier, although the cages were wired below to prevent escape by burrowing, and although the burrowing-reaction had been evinced before weaning, at no time did the turf in the cages show any sign of having been scraped. Even during the two days and nights that the escapees were at large there was no evidence of any attempt at burrowing. Presumably there was the recognition that the brushwood pile offered full security, at least from the only potential enemies at that time—ourselves. Even when we demolished the pile of wood, a short time later, no signs of attempted burrowing were found.

It may be that there were flaws in our observation or even in our treatment of these rabbits. It may be possible to question the correctness of any of the deductions I have made. It could be argued that the fact of the rabbits being captive, however benign the conditions of their captivity, must have lessened to some extent the value of our observations. Even so, one thing emerges that is beyond question. In spite of having been deprived of the natural mother's attentions from an early age the young rabbits were fully equipped for an independent life. Certainly we had not taught them this. The requisite behaviour had emerged at the appropriate moment. The experiment was sufficient to show that in this species at least there is little need for parental example or teaching.

There was one aspect of behaviour, however, that I had long wished to check, and in keeping this litter of young rabbits the opportunity was at last presented to me. Several years before, when we lived in the outer suburbs of London, some of our immediate neighbours had found there was a half-grown rabbit in their garden. Since this district was suburban it must be presumed that the rabbit had come from one of the parks, the nearest of which was about a mile away. The rabbit seemed to have taken up permanent residence in their garden, and my neighbours feared that their lawn might be completely spoiled by its tunnelling. So they caught the rabbit and lodged it in a wooden shed,

making a wire-meshed door specially for it, so that the rabbit not only had plenty of room but could have a good view of the world around. There it lived and became tame enough to take food from the hand. Now comes the point. If, as often happened, a blackbird in the garden uttered its alarm-call, the young rabbit would prick up its ears and immediately scuttle to the darkest corner of the shed. Although we watched our small family we noticed no reaction at any time to the frequent alarm-calls of blackbirds and others.

It is difficult to say if the response of our neighbours' rabbit was typical of what takes place in the wild. Blackbirds do unwittingly act as sentinels and I have the impression, from what I have seen of wild rabbits, that they do take notice of such alarm-calls. If so, and if our young rabbits offer any criterion, the response is not innate but learned, and from analogy one would expect it to be learned at an early age from other rabbits, possibly from the mother. So perhaps we may reach this general conclusion, that young rabbits have a fairly adequate equipment for living which is hereditary, but that, either from the mother or from others of their kind, this is augmented, through learning by example or by deliberate teaching. This is not a particularly profound thought but it is helpful to have even this small point cleared up.

CHAPTER X

THE INFANT DOLPHIN

SQUIRRELS, rats and rabbits are low in the mammalian scale, but not so low as the kangaroo, platypus and echidna. Ideally we should now study some of the highest mammals to see how they compare. The difficulty, however, is which to choose. We are all moderately acquainted with the infancy of the highest of all mammals, ourselves. Most of us have a fair knowledge of the infancy of cats and dogs. If therefore we can select for our example some animal at a similar level to these we shall have, in conjunction with our studies of kangaroos, rats, squirrels and rabbits, a good sequence by which we can assess the infancy of mammals as a whole in general terms. In fact, nothing could suit our purpose better than to study what is known of dolphins.

Whoever first had the idea of building an oceanarium is to be highly commended. It gave the opportunities for the close study of an animal whose ways would otherwise be almost a closed book. The oceanarium, at what is known as Marine Studios, is an unusually large marine aquarium in Florida consisting of stout concrete walls forming massive tanks for holding sea-water. One tank is circular, 75 feet across, the water in it 12 feet deep. Connected to it is another larger tank, 100 by 40 feet, with the water in it 12 to 18 feet deep. Set in the walls of the circular tank are 300 thick plate-glass windows through which visitors can watch dolphins that have been caught at sea in nets and brought in with every precaution to avoid injury. In the tanks the dolphins feed, sleep and play, giving every sign of quickly settling down. Several young have been born there; one of these, if still alive, will now be eight years old.

Those who have studied the emotional and other behaviour of the dolphins rate them at least as high as dogs in their mental equipment, possibly as high as chimpanzees, and in certain respects even higher than the man-like apes and making a closer approximation to man himself. Certainly the brain is large, and the cerebrum—that part often referred to as the thinking brain—is large and heavily convoluted. On the other hand, the intelligence of dolphins is difficult to assess, even in comparative terms. In the first place, we have the usual difficulty that

nobody quite knows what we mean by intelligence. Secondly, the fore-limbs of dolphins being mere flippers, the hind-limbs being of course absent altogether, these animals lack manipulative power so that the usual tests of intelligence, as applied to man and the man-like apes, cannot be used to assess the intelligence of dolphins. In a way, this is a tremendous advantage since a dolphin's behaviour can be seen in simple terms.

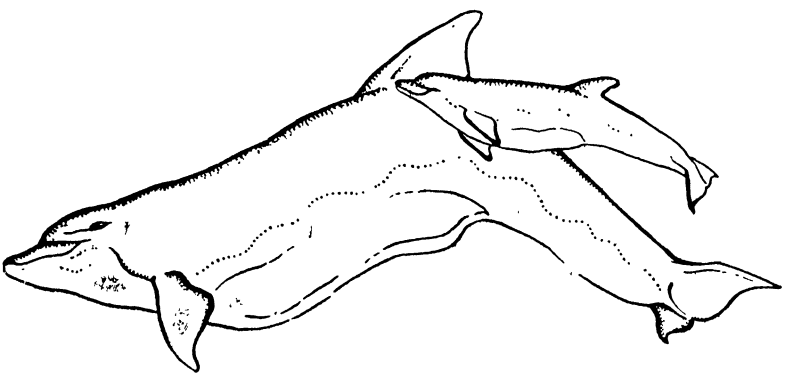
The great advantage of the oceanarium is that it affords the occasion to watch a wild animal under almost completely natural conditions. There is good reason to suspect that much of our knowledge of apes and monkeys, being derived from captive animals, is distorted. The close proximity of human beings alone is sufficient to ensure, in animals of their mental level, some degree of self-consciousness. This may, indeed, be true of the dolphins, but it is less likely. Furthermore, it has been possible to watch the whole sequence of birth and infancy in dolphins. So although these wholly-aquatic animals are in some respects less typical of the higher mammals as a whole, the circumstances invite us to look more closely at what they have to tell us.

One young at a birth is the normal, although twins are not unknown, the young dolphin being born tail first. This is a necessary prerequisite in an animal that must swim to the surface for its first breath. The whole process of birth may occupy an hour or more, but as soon as the head is free, the newly-born swims upwards, breaks surface and fills its lungs. At the moment that it is finally free from the maternal body, the mother executes a quick right-about-face, ready if need be to assist her offspring to the surface.

The tendency on the part of the newly-born dolphin to swim upwards is without doubt an innate reaction. The right-about face of the mother may possibly also be so classified, but it seems also to merge into something having very much the appearance, if no more, of an intelligent or reasoned action. Thus, as the newly-born swims upwards she accompanies it, swimming underneath it ready to give assistance if need be. Further, it has sometimes happened that the mother has been joined by another female, the two adults then swimming up in close company, one either side but slightly below the infant. Moreover, if the calf is still-born the mother will lift it up on her snout, rise with it to the surface, and remain there in a pathetic endeavour to afford it the life-giving air. In one still-birth the mother endeavoured to raise the infant by seizing one of its flippers in her jaws. This variation in method alone suggests something more than a simple reflex, as does the occasion when, on the

death of an infant six months old, the mother tried to raise it by grasping its body between her flippers.

The young dolphin resembles the adult in all respects except the larger size of the head, and the presence on the sides of the body of six light-coloured vertical creases, evenly-spaced, believed to be the result of the unborn infant lying doubled up within the womb. Since they occur on both sides of the body, they suggest that the foetus lies curled first on one side then on the other. Another feature of the newly-born dolphin is the single row of seven or eight curled bristles, or whiskers, on each side of the upper jaw to the front of the snout. These are lost before the infant is a month old, although the hair follicles remain



Dolphin and young

throughout life. The gums are toothless but are marked by prominences where the teeth will later break through. The eyes are open at birth. The neck, visible in the adult only when it is emaciated, shows plainly in the infant. The dorsal fin and the tail-flukes are soft at birth and stiffen during the first two weeks.

The period of gestation in the dolphin is not known for certain but is believed to be between eleven and thirteen months, an unusually long period. Dolphins, porpoises and whales, which together comprise the wholly aquatic mammals knows as the *Cetacea*, show many signs of having descended from terrestrial mammals. Among these such a long period of gestation is characteristic more of the herbivores. A long gestation period seems usually to be correlated with the need for the young to be fully developed at birth, capable of keeping up with the mother should flight become necessary, and able to do most things for itself except find its own food. With the *Cetacea* it is not so much the

need for escape from enemies as of keeping up with the school which, as far as we can tell, is constantly on the move. So we find that the young dolphin, from birth, can swim as fast as the mother, even while the dorsal fin and the flukes are still soft, the flippers needing to move at a faster rate than those of the adult.

The young dolphin can, therefore, stay close to the mother at all times. When swimming it takes up position beside and slightly above the mother. In sleeping, the infant rests under the mother's tail, its nose just touching the hinder end of the abdomen. Nursing takes place at intervals of twenty minutes or so during the first two weeks, these intervals becoming longer as the infant grows. During the first two weeks the mother rolls on her side to accommodate her nipples to the infant, but later it is the infant that must roll to feed.

The teats do not project. This would interfere with the streamlining of the body. Instead they lie in a pair of grooves at the hinder end of the abdomen. The milk accumulates in reservoirs communicating with the teats, and as the young dolphin seizes a teat between the tip of the upper jaw and the grooved tongue, a strong muscular contraction by the mother drives the accumulated milk forcibly through the teat and down the throat of the young one. The nursing responsibilities of a dolphin are therefore of the very slightest. Each suckling lasts only a few seconds, and in any period of nursing the infant may suckle once or as many as nine times, sometimes rising to the surface between sucklings to breathe. Other than this there is no nest-building, no nest sanitation nor fresh bedding to be provided. There is no need to clean the offspring by licking or other means. In moments of disturbance or alarm there is no necessity for retrieving, nor need for anything other than to call the offspring to follow. All this is in striking contrast to the over-burdened yellow-hammer, or, indeed, most of the other higher animals. With domestic chores virtually non-existent, or reduced to the barest minimum, to say the least, the *Cetacea* enjoy unusual advantages.

If we couple the facts of this lightest of nursing burdens with a fine development of brain it is reasonable to look for other activities of a high order for the outlet of energies. Indeed, we could almost with reason suggest that if the *Cetacea* had grasping hands they might have built in the sea an empire corresponding to that which man has built on land. As it is, these superb animals seem to find an outlet in play. We may suspect, however, that there are other subsidiaries.

A hint of this surrounds the juvenile when it first enters its watery cradle. As might be expected the mother is prepared well in advance for

its coming. Her milk is already available some days beforehand as shown by her readiness to allow orphans put into the same tank to suckle, slowing down to give opportunity as well as rolling on one side to facilitate the operation. But her bodily preparations include other things than this. As much as four months prior to the birth, she shows a tendency to withdraw from the rest of the group. In the particular species studied in Marine Studios, the bottle-nosed dolphin,[1] the group appears to consist of a dominant male, perhaps three females and young of varying ages. In captivity, at all events, the males are aggressive towards the young, often biting them. Whether the same obtains in the wild is unknown, but it may account for the behaviour of the females.

Where two or more females in a group are in calf they join each other in keeping apart from the rest. They may continue to play but their interest in it diminishes as term approaches. When the moment of birth draws near the pregnant dolphin restricts her swimming movements to the minimum, reserving her muscular efforts to assisting the delivery of the infant. It is then that the other females show a marked interest in her, one after another examining her closely and all staying in the immediate vicinity. This may be due to more than mere curiosity. It has been seen in domestic cattle that the cows, if free to do so, may form a ring round a parturient female. They will also do so around the carcase of one of their deceased fellows. The action even here seems to have something more in it than curiosity. Rather it seems to partake of a ceremonial, which is accompanied by a concerted raising of the heads on the part of those forming the ring. In both dolphins and cattle there may be some relation between these actions and the rudimentary midwifery already seen in elephants.

Two advantages may be suggested, if this same behaviour also takes place in the wild. First, it would slow down the movements of the group, possibly of the school as a whole, so that the mother and offspring would not be left behind. Secondly, it would be a protection from attack. In the oceanarium small sharks and other animals are also kept in the tanks. The snapping of the umbilical cord, which seems to occur just before the final freeing of the head in birth, releases a small amount of blood. Bleeding quickly ceases, but even that small quantity of blood readily diffuses through the water and attracts the attention of the sharks.

[1] The scientific name is *Tursiops truncatus*, the bottle-nosed dolphin according to American usage, and porpoise in British usage. The name 'dolphin' is used because all the literature on its habits, being published in the U.S.A., refers to it by that name.

The solicitude for the welfare of young dolphins continues in the females for some weeks. If there is anything at all in the suggestion that the clustering around the parturient female has more in it than the lure of curiosity, we must suppose there is some appreciation of what is taking place. We might even suppose some communication between the individuals concerned. That is not beyond the bounds of possibility. Certainly in other walks of dolphin life individuals do communicate freely with each other.

The young dolphin is vocal from the moment of birth, using a high-pitched whistle. It is the same call as that used frequently by the adults, and offspring and mother are in constant communication by its use. On one occasion, as soon as a dolphin was born, it and its mother were herded towards the other tank, to save both from possible attacks from the males. The youngster was driven through the connecting gate but the mother proved more difficult. She was scared by the walkway over the gate. So they became separated. The two called to each other throughout the first part of the separation. During the few minutes that elapsed before the mother was finally shepherded in, the youngster selected an immature female and attached itself to her. She, apparently disturbed by this, fled round the tank for a minute or two at something over twenty miles an hour, the week-old youngster keeping pace with her all the way.

When the mother finally entered the tank to join her calf she was surrounded by those already in it. The youngster, momentarily separated from her by the milling crowd, rose to the surface and circled rapidly in a diameter of some six feet exactly over the spot where it was last in contact with its parent. While circling it whistled ceaselessly, except for pauses to take in air, until the mother could come to it.

On another occasion, when it was only thirteen minutes old, a male calf swam under a walkway. The mother darted under it and guided him back with her snout. This happened several times. The same calf also collided with the wall of the tank. After this the mother flipped him away from the wall with her snout whenever he showed signs of approaching it.

The fear of the walkway, a structure overhead and clear of the water, requires a word of explanation and introduces us to the subject of cetacean senses. Contrary to usual beliefs the dolphin can move the eyeball. Its vision underwater is difficult to assess but its vision out of water can be gauged by its play. With its head out of water a dolphin has been seen to respond to a wave of the hand fifty feet away. Also, a

dolphin racing through the water after a fish thrown into the air follows it with sufficient accuracy to catch it.

It is not always clear whether schools of dolphins or porpoises keep formation by sight or sound. Probably both play a part. Underwater hydrophones, in the sea as well as in the oceanarium, have shown a wide range of vocal sounds in several species of cetaceans. Hearing is evidently acute and the calls have been variously described as whistlings, barkings, chatterings, gruntings and the rest. The captives in Marine Studios use three sounds. A snapping with the jaws is a sign of aggressiveness. Whistling and barking are the normal means of communication, the first being accompanied by a stream of bubbles from the blow-hole.

The whistling is most evident at moments of nervous excitement and is a measure of the sensitivity of these animals. That they are capable of a high level of emotional tension as well is shown by their reaction to sounds and to strange objects. Switching on the sonic depth-finder on board ship will cause a school of dolphins or porpoises surfacing to disappear at once. A shot from a rifle will send them streaking away. A fresh porpoise introduced into the Florida tanks causes a pother of whistling, as will the introduction of any strange object. This high level of emotional behaviour seems also to be linked with a hign level of play achievement.

Dolphins' play begins very early, almost from birth. The first efforts of young dolphins seem to be concerned with swimming about the heads of other dolphins. Then, as they gain confidence, they begin to chase each other, the less experienced imitating the actions of the more adept. When the mother is resting the infant will often steal away to join its fellows; and she, after a while, will whistle it back. It seems almost as though she allows it out to play and brings it in when it has had enough. She does not go after it, however, but calls it in. There was one mother introduced into the tanks who was shy and would not mix with the other adults. Moreover, she would not let her infant play with the other infants.

One young dolphin was fond of playing with another youngster, racing round the tank or leaping out of the water. After some time its mother would give chase, swimming between them to separate them. This resulted in a mad chase round the tank, the mother trying to butt one or the other until finally her own infant returned with her to feed and then sleep. Is this the romp before bedtime, the refractory and disobedient child that must be fetched, or a little of each? Or is it the

parent joining in the romp? Whatever it is, it seems to contrast strongly with what I have called the impersonal attitude of the kangaroo and the wood rat. Moreover, it makes it difficult not to think of or describe the actions of dolphins in human terms.

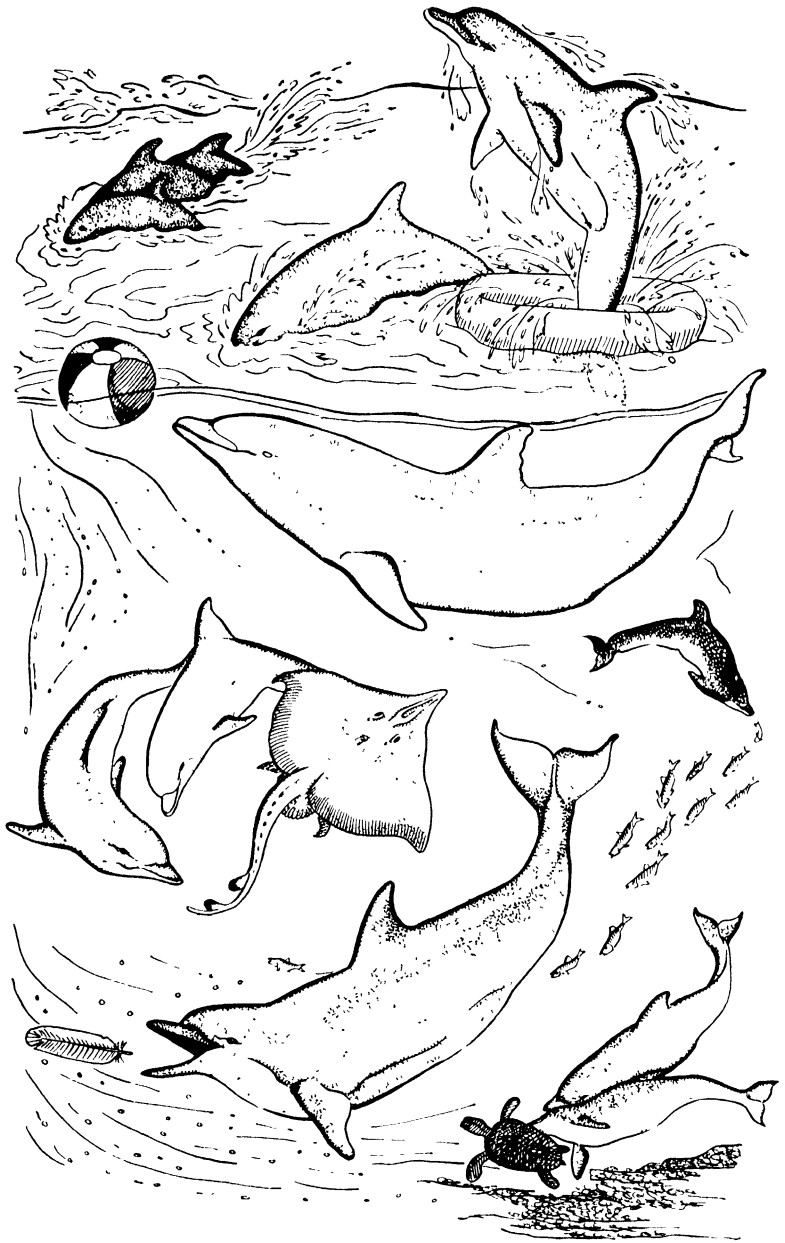
Of all the patterns of play in animals hitherto documented in the scientific literature the most remarkable and most significant is that seen in the dolphins at Marine Studios. Play is not necessarily the prerogative of infancy, but it is one of the characteristic expressions of life, and a study of dolphins that did not include a detailed description of their observed play would woefully fall short, even if we do not pursue the subject in other animals.

It is sometimes objected that the patterns of behaviour interpreted as play in animals are due to low intensity drives. That is, when the normal appetite or instinct is at a low ebb. Thus a low intensity hunger drive, in other words, when hunger has been satisfied, would result in a cat playing with a mouse, according to this interpretation. We see an illustration of what is meant here, also, as when a child not really hungry 'plays' with its food. Some of the play actions of dolphins could be so interpreted. A young dolphin will poke its snout in among the rocks apparently to scare the fishes. The action is very like that of adults when driving fish out to catch and eat them. Young dolphins will also frequently catch small fish, let them go and chase them again. There is no evident intention at serious food-seeking although the fish often suffer and die subsequently.

Whether the tricks of nipping fishes to make them swim in order to chase them, of tweaking a shark's tail or of nosing a turtle up on edge to push it across the tank are the result of low intensity feeding drives is less certain. When, however, a young dolphin takes a piece of squid or a dead fish, lays it before a group of live fishes, waits for them to start nibbling, then darts in to snatch it away, we seem to be in the presence of something that can only be described as pure fun.

Dolphins are also fond of being petted by the human attendants at the oceanarium. They will come to the surface to have their snouts tickled or their backs scratched. It was found that when bristle-brooms were weighted to anchor them to the floor of the tank, the dolphins readily rubbed themselves against them. This, as well as the fondness for being petted, could be interpreted as the normal and widespread habit of grooming. Most mammals rub themselves against something.

Leaping out of the water could be interpreted as a low intensity escape drive, except that it is carried out with great vigour and seems to



Dolphins at play

partake more closely of the nature of pure play. Then there is the game dolphins play of swimming round with short dives and striking the surface with the flat of the tail in a rhythmic manner, in a sort of aquatic dance. There is the game of 'fetch', actually initiated by a young dolphin which threw an inflated inner tube over the rail and waited for one of the attendants to throw it back, a variant on the dog waiting for a ball to be thrown. Throwing a ball or an inner tube, leaping up through an inner tube, retrieving feathers, all enter into the normal repertoire at Marine Studios.

Then we come to outstanding incidents. Sea-water is forced into the tanks under pressure. A young dolphin with a feather in its mouth was seen to thrust its snout into one of the jets so produced, release the feather and chase it as the current carried it away. Another would release a feather into the eddy adjacent to the jet then back away, open her mouth and catch the feather as it was swept past her. The feathers come from pelicans also living in the tanks. Balancing a feather on the nose, flipping it backwards to catch it as it falls, is varied by other young dolphins joining in to snatch it away, the rest then chasing the one holding it.

On one occasion a human observer threw a feather to a dolphin, which returned it by flicking it upwards with the tip of the lower jaw. There came the moment when the feather failed to clear the rail, fell back and stuck to the wall just above water level. Because its lower jaw projects in front of the opening of the mouth it was impossible for the dolphin to retrieve the feather from the wall in what would appear the obvious way. It quickly solved the problem by rising out of the water and wiping the feather off with the side of its head, after which it resumed the game. What is more noteworthy, the use of this stratagem was repeated whenever this same situation arose.

More significant, we have in dolphins not only what appears to be play for its own sake, as well as an ability to solve problems, and other signs of advanced intelligence, but of the ability to build up a culture. Observers at the oceanarium agree that the repertoire of play was constantly being added to, on the initiative of the human observers or of the dolphins themselves, and a young dolphin freshly introduced would in time learn the whole repertoire. This alone puts much of this activity into the realm of play as a distinct instinct. Although low intensity drives could account for some, or even much, of it, the emergence of a 'play culture', however rudimentary, is of particular significance.

We are but at the beginning of the study of the behaviour of

dolphins, but it is a promising start and its pursuit may yet shed a great light on the behaviour of mammals as a whole. One thing stands out very clearly even in this brief summary. Whales, dolphins and porpoises have found a way of life which is relatively easy—a watery paradise. The story of their infancy reflects this, for it consists of very brief periods for feeding, a certain amount of time for resting, and abundant time as well as the opportunity for play. Whether they are linked or not is largely a matter of opinion, but a capacity for play and for emotional behaviour increases as we ascend the animal scale. Both are almost certainly to be correlated with an increasing capacity of the brain, and this in turn is joined with an increase in parental care.

CHAPTER XI

EDUCATING THE YOUNG ANIMAL

EVEN the small amount of information about dolphins that it has been possible to include here leads us to wonder how far animals contribute to the education of their young. Indeed, one of the commonest questions asked is: Do birds teach their young? Most people take it for granted that mammals do; and they take it for granted that any animals below the level of birds do not, but they seem to have some doubt about whether birds do so or not. It is a very moot point whether any bird teaches its young anything, except possibly by example, and even this is in doubt. Perhaps then we may digress to examine this question, and in doing so we can most conveniently start with the birds.

The most important source of learning, in the young animal or the human, is probably in its play activities. The great majority of animal psychologists today refuse to admit that play is anything more than a vacuum activity or a displacement activity. That is, it is not a distinct activity, has no separate function, and cannot be studied as a thing apart. There is a minority that see it as a distinct instinct with a well-defined function in the development and well-being of the young animal. It is not possible here to present adequately the arguments for or against. In my opinion, the dolphins alone prove the case for the minority, and we may leave it at that.

The academic ornithologist tends to adopt an attitude of scepticism towards any suggestion that birds educate their young, and the field naturalist for the most part upholds this. Yet lay people, especially those with more than a passing interest in the subject, who approach the matter with few pre-conceived ideas, are not easily converted to this view. Their opinion is often based on no more than casual observations which are difficult to test or confirm. For example, a friend of mine told me some years ago this story of a young robin. She noticed when having tea in the garden that one young robin was particularly tame and came very close while they were at the table. It was seemingly unafraid. As the days passed, however, this tameness gave place to more normal behaviour, and she was quite convinced that the

responsibility for it lay with the parent birds. She had noticed that when the young bird first took to coming near the tea-table, one or other of the parents hovered in the background, showing signs of anxiety or distress. Later, they appeared to make deliberate attempts to head the youngster off as it made its way from the hedge to the party gathered on the lawn.

No doubt I should have received the story with a greater scepticism than I did had I not that same year had a similar experience. It was while on holiday in Sussex, and the subject this time was a young blackbird. It was fully fledged and feeding independently and was doubtless nearing the time when it would be completely independent. In fact, one would have thought it had already left its parents. Yet something very similar to what my friend had described for her robins took place. It could be argued, of course, that in both instances the young bird, tempted by the prospect of food or even merely from curiosity, was straying beyond the boundary of its home ground. It would be natural then that the parents, if they still had any interest in it, should try to restrain its further wanderings, and that this might give the impression of their teaching it to have nothing to do with human beings.

The story of the robin was for me secondhand, and secondhand information is always a little unsatisfactory, even while interesting and often thought-provoking. So far as the young blackbird was concerned, however, I had been able to make not only my own observations but also to check them. For example, I would watch through a window that part of the lawn where the young bird was apt to wander. While no human being was about it would wander freely and any adult blackbird in the vicinity would take little notice of it. If I then went out on to the lawn, the young bird would perhaps move away a little, or show itself slightly hesitant, but in a short while it would overcome any fears it may have felt and come quite near me. Then, and then only, would an adult blackbird appear from the herbaceous border in front of the hedge and move to and fro across the lawn, well away from where I stood, with its attention on the young bird. If the latter moved towards it, as it was bound to do in the natural course of its wanderings, the older bird would approach it. In a short while both would be moving towards the herbaceous border, the young bird leading. In four to five days from my first noticing this there was a complete change from the obvious tameness noted on the first day. The young bird kept its distance all the time.

Such stories must inevitably make us think of robins, and their

proverbial tameness in the garden. One view put forward by ornithologists is that robins search for food wherever large mammals disturb the ground, whether the disturbance be from the hoofs of a horse or a man's spade. Therefore, they argue, the robin which sits on the spade, apparently tame, is merely reacting to this impulse to search for food in its usual manner. The gardener is merely another big mammal to a robin. Such a robin may, if we are careful in our behaviour towards it, continue this apparent tameness, but fundamentally robins are as shy of us as any other garden bird. This argument is, to some extent, borne out by the behaviour of blackbirds. They show a similar tendency to approach more readily when the soil is being turned in the garden, especially when they have nestlings to feed. Their boldness seems to vary from year to year, however. In the spring of 1953, in my part of Surrey, it was noted by several residents that blackbirds were unusually tame and would forage within a foot of one's spade. This may, of course, have had something to do with weather conditions. In any event, the increasing shyness of both the young robin and the young blackbird was probably due to a gradually increasing awareness of potential danger, as in our young rabbits. It is in the nature of very young things to be trusting. They have to be, as a rule, since they are so dependent on others.

Taking all these things into consideration, it has to be admitted that the two stories of the tame young robin and the tame young blackbird being taught better by their parents may be an illusion. On the other hand they may contain a germ of truth. As we have seen, tameness in birds may vary with circumstances, with the season and less markedly with the year. It varies from one individual to another. It is not impossible therefore for one young garden bird, robin or blackbird, to be more tame than its fellows from the same brood. It is conceivable that this tameness may wear off as the youngster grows older, and that this was what was happening in both the instances quoted. If so, then the actions of the older bird or birds in both stories had nothing to do with the diminishing friendliness of the youngsters. If this view is correct, then the observations made by my friend and myself were subjective. That is, we were reading into the event what we supposed ought to be happening, and not what was really happening. It is so very easy to do this, and because of the ease with which it can be done the scientific student of animal behaviour is apt to use the most guarded language in describing what he sees for fear of falling into error. In any event, two such observations do not establish a point beyond doubt. Science

demands that several scores of such incidents should be fully documented by competent observers before they can be accepted as evidence. I have myself observed several similar incidents since 1953, in which there was every appearance of parent birds teaching their young to avoid human beings, but I still cannot be sure that this is the correct interpretation of these events.

More solid evidence can be obtained from other sources. For example, those with experience of the timber wolves of North America have found that, in a given litter of young, one or two will be more easily tamed than the rest. They have also found that beyond a certain age none is tamable. As to the first of these, it is surely a common experience with litters of kittens and puppies also. It is the old matter of differences in personality. Even the two yellow-hammer chicks showed such differences from the beginning, which made me describe the one as more greedy than the other. Even if we describe it in terms of innate reactions we still do not dispose of the fact that the synthesis of these reactions gives us personality.

The question of tameability can be approached another way. Our litter of rabbits showed us that as infancy advances the young animal develops qualities of independence especially in obtaining its own food. Other qualities also emerge, including the tendency to wander farther afield. And from these there is no turning back. If you want to keep tame a young animal taken from the wild you stand the best chance if you hand-feed it all the time. It is the counterpart of the process that we saw at work in the chick which when kept from a hen for ten days did not recognize a hen as a parent or guardian. Innate tendencies, in fact everything about the developing youngster, not only have a mechanism, they also conform to a time-table, and you cannot set the clock back. It could have been, with both the robin and the blackbird, that their tameness, as well as the loss of it, was according to schedule. The actions of the parents, in that event, merely added a touch of delusion, or confused the issue for the human observers.

We can now turn to what is perhaps one of the more emphatic claims to have observed deliberate teaching of the young by adult birds. This is contained in a book, *The Lore of the Lyre-bird*, by Ambrose Pratt, the Australian author and journalist. He describes how during the mating season the male lyre-bird builds a series of display mounds in the vicinity of the nest and, during the four weeks that the hen is incubating her single egg, moves from one mound to the other singing and displaying at the hen at frequent intervals. He takes no part in the nest-

Lyre-bird family : hen (*bottom left*) and young (*bottom right*)

building, neither does he help with the incubating nor the feeding of the chick.

On hatching, the chick is covered with down and does not become fully fledged until its second year, the first twelve months of its life being spent entirely in or near the nest. It does not mature until the fourth year and remains with the parents throughout that time, and these continue to protect it and, according to Pratt, to educate it. So it comes about that the lyre-bird is a 'family bird' and at any given time the family may contain, in addition to the parents, one-year, two-year and three-year-old chicks. Ambrose Pratt makes the point that the tribal call, as he names it, is inborn in the young lyre-bird but he maintains that the mimicking of other sounds is taught. In fact he describes how he and others have observed 'singing lessons'. It seems that the hen lyre-bird "is a skilful mimic, and she can dance quite prettily. Her artistry, however, is much inferior to that of the male, and she performs only for the purpose of teaching her offspring." He describes such scenes as a male lyre-bird patiently teaching a young male the song of the kukuburra, or laughing jackass, uttering it note by note, the young one dutifully imitating it. Perhaps the most remarkable assertion is that lyre-birds include in their repertoire the songs of other bird species that once lived in the localities concerned but are no longer found there. He concludes with the comment that they "may be the living historians of a bygone age and the conservators of the songs of birds for centuries, perhaps, extinct."

Finally, it is appropriate to quote Pratt's own estimate of these remarkable birds. "The family life [of the lyre-bird] distinguished him as one of the most sedate and respectable of all the wild creatures known to man. His monogamous habit and lifelong loyalty to his mate suggests an elementary conception of social virtue, and the validity of this suggestion is curiously confirmed by the orderly instinct which impels these birds to settle and remain settled, as families, in defined areas and to respect each other's established territorial family rights. When, added to all this, we remember that the young remain under parental protection for at least four years, it is difficult to avoid the conclusion that the [bird] is possessed of an extraordinary mentality. Up to the present no anatomical work on the [bird's] brain structure and nervous system has been attempted, and we are equally ignorant concerning the conformation and texture of the organs that enable him both to dispense sweet music of his own and to reproduce every sound he hears. Obliged as we are, still, to judge him solely by his more superficial characteristics and

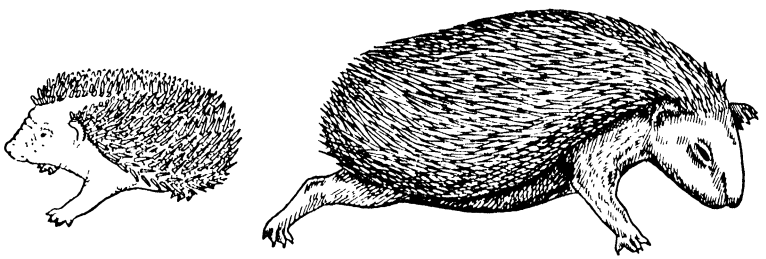
the study of his ways and customs, it is impossible to comprehend him fully, but we can nevertheless be very sure that he has a high order of intelligence and deserves to be regarded as one of the most interesting and complex of Nature's living masterpieces."

This picture of the lyre-bird is in striking contrast to all we know of other birds. It is no surprise therefore to find that Pratt, and those who think as he does, have their opponents and their sceptics. What then do we know of the 'education' of other young animals? We know that they are plentifully endowed with innate abilities, also with the power of learning from experience, and with emergent skills. As to this last, a good illustration is seen in the bower-birds, also of Australia, as already mentioned. The manner in which, year by year, the young bower-bird's skill increases could be interpreted as an emergent skill, comparable with that of the boy who learns to carve by first whittling wood. So far as I know nobody has watched to see whether the mature male bower-bird teaches the young one, or whether it learns by imitation, whether it is merely the unfolding of an instinct or truly a skill that grows with repetition. The fact that in the end the bowers made by males of the same species look very alike is nothing to go by, the carvings whittled by untutored hands are not so dissimilar for a given race of human beings.

It is necessary to belabour this point for it is a highly important one. Most ornithologists would say that at best parent birds teach, if they teach at all, by example and encouragement. This is almost certainly true for the great majority. Hand-reared birds that have never known their parents, or even other members of the same species, feed and preen themselves, fly or bathe, and do all the things basically necessary for living. Yet there is one thing that many young birds are taught: when it is time for them to look after themselves. When they first leave the nest the parents continue to feed them. This goes on for a period varying in length with the species. There comes a time when the fledgling does one of two things: either it develops the independence to feed itself, or it continues to sponge on the parents. In the latter event, sooner or later the parent will rebuff it. It is not at all uncommon therefore to see a parent bird at the food table, for example, with its youngsters, and as it takes food up in its beak one of the youngsters may try to take it and receive a rebuff in the form of a parental peck. We may be sure, also, that when this happens it will not be long before the youngster will either wander away from the shelter of the parental wing or be driven forcibly out into the world to seek its own livelihood.

We can, perhaps, hardly expect a bird, with its limited intelligence, to do much in the way of teaching its young in the few weeks that elapse from hatching until the family disperses, especially if that family numbers four, six, eight or more. All their time is occupied in feeding them, anyway. There is more likelihood of it among the larger birds of prey, where usually there are two youngsters only which remain with the parents for two months or more.

We have more reason to suspect a certain amount of teaching, whether deliberate or not would be very difficult to say, among some of the more advanced mammals. Bitches appear to teach their puppies to snap, by a kind of play, and seem to chastise the puppies if they are too enthusiastic and bite their mother in the process. Cats also appear to do a certain amount of training of their kittens. A female hedgehog will



Young hedgehogs: (*left*) three days old, (*right*) three weeks old

take her young family foraging; and we have the indirect evidence that a vixen that has taken to raiding hen-roosts yields a family that are also chicken-stealers. These all suggest education in some form but no precise observation has been made and the matter is still very much in doubt.

I have myself recorded earlier in this work an incident of a water vole apparently chastising its young and a similar thing was seen in wood rats. The female of most species of rhinoceros guides her young one through the bush, driving it in front and using her horn gently to keep it going straight ahead. An elephant has been seen to pull up a sapling with its trunk and belabour a refractory youngster. But all such incidents are at best straws in the wind indicating a possible line of enquiry but so far proving little.

What may perhaps be regarded as an illuminating remark in the above connexion is that made about dolphins in the Florida ocean-arium. They, as we have seen, are said to develop a play-culture.

Whether this is an incorrect use of the word 'culture' must remain a matter of opinion. It is a convenient word to describe a situation in which the members of a gregarious species each contributes to a creative activity with all members profiting from the common pool so created. If a porpoise initiates (i.e. invents) a game this must be regarded as creative. If other porpoises learn this game by imitation of the inventor they are sharing in the 'culture'. And the final prerequisite of a culture must be that it can only be developed by a gregarious species. It may even be that a culture, even in this rudimentary form, is possible only with species having a 'family life'. And a culture, however simple, is a means of education.

The dolphins in the oceanarium seem not to be mature until at least four years of age; and it is usual for the youngster to remain associated with the parent and with younger brothers and sisters for part of that time. Elephants also have a similar family structure. Something of the sort can also be seen in ostriches and possibly emus and cassowaries, and also rheas. A rudimentary form of it is seen also in moorhens, in which the members of the first brood still remain with the parents when the second lot of chicks are fledglings. I have a detailed account in my files of at least one observation of what looked like an elder moorhen youngster fetching the mother to deal with a recalcitrant second-brood chick.

The intelligence of elephants is proverbial, their mental accomplishments high. Porpoises and dolphins, it is now becoming realized, also have a high level of attainment. Could it be that the lyre-bird is similarly advanced as compared with most other birds? Are the undoubted accomplishments of the bower-birds in the making of the bower due to the development of a rudimentary 'culture'? Do the primitive birds like ostriches, and possibly emus, cassowaries and rheas, owe their survival into modern times partly at least to the advantages of a family life? Penguin young are kept in nurseries after they reach a certain stage of development. Does this account for the enormous numbers and the success of penguin development and persistence despite numerous enemies and the fact that in some species only one young is born at a time?

These are pertinent questions to which no one has essayed an answer so far. The advantages of family life are clear enough in the primate species, including our own. It may yet prove that Ambrose Pratt—and those who think like him—was right about the high level of attainment of the lyre-bird. As matters stand, however, there is little enough known

for certain to support his view, and the views of those who believe that some animals, including birds, do teach their young. Moreover, the arguments against are mainly negative—arguments such as, "I don't believe it", "It is not possible", etc.

Can we say that human parents educate their children, apart from setting example and encouraging natural efforts? Do they, apart from our organized system of school education, do more than make available a culture which is a social heritage? If the answer is 'yes', then it is my opinion that some animals must also teach their offspring. It is my conviction that just as our physical features can be traced up from the animal kingdom, so we can trace back to the origins of our psychology. The origins of every human characteristic can be found at some lower level in the animal world. Many of them go back further than we ordinarily suppose. For any characteristic, trait, or habit, the only question is how far does it go back. Therefore, if we teach our children, as distinct from educating them in schools, then I would expect some of the higher animals to do likewise, if to a lesser degree. Which animals do so would be, however, largely a matter for future research.

Into this pool of doubt and uncertainty we can throw the story of the young moorhens. Each of us can then watch the ripples and interpret them how we will. The story is this: Several competent observers have seen, in the past few years, young moorhens helping to build the nest. This usually happens under conditions of emergency, when the nest has become flooded and must be built up. Then, the parents were seen swimming about and gathering sticks, passing them to the young bird in the nest who built them into the fabric of the nest. It is usually assumed that nest-building in such birds is an innate reaction associated with the maturing of the reproductive glands. How then do we explain a very young moorhen showing this behaviour?

CHAPTER XII

POLAR BEAR CUB

JUST as the lives of full-grown mammals have been less fully documented than have those of adult birds, so the stories of infant mammals can be less readily detailed than those of young birds. This is not solely because birds more readily present themselves to our view. It is also because in them, as in ourselves, sight is the most important sense, with the result that the reasons for their actions are more readily apparent to us, who, like them, use sight more than any other sense. In most mammals smell is the predominant sense and the language of smell is largely unknown to us. Moreover, the psychology of mammals, young or old, is less simple than that of birds; the brain is more specialized, and in some the structure of this essential organ comes very near that of our own. That much we have seen in our study of the young dolphins, but there we were dealing with animals living in a vastly different medium, and it will be instructive to compare their lives with that of a land animal having a similar mental development, and one, moreover, which had no natural parents to guide it. For this we can hardly do better than to turn to the story of a polar bear cub brought up as one of the family.

The fuller account of this cub is given in *Snow White*, by Vlásak and Seget. For our present purpose it will be sufficient to summarize the story in order to amplify some of its special features. We begin then by introducing Nora, a female polar bear in the Prague Zoo. For several years running she had given birth to two cubs and on each occasion the cubs had died within a short time of birth. The mother had on each occasion failed to produce milk and her babes had died of starvation. This alone is of interest. Under normal conditions the growth of the embryo is associated with physiological changes within the mother's body which prepare the way for the infant's care and welfare after it is born. From the little we know of polar bears in the wild it seems that when about to give birth the female prepares herself a lair in the ice, or among the rocks or in deep snow. There she stays all the time she is suckling, going without food throughout this time. The entrance to the lair becomes almost blocked with snow and the temperature within rises to as much as 86° F.

Whether, in the case of Nora and her cubs, it was a matter of temperature or something lacking in the mother's diet is not known. As will be shown in a later chapter there is evidence of a failure of milk in other wild animals when held in captivity. At all events, after a series of these failures there came the time when the superintendent at the Prague Zoo, Jan Vlásak, decided that the cubs should be taken from the mother at birth and hand-reared. As things turned out, it was possible to take only one from her since she made it impossible to take the second one away until it was too late to save it. The one cub was placed in the care of a fox terrier bitch that had recently had puppies. Unfortunately, her milk was beginning to give out, too, and ten days later it was necessary to find another foster-mother. With some difficulty this was done, but the milk of the second bitch was also giving out and before a third foster-parent could be obtained the cub had died.

In December, 1942, Nora gave birth to two more cubs. This time all preparations had been made beforehand for rearing the cubs in the superintendent's own house. Careful study had been made of all the information that could be obtained about the rearing of polar bear cubs. On December 20th the first cub was born, the second being delivered an hour later, at which time both were removed. Subsequently, the elder of the two died leaving the younger, a female, which was given the name of Snow White. It is important to note that she was removed from her mother immediately after birth, which means that any characteristics later to emerge would owe nothing to the influence of the natural mother.

A polar bear cub is very small at birth, a foot long and $1\frac{1}{2}$ pounds in weight. It is also particularly helpless and remains so for a long time. It cannot walk independently for at least 70 days. Its eyes do not open until the thirty-third day. The ears do not open for 26 days and the hearing remains imperfect until the sixty-ninth day. In Snow White there was no indication of a functional sense of smell until the fiftieth day, when the nostrils were first seen moving in a sniffing movement. For two months, then, the cub is without visible signs of sense-organs except touch and taste and the use of these must be presumed. It is understandable therefore that cubs born under natural conditions need to be incarcerated in the lair for three months.

There is something of a parallel between the bear cub and the young kangaroo, and both present the antithesis of the domestic chick, which almost from the moment of hatching can respond to external stimuli. In the cub it is not so much that the eyes are unopened, they are not

even developed. Vlásak reports that at first the lids were completely joined, the sockets appearing sunken under them. By the end of the second week the eyeballs began to be dimly outlined under the lids, and shortly after this feeble movements of the eyeballs could be detected. From the eighteenth day on their colour began to darken slightly and to show faintly through the pink lids. On the twenty-third day a faint line appeared across each lid where five days later the first opening occurred, in the middle of this line. During the next six days the opening slowly extended in both directions until, at the end of the fifth week of the cub's life, the lids were fully open. For another fortnight the eyes remained dull and dead-looking, bluish and misty, and even when the eyes acquired a lustre it was some days before they were being focussed at all well.

Another point of interest is that although the ears did not open for 26 days, when a yellowish discharge began and continued for six days, and although the cub appeared not to respond to the human voice until the end of the seventh week, she would start at any sudden sound, such as the banging of a door, from the sixteenth day onwards.

Kittens and puppies are born blind and helpless but learn to be independent in a relatively short space of time. The polar bear cub, as we have seen, takes some three months to reach this stage, which is shorter in time than that taken by the human infant. The life-span of the polar bear, by the way, is between 40 and 50 years, which is comparable with that of the human being. In the cub, therefore, we have a subject which is as nearly intermediate as we can find between the young of the more familiar carnivores, usually regarded as having advanced intelligence; and the human child. It is not surprising then that all who know polar bears in the wild or in captivity tend to speak of them in human terms. Vlásak, indeed, makes the comment that Snow White was so like a human being in her ways that in the end their nursing of it differed little from that given a human baby.

The first thing that the foster-parents of Snow White found was that although she grew slowly at first, during this same time she rapidly developed fixed habits. She quickly grew used to fixed times for meals and herself kept to them with almost machine-like precision for two months. The times for feeding were every two hours by day and every three hours by night. Before a fortnight had passed she had begun to exhibit her pet fads. At one time, she would only feed standing upright on her hind-legs, holding her nurse's hand in her fore-paws and swinging one hind-leg in the air. Suddenly she would drop this habit and

adopt another, but whatever her particular fancy for the moment, nothing would deflect her from it. Nothing would induce her to take her food if she could not stand erect and swing one leg, or indulge whatever was her whim at that moment. Instead, she would give vent to the most heart-rending wails and whines, and these, as soon as she was allowed her own way, would change to contented gurglings and purrings. There were other ways in which Snow White showed decided likes and dislikes and insisted on having her own way. She behaved altogether in a way that would cause us to say of a human baby acting in like manner that she had 'a will of her own'. To the onlookers, her personality was developing long before her eyes and ears were open, and long before she could stand up unaided or walk alone.

Although she made feeble attempts to raise herself when about three weeks old, it was a long time before she could hold up her head or stand on her own feet. And it was not until after the eyes were fully functional that she made any real progress in moving about. At first she paddled herself about, using the legs as oars, and finally, on the fiftieth day of life, she succeeded in staying on her feet. From taking uncertain steps she learned first to walk steadily, then to climb. These things in no way diminished the labours of those responsible for bringing up the cub. She had cut her first milk teeth on the forty-fifth day, and this and subsequent teething were often accompanied by bad temper, loss of appetite and digestive troubles.

Vlásak tells us that it was quite impossible to teach the cub or to train it. Sanitation resolved itself into cleaning up after the little bear. In other ways, too, although it had known no other home, it seems to have behaved as if surrounded by a polar landscape, climbing stairs as well as every available piece of furniture, and insisted on having the freedom to wander at will throughout the flat. On the other hand, it had at first a rooted objection to water. This was discovered after Snow White had sullied her fur by rolling in mud, on one of the first occasions when she was allowed into the garden. Her first bath, resulting from this, was accomplished but with the utmost difficulty. In a short while, however, she grew to like water, and actual bathing became a riot of splashing, to the detriment of the walls and ceiling of the bathroom. She developed an insatiable curiosity and no pail or receptacle was safe from her inspections. She also acquired the habit of gazing at her own reflection in the surfaces of polished furniture. Did she long for a playmate in spite of the petting of numerous human beings? Did she recognize in this reflection the shortened muzzle, rounded forehead

and disarticulated limb movements of a young animal, and see in this image a young animal like herself?

She was certainly fond of play, of being chased by her human companions and of playing hide-and-seek with them. She would also play on her own. One of her favourite pastimes was to walk upstairs and then come down backwards, although she was fully capable of coming down head first. If a broom were being used in sweeping she would pounce on it and not rest until she had vanquished the imaginary foe. She would leap here and there, bound sideways and go through all the antics better known to us in kittens. And she would jump up and down on one spot with all four feet at once.

One civilized habit she did develop was to wander to the front door whenever the bell rang.

One would like to know how the mother deals with the cub in the wild, for from what one can see of films of polar bears taken in the Arctic, most of Snow White's behaviour was not particularly the result of living in a human habitation but the natural impulses being developed in unnatural surroundings. We may presume, however, that just as the human foster-parents were compelled to be continually on the *qui vive* and often found it necessary to try to curb the young bear's exuberance, so the natural mother must seek to exercise some form of discipline. This much is indeed suggested by what the films show us.

There are two outstanding points of interest in Vlásak's account of his unusual pet. The first had to do with the change from the milk to the solid diet. Bottle-fed with milk from the start, she was given thicker milk foods, such as semolina, at a later stage and attempts were made to induce her to take such foods from a dish. These were finally successful —after nearly four weeks of perseverance. During the third and fourth months she was occasionally given beef or other meat broth, but she still preferred milk although she would take bread soaked in it. When she had learned to use a dish she was introduced to meat—boiled or minced veal. She would take a little, "as if for politeness' sake", and then spit it out again immediately. If she did swallow a piece it was passed undigested. She began to take it more readily at three and a half months but it was not until the age of eight months that she took it with relish. There is in this something singularly reminiscent of the first chewing of rabbits and squirrels. Fish was never popular with her.

The next point demonstrates the importance of the licking and grooming bestowed on their young by mammals. On the tenth day after birth, Snow White's skin began to peel in tiny scales, first from the

bare lobes of the ears, the corners of the mouth and the bare pads, then finally from the whole surface. During the five weeks this lasted there was constant need of brushing. Then followed a moult when the dull hair with which she was born was replaced by a thick woolly fur. The moult lasted sixteen weeks. This brushing, and we may presume the natural licking by the parent is the same, not only kept the skin clean but was evidently pleasurable to the cub. It had other functions, however. It was used deliberately to encourage digestion and to aid the motion of the bowels, and also to encourage deep breathing, improve the circulation of the blood, secure a uniform distribution of the temperature in the body and other things besides. On an occasion when the cub took far more than the normal rations she became afflicted with spasms, cried continuously and finally was seized with convulsions. She groaned and whined and in the end she fainted. She was saved largely by persistent massage from her nurse.

Snow White was successfully reared not alone by the devotion, persistence and skill of her foster-parents but as the result of the advantages they possessed as members of a civilization. They were able to study the literature to provide themselves in advance of the cub's birth with the necessary knowledge and equipment, and they were able to draw upon the resources of that civilization for cod liver oil, glucose and other foods essential to the diet. Even so, there were several anxious moments. This only goes to show how well adjusted are the physiology and the behaviour of a natural mother to enable her to meet the needs of her offspring without all these advantages.

The tendency today, among students of animal behaviour, is to stress the large part played by innate reactions in the development of young animals, and also the part played by the environment in calling these forth. There is undoubtedly much truth in this, as we have seen. On the other hand, the story of Snow White, as indeed of all animal pets, seems to suggest that it is something within the organism itself, rather than in its surroundings which plays the dominant role. The story of Snow White, as told *in extenso* by Vlásak and Seget, and which is inadequately summarized here, is of the insistent development of a personality in spite of unnatural surroundings and wholly unnatural guardians and mentors. It emphasizes that the education of a young animal depends more upon a capacity to learn than upon the parents', or foster-parents', capacity to teach. That is, if there be positive education of the young by the parent it must comprise a comparatively small proportion of the total learnt.

The story of Snow White also suggests that, cuckoos excepted, adoption by animals must be limited to the young of related species. Adoption by human beings, as in the keeping of pets, is difficult enough, in spite of the many advantages we possess. It must be vastly more difficult for dumb beasts. Here, then, we have a guide to the feasibility or otherwise of the stories that crop up from time to time of human infants alleged to have been adopted by animals. This is, therefore, an appropriate point at which to discuss this somewhat exotic aspect of infancy.

The first and most famous of these stories is, of course, that of Romulus and Remus. Romulus, the founder and first king of Rome, and his twin brother were said to have been thrown as infants into the Tiber whence they were rescued and suckled by a she-wolf. If the story of Snow White's upbringing fails to cast doubt on this one the difficulty of fostering the previous cub with a succession of bitches should do so. Supposing, however, a dog or even a wolf were capable of nursing a bear cub, there is not only the longer period of suckling needed for the human infant but the patterns of behaviour of the human infant would diverge more markedly from those of a wolf than would those of a bear cub from the behaviour of its human foster-parents. The question of diet is important. As we have seen, Snow White not only tended to reject the meat given her but the first portions taken remained undigested. Without going into more details, it is difficult to believe that the methods used by the she-wolf for the change from a milk to a solid food diet might not produce serious disorders if no more in a human infant. At the best, we can but say that the adoption of human babes by a wolf must be considered improbable. Even less possible is the story of a human child having been adopted by a gazelle, which was current some years ago. In fact, whenever the circumstances of these animal-adoption stories are investigated by a competent witness, as happened in the most recent of them, it is found that there is no basis of truth whatever.

This may also be a suitable moment to deal with another kind of story, one of which I have had personal experience, that gains currency periodically. Some years ago I was told that a bitch, which had as her constant companion a tom-cat, had been delivered of a litter of hybrids. I approached the owner of the bitch who assured me that what I had heard was perfectly true and that the litter contained obvious cat-dog hybrids. When I begged him to let me see them, pleading that if true this was of great scientific interest, he refused utterly, explaining that he had buried them and that they were "much too horrible to look at". And that was that.

Another of these recurrent hybrid stories concerns the so-called rabcat, a hybrid of the cat and the rabbit. There have been a number of these. The owner of one litter said to be of this origin kindly sent me photographs from which it was clear at first glance that the kittens were of the manx variety, the tailless cat that occurs as an occasional mutent of the domesticated cat.

Animals do hybridize, of course. The mule from the horse-ass cross is too well known to need further comment. There have been offspring in captivity of the lion and tiger. Hybridization in birds is well known to aviculturalists, but, in all, the parents of a given hybrid belong to closely-related species. The less closely related the less the likelihood of a cross no matter how favourable the other circumstances. Until firm evidence to the contrary is forthcoming, therefore, stories of unusual crosses must be treated with the greatest reserve. Even the dog-fox cross, which has been mentioned probably more than any other hybrid, still lacks confirmatory evidence.

CHAPTER XIII

INFANT ODDITIES FROM AFRICA

IT IS quite remarkable how readily we cherish stories of unusual events and of mysteries. There is, however, no need to invent such things as animal-adoptions, rabcats, and the like. The field of animal study is full of real-life puzzles and curiosities. Logically, we should consider now the infancy of the large hoofed animals, of which Africa offers so wide a selection. And in doing so we can also conveniently give some passing attention to what may be called, for want of a better term, oddities.

There are a number of animal infants with which most people have at least a passing acquaintance. We are familiar with puppies and kittens born in litters, blind and helpless, and tended by the mother until an advanced age, which is more or less the rule with carnivores. It is also something of a commonplace that within a few hours of being born a calf is able to run about, a little unsteadily at first but rapidly gaining confidence and skill, and is thereafter mainly dependent upon the cow for feeding and protection. This is more or less the rule with other hoofed animals, and the story of the cow and her calf is repeated with slight variations in the mare and her foal, the ewe and her lamb, the sow with her litter, and so on. Other household animals, such as rats and mice, have litters, like those of the carnivores, of blind and helpless young, but whereas the carnivores are capable of defending their young, rodents must resort to other methods for their protection. In the event of trouble, either the litter must be removed to a new nesting site or the mother must make her escape carrying the young with her.

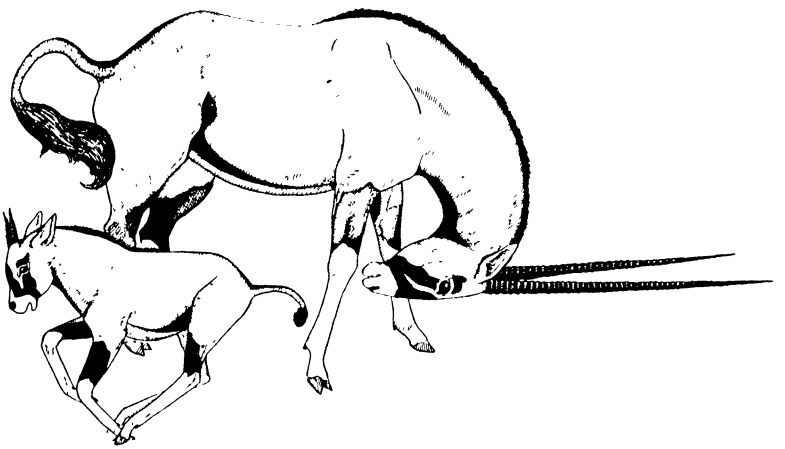
These general terms apply with more or less variation to three of the largest groups of mammals, carnivores, hoofed animals and rodents, and, apart from the hoofed animals, we have had single examples in greater detail in previous chapters. There is no particular point in enumerating further examples of the same kind, which would lead to needless repetition, but rather to consider those that differ from them. This certainly narrows the field for in few instances outside those already dealt with is our knowledge more than very incomplete. Even these gleanings do, however, bring to light a number of interesting contrasts and contradictions.

For one which provides striking contrast we must go to Africa and travel backwards in time, to when that part of the continent lying south of the Sahara was teeming with big game. The number of large hoofed animals inhabiting that part of the world 150 or 200 years ago is difficult for us now to visualize. And at the same time there were many carnivores, lions, leopards and wild dogs, with their attendant hyenas and jackals, subsisting mainly on the flesh of the big game. One thing we do know, however, is that the numbers of these carnivores were not nearly as great as those of the herbivores on which they preyed, yet the numbers in their litters were relatively much larger. For example, the average number of lion cubs in a litter is four, and it may be as many as six. The lion cub is born blind, after a gestation period of three and a half months. The eyes open on the sixth day but the milk canines are not replaced by adult teeth until the young lion is about a year old. During that time it remains with its family, largely dependent upon the parents, and learning all the time how to hunt its food and generally to look after itself. The lion cub, although born at a comparatively early stage of development, has therefore the advantages of a close parental care over an extended period, of a long period of learning while protected by large, well-armed and highly aggressive parents. It comes as near as an animal can to being born with a silver spoon in its mouth.

The eland may be taken to represent many of the members of the hordes of big game upon which lions and other carnivores preyed. It is the largest of the antelopes, with a powerful pair of horns, yet it is, as a rule, particularly timid and inoffensive, naturally gentle and harmless. Even when wounded an eland will rarely take offensive action. Its chief natural enemies are the lion, leopard and wild dog but these prey on the individual separated from the herd, or on the newly-born young. As with so many of the big game, only one young is born at a time, twins being very exceptional. The gestation period is nearly three times as long as that of the lion, from eight and a half to nine months. The rate of breeding is therefore slow. The young, moreover, are born fully developed, able to run about in a matter of hours after birth, and there is relatively little parental care. Incidentally, the young at birth have the colour pattern of the adult female. On the face of it, there is an irony in the fact that the young eland starts to grow horns within a few weeks of making its first appearance. It looks as though this were a wise provision, to equip the young for self-defence because of the parents' temperamental disability in this respect. Even so the calf, like its parents, readily takes fright, bleating like a domestic calf, the mother

answering with a soft bleating note. Yet in spite of the slow rate of multiplication, the minimal amount of parental care and the eland's natural timidity, its numbers are far greater than those that prey on it.

Then we have the gemsbok, a smaller related antelope, with nearly the same natural enemies. Gemsbok are shy, but very inquisitive, and ready to defend themselves with skill and amazing energy. The result is that wild dogs usually avoid them, leopards reserve their attentions for the young, and even lions have found themselves transfixed on the horns of the adult gemsbok. The young, born after a period of gestation only slightly shorter than that of the eland, are reddish-brown at first,



Gemsbok defending young

becoming paler as they grow, the dark markings of the adult appearing first as indistinct tones of greyish-brown. Although born fully-developed, the young are hidden for several months in the bush and are there looked after by the mother before joining the herd. It may be that this slight increase in parental care, a combination of lying hidden during the hazardous infant months and the protection afforded the young by a belligerent parent, gives the young gemsbok a high chance of survival and accounts for the millions that formerly migrated in columns across the southern part of Africa.

An interesting detail, by the way, is that the young gemsbok is actually born with horns, nearly an inch long, bent backwards and knobbed at the points, the knobs disappearing only when the animal is full-grown.

Long periods of gestation, with the young born at an advanced stage of development, and a single young at a birth, are general for cattle, antelopes and deer, among the larger cloven-hoofed animals, and it is generally true of the smaller species, although the gestation period tends to be shorter. In the common duiker, for example, one of the small spike-horned short-legged antelopes, the largest of which stands three feet at the shoulder, the smallest no larger than a hare, the gestation period is only four months. Incidentally, there seems to be no constant relation between the size of the adult, or the stage of development at which the young are born, or for that matter the number of young at a birth, and the period of gestation. Thus, the European hare, the size of the smaller duikers, has a gestation period of 30 to 40 days, as against the 120 days or more of the duikers, yet its young are born at an advanced stage of development. Moreover, the European rabbit, with its helpless young, contrasting with the leverets born fully furred, with eyes open, and able to move about soon after birth, has a gestation period of 30 to 32 days, little less than that of the hare.

To return to the African big game, there does seem to be something in the nature of a rule, that predators, among the higher animals at least, remain vastly inferior in numbers to their prey. This despite the large litters and the advantage of a close parental care. Why, since their litters average four in number and remain with the parents for a whole year, should lions not increase exceedingly in number? It is not that food is insufficient to support them even today. And in the past there were gemsbok by the million, zebra in vast hordes, eland, wildebeest, hartebeest, and many more besides, yet the numbers of lions remained relatively small. We have no answer to this paradox, only speculation. There may conceivably be a parallel, as shown by recent investigations, with the position of the tawny owl. The populations of these birds-of-prey seem to be more or less static. Yet each year each pair of breeding birds produces two young. Theoretically, each year the number of tawny owls should be nearly doubled, or, to give a more conservative estimate allowing for all circumstances, increased by twenty per cent. One of the findings of this recent research is that there is a very high mortality among young owls when they leave the nest. And the cause appears to be starvation : starvation in the midst of plenty, in the midst of an abundance of voles, shrews, mice and the rest.

It has been suggested that the young owl, being so assiduously fed by its parents while it is in the nest, finds itself incapable of feeding itself once it leaves the parental wing. A contributory factor may,

however, be found in the way a tawny owl already in possession of a territory will harass a newcomer to it. I have found that young tawny owls kept in captivity will not take food while a wild owl is calling or even when it is merely in the vicinity. Moreover, the wild owl hunting the neighbourhood returns again and again throughout the night to sit on or over the aviary. In the wild such circumstances would be disastrous to the young owls. One result seems to be that the countryside is parcelled out among a number of adult owls, with the young owls able to do little more than take over a territory made vacant by the death of its former owner, thus keeping the population at a steady level.

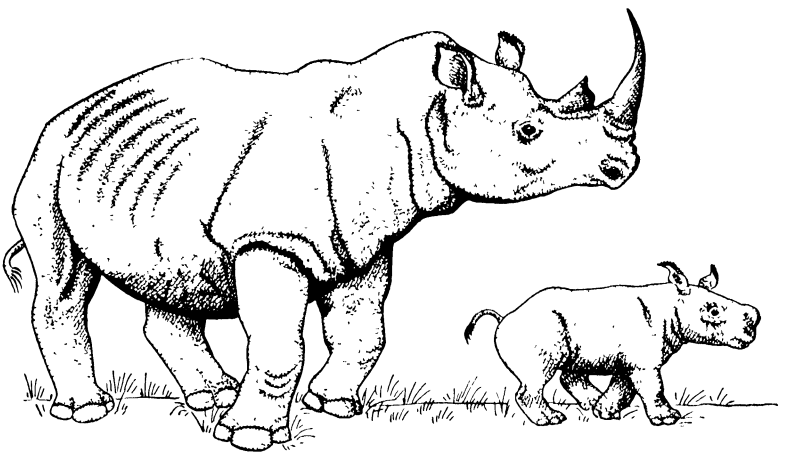
Similar factors to these, and possibly others in addition, may keep the populations of lions—except where man intervenes—relatively static, in spite of the high birth-rate.

It is of interest to note here that when, a few years ago, it was thought necessary to reduce the number of lions in the Kruger National Park, the reduction in their numbers, by shooting, was followed by a period of larger and more frequent litters. It may be that this was pure coincidence, or it may be that there is here yet another interesting natural phenomenon some day to be fully revealed. As we shall see in a later chapter, it is only within recent years that facts have come to light establishing the ability on the part of a number of unrelated animals to control the numbers of their offspring. There is nothing conscious in this, of course, but it does happen at the dictates of circumstances, and one immediately wonders if the converse, namely an increase in the birth-rate, could conceivably result from comparable circumstances. It is most unlikely, however, that the victims of the lions' predations possess any similar ability to increase the numbers of their offspring, as the result of persecution or from any other causes. They are essentially slow-breeders. Zebras, the favourite food of lions, with a gestation of 12 months duration and foaling every second year, and giraffes, with a gestation period of 14 to 14½ months, furnish two further examples of this slow-breeding and it is difficult to see how any appreciable speeding up could be effected. The answer to this anomaly must lie in a far greater rate of survival of the young, in spite of predation.

Since this slow-breeding rate seems to be typical of all the large herbivores, it is a reasonable assumption that the secret of their large populations must lie in the abundance of food to hand and the easy feeding enjoyed from the moment of weaning. Whatever may be the disadvantages of vegetarianism, and one of them is the need to assimilate large quantities of food, there is the positive advantage that,

as a rule, there is no lack of this food. Recent studies, with results too tentative as yet to be profitably applied here, suggest that social factors also influence numbers of populations. These studies have been made on small rodents but there is a social factor brought to light in a comparison of the infancy of the rhinoceros and the elephant.

These two large pachyderms differ in a number of ways. The rhinoceros is solitary and, playing a lone hand, is highly sensitive to danger and quick to attack. In this it is aided not only by its weight but by its skill and speed in manœuvre. Incidentally, the formidable horn or horns carried on the snout are seldom used in fighting. The elephant,



Rhinoceros and young

on the whole less readily aroused to aggression, is no less sensitive to danger, but enjoys the benefit of a community life, the strength in numbers of the herd. The two African rhinoceros, and the Indian, have a gestation period of about 18 months. The single calf is at first hidden in the bush but within the space of a few hours, or at most a few days, is able to follow the mother. Later, in most species of rhinoceros, the youngster precedes the mother, who guides her offspring with her horn. Sometimes two calves may be seen with a single female, an elder and a younger calf, but whether in such instances one has been adopted is not known. As a rule the growing calf is driven off when another is born. Since the calf is suckled for two years, sometimes longer, this gives a total period with the mother, including the gestation period for its successor, of three and a half to four years.

The gestation period of both African and Indian elephants is from 18 to 20 months, and suckling persists for another two years, although the milk tusks are shed at five to six months. There is normally a single calf, but twins are sometimes born, the newly-born being hidden in the bush at first by the mother although able to walk almost immediately after birth. Growth is very rapid at first and within a week the calf, only two and a half feet or so high, is able to keep up with the mother's ordinary walking pace for reasonable distances. The elephant cow is single-minded in her devotion. She will never suckle a strange calf and is readily vicious when she has young in attendance. Only when the herd is hotly pursued and the calf is too young to keep up with its mother is it allowed to drop out and take its chance.

It has, incidentally, been held against the mother kangaroo that if suddenly surprised she will bound away leaving her youngster to hide in the grass. She has been maligned for the greater crime of forcibly ejecting the half-grown young from the pouch if hotly pursued. This behaviour seems comparable, however, with that of the more highly-evolved and highly intelligent elephant, which has on occasion been held up as a shining example among animals of devoted motherhood. In both instances, the distressed female is handicapped, the one by the awkwardness of carrying a well-grown offspring in an abdominal pouch and the other by a lack of natural means of carrying the youngster for any distance. If the two appear to suffer by comparison with some of the rodents and other more lowly mammals to be discussed later, it is also clear that we have to make allowances for these natural handicaps.

To return to the elephant more particularly, there is the special benefit enjoyed by its young over the young rhinoceros. This is the social factor to which I have referred. The growing calf is not driven away when, over two years later, its new brother or sister arrives. As with dolphins there is something approaching family life, and an elephant cow may have two or three calves of different ages in attendance and under her care.

Reference has already been made to the lack, or apparent lack, of any rule governing the ratio between such things as size of litter and size of the adult, on the one hand, and the period of gestation, on the other hand. In the large pachyderms, which include the hippopotamus in addition to the elephant and rhinoceros so far considered, there is a fair measure of uniformity. There is the single calf, with twins as a rare event. There is also the long period of gestation, but whereas this is 18 months in the rhinoceros and 18 to 20 months in the elephant, in the

hippopotamus it is eight months only, and six months in the pygmy hippo. Moreover, while the rhinoceros is classified with the horses, and the elephants are placed in an order, the *Proboscidea*, on their own, the hippopotamus is grouped with the cloven-hoofed animals, which, as we have seen, normally have a period of gestation much longer than eight months.

While on the subject of size in relation to the period of gestation, an even greater anomaly is found in the hyraxes, or dassies, small rabbit-like mammals classified in a separate order, the *Hyracoidea*, having little external resemblance to elephants yet believed from their internal structure to be their nearest living relatives. The hyrax is born with the eyes open, is very active and able to run about soon after birth making loud chirping noises like those more familiarly known in small birds. This general precocity at birth accords with that found in elephants but, by contrast with the single birth normal for elephants, a hyrax litter may contain three to four young. They become sexually mature at two years whereas elephants mature at 18 years. Hyraxes, moreover, enjoy a life-span of only six to seven years, compared with the 70 years of an Indian elephant, the 50 years of the African elephant and the 40 years of a rhinoceros, its nearest relative after the elephants. Yet in spite of its small size and short life-span, the period of gestation of a hyrax is just over seven months as compared with the eight months for a hippopotamus.

The reasons for regarding the hyraxes as close relatives of elephants are not easy to state. The more important of them depend upon somewhat specialized knowledge of anatomy. The others are more confusing than enlightening. Externally the animals have blunt, hoof-like nails on the four toes of the front feet. They also have similar hoof-like nails on two of the hind-toes; but the third toe on the hind-foot bears a curved claw. In general appearance, however, the hyrax is more like a rodent. The body is clothed with a soft, usually greyish-brown, fur and the head is blunt-nosed with short ears. It has no tail, but on the back there is a glandular patch outlined with white or blackish fur, recalling that found in certain large South American rodents, some of which, incidentally, also have hoof-like nails. Its teeth, also, are peculiar. The single pair of upper incisors are triangular in section and sharply-pointed. The lower incisors, four in number, are flat and broad. As in rodents, the incisors are separated from the seven grinding cheek-teeth by a gap. These cheek-teeth have a pattern strongly similar to that found in the cheek-teeth of a rhinoceros. If only the young hyrax did 'climb up its

family tree', as all animals were formerly held to do, we might be able to make more sense of the collection of oddities it embodies.

The young elephant does little better than the hyrax in this matter of climbing the family tree. At birth it is unmistakably an elephant, very similar to its parents except in size and in the relative length of the trunk. True, there are extensive patches of close-set hair over most of the body, which might be construed as a link with the woolly elephants of former times. On the other hand, if elephants are derived from trunkless ancestors there is little clue to this ancestry in the modern elephants. The trunk appears early in pre-natal development, and if the infant elephant uses its trunk little that is rather a feature of infant behaviour than a clue to ancestry, unless the fact that the young elephant drinks with its mouth instead of taking up water with the trunk, as the adult does, can be so construed.

Altogether, the young Indian elephant cannot be mistaken for anything other than an elephant, although there are several ways in which it differs from its parents, apart from size and the length of the trunk. The proportions of the body are different, the head being proportionately larger than in the adult, but this is not unusual in young animals. The ears are larger in proportion to the head. The forehead is sloping instead of being domed, and in this it resembles more the adult African elephant. There is, of course, no inherent reason why a young elephant should not be a perfect replica of its mother except in size. So we are prompted to ask whether there is any significance in its having even these few features noticeably different from those of the parent. As is well known, it was a favourite theme of the nineteenth century that every individual in the course of its life-history recapitulated the history—or some parts of it—of its race. There was great joy when it was discovered that a newly-born human baby could actually hold on and support itself with its hands. This seemed to suggest beyond doubt that all human beings are descended from some ancestral tree-dwelling primate, swinging by its hands through the trees. On the other hand, what are we to say of the absence of teeth in the newly-born human being? Nobody has yet suggested that our remote ancestors had no teeth. On the contrary, it is accepted that this is a special provision linked with the long period of suckling.

The relatively large size of the head of the young elephant presumably has no more significance than that the brain, essential for the control of every aspect of living, must not be below a certain minimum capacity. The relatively large size of the ears may be linked with the

need for acute hearing—one of the most important senses in elephants —or it may be related to the need for ventilating the body, for in the elephants the ears serve the purpose of the sweat glands in ourselves, as a means of ridding the body of surplus heat, thus obviating heat-stroke under normal conditions of activity. The shortness of the trunk may be no more than a baby character, so to speak, and with no more significance than the fact that the human nose has humble beginnings whatever feats of glory it may achieve in some of us in later life. If we apply this Recapitulation Theory, as it is called, to the sloping forehead of the young Indian elephant, we are perhaps on slightly more certain ground. One of the chief features distinguishing the Indian elephant from the African is that the former has a 'domed' forehead and the latter has a sloping forehead. Moreover, most of the fossil elephants had sloping foreheads, the mammoth being one of the exceptions. It is possible to suggest tentatively—and very cautiously—that a sloping forehead is a primitive character, that the Indian elephant is one step higher than the African elephant and that the young Indian elephant is showing an ancestral character in its sloping forehead.

Unfortunately, all these things are arguable and capable of at least two explanations, but they represent the kind of interpretation that is always being looked for by the biologist.

If the young elephant offers us material for no more than slender surmise, the behaviour of the young hippopotamus gives us more solid ground for speculation. But it is speculation. To appreciate it we have to start with the adult. The scientific name is *Hippopotamus* (literally, river-horse) *amphibius*, and the beast bearing the name is about as truly amphibious as anything can be. The body is massive and barrel-shaped, up to 14 feet long in a well-grown adult and weighing up to four tons. There is little to be seen of a neck, and the head, also massive, ends in a capacious mouth with an unusually wide gape. The tail is small and the legs are short stout pillars, which keep the large belly, when the animal is on land, barely off the ground. The four toes on each foot end in small hoofs. There is nothing in all this to suggest an aquatic animal. Moreover, there is no rudder-like tail and no webbed feet as in otters, say. On the other hand, the ears and eyes are small and set well up on the head, and the nostrils are situated high up on the snout. The position of these is such that the huge beasts can submerge in water with only ears, eyes and nostrils showing above the surface.

Although the movements of a hippopotamus on land are ponderous the animal can move at a fair speed and with some agility, and it

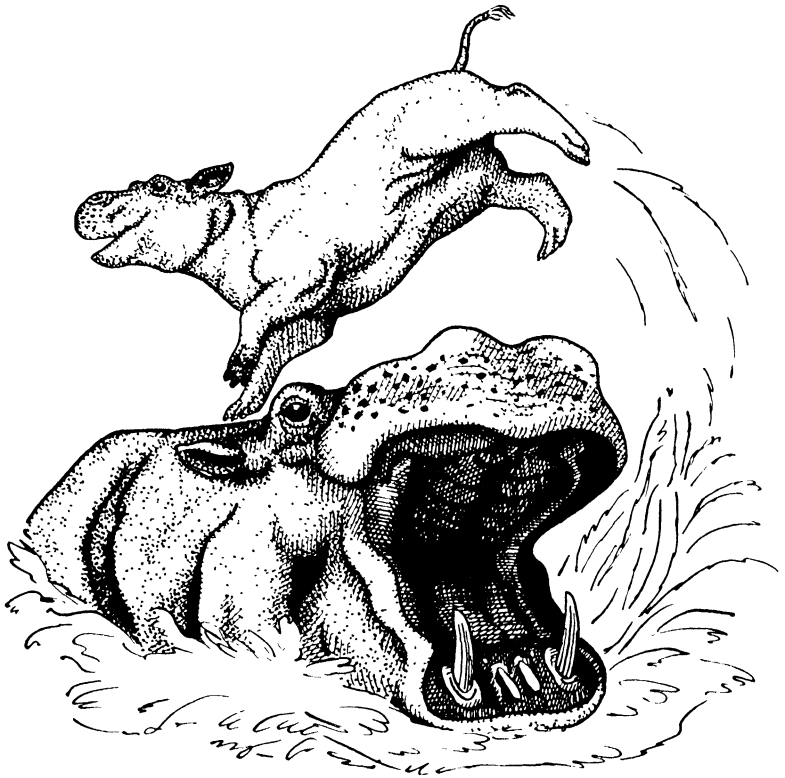
regularly feeds on land, at night, and may travel six or seven miles in search of vegetation. Nevertheless, more time is spent in water, the hippo being an expert swimmer and diver, capable of remaining completely under water for two and a half to four and a half minutes or longer. The hippopotamus, therefore, has the appearance of a land animal that has almost completely taken to water, yet still feeds on land. Therefore, it is of particular interest to see what happens in the infancy of a hippopotamus.

The birth of the single young takes place in shallow water, perhaps in reed-beds at the margins, although at least one observer has recorded a birth on land. The baby hippo can walk soon after birth, but it can swim perfectly even before it is able to walk. One born at the London Zoo in 1926 followed its mother to water when eight and a half hours old, shuffling on its knees, but once in the water it swam with ease and skill. Thunberg, in his *Travels in Europe, Asia and Africa* (1796), tells of a female hippopotamus coming from the river and retiring to a little distance from its bank to calve. After a while mother and infant emerged, whereupon one of the party watching this fired, killing the mother. The Hottentots accompanying the party, thinking they could seize the calf alive, ran from their hiding place, but although only just born the young animal eluded them and made its way to the river, plunged in and swam safely away. The newly-born hippo apparently recognized its proper place of safety, without instruction, and without having an example to copy. The action recalls the unfailing instinct of the young turtle to make for the sea as soon as it emerges from the nest in the sand.

There is this difference from the turtle, however, that the actions of hippos do not seem to be invariable. It is as if the species has not completely made up its mind whether it is terrestrial or aquatic. So we see anomalies and contradictions. Thus, birth may take place in water or on land; the newly-born calf may run to water immediately after birth or shuffle to it on its knees eight and a half hours later. In its physical features we see relics of a former completely terrestrial life: the young hippo has a recognizable neck, and toes relatively much longer than those of the adult. Then, conversely, we have what is almost a contradiction of this, not only in the way the young makes for water but in the behaviour of a female hippo in the London Zoo. As her term approached she was locked in her shed, for obvious reasons, with a good supply of hay for fodder. She spent the night prior to the birth of her young, however, in taking mouthfuls of hay to her water trough, soaking it, and spreading it on the floor, as if there were an instinct impelling her to pro-

vide the nearest approach possible, under these unnatural circumstances, to a damp bed of reeds.

Memory connotes an interest in or a skill derived from previous experience. Instinct, however we choose to define the word, relates to



Mother hippopotamus tossing young (in play?)

skills or interests not associated with previous experience. Yet there are times when the results of the two are remarkably similar. The female hippopotamus in question had had no previous experience, so far as is known, of calving, yet in anticipation of it she endeavoured to create natural conditions out of quite artificial circumstances. The swimming of the newly-born infant, on the other hand, belongs to an essentially different category. This has not been fully investigated but it is reasonable to suppose that the mechanism may be similar to that of a young

seal. It has recently been found that a young seal will swim immediately upon being fully immersed in water. Moreover, the reflexes responsible for the swimming movements will be set in action by such immersion even when the young seal is unconscious or practically lifeless.

The mother hippopotamus anticipates her infant's needs not only before it is born but also when it has arrived. If it ventures out of its depth, although it can swim, she seeks to raise it on her head. Then again, she rolls on her side at first to suckle it, but later the young one must itself roll to feed. Suckling takes place under water, the young hippo coming to the surface every twenty seconds to breathe. Finally, although we have few records of this, play seems to take place in water and consists of the mother submerging her head under the swimming youngster and lifting it out of water causing the infant to take a tumble back into the water.

Although hippopotamuses have been known to Europeans for so long, the first being exhibited in Rome in A.D. 138, remarkably little is known about their behaviour.[1] This is to be regretted for the little we know of their infancy suggests that the fuller story would be most illuminating. For example, the behaviour of the mother hippo towards her infant, and of the infant intself, *while in the water*, is remarkably reminiscent of the behaviour of the mother dolphin and her offspring. Does this mean that because the hippopotamus and the dolphin are both aquatic the more important features of their behaviour must be closely similar? Or does it mean that the two animals are related, perhaps descended from a common terrestrial ancestor? There is no positive answer to these questions. There is, however, one piquant piece of information, recently discovered: that serological tests, so important in establishing the relationships between different kinds of animals, suggest that whales, porpoises and dolphins, like hippopotamuses, are closely related to the more familiar hoofed animals.

[1] Since going to press a monograph has been published on this by René Verheyen.

CHAPTER XIV

RIDING PICK-A-BACK

THE lemurs, monkeys and the great apes, which together form the order Primates, come nearest to ourselves in having the brain-case unusually large and the brain highly developed. Like us they have noticeably long limbs; and most of them have a tail used for balancing and, in the South American monkeys, for grasping also. Their hands, like ours, are grasping, but unlike ours the feet are also grasping, the largest toe being opposable to the other four. The majority of the Primates are tree-dwellers yet, with few exceptions, they make no nest for their young, but carry their babies from birth clinging to the maternal body, in a form of pick-a-back, using this term in a somewhat wide sense. It is a method of transport that comes easily to the human infant, also.

The best way to deal with infancy in Primates is to start with those usually regarded as the most primitive, the lemurs of Madagascar. They range from the size of dormice to that of a cat. All have well-developed tails and fox-like muzzles. Most of them are nocturnal and all feed mainly on fruit and insects. One young at a birth is the general rule except in the mouse-lemurs, which may have two or more. Among the larger or true lemurs, the newly-born baby clings transversely to the mother's belly, but for greater security throws its tail over her back and wraps the free end round its own neck. If twins arrive they cling with hands in opposite directions across the mother's abdomen—or the father may take one of them. This use of a natural sling is continued for three weeks, after which the youngster clings habitually to the mother's back except at feeding time. The only exception to this is in the ring-tailed lemur, which carries its young lengthwise, and the aye-aye. The latter, squirrel-like and the size of a domestic cat, with a coat of long coarse black hair, has the fingers on the fore-foot long and slender, the third finger particularly long and used for probing rotten wood for insect grubs. Being nocturnal, it sleeps by day in a large spherical nest, and there the young are born and nursed.

The rat-sized lorises of Africa, related to the lemurs, also carry their young clinging to the long fur on the mother's belly, but the female galago or bush baby—so called bacause it cries at night with a sound

like that of a human baby—will prepare a nest in a hollow tree when about to give birth. Bush baby twins are frequent and after a period in the nest they are carried by the mother in the same way as are the lorises. By that time, however, the young are fairly well grown and when there are twins they become something of a burden to the mother, clinging to her back or her underside.

The tarsier, found from the Philippines to the Celebes and Sumatra, is believed by some zoologists to represent the ancestral type from which the higher primates, including man, have been derived. It is rat-sized, with a ten-inch tufted tail, and is remarkable for its huge eyes. The young tarsier is born in an advanced condition, fully furred, with eyes

Great anteater with young riding pick-a-back

open and able to scramble among the twigs. At three weeks of age it will take living food, the normal diet of a tarsier, including lizards, grasshoppers and small birds. Nevertheless, in spite of its precocity at birth it also is carried clinging by hands and feet to the mother's belly. The natives maintain that the mother tarsier will sometimes carry her youngster in her teeth in the manner of rats, cats, dogs and others, but this has not been confirmed. If, however, we must deny this measure of versatility to the mother, we have to concede a stranger behaviour in the baby. While mother is asleep the baby crawls over her and may even be seen sitting on top of her head. Even if the zoologist is wrong in seeing in the tarsier something approximating to our remote ancestors, there may be women prepared to agree that in some respect the tarsier baby is not markedly different from the human baby.

With the lemurs, lorises, bush babies and tarsiers we come to the end

of the more primitive primates, known collectively as the *Prosimii*, and must turn our attention to the *Anthropoidea*, the monkeys and man-like apes. The first group of these are the New World monkeys of South and Central America, with one group of them, the capuchins, extending north into Mexico. The *Anthropoidea* include, in addition to the capuchins, the night monkeys, bald-headed monkeys, howling monkeys, spider monkeys, marmosets and others. These all differ from the monkeys of Africa and Asia in their widely-set nostrils, in having the tail prehensile, and in possessing nails instead of claws. In addition all carry their babies on their backs except at feeding time. This does not mean that all are born at the same stage of development. Newly-born night monkeys, for example, are relatively helpless until about three weeks old, whereas the capuchin baby clings to its mother's back practically from birth, with its arms round her neck and its legs straddling her waist. The young marmoset is carried at first by the mother but after a short while the father takes over, handing the youngster back to its mother at feeding time.

A young night monkey was born in the London Zoo in 1933 and was successfully reared although this was not due to the mother, who had no milk for it. This is, apparently, often the case also with marmosets in captivity, as well as polar bears. One female marmoset, for example, lost three pairs of twins through her inability to feed them but finally her breasts did develop and she successfully reared a pair of twins. This raises a doubt whether such instances are the result solely of conditions imposed by captivity, and whether they may not occur with greater frequency in the wild than we think. Cow elephants have been known to suckle calves and female seals suckle pups other than their own, and this may have been because of a milk-sterility in the proper mother, although it is often due to the mother having died. Where such fostering does not take place, as in more solitary animals, this same sterility could contribute to infant mortality and may be one of the factors responsible for keeping the rate of increase of carnivores at the low level mentioned in the previous chapter. We have only slight information to go upon in this matter.

To return to the young night monkey, it weighed $3\frac{1}{2}$ oz. at birth and was very helpless, but growth once started was rapid. At ten weeks of age it had achieved a weight of 10 oz. Although otherwise so helpless at birth it could cling firmly with its limbs, and this continued for three weeks when a rapid change set in and it began to walk. It continued to depend mainly on clinging, however, until the seventh week when

another rapid change took place and it began to leap about, climb everywhere and run actively. Although the eyes were open at birth the young monkey could respond to light by seeking to avoid it, but it could not distinguish objects and it was not able to look about and obviously take stock until the second week. There is much yet to learn about these early days before sight has fully developed. It is not even certain that the reaction to light is necessarily through the eyes. Young desert shrews, for example, although born naked and blind, are unusually active, but they shun the light. When exposed to it they will crawl and wriggle energetically away from it.

The New World monkeys and the Old World monkeys belong to different families, the former being known as the *Cebidae* and the latter as the *Cercopithecidae*. These differ not only in whether the tail is prehensile or not, whether the fingers bear claws or nails, but in certain less obvious anatomical details such as the number of teeth. The two families may have sprung from a common stock but they have diverged widely, and this divergence is no less apparent in the care of the young. The Old World monkeys, the *Cercopithecidae*, all agree in a more prolonged nursing period and the greater solicitation shown by the mother for her baby, which is always carried on the mother's belly, and it does not maintain its position there solely by its own efforts, as in the infant *Cebidae*, but receives support from the mother who uses at least one hand to protect it, especially as she moves with it through the trees.

The babies of Old World monkeys are born with eyes fully open and with the body clothed with a fine silky fur. This is usually different in colour from that of the adult. As we have already seen, former attempts to see ancestral patterns in the coats of young mammals are probably delusory. Certainly the coats of young *Cercopithecidae* conform to no such rules. The majority of the macaques, Asiatic monkeys about the size of a fairly large cat, have coats that are usually tawny or brown. The babies are, with the exception of the rhesus macaque, always black or blackish. The baboons, the largest of the African monkeys, with dog-like muzzles and often with highly-coloured sitting pads of skin, known as ischial callosities, have coats varying from ash-grey to brownish-grey or even greenish-brown. Their babies are, however, black or blackish without the vivid reds or blues that adorn the hindquarters of the parents, or, as in the old male mandrill, the face.

The large langurs or leaf-monkeys of southern and south-east Asia are often brightly-coloured. The Hanuman monkey of Northern India

is fawn or light ash-brown, with a black face. The douc langur of Indo-China is a grizzled silver-grey with pure white arms, rump and tail, black thighs and hands, and chestnut-red hind-legs. So the catalogue could be continued, olive-green flecked with golden yellow, tawny, black or red in various combinations. The babies are, however, black or blackish, except for certain Malayan species, which are grey or greyish-white as adults but have bright orange coats as infants. In the colobus monkeys of Africa, related to the langurs, the adults are black or black-and-white, sometimes red, and the infants are completely white.

Finally, we have the *Pongidae*, the family of man-like apes, which include the gibbon, the orang-utan, the chimpanzee and the gorilla. To a greater or lesser extent these move through the trees swinging by the arms and with the legs more or less drawn up under the body. The females do not therefore use their hands to support the young, which are cradled on the legs as they cling to the belly of the mother. Although some of these apes are well known in captivity, singularly little is known of the behaviour between parent and baby, and one of the remarkable features is the apparent surprise and helplessness of the mothers when their babies are born. Often this persists and the mother will have nothing to do with her infant. These may be the result of unnatural circumstances in captivity and comparable with the infanticide seen in other mammals when held captive. One important observation comes out of this, however, that after having shunned her baby initially the captive ape-mother has been seen to pick it up and cuddle it to her breast at the first cry it utters. The sound-stimulus calls forth the maternal reaction and once cuddled the infant finds the teat and the full bond between mother and infant is established.

In the primates the period of gestation is closely corellated with the method of classifying these animals. For lemurs it is about two months, for American monkeys it is four to five months (139-150 days, varying with the species), and for Old World monkeys, including macaques and baboons, it is five to seven months (153-220 days). In the apes we have seven months (210 days) for the gibbon, seven to nine (210-270) for the orang-utan and eight to nearly nine months (235-260 days) for the chimpanzee. Little is known of the early development in the gorilla, the largest of the apes, and the period of gestation, not known for certain, is probably about nine months. In the apes pre-natal growth approximates, except in gibbons, to that of the human infant. It is of interest therefore to note some of the known statistics of their post-natal growth. The young gibbon and the young orang-utan begin

Chimpanzee and young

to walk at six months but the chimpanzee begins to take exercise by about the third month and it receives considerable tuition in walking and climbing from the mother. Although relatively precocious in learning to walk and able to take solid food at six months, the young chimpanzee will continue to take milk from the mother for two to three years, long after this is strictly necessary to it. And despite the different ages at which they begin to walk, orang and chimpanzee mature at about the same age, namely eleven months or thereabouts.

Of all the apes, the orang-utan is most marked for using the arms in locomotion, swinging through the trees entirely by the arms, and using the legs very little even when progressing over the ground. The young

orang, on the other hand, tends to walk erect at first. This can hardly be a special provision for infancy and could more reasonably be interpreted as a relic of ancestral behaviour. Such a view seems much more reasonable when we take into account what happens with other apes. The gibbons are much in the habit of walking erect over the ground, usually with the long arms held high over the head, although their proper home is in the trees. Chimpanzees roam the forests in search of fruit and sleep in the forks of trees. They are, however, at home on the ground, the weight of the body being taken by the flat of the foot and on the knuckles applied to the ground. Gorillas normally walk on all fours, but can readily adopt a fully erect position. They habitually keep to the ground, wandering in family parties in search of fruit and vegetable matter, and they sleep in temporary litters of branches and leaves pitched either low in the forks of trees or on the ground between buttress roots. Taking all the evidence available from the man-like apes, it is clear that they are less tree-dwelling than is normally supposed and it seems more likely that their ancestors were more ground-dwelling than tree-dwelling. Against this view the young orang's habit of walking erect becomes the more significant; and if we accept the apes as our nearest relatives in the animal kingdom then the newly-born human infant's ability to hang by its arms can only be construed as a relic of the time when our ancestors carried their young in the same way as the apes do today.

If the apes, and the primates generally, represent our closest relatives, it is worth while also seeing how far they contribute to their infants' training as compared with the efforts made by human parents in this matter. The general view, of those who have studied them, is that monkeys do little in the way of training their young. Indeed, it would seem that apart from feeding them and carrying them about they pay little attention to them. This may be because we have not made a sufficiently close study of them or have not so far learned to understand their ways.

To suppose that there is such an impersonal attitude on the part of a female monkey to her young contrasts with the known fact that she will carry her still-born infant, or one that has died subsequently to birth, until it is completely decomposed. Moreover, a female monkey deprived of her young one has been seen to carry a dead rat until it more or less fell to pieces. This behaviour, in turn, also contrasts with the observation already noted that a female monkey will often ignore her new-born until it cries. Above all, whatever else we may say of these

contradictions, they should warn us against over-simplifying reactions from the maternal instinct. In primates, at all events, it looks as if the young one normally clings naturally to its mother, but will be picked up by her if it cannot make the effort itself, and that she will be drawn to do so by its cries or by the feel of its fur.

To return to the education of the young primates, there can be little doubt that if the parent monkey contributes little to it this is offset by the gregarious life they lead. Since, in most species, there is no regular breeding season, there will be in the troop youngsters of all ages and it is feasible that, as in dolphins, a play-culture of sorts is developed. Gibbons are social animals, living in family parties or larger bands and, since we are told authoritatively that the young ones receive little maternal tuition, it seems probable that here again, especially as the adults can breed at all times, some form of play-culture emerges to aid the infant education.

As with everything else little is known of gorillas, but their family parties seem to be like those of the orang-utan, composed of one old male and several females, some having young. It is a marked feature of young apes, and most monkeys and lemurs, that they are playful, energetic and restless, and it is difficult to believe that the young of various ages do not intermingle, playing together as we have already seen young baboons will play. If young apes are so singularly like human infants in their thumb-sucking, toe-pulling and other similar activities, and if they become, as they grow up, mischievous to the point of earning effective, if harmless, maternal cuffs, then it is difficult to believe that the whole parent-offspring relationship does not follow somewhat the lines more familiar to us in our own experiences.

It may be that our views on this are a little out of perspective. Chimpanzees, being more amenable for the purpose, have been intensively studied. According to Dr. Henry W. Nissen in *The Story of Animal Life*: "The young chimpanzee exhibits a tremendous variety of 'play' behaviour. He invents endless acrobatic games—somersaulting forwards and backwards, gyrating like a moving, spinning top, with hands extended gracefully over the head, holding to a wire partition and then flipping over backwards to the ground, climbing out on a limb to its outer end until it is sagging down to where the animal can drop safely to the ground or to a lower limb, and so on, endlessly. He finds new ways of eating and drinking—peeling a grape and eating the inside first, the skin later, taking a mouthful of milk, spilling it on the concrete floor and then lapping it up. . . . The chimpanzee discovers novel ways

of looking at the world—by standing upside down or bending over and peering through the legs, by punching a hole in a leaf and, holding the leaf close to one eye, looking through the hole, by producing a puddle of urine and gazing at the reflections therein. He decorates his body with a stray piece of cloth or rope draped around the neck—examines strange objects in minutest detail and tears them apart down to the smallest possible fragment. . . ."

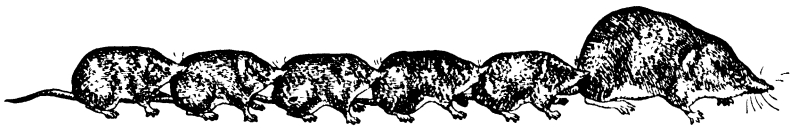
Young chimpanzees in company will tease, bluff, attack, walk tandem, make friendly overtures by kissing, offering a gift of food, or other solid object. In fact, they will do almost all the things we see human children do; and from the little we have seen of the young gorilla and orang in captivity their repertoire of antics is not wholly dissimilar. If the mother ape is seldom seen engaged in active instruction of the young it may be that her services are hardly required, for it needs little imagination to picture, from observations made on captive animals, how young apes might disport themselves in the wild while no interfering human is present to disturb them.

It was the practice formerly, in classifying mammals, to start with the egg-laying platypus and echidna and the marsupials at the beginning and end up with those regarded as the most specialized, namely the primates, including man. This was based to a large extent on the increasing brain-capacity. The modern classification sees the primate placed low in the mammalian scale—a blow to man's pride. This order was based on the increasing specialization of the body. It is of interest to note here that this new classification falls, with rare exceptions, into line with the treatment of the young. Excluding platypus, we have at the lowest levels the marsupials that carry their young in a pouch and, in some instances, on their backs as they grow older. The koala, or Australian teddy bear, is a familiar example of this. Less well known, perhaps, to us on this side of the Atlantic, is a similar behaviour in the American opossum. Then, in this new scheme of classification, come the insectivores, which make nests for their young instead of carrying them, followed in rapid succession by bats, lemurs, monkeys and apes, and sloths, anteaters and pangolins, all of which carry their young clinging to the body. After this we have rabbits and hares, the vast order of rodents and the carnivores, which litter in some form of nest and carry their young in the mouth, in the manner known as retrieving. Finally we have whales, porpoises and dolphins, and the large group of hoofed animals, in which the young are born at an advanced stage of development and are largely independent, except for feeding, from the first.

It is never possible to draw hard-and-fast lines where living things are concerned. As far as it is possible to group mammals on the ground of infancy we can divide them into these three groups, approximately. So far as the pick-a-back method is concerned, it is, of course, mainly used by tree-dwellers, and most appropriately by the sloths that spend so much of their time hanging by their hook-like claws from the branches of trees, in which position the body forms a natural cradle or sling. Contrasting with this natural cradle method is that of the young sloth bear, of India and Ceylon. It rides its mother's back like an expert jockey, maintaining its seat even when she is going at full speed. Perhaps one of the more remarkable is, however, the African ground pangolin. Her single youngster clings to her tail and if anything happens to menace its safety she brings her tail under her body, brings her neck under also, and in the cavity so formed shelters the young one, her body scales offering protection to them both.

Finally, probably the most extraordinary instance of the young riding pick-a-back is seen in the rock elephant shrews of Africa, which are related to our common shrew, and are therefore one of the insectivores. These, as we saw earlier, normally make a nest either underground or, as in the hedgehog, in deep leaf litter. The rock elephant shrew lives among rocks over which, if disturbed, it flees with lightning-like speed or takes long leaps to find a sheltering crevice. The female bears one or two young, very large in proportion to her own size, and these are suckled at teats on top of her shoulder blades; and she carried them about attached to these, even when moving and leaping at speed. Moreover, if alarmed she will, before dashing away, make sure that the young ones are on the teats.

We can hardly leave the subject of transporting the young without referring to the caravans formed by shrews. This has not been often seen but it has been watched under circumstances that leave no room for doubt. It has even been filmed. Should the litter, when young, leave the security of the nest, the slightest alarm—a small noise, even a change of temperature or a slight fall of rain—sends the youngsters scuttling behind the mother. One grips the fur of her back near the root of the tail, another grips the fur of that one in a similar way, and so on until the whole litter, numbering eight or more, is lined up in single file. Then all move off, instantly falling into step and keeping in step all the time. If the mother quickens or retards her pace, the youngsters all do the same. When she leaps a low obstacle, the caravan goes over as one, keeping in



Female shrew with litter following in 'caravan'

step all the time. If a real fear afflicts the mother she stops dead still. Instantly the whole caravan does likewise, without the twitch of a nose or whisker. Sometimes a double row will be formed, or the formation may take other patterns, but always there is this unanimity of action, and the grasp they have of each other is so firm that the mother can be picked up and held with the litter hanging in a string from her.

Unfortunately, we know all too little about this quite remarkable procedure, but it appears that hedgehogs and weasels may do something similar, and presumably the mother otter swimming with her youngsters holding her tail comes into the same series. The perfect unanimity of action in shrews is the more remarkable since their eyesight is poor. Indeed, the young ones have been seen to try forming a caravan before they have their milk-teeth, and are therefore unable to grip effectively, and also before their eyes are open. The actual gripping is therefore clearly an innate reaction, comparable with the gaping reaction of the nestling yellow-hammer, but the liaison between mother shrew and litter, while varied, is always so close that we must visualize a complex of factors at work, involving probably smell and touch, possibly ultrasonic sound signals. That much is, however, speculation.

CHAPTER XV

RELICS AND ANCESTORS

ALTHOUGH so small and helpless at birth, the newly-born polar bear cub was completely clothed with short hair. The paws were particularly broad in proportion and the toes well-defined and armed with long curved needle-sharp claws. Although unable to support itself or hold up its head, it crawled actively about using especially the fore-limbs, which were noticeably longer and better-developed than the hind-limbs. This recalls the condition seen in the newly-born kangaroo, and it will probably be found eventually to hold true for a number of other animals. We have already noted how the fact of a very young human infant being able to support its own weight hanging from a stick by its hands offered a very simple comparison with an orang-utan hanging from a branch in its natural habitat. It was noticed, furthermore, that the human infant tends to turn the soles of the feet inwards, and this seemed plainly to point to a similarity with the feet of the great apes, and especially the orang-utan. Taken together, at a time when the Recapitulation Theory—"during its life-history an animal climbs up its family tree"—was much in vogue, these two observations were god-sent evidence that man's ancestors dwelt in trees and that the behaviour of the human infant was a relic of those times.

It was very natural that the older biologists should have seized, often uncritically, upon anything that looked like supporting evidence for their theories. Their interpretation in this instance may, indeed, yet prove to be correct. All the same, there is another possible explanation, which seems equally reasonable. As we have seen, there are many instances of animals carrying their young about with them and in the monkeys and apes this is accomplished by the babies clinging to the mother's body. It is usually said that they cling to the fur, but it seems much more likely that if the young do hold on to the maternal fur this must be incidental. The general impression from watching these animals is that the youngsters wrap the arms and legs around her body; and, moreover, the limbs most used are the arms. Not all monkeys and apes are tree-dwelling, and this method of transporting the young is seen not only in those that live entirely or only partially in trees but also in those

that live mainly on the ground. Seen in this light, the newly-born's ability to hang on by its hands represents no more than a family trait, that of the infant clinging by its hand or arms to the mother; and supplies no evidence that man's immediate simian ancestors were tree-dwellers. They may have lived in trees, but this feature of the baby's behaviour does not necessarily constitute a relic of the adult habit of swinging from branch to branch. It is merely a juvenile trait common to all Primates.

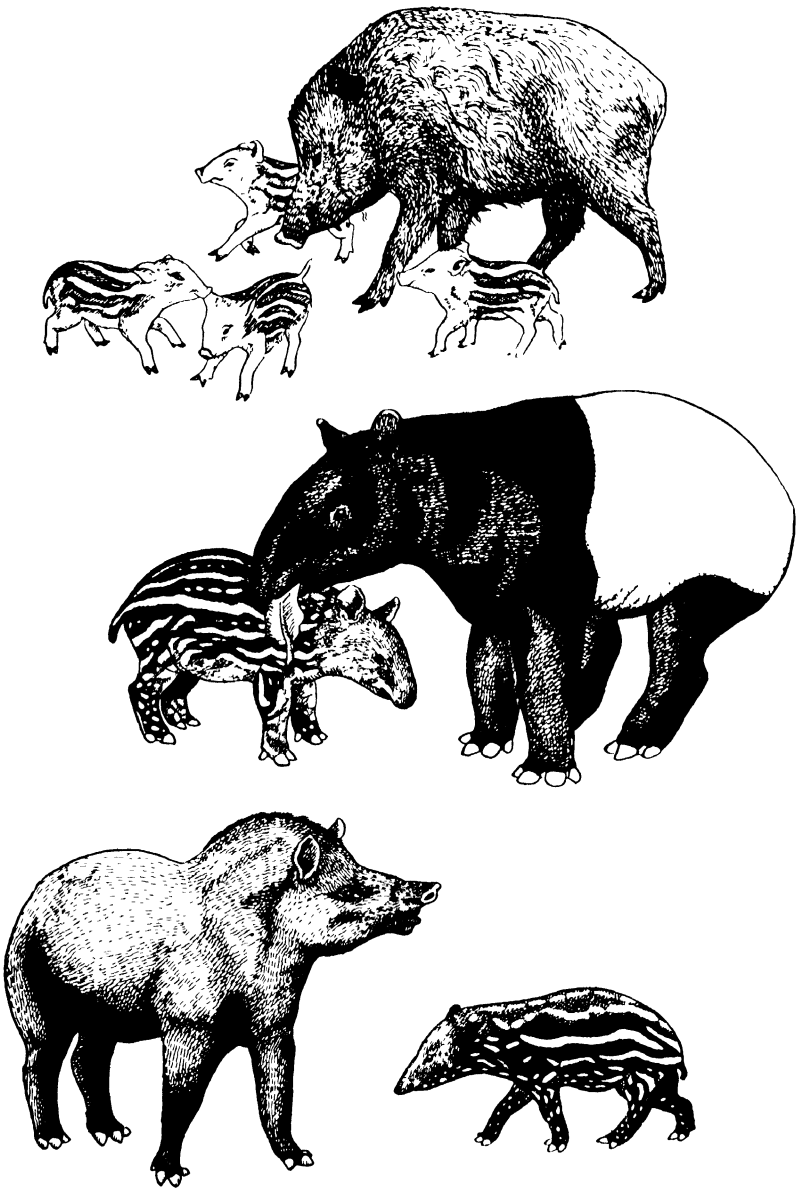
There are relics, of course. The muscles of the ears in human beings are, perhaps, the classic example. We cannot move our ears as most other animals can. There are, however, some human individuals that can do so, but we all have the necessary muscles even if they are somewhat degenerate. These are, however, present in the adult as well as in the infant. Perhaps a better example of a relic, and one that appears in the young, is seen in seals. On every count these aquatic animals appear to be related to land carnivores and the usual assumption is that their distant ancestors moved on all fours. In the young seal the limbs certainly are more leg-like than those of the adult, and the baby seal at first endeavours to move on all fours in the typical quadripedal manner. Later it moves the limbs in pairs, in the manner of oars, and finally adopts the gait of its parents, which naturally differs from one species of seal to another. The way in which certain young seals curl up to sleep is also extremely dog-like, but that may be evidence of affinity with dogs or it may merely be that this is mechanically the best way of relaxing for sleep or of reducing the loss of heat from the body while asleep. The fact that it is found in the young seal and not in the adult may be purely a result of the bulkier form of the grown seal. Or it may be that having better insulation the grown seal does not need to curl up to preserve body-heat. We can only speculate on these things, and one person's opinion is almost as good as another's. Already, therefore, it is becoming clear that, for the most part, those things which were formerly seized upon with eagerness to support theories of ancestry are, to say the least, unreliable evidence. The best we can say of them is that they are features suited to the infant way of life, and that a few of them suggest a clue to ancestry.

A particularly good example of the delusory nature of these so-called relics in the infant animal obtains in the tapirs. These are water-loving stoutly-built animals, about the size of a large pig, practically tailless, with a trunk-like snout, and having four toes on the front feet and three on the hind-feet. The Malayan tapir, of Malaya, Sumatra and

Borneo, has the head, fore-quarters and all four limbs black and the rest of the body white. The South American species of tapirs, on the other hand, are entirely blackish-brown. Although separated geographically by wide distances the two kinds of tapir are regarded as closely related. This relationship is assumed from their great similarity in every respect other than colour. And then we find that the young of both kinds are very similarly marked, with well-marked patterns of stripes and spots. The similarity of pattern in the young has therefore been seized upon as an outstanding example of the appearance in the young animal of ancestral characters. That is to say, the argument would run, that because all young tapirs wherever found show this pattern the ancestors of the tapirs must also have been marked with spots and stripes.

This may be perfectly true, yet the fact remains that new-born wild pigs are striped and to some extent spotted in a pattern very like that found in young tapirs. Indeed, we may go further and say that at first glance young tapirs and young pigs are remarkably alike. True, the young pigs quickly lose this pattern and assume the coarse-haired greyish-brown coat typical of the adult wild pig, but if similarity of infant pattern counts for anything we should be justified in looking upon tapirs and wild pigs as closely related. Yet, in our classification, we place the tapirs with the single-hoofed animals, the horses and zebras, and we place the wild pigs with the cloven-hoofed. So we must assume either that our classification is wrong, or that infant colour-pattern has a very limited value in tracing the ancestries of animals.

Before pursuing this point, however, it may be worth looking for reasons why tapirs, with four toes on the front feet and three toes on the hind-feet, should be classified with horses, which have only the single hoof. The great majority of land-living vertebrates have four limbs, and, excluding birds which we shall deal with in a moment, a large number of these have five toes. Since, as in monkeys, we speak of fingers on the fore-limbs and toes on the hind-limbs, it is simpler to refer to all as digits. Even when the number of digits is four it is usually possible satisfactorily to show, by their size and the relation they bear to the rest of the limb, either that the first toe is missing, or the fifth, as the case may be. In the same way, if only three digits are present, it is possible to show that this has been derived from an original five-toed condition. So we have arrived at the general principle that the limbs of the typical land-living vertebrate are based on a pentadactyl plan, that is, on a limb ending in five digits. This is an accepted principle and nothing more



Wild pig and young (*top*), Malayan tapirs (*centre*), South American tapirs (*bottom*)

need be said here concerning its truth. It was necessary, however, to digress this much because of what follows.

There have been unearthed numerous fossils of horses and horse-like animals. These when laid side by side show a reasonably connected sequence from a small animal the size of a hare with five toes on each foot, through varying stages to the modern horses and zebras, with their single toes. One of the most striking changes in this sequence is the gradual reduction in the number of toes to three and finally to one, with the nail enlarged to form a hoof. The one toe left is the third or middle toe, but even in modern horses there are also the remains of the second and fourth toes. These are hidden under the skin in the form of the so-called splint-bones, and are stronger in the unborn foal than in the fully-grown horse. Very rarely, a foal is actually born with three toes instead of the customary one hoof. Not only are the splint-bones true relics, therefore, but they are apparently more emphasized in the infant horse than in the adult.

The tendency towards a three-toed condition as seen in their hind-foot suggests the relationship of the tapirs with horses, asses and zebras. On the other hand, the young of these last three are never, like the young swine, patterned anything like the young tapir. If there is any pattern it is banding as in the zebras. To say the least this question of colouring is puzzling.

This insistence upon the unreliability of colour as a symbol of relationship is in contrast to the point made in Chapter Five regarding the speckled breasts of the young of the thrush family. Certain colour patterns in the young, because they are so constant, serve to indicate a family relationship. They do no more than this, and even this must be treated with reserve. Thus, the young of the waders, the plovers and other long-legged birds of that type, usually bear patterns with some form of striping, and these are fairly alike throughout the group. A few, indeed, do in fact recall strongly the pattern found in young tapirs. On the other hand, although the young of the little grebe, and to a lesser extent the great crested grebe, have a pattern of stripes and spots very reminiscent of that in the young tapir, closely related grebes show none of these characteristics. So we see in one family a fairly constant pattern in the young; in another family we find it less constant; and in a third, we have striking differences in pattern between the young of one species and those of another closely-related species.

The big cats show a similar diversity. The lion cub is barred, with spots on the legs, but the pattern is very variable from one set of cubs to

another. In some cubs there is practically no pattern. In the young leopard the body is spotted but the spots are small and ill-defined and not grouped in rosettes as in the adult. The tiger cub is barred as in the adult, but the bars (usually referred to as stripes, a name which should be reserved for longitudinal markings) are less well-defined. Most young deer are spotted, even where the adults are not, and this is true of fawns characteristically dropped in woodland as well as those that pass their time in the open. Indeed, the favourite idea that a fawn has a spotted coat because the dappled light falling on it through the woodland foliage serves to conceal tends to lose its point when we remember that other fawns born and reared away from woodland and dappled sunlight also have spotted coats.

Taking everything into consideration, the colour patterns of the young animals have, to say the least, only a doubtful value as a guide of relationship and it is most improbable that they shed any light on the colours of ancestral mammals. The facile assumption usually made, that the ancestral adult mammals of millions of years ago all had stripes and spots, similar to those of the young tapir of today, has little to support it. It may indeed be correct but a more thorough-going study will be needed before it can be accepted with complete conviction. As I said in my preface, the study of colour patterns in young animals is apt to lead, in the present state of our knowledge, to doubtful as well as contradictory conclusions.

The remarkable thing about this study of relics is this, that it was used in the closing years of last century and the early years of this to support the theory of evolution. These so-called relics were seized upon greedily by the scientists of those days and ideas based on them have since passed into general currency. The fact that so many of them are now shown to have been insecurely founded does not, however, invalidate the theory of evolution they were used to support, which is probably more firmly established than formerly.

An example of the kind of relic which helped this theory is seen in the dog's habit of turning round and round before lying down to sleep. This was accepted as a relic of behaviour which, after thousands of years of domestication, survived to remind us of the time when the dog's wild ancestor trampled the long grass before settling down to sleep. This is, in fact, a tremendous shot-in-the-dark. To begin with, even today we have little idea what was the wild ancestor of the dog. It is usually accepted, hypothetically, that it may have been the wolf and that the jackal may have contributed to its lineage. It is not the only

domesticated animal about which there is this doubt. We are not sure of the ancestor of the sheep. As to the domesticated ass, it does not appear to be closely related to any wild ass now living and at least one authority has suggested that it may have been derived from a species now extinct. The ancestor of our cattle is known, but it too is now extinct. The ancestor of the horse may have been the tarpan, which again is virtually extinct. There is therefore nothing far-fetched in the idea that the ancestor of the dog may equally have become extinct.

On the other hand, supposing the ancestor of the dog to be the wolf, I have found no mention anywhere of a wolf turning round in long grass before settling down. Against this are the facts that dogs of today show this habit less than in past years and that the habit was always more pronounced in kennel-kept dogs. It is probably a habit due more to our ancestors than to the dog's. Whatever the truth may be it is clear that a much wider study will be needed to establish it, and the habit in a dog of turning round before resting is given here as an example of the need for looking very closely at so-called relics before drawing conclusions from them.

There may, indeed, be relics of this kind in infant animals. Much more commonly, they are special infantile structures wrongly interpreted. The sense of smell in human beings, for example, is very poor and the membrane upon which it depends has a total area of the average-sized postage stamp. In the human infant it is relatively much larger. This could mean that man's ancestors had keener noses, but against this we have to set the poor sense of smell in monkeys and apes generally, eyesight being by far the dominant sense and hearing second, as in ourselves. It seems, rather, that we should interpret the better sense of smell in the human infant as a special equipment during the time when the eyes have not started to function fully. In human and most other mammalian young there can be little doubt that the mother's nipple is first located largely by smell.

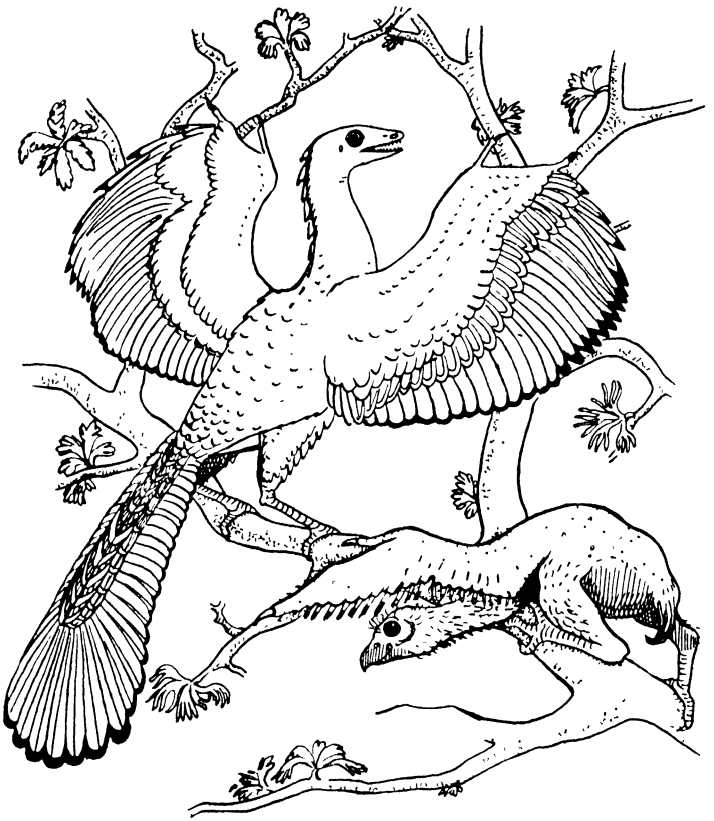
An even more markedly special structure is seen in birds. Young birds prior to hatching bear a pointed cap on the end of the beak which is shed soon after hatching. This, known as the egg-tooth, has been described as a kind of tin-opener for opening the shell. Reptiles have something similar, but the 'tin-opener' in most reptiles is more of a horny wart, known as a caruncle. Nobody has yet suggested that the egg-tooth or the caruncle is there because the full-grown ancestral birds or reptiles had such a thing on the beak. It is accepted as a special structure serving the young animal for a particular purpose and shed as

soon as the purpose is achieved. And yet the young platypus, representative of the early mammals and having many reptilian features—as well as a duckbill—has both an egg-tooth and a caruncle to break its way out of the shell.

This does not mean that platypus is partly bird as well as being partly reptile and partly mammal. The possession of both an egg-tooth as well as a caruncle is mentioned merely because it is an interesting fact. The interpretation is, however, obscure. Certainly mention of the presence of the duckbill, thrown in for good measure in the preceding paragraph, has nothing to do with any relationship with birds, so far as we can see. The bill of the platypus, so like that of a duck in shape, is enclosed in a horny sheath. It is a highly sensitized organ of touch, the platypus having little sense of smell. Both these characters are very bird-like, but against them we must set the fact that the young platypus has teeth in the upper jaw which are shed as it grows up. These are curiously-shaped ridged teeth unlike those of any other mammal, which is unfortunate since they are almost certainly a true relic, but they give us no clue to the ancestry of platypus. They are also unlike those of any bird or reptile. It is most tantalizing that when we do find a true relic we should be unable to interpret it.

The teeth of the infant platypus are not, however, the only exasperating relics. No living bird has teeth although many fossil skulls of birds possess them. In the nestling tinamou, however, there are in the forepart of both upper and lower jaws a short series of small white teeth. The tinamous, as we have seen, are somewhat tentatively classified with ostriches and emus as very primitive birds. These nestling teeth do nothing, however, to help us in classifying the birds that possess them. They may constitute a true relic or a special structure; we cannot say.

There is hardly more certainty about the claws of the hoatzin of South America, another supposedly primitive bird, although statements about them are apt to be more positive. To understand these we need first to have clear in our minds the structure of a typical bird wing. The fore-limb of birds, the wing, is supported by bones bearing a close resemblance to the typical pentadactyl limb of other vertebrates. There is the humerus or upper arm and the radius and ulnar supporting the forearm. There is also a third or outer part of the wing which comprises chiefly two much elongated wrist bones. Attached to this are the remains of three fingers, which have all but disappeared. The earliest known remains of a fossil bird are of Archaeopteryx, often called the bird-reptile. Whether it flew or not is a matter for conjecture,



Archaeopteryx, the fossil 'bird-reptile' (*above*), compared with young hoatzin (*below*)

although it had feathers, but the presence of three well-marked clawed fingers on the wing suggest that with their aid it may have moved by climbing about in trees, as well as by either flying or gliding. In the nestling of the hoatzin the fore-limb has two well-marked clawed fingers very like those of Archaeopteryx, and a third finger that is clawless.

The hoatzin is a pheasant-like bird not closely related to any other living bird. It lives in the Amazon region, nesting in trees on the margins of rivers or lakes. The nest is a loose platform of sticks on a bough or in a bush overhanging the water. Soon after the young are hatched they climb actively about the nest, and shortly start to scramble over the

branches of the tree on which the nest is laid, holding on by their beaks and clawed toes and also using the clawed digits on the wings. As the young bird grows, the upper arm and forearm grow more rapidly than the outer third, and at the same time the clawed digits become relatively much smaller and lose their claws, until finally the bones of the wing look very like those of any other flying bird. It is usually assumed that the clawed digits of the hoatzin constitute a relic, a link with the ancestral birds, such as the Archaeopteryx, which disappears as the young bird grows up. This assumption is fostered, moreover, by the reptile-like appearance of the nestling as it clambers about on all fours, and also by the unusual, almost 'ancient', appearance of the adult bird. But, here again, there is no means of knowing whether this Archaeopteryx-like feature of the wing is a relic from ancestral birds or a special structure suited to the peculiar habits of the young hoatzin. Certainly, the young moorhen as well as the nestlings of several others living in reeds or other water-plants also have a claw on the first digit, and that too is used in scrambling over the nest, although it is seldom suggested that this is an ancestral relic.

Perhaps one of the most convincing relics is found in the whalebone whales. Some of the whales, the toothed whales, such as the sperm-whale, have jaws armed with closely-set conical teeth, their food including fish or squid, or other whales and seals in the case of killer whales. The whalebone whales feed on large numbers of very small shrimp-like plankton which are strained from the water through the baleen plates or whalebone growing down from the roof of the mouth. The unborn young of the whalebone whales have teeth in their jaws; but that tells us only that their immediate ancestors almost certainly had teeth like the toothed whales, which is no more than we should suspect from the anatomy of whales as a whole. But they tell us little of the more remote ancestry of whales.

We hear less today about relics, and there is a greater tendency to attach a limited significance to them. These few examples serve not only to show that their significance is obscure and often contradictory, but that at best they indicate immediate twigs on the family tree rather than taking us back to the main branches.

CHAPTER XVI

THE MATERNAL INSTINCT

NO OFFSPRING is produced in a vacuum. It is part of its parents. To a greater or lesser degree it is dependent upon one or other, or both, for survival in its early days. The attachment of the young to the parent is readily understandable. The attachment of the parent for the young is less easily comprehended. What binds a parent to its young, compelling it to accept this tremendous burden? As we shall see later, attempts have been made to reduce the parental instinct to a simple response to a limited number of sign stimuli but one has the feeling that this simplification may be misleading.

Let us try first of all to assess the strength of the parental instinct. The blackbird is not, under ordinary circumstances, outstanding for its courage. Rather, one of its main characteristics is the readiness with which it will give its alarm note and fly off. Courage is, of course, relative; certainly it is difficult to assess; and the mere fact that this particular bird should so readily raise the alarm instead of seeking security in silence and secretiveness suggests that it is no more a coward than any other bird. Whatever view we may take of its day-to-day behaviour, however, when it has young the blackbird can rise to heights which in ourselves would be called heroism.

In a town garden, where the domestic cat is an inevitable feature of the landscape, it is a common experience to see the blackbird, the cock especially, display its paces in devoted and selfless parenthood. Usually, the presence of a cat near a nest or young sets off the loud and persistent alarm call of the parent, to which is joined the alarm calls of a motley collection of other smaller birds. But, although as vociferous as any, a blackbird is also prepared to play a lone hand and 'buzz' the cat. The blackbird, usually the cock, although he is sometimes joined by the hen, flies at the cat's head, skims just over it, banks and dives again and again. If it is not the triumph of mind over matter it represents the triumph of determination over superior weapons, for in theory the cat could readily claw down the bird. Armed only with a fairly soft beak, the blackbird uses the age-old tactics of confusing its enemy by speed and persistence.

Blackbirds are, of course, not alone in using these tactics. Swallows

will combine to buzz a cat, and will do so with such vigour as to keep the cat grovelling in a shallow ditch. Crows have been seen to attack a fox in the same way, but whereas crows have stout beaks and swallows are arrow-swift, a blackbird is ill-equipped for such combat. Yet, such is the urge of parenthood, it will attack this powerful carnivore and hereditary enemy, single-handed if necessary, in defence of its young.

It is not only in the use of aerial power against a ground foe that the belligerence of a blackbird shows up to advantage. Many a magpie, whether attempting to rob the nest or no is not always clear, has been chased from bush to bush and finally forced to flee. A magpie is a heavier bird and has the advantage of a more powerful beak, but these count little in the face of outraged parenthood.

Perhaps the best exhibition put up by a blackbird was against an owl. Going into the woods at half-dusk one evening, my attention was caught by the insistent alarm notes of a blackbird, not at shoulder or head height as is usual but at least thirty feet up in a group of tall trees. Although night was falling, it was possible to follow this event, partly by sight and partly by sound. A blackbird was chasing a brown owl, a vastly bigger bird with hooked beak and powerful talons, from branch to branch and from tree to tree. Eventually the owl gave up and flew away. It is true that we now know that whereas the brown owl reacts to a moving mouse and only reacts, by seizing it, to a bird that is still, that knowledge is very recent and we can assume that a blackbird does not know it.

Blackbirds are not alone in their victories against heavy odds. A female shrew, almost the smallest mammal in the whole world, has been known to make a well-grown cat beat a retreat. A goose has been seen to attack a motor-car because it thought the goslings were threatened. And, merely to pick out another from the many similar stories, a doe-rabbit attacked a stoat as it was carrying off one of her babies. She rushed at the stoat repeatedly, lashing out with her hind legs until, according to the eye-witness, she finally sent it flying downhill a distance of ten to fifteen yards, after which she retrieved her baby and carried it off in her mouth. This fight is in striking contrast to the usual timidity of rabbits, and serves to show what the presence of young will call forth.

Stories similar to these could be repeated without end. They are to be found in the pages of the scientific journals, in books of general natural history or travel, in the weekly or monthly magazines, in the daily newspapers, and there must be hardly a person of ordinary powers of

observation who could not contribute from first-hand experience. In short, we may take it for granted that an animal parent will behave in ways quite remarkable and quite out of the ordinary for the welfare of its young, working indefatigably to provide for its comfort or to obtain food for it, or exposing itself to extreme bodily dangers in its defence. And for what reason? It is, of course, due to the maternal or paternal instinct. The difficulty lies in saying what this instinct is.

We have progressed far in the analysis of animal behaviour. It has been possible to study isolated features of it, such as innate reactions and reflexes, and to show satisfactorily that some are controlled by secretions from the ductless glands, and others by external conditions such as changes in temperature, in the intensity of light and so on. We are becoming used to thinking in terms of inherited behaviour patterns stereotyped and regular for a given species, subject to wrong functioning when the works go wrong, but normally leaving little room for the exercise of volition, or free-will as it would be called in ourselves. In general, this holds good, subject to qualifications, as we have seen. Can we analyse the maternal instinct in this way?

Few things in the living world are clear-cut. So long as one's attention is confined to a single piece of behaviour, in one or a few individuals, it is possible to record fairly definite and simple results. Go further, however, and we begin to find the exceptions and the deviations from the normal, and the results then become less definite. They become less definite still the greater the number of individuals studied, and the situation becomes even worse as the study embraces a greater and greater number of species. Even when dealing with a single species, no matter how much we speak of stereotyped behaviour, the fact remains that individuals differ. Because one doe-rabbit attacked and vanquished a stoat in defence of her young it by no means follows that all does will do likewise. There must be many instances of mother rabbits, devoted to their young, who in moments of danger put personal safety, if not first, at least high up on the list of priorities. There may be others who, while not lacking the courage, fail to show the same persistence, aggressiveness or even resource in attack. In fact, if this were not so stoats would often experience thin times. In the same way, it is not a commonplace for shrews to defy cats or for geese to attack motor-cars, otherwise people would not write to the papers about it.

As between species there is even greater variation. In one species—blackbirds—both parents seem to be equally devoted to the care of the young even if their share of the duties is unequal. The hen does most

of the incubating, the cock springs most vigorously to defence in face of an enemy. In rabbits, on the other hand, although the buck is a persistent wooer, the doe must deposit her litter in a stop, a shallow burrow away from the main warren, otherwise the buck would probably kill the young ones. If she does have her litter in the main warren then she must guard them night and day, whereas if the litter is in a stop she visits them at night only and then merely to feed them.

It would be possible to fill a book with one after another of such examples, not only from among mammals and birds but from other levels of the animal kingdom, as low down as insects or even as low as worms that crawl on their bellies or swim in the sea. But all this information leads us to one conclusion: that at whatever level we find parental care we find species in which, on the one hand, both parents show devotion, even self-sacrifice, and, on the other, those in which the female alone shows these qualities and often must protect her offspring from the male. Why, if self-preservation is so compelling an instinct, should the presence of young, or even of eggs, cause such a reversal?

The usual assumption is that those species in which male and female share equally the responsibility for the young are relatively the more highly evolved. That is, however, based on little more than an inspired guess. Any reasoned argument to support it would run something like this. At the very lowest levels of the animal kingdom eggs are laid indiscriminately and, once laid, they must take their chance unaided. At most they may be retained within the maternal body to undergo the first stages of development. At slightly higher levels of animal life we find the occasional species that show a parental care. As we ascend the scale, parental care becomes more evident, the parental instinct finally attaining its fullest expression in the upper reaches of the animal kingdom, namely in birds and mammals.

This suggests that some mechanism in the life-processes is developing, somewhat erratically perhaps, with the increasing specialization in body structure. It is also evident that in its first stages, if not at all times, it is most strongly developed in the female. This is really no more than we should expect. It seems only natural that the maternal parent, responsible for carrying the egg—as distinct from the ovum—or the embryo, as the case may be, should show a greater attachment for something she has borne, which is, in fact, part of herself. Such an explanation may be commendable for its simplicity, but it would not explain the devotion shown by many male parents. Also, it would not explain, for example, why the hen red-necked phalarope lays the eggs

and yet the cock incubates them and tends the chicks. It would also leave unexplained the question of infanticide, which will be dealt with more fully later. And it would not explain adoption.

Behaviour in any given species is expressed today as a compound of inherited or innate releasing mechanisms which can be set in motion by sign stimuli from without. These sign stimuli may be sights, sounds, smells or stimuli appreciated through touch in its various forms. The sight of a nest may cause a gravid hen to lay, the touch of the eggs on the brood-patch on her breast causes her to brood. The smell of newly born puppies causes a bitch to lick them, thus cleansing them. The sight of a gaping nestling causes a bird to push food down its throat. When the puppy thrusts its nose against the maternal abdomen, the bitch in muscular response makes milk available to her offspring. Is it all as simple as this? Can maternal instinct, paternal instinct, infantile behaviour and all the rest be broken down into inherited behaviour patterns with their innate releasing mechanisms? Can behaviour be reduced to something approaching a series of coin-in-the-slot machines? Is there nothing to be said for retaining the concept of maternal instinct as a complex of reactions, or is it something called forth by relatively simple stimuli?

Let us start at the beginning once more. The ovum maturing within the body of the female gives out chemical messengers to the organs of that body. In response the body carries out certain actions to secure the fertilization of the ovum. In turn the fertilized ovum sends out further chemical messengers calling forth more responses from the maternal body. From the beginning, therefore, until the laying of the egg or the birth of the young, there has been complete liaison between offspring and parent. It seems the most natural thing that the bond formed between mother and child pre-natally should continue even if expressed in different terms, that is by sign-stimuli instead of bio-chemically.

The qualities of femaleness and maleness are not so fixed or so distinct as we normally suppose. It is possible even in the higher animals for an individual to change its sex after adult life has been achieved. The hen of the domestic fowl that grows wattles and a comb and crows is the best-known expression of it, but it is common enough in other species. There is also the frequency with which inter-sexes are met. In some species, indeed, there is a juvenile hermaphroditism and sex is determined by external conditions. This subject is, however, outside our present discussion and these few examples are given merely to support the assertion that, in plain terms, within every female there lurks to

Animals and their young: cheetah (*top left*), brown bear (*top right*), baboon (*centre*), koala (*bottom left*), zebra (*bottom right*)

some extent the qualities of the male, and *vice versa*. So, when need arise, the male parent will show the qualities of the female parent and will to a large degree take on the responsibilities of a lost mate.

We may conclude, then, that the innate releasing mechanism appropriate to the care of the young is dormant in the male in many species, is only partially called forth so long as the female partner discharges her functions, and comes out as fully as anatomical structure will permit in the event of her demise. The fact that it can emerge and be strong means that a bond between parent and offspring can be to some extent independent of pre-natal influences. This is supported by the manner in which a young bird or mammal, orphaned at an early age and hand-reared by a human being, will become fixated, as we say, on the foster-parents. In other words, the bond between mother and young consists of the following elements. The young is fixated upon the being (parent or foster-parent) from the moment it enters the world. The parent responds to the sign stimuli of the young through its innate releasing mechanism. And, where the mother is its true maternal parent, it is not unreasonable to suppose that pre-natal events may serve to strengthen the parent in its bond with the offspring.

In the present state of our knowledge it is not easy to probe satisfactorily the true nature of any innate releasing mechanism. It is like that of electricity, better known from what it does than by what it is. The stimuli bringing the innate releasing mechanism of the maternal instinct into play have, on the other hand, been subject to speculation although not to direct experiment. The suggestion has been put forward that for human beings the sign stimuli calling forth the parental instinct are a short face in conjunction with a large forehead, protruding cheeks and maladjusted limb movements. This hypothesis is supported so far as human beings are concerned with three main arguments: that dolls are fashioned to meet the demands of the human innate releasing mechanism (or parental instinct); that the film industry is striving to produce the ideal baby or child to appeal to its patrons; and that childless women seeking substitutes for babies in their pets are prone to choose those with shortened muzzles or beaks, large foreheads and maladjusted limb movements.

It is conceivable that the hypothesis, in part or in whole, may have something to commend it although the supporting arguments seem to lack adequate foundation. It is surely natural, if a doll is to represent a baby, that its face should have a baby's features. But many a girl has expended all her juvenile love on a rag-doll with virtually no features.

Moreover, when war conditions made dolls almost a thing of the past, many thousands of small girls in Europe showed the same devotion to a piece of wood wrapped in rag as their more fortunate sisters elsewhere bestowed on expensive dolls with short faces, large foreheads and protruding cheeks.

As to the second argument, it is natural, surely, for the film industry to search for the ideal baby or child and for the same reason as it seeks out the (supposedly) ideal women and men. Moreover, to present the audience with a film-picture of a supposed child with long nose, small forehead and sunken cheeks would be to present something worse than a caricature, something the audience could not accept as true to life. On the other hand, Pinocchio was acceptable as a juvenile in spite of his long nose, which tends to undermine at least one of the arguments.

It may be that the third argument carries more conviction, yet plenty of childless women have confessed to bestowing on their pets the affection they might have given their children, and their pets have included dachshund, rook, magpie and others with long muzzles or beaks, flat foreheads and no cheeks to speak of. True, they also adopt cats, canaries and pekingese dogs that come somewhat up to the postulated standards, but the fact is that a woman, childless or otherwise, will be attracted to any young animal, whether its muzzle is short or long, its forehead large or not, or the cheeks protrude or are flat.

Perhaps the suggestion of an artist friend has something to recommend it: that all young animals are beautiful and this explains their attractiveness to the adult. That would, of course, connote an aesthetic sense in animals. But I must say that I saw little of beauty in the young yellow-hammer before it had grown its down.

It must be a matter of common observation that the fact of an animal being young is responsible for its attractiveness, for calling forth the parental instinct. It is not their helplessness—that is the maladjustment of movement—for a fawn, agile almost from birth, is as likely to evoke a parental response as a young rabbit hardly able to stand on its feet. Mere size may have much to do with it, for any average crowd of people will be far more interested in a model engine than the full-sized article. Indeed, the one way in which to interest an audience in any subject is to produce for their inspection a small replica of the article being discussed. Yet size cannot be everything, else the meadow pipit would not accept the cuckoo in the nest.

It is highly probable that the infantile features, such as the short face, rounded forehead and protruding cheeks, the helplessness or malad-

justment of limb movements, small size, complete absence of aggressiveness, and possibly other things besides all contribute. To varying degrees and in varying combinations such sign stimuli are effective in all species, human or otherwise, that include a parental care in their normal behaviour. In addition there must be sign stimuli peculiar to each species. Thus, a young thrush in a nest extending its gaping mouth upwards calls forth the parental instinct in an adult thrush. The response is an attempt to feed the youngster by thrusting food down its throat. The same sign stimulus from a young thrush could be effective with an adult blackbird, because the action is close to that performed by a young blackbird. On the other hand, a hen pheasant, the young of which can pick up their own food almost from the moment of hatching, would be unaffected by the gaping action. It would be without significance for a hen pheasant.

It seems there must be a broad basis, within the innate releasing mechanism of all species showing parental care, by which infancy is recognized and that some of the features of it are common to all those species. In addition, this general recognition of infancy must be more pronounced as we ascend the animal scale. In birds it is relatively limited, in mammals it increases with the specialization of the brain and reaches its highest expression in ourselves. Man will adopt almost anything, as witness his penchant for domesticating animals and keeping pets of all kinds. To try to reduce all this to a simple formula is to over-simplify to the point of delusion.

There is another aspect to this subject which justifies the space given to it here: that the stimulation of the parental instinct is not a one-way process. It is not alone dependent upon a series of sign stimuli but requires also a receptiveness on the part of the parent, and there can be little doubt that the ease with which the parental instinct can be called into play depends much upon the intensity of that instinct at the appropriate moment. In other words, it is necessary to see the innate releasing mechanism as a dynamic and not a static thing. A cat deprived of her kittens has been known to foster a family of young rats. With her whole body geared to the needs of her offspring, with her maternal instinct in full flood, certain features of the young rats change her mood from murder to mothering. It is possible to imagine two women, one of whom will respond to the slightest sight of a baby, or to its feeble cry, while the other will need to see the whole range of infantile features, short face, rounded forehead, prominent cheeks, maladjusted limb movements and the rest, even its plaintive wails, before she will pick it up and nurse it.

Not only will the parental instinct vary with the individual and in the

individual from one time to another, but it seems possible for it to pass readily into another instinct. How often do we see the young mother hug her baby and say something like: "You darling, I could eat you."

It is possible, of course, that such a remark has no basic significance, yet the fact remains that the maternal instinct can readily change into one less concerned with the welfare of the offspring—from mothering to murder, in fact.

It is often remarked that carnivores will on occasion eat their young. When this occurs it is usual to find some reason for it; and one that redounds to the credit of the (allegedly intelligent) parent. For example, a sow badger was presented to a zoo, straight from the wild. A day or so later she gave birth to a cub, which she devoured. One writer described the event in glowing terms: that the sow missed the smell of the earth and the vegetation, realized that here was onerous captivity, a place far removed from their beloved natural home in the wood and lacking freedom to mix with their fellows and do all the things that badgers wish to do. In short, no sort of place for her cub to live in; so she ate it. One could wish that this interpretation were correct. It would give an even greater romance to the study of wild life. Unfortunately it is probably not the correct explanation for the act of infanticide.

A more usual explanation is that animals will kill, and often eat, their young if they or their nest are disturbed by human hands. Certainly it does sometimes appear to be so, but taking all the evidence into account it would seem that there is another more feasible explanation. Putting the scraps of evidence together the story runs somewhat as follows. In nest-building birds there is an inborn tendency to keep the nest clean and the simplest way of doing this is for one or other parent to swallow any foreign bodies. These include the droppings of the young, fragments of egg-shell left after hatching, parasites and so on. If one of her own eggs becomes cracked accidentally the hen will eat it, merely to clear up the mess. It is but a short step from this kind of house-tidying to the parents eating eggs that are still whole. Predatory birds, such as jays and magpies, which often take eggs of other birds, kept in captivity under the best conditions and allowed the freedom of a large aviary, will sometimes dispose of their own eggs, either eating them or taking them away and hiding them. This is known although how they do it has not been observed. It may be presumed that something of the sort may take place in the wild.

Non-predatory birds may also do the same thing although the proof is not so easy to obtain and rests more on circumstantial evidence. A

typical example is of a pair of blackbirds that nested in the rose bushes outside a bedroom window three years in succession in such a position that every action could be observed by the occupants of the house without (apparently) disturbing the birds. Each time the eggs disappeared completely before hatching, the nest itself being undamaged and, so far as one could see, undisturbed. The eggs could, of course, have been taken by jays or magpies, or by rats or grey squirrels. The house, in the suburbs of London, was so situated as to make all these things unlikely. The regularity with which the eggs disappeared also casts suspicion on the blackbirds themselves. From such disconnected observations there are, at the least, grounds for suspecting that non-predatory birds are as capable of 'infanticide' as the predatory species. The habit of the domestic hen, of eating her egg as soon as it is laid, is well-known.

This seeming contradiction, that the parental instinct directed to the welfare of the offspring should be so readily replaced by actions directed to their destruction, is incomprehensible except in the light of what has been called substitution activities. These have also been called irrelevant behaviour, a more expressive term but one that has been largely ignored. Irrelevant or substitution behaviour is the performance of a normal activity in an abnormal manner. It results from a situation causing apprehension. Thus, it is normal for some birds to pull a nest to pieces to obtain material for building a new nest. Observers have noticed that when watching a bird on the nest, producing a state of apprehension due to the presence of a human intruder, a bird may start pulling to pieces the nest in which it is brooding. Given the possibility of an irrelevent switch in behaviour, parental devotion could readily be transmuted into some form of infanticide, if the destruction of eggs can also be so named.

Incidentally, the fact that the egg is taken away whole is not surprising. A blackbird or thrush will take a snail to a hard surface, such as a stone, to break its shell; a gull stealing eggs takes them away to drop them from a height; a rat or stoat on the same mission rolls or carries the egg away to eat it at a more or less distant spot; even a dog will carry an egg intact to devour it on firm ground.

Another form of infanticide is seen in such species as the herring gull. Nesting on the ledge of a cliff a gull will fight for the security of its nestlings. Should one of its chicks stray from the vicinity of the nest during the course of such an encounter, the parent bird will, as likely as not, having driven the enemy away, peck the brains out of the errant chick, later batter its body to a pulp and devour it. It is as though the

chick is recognizable as an offspring in relation only to the territory formed by the nest and its immediate vicinity. Similarly, should a predator kill one of the chicks, the parent will devour its carcase, although this behaviour must be regarded as in line with the general scavenging of the nest already alluded to.

Mammals are presented with a slightly different situation although their behaviour conforms to the same general principles as those seen in birds. In them we have the same inherent impulse to keep the nest clean, and this leads to swallowing the faeces of the young as well as eating the afterbirth. A relic of such behaviour can be seen even in those animals, such as cows and sheep, where there is no pretence even of making a nest. Although herbivorous they consume the afterbirth. In all, moreover, there is the practice of licking the young all over, a practice which makes for cleanliness although under other circumstances it can function as a gesture of affection. In mammals, then, it is conceivable that an irrelevant or substitution activity could result in a switch from sanitation (eating the afterbirth) or affection (licking) to actually consuming the young. It is not the handling of the young by human beings but the apprehension produced by their intrusion that gives rise to infanticide. Equally the badger's unnatural behaviour when incarcerated in a bare cage in a zoo was probably no more than an irrelevant or substitution activity.

Does the human mother's remark, while expressive of a deep affection, put into words something that lies deeply-buried in the recesses of her mind? Whatever doubts we may have on the stimuli needed to call forth the maternal instinct there is little doubt that the instinct itself can, in many animals, be readily transformed from protective to destructive, just as aggressiveness and submissiveness are apparently separated by a very thin line.

Before leaving this subject, so fruitful in material for endless debate, we might recall how the foster-parents of a young cuckoo, after trying to drive its mother away, will lavish their parental instincts on a youngster far larger than themselves. Such is the force of that instinct that a nesting bird, presented experimentally with eggs of varying size, will accept and try to incubate the largest of them, even if several times larger than her natural eggs. And a mother rat, under the urge of an exaggerated maternal drive, has been seen to fill her nest to overflowing with young rats not her own, baby rabbits and kittens, to the number of one hundred. Beside such performances the rearing of a young cuckoo by parents smaller than itself is child's play.

CHAPTER XVII

CONTROLLING THE FAMILY

THE main theme of infancy as revealed so far is that the offspring is equipped for survival. Complementary to this the behaviour of the parents alters radically so that their main preoccupation, either of the mother alone or of both parents jointly, is to aid that survival. Yet, in spite of all, animal populations remain more or less static over a period of years. In some species, notably in lemmings and voles, there are violent fluctuations in their numbers but these are cyclic. For several years their populations rise enormously only to return to normal. In lemmings the large increases in population lead to overcrowding, suicidal migrations, increases in numbers of enemies and, finally, as the result of heavy casualties, a return to normal numbers. In other species the increases lead to overcrowding and disease followed by a return to normal. Why then do those species which show no such violent fluctuations not show a steady increase since broods and litters usually outnumber the parents?

Mention has already been made of the fact that some birds if robbed of their eggs or young will lay more eggs to make good the wastage. We can set against this statistics showing the fortunes of young birds, which have been fairly fully investigated. Nests are sometimes robbed, by other birds or by four-footed thieves, but the percentage in the species studied is very small indeed. And of the nestlings from nests not totally despoiled all but the smallest percentage are successfully fledged. It is after they have left the parents that the heavy casualites occur among the young. We are without similar statistics for mammals but it is reasonable to assume that the same story could be told of their young. There are some mammals, however, with an ability to control the birth of young.

As a rule, the egg-cell begins to divide after fertilization and this goes on without ceasing until the animal is fully mature. In some mammals there is, however, what is known as delayed implantation. The egg-cell is released from the ovary and, being fertilized, begins to divide in the usual way up to what is known as the blastocyst stage. That is, a sphere of cells is formed, filled with fluid, and with a group of cells within the sphere destined to form the future embryo. The

blastocyst, or blastocysts if the animal produces more than one young at a time, should become attached to the wall of the uterus in the normal course of events. In delayed implantation this sphere, no larger than a pin's head, passes into the uterus but remains loose, lying dormant for a greater or lesser length of time.

Badgers pair at any time from mid-July to the end of August but the blastocysts may not be implanted until the end of the year. Then they become attached, and further development proceeds until some eight weeks later when the young are born, from the end of February to the end of April. On one occasion a female badger was caught and kept in captivity. She seemed sufficiently content with her lot, being allowed plenty of freedom in the stables in which she was housed. She had no mate, however, nor was it possible for one to have access to her, yet nearly a year later she gave birth to two cubs. The only explanation seems to be that she had mated prior to her capture, and that implantation was delayed until she had fully settled down in her new home. In other words, it looks as though a psychological upset had caused the blastocysts to remain dormant long beyond the usual span.

Delayed implantation seems to be a regular feature of badgers, stoats and martens, in the wild, and also of their domesticated relative the ferret. Stoats breed once a year, in April, and from July to February the females have unimplanted blastocysts. In March these become implanted and a month or so later the young are born, mating again taking place soon after. A similar thing occurs in the American marten, and investigations carried out on this animal suggest that if after mating they are subjected to increased illumination implanting will take place without delay. It is believed that the increased amount or duration of light acting on the eye influences the pituitary gland to secrete the necessary hormones. These act upon the reproductive organs to produce implantation of the embryo. In more romantic language, Nature, by means of the lengthening days, tells the female marten or stoat that spring is on the way, and the message is conveyed to her brain which sends out messengers to arrive ultimately at the blastocysts and tell them to carry on development.

There are, however, other causes of delayed implantation, and for one of these we cannot do better than turn to some recent investigations carried out on an Australian marsupial, the Rottnest Island wallaby. In the female wallaby an egg-cell leaves the ovary every month from late January to the end of October. At the end of January mating takes place and some twenty-six days later the young wallaby is born, enters the

pouch and becomes attached to the teat, as is usual in marsupials, and continues to be nourished from the teat for some three months. This gives a period of about four months from the time of mating to the weaning of the young wallaby. Just after the birth of this youngster, however, another egg-cell leaves the ovary in the mother and she again mates, and the chances are that the second egg-cell becomes fertilized. If this were to develop normally, she would give birth to a second young wallaby a month later and two months before the first was weaned. This would cause overcrowding in the pouch and the death of the second of her offspring. Such an unfortunate state of affairs does not, however, occur. The second blastocyst remains unimplanted until the first youngster is weaned.

That such a state of affairs is due to a biochemical influence within the maternal body can be deduced from a knowledge of the changes which take place in both its anatomy and physiology. The details of these need not be given here. It will be sufficient to say that they are known. A more direct proof can be shown, leaving no doubt that the implantation is governed by what takes place in the pouch. If the first youngster is removed from the teat, for whatever reason, suckling comes to an end, the flow of milk is terminated and the result is the equivalent of normal weaning. Within the twenty-six days the second blastocyst will have become implanted, development will have proceeded normally and the second youngster will have been born.

Delayed implantation may be due therefore to physical conditions such as the shortening of the day, to psychological upset, or, as in the Rottnest Island wallaby, to physiological causes within the mother's body. In the case of badgers, which are nocturnal, the lengthening day can have little effect unless it be the converse of this, the shortening of the night. Other Australian marsupials show this same delayed implantation. Some years ago there were two red kangaroos in the Philadelphia Zoo. The male died and subsequently to this the female suckled a young one in her pouch. As soon as this one had left the pouch she gave birth to a second, although a year had elapsed since her mate had died.

It is easy to see the advantages of this lull in the development of the blastocyst in wallabies and other marsupials. Clearly it ensures the maximum chance of survival of the offspring while ensuring a succession of them by preventing overcrowding in the pouch, and yet making certain of several births in the season irrespective of a mate being available when suckling comes to an end. The purpose in the case of

badgers, stoats and martens is not so obvious. It may therefore be profitable to look more closely into the family affairs of stoats.

As we have seen, the young stoats are born in April, and shortly after this mating takes place. If the fertilized egg proceeded then to run the usual course another litter would be born in May; and presumably the process might be repeated each month during the summer. Even if it stopped at the second litter, the female would still be burdened with two families of differing ages. Such a rapid succession of litters does occur in other mammals, but this is a point we must return to later. It is sufficient to say here that even a rapid succession entails no great drawbacks in an animal living on vegetable or other readily accessible food, whose youngsters can fend for themselves fairly soon after weaning. In a carnivore which must hunt its food, the offspring must learn to hunt.

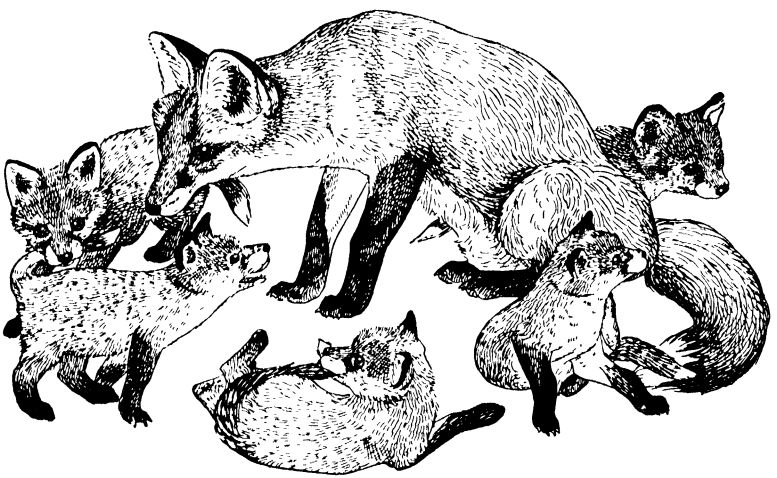
Young stoats, like the young of all carnivores, are born more or less helpless and must be sheltered and nursed during the first stages of their lives. The time comes, however, when the parent brings live but partially disabled prey for them to feed upon. This teaches them first to take solid food, secondly to kill and thirdly it initiates them into the not-so-gentle art of hunting. Later, when they are better able to go abroad, their education in this art is continued, for the family goes about in a party. Sometimes several family parties unite, thus giving rise to the stories of packs of stoats. Hunting live and usually speedy prey requires skill and a more or less extended period of time in which to develop that skill. This means, if nothing else, that the mother should not be otherwise encumbered.

Another advantage in the delayed implantation, at least as far as the stoat is concerned, lies in this, that the young female, born in April, is ready to mate at the age of two months. But for this provision, the young female stoat would herself be burdened with her own family before she had learned fully to look after herself.

There is, of course, no reason why such a method need be employed. It would be sufficient that a second mating should not take place in the one season, or that the young female should take longer to mature. It merely happens this way and we have to accept it and study the way in which one feature of the life of the stoat has come to dovetail in with another to produce the best results.

In foxes we have an entirely different situation, although they like the stoats are hunters, with the same need for extended education of the young. Foxes mate in January and in March or April the cubs are born.

There is usually only the one mating, and should the vixen be killed the dog does not take another partner. The cubs are suckled for eight to ten weeks before being weaned, but they do not have their permanent teeth until some sixteen weeks of age, when they are about three-quarters grown, full maturity being reached in a little over six months. There is the same 'education' of the young as in the stoat, and the same need for an extended period in which that education shall proceed. The difference is that stoats mate soon after the birth of a litter, while foxes do not mate until the following year. Thus there are two different methods of achieving the same result although requiring different internal histories.



Vixen with cubs

There is still a great deal to be learned about delayed implantation. In fact, the study is very much in its infancy, and it would be possible to dismiss it at this point as merely an alternative method of reproduction bringing advantages to parent and offspring alike, and, as a consequence, to the species as a whole. There is, however, another highly significant aspect, and one which bears closely on our main theme. We are accustomed to the general principle that life is the sum total of activity of the protoplasm, and that that protoplasm is in a constant state of change, of breaking down and building up. In the delayed implantation, however, we have something which must approach very nearly to a perfect state of suspended animation, otherwise the blastocyst of, say, the red

kangaroo could not have remained static for a period of twelve months. There may have been changes in the blastocyst during that time, but these must have been extremely slight, so slight indeed as to be virtually inappreciable.

The other lesson to be learned from delayed implantation is the intimate connexion between parent and offspring, even at this early stage, and, for that matter, between parent and offspring, on the one hand, and the external environment, on the other. Whatever may be the processes involved, whether lengthened hours of daylight, hormones, or anything else, the close connexion cannot be denied, and it is a connexion maintained by comparatively trivial events.

There is another field of the parent-offspring relationship in which similar lessons are to be learned. This can best be approached by way of a letter sent to me some time ago. The autumn and winter of 1953-4 were exceptionally mild, although there was some moderately severe weather after the turn of the year. At all events there were records of robins and blackbirds incubating clutches of eggs in December and January. The letter referred to spoke of a hare killed in December and containing young very near term. The writer asked several questions. Was this exceptional? Do hares normally mate in autumn and if so what happens to the young if the winter is severe? We can best examine the answers to these questions by enquiring first into the life-history of the hare.

There is quite an added point to this, for a résumé of what little is known of the infancy of the common brown hare, a creature familiar to everyone by name if not by sight, shot by the thousand every year, the centre of numerous legends and beliefs, is an indication of how deficient our knowledge is in regard to so many common things. We can leave aside the very ancient beliefs, now no longer tenable, that hares frequently change their sex, that they are of both sexes or that the female can bear young without the male. Similar things have been said of other mammals, such as hyenas. But if this gap in our knowledge has been sealed, there are many left unfilled. Even so, one of the more recent discoveries is almost as fantastic as the ancient beliefs about the animals' sex.

Turning first to what is not known, we can avail ourselves of quotations from one of the more recent standard works on the subject. In *British Mammals* by Barrett-Hamilton and Hinton (Part XII, page 285) we read: "It is impossible to say how many litters are brought forth by each doe during the twelve months. . . . The period of gestation is usually stated to be thirty days . . . it is probable that the period of forty-

two days mentioned by some writers is more nearly correct. . . . Superfoetation may be rare, as it is difficult to obtain satisfactory evidence of it; and in some cases the facts may be explained as indicating only a delayed development. A doe described by Dr. Cuthbert Johnson contained two lots of young; a single one with hair and open eyes, and three others bald, pink and about the size of full-grown mice. Captain Mayne Reid writes of another doe suckling two sets each of two young, but of different age, at the same time; but as the incident was not observed by himself, confirmation of the existence of such a practice would be desirable. Knowledge on these points is very meagre; but, if the period of gestation is forty-two days, if the young depend on their mother for three weeks, and if the doe, like the rabbit, pairs again shortly after parturition, then one litter should be off the dam's hands sometime before the birth of the next. If the period of gestation lasts only for thirty days, then one litter would run more closely on the heels of its predecessor."

In a work at least as authoritative and certainly more recent, *British Mammals* by L. Harrison Matthews (1952), the writer contents himself with the statement that the "details of the breeding processes in the hares are not known with anything like the completeness that they are known in the rabbit". Piecing together such details as we know, we find that newly-born leverets are less thickly furred on the underside than the adults and are without the chestnut tints on the back. The ears are short, the tail less furry and the body lacks the long hairs of the adult. Otherwise they are born very like the adult, apart from the length of the hind-legs. Their eyes are open and they are able to run soon after birth, if not immediately they are born. And in a short while they come to resemble the parents more completely.

In proportion as the leverets have so complete a post-natal independence, the maternal instincts of the parent are little developed. She prepares no special nest or nursery. She does not pluck fur from her own breast as does the rabbit. At first the mother and litter are huddled together in the form, but in a very short time each leveret squats in its own form. There they are visited by the mother, usually after dark, to be suckled by her. The doe has been seen on some occasions, at least, to carry each leveret in turn in her mouth and place it in its separate form. The period of maternal feeding does not last long, apparently, and the leverets disperse, either of their own volition or driven away by the doe. Nevertheless, there is this to be said for the doe: she will fight courageously in defence of her young, and in order not to give away the presence

of her leverets she departs from her young with an enormous leap—one leap of 15 feet was measured in the snow.

Another point in doubt concerns the size of the litters. J. F. M. Dovaston, in the middle of the nineteenth century, kept a number of hares in captivity but with comparative freedom in a wire enclosure. According to his great-nephew, W. D. Dovaston, the litters always consisted of five. This conflicts with other results obtained from several reliable sources, and from these it seems that the young doe does not breed until a year old. Her first litter usually consists of one young, sometimes two, her second litter of three or four, her third of three, and her fourth of one or two. There is also the belief among those who have studied the subject that the more litters produced in one season the smaller the number in each litter. This seems to be supported by what is found in the higher latitudes. In the barren grounds of Greenland and North America the Arctic hares have fewer litters than their more southerly relatives but each litter comprises eight, nine or ten.

It can be misleading to adduce supposedly supporting evidence of this kind since litter-size varies with the species. There is, of course, a general tendency for the smaller animals to bear the more bigger litters, but in many species, including mainly those in which the adult reaches a moderately large size, the first litters, clutches or broods include few offspring. In them there is also a tendency towards the production of fewer offspring under circumstances giving a greater chance of survival. So the general statement can be made that within closely related species there is a flexibility in litter-size, the numbers being influenced by weather conditions, the availability of food, the health and age of the parents and other circumstances such as the psychological state of the parents. This again is a field of study that remains as yet relatively unexplored, but mention of it brings us back to one form of control of litter-size recently investigated in hares, namely the reabsorption of embryos.

Investigations carried out on the brown hare of the Caucasus and that of the region around Moscow have given an interesting series of numerical results. In the Caucasus the brown hare breeds all the year round, with a peak in spring and early summer, very much as in the brown hare in Britain. The average numbers of embryos carried at one time by a single female are 3·7 in summer and 1·7 in winter. The number of young born averages, however, only 2½ per litter and a total of 10 for the four litters in one season. There are, therefore, some 16 per cent fewer young born than egg-cells fertilized, and this is explained by the

reabsorption of a percentage (16) of embryos during the period of gestation. In other words, a proportion of the embryos reach a certain stage of development, when their cells begin to disintegrate and their substance is taken back into the body of the mother. This reabsorption has been suspected or known for a long time in many species, even on very rare occasions in the human female.

Contrasting with the Caucasus hares, those of the Moscow region produce only two litters a year, with averages of three embryos in spring and five in winter, giving an average of seven young for the year as against the 10 for the Caucasus hare, with a reabsorption rate of 14 as against 16 per cent.

It is possible to give these figures but without drawing any firm conclusions from them, the study being in its infancy. Nothing is known about reabsorption in our own hare or in related species of hares. The main interest is, however, that this reabsorption can take place and that it can vary not only with the individual hare but from one region to another. Presumably, therefore, like delayed implantation, it is subject to influence from climatic conditions, and, by analogy with what is known of delayed implantation, it is not unreasonable to suspect that it may also be subject to influence from the psychological condition of the maternal parent. More is, however, known about the reabsorption of embryos in the female rabbit.

Contrary to popular idea, there is a well-defined breeding season, from January to June, with a peak in March, although mating may occur over a longer period. The litter is born approximately a month after mating, and immediately after this mating takes place again. There is, therefore, a succession of litters at more or less monthly intervals.

The litters number three to six, the number varying as in the hare in the course of the season, but seven and eight to a litter has been observed and even as many as fourteen, although in the case of these higher numbers it is probable that they represent more than one litter. The control of numbers in rabbit populations, referred to earlier, is dependent upon the reabsorption of embryos similar to that described in the hare, but to an extent which is little short of remarkable. Perhaps it should be admitted that the phrase 'to breed like rabbits' is correct. What is misleading in the phrase is the suggestion that rabbits attain the highest rate of multiplication. The two things are not the same. It has been found in a population of rabbits in North Wales that from mid-March to mid-May more than 90 per cent of the females were

pregnant and most of them had already been pregnant once before in the season. At the same time, it was also found that 60 per cent of all the litters conceived were never born. Even in the litters born, some 10 per cent of the embryos were lost before birth. Most of the litters so lost reached the twelfth day of development and then disintegrated and were reabsorbed, while some were reabsorbed at an even earlier stage.

The process of reabsorption is extremely rapid, no more than two days elapsing from the first signs of degeneration to the complete disappearance of their remains. Further, as soon as it is complete the female behaves in every way as if she had just completed a successful pregnancy. The cause is so far unknown. It seems to have nothing to do with the size and condition of the mother, or whether the litter is the first of the season or not, whether the mother is suckling or not or whether she has already lost a litter or not. There are no signs that it is due to a disease, lack of food or any physiological derangement in the glands normally controlling the pre-natal growth.

While the cause of the reabsorption of the embryos is not known we know how it takes place. At an early stage in development the embryo bears a small yolk sac. This is normally filled with a clear fluid, but in an embryo about to be reabsorbed the fluid turns to a cloudy jelly, due it is believed to the presence of fibrin. This is the substance in blood which causes it to clot and there seems to be little doubt that the fibrin is passed into the yolk sac from the maternal blood.

This remarkable story of the reabsorption of the embryos is a recent discovery and very far from complete. Even as much as we know emphasizes, however, the close connexion between the parent and offspring at all stages, but it goes further and suggests a subtle chain of events by which the future of the offspring is influenced by the conditions under which the parent is living.

Returning to the letter, mentioned earlier in this chapter, which told of a hare containing a leveret in December, the answer could take the form of one of two alternatives. It could be that this event is less unusual than we might suppose. We have already seen that little is known about the breeding habits of the hare, but we have also seen that a jump of 15 feet was made *in the snow* by a doe departing from one of her leverets after having suckled it. A second answer might be equally plausible, that in a normal season, with less mild weather in autumn and winter than the one in question, conception might take place and the embryos be reabsorbed in response to severe climatic conditions. The

results of the investigations on the Russian hares makes this at least feasible.

All this makes it reasonable to suppose that the body of a hare or a rabbit is highly susceptible to change in the outer world and can set in train events leading to the destruction of the future offspring if conditions for their welfare are likely to be unfavourable. It is a short step from this to similar or to other totally different changes in the outer world acting through the psychology of the mother to produce the same result even after the young one is born. In the present state of our knowledge this is and must remain pure speculation, but it is speculation based on observable fact and therefore justified. We know infanticide does take place. There must be a reason for it, and the explanation given here is no more fantastic than the proven phenomenon of reabsorption. The main difficulty against substantiating it is that it is so much more difficult to analyse a psychological cause than a physical one.

CHAPTER XVIII

INFANT CRIES IN THE NIGHT

THE study of the more obvious aspects of animal infancy is no more than a necessary preliminary to the study of deeper problems. A few of these are touched upon lightly in the ensuing pages, and we can conveniently start with the story of the trapped hedgehog.

Darkness had barely fallen, on an evening in late spring some years ago, when I heard piteous cries coming from the woods opposite my house. They were sufficiently loud and unlike anything I had heard before to draw me to find out what it could be that was making them. I took a torch and set off into the woods. Even by day, the cries of animals have a curiously ventriloquial quality, especially when heard in a wood. By night they can be even more misleading. It was not long before I found myself scrambling through thick brambles, negotiating ditches, pushing my way through thorn hedges and finally climbing a barbed-wire fence round an orchard that backed into a wood. Eventually, I found the cause—a hedgehog caught in a trap.

Unfortunately, there was no simple way of helping it. In the orchard was a hen-house, surrounded by a high fence of wire netting, and it was within this that the poor beast was caught by one leg. It might have been possible to tear the fence by force, but this seemed hardly justifiable, while an alternative remained. That was, to go back to the road, make my way to the house and ask permission of the owner of the orchard to go in and rescue the hedgehog. The way back proved even more troublesome, and, having fallen in a deep ditch hidden by grass, I finally hobbled up the drive to the house with a badly twisted ankle. In the house, the downstairs windows were all in darkness, those upstairs being lighted, showing clearly that the household were retiring for the night. I stood irresolute, looking first at the lighted windows, then at the bell-push, while listening to the cries still coming from the orchard, and trying to keep the weight off my injured ankle.

It was probably the coward's way out, but I reasoned that since those in the house could hardly fail to hear the cries, yet were not even bothered by them to the point of looking out of the window, there must be a ready explanation. It could be that the trap had been set precisely for the purpose of catching the hedgehog, which may have

formed the habit of stealing eggs from the roost. In such a case they would not thank me for knocking them up at that hour of the night. Eventually the throbbing ankle won. I went home.

In imagination I continued to hear those cries at intervals for several days afterwards, but in proportion as the humanitarian in me became stilled, the scientist in me—if I may so glorify the spirit of curiosity—gained the upper hand. A question remained unanswered in my mind. While watching through the wire fencing, with the beam of the torch full on the hedgehog, there had been imprinted on my memory a picture of the beast's efforts to free itself. First it would struggle violently to free itself, heaving its body off the ground in its efforts to accomplish this; and during this time it made virtually no sound. Then, it would sink down, raise its head until the snout pointed upwards, open its mouth and cry out. So it alternately struggled silently and relaxed to cry out. Assuming the pain to be greater when it tugged at the leg it seemed reasonable to suppose that the cries were not merely from pain. Rather, it seemed that they were in the nature of calls for help. But what help could a hedgehog hope for? From a human being, perhaps, if the fence had not been in the way, but we can dismiss the idea that the animal expected any help from that quarter. It is difficult to believe that hedgehogs ever rescue each other from such a predicament, or would be capable of doing so even if they had the urge. It could be possible with some animals and there are reliable stories to show that attempted, even successful, rescues are made by rats, foxes and others under similar circumstances. With hedgehogs this would appear unlikely. If, then, the cries could avail nothing, why were they made? This was the question that recurred for me during the ensuing days.

We can only guess at the answers to such questions, and often the best guess rests on an analogy. In this case, I could not help comparing the episode of the trapped hedgehog with another event involving human suffering. It was Christmas Eve, a time when even the more trivial troubles of human beings present themselves more poignantly than usual. I was hurrying home to be with my family, and as I approached the railway-station, a small crowd blocked the entrance to the station. At the centre of the crowd a youth, of perhaps seventeen years, lay on the ground, held there by two policemen. From the comments of the crowd, as I pushed my way through them, it was obvious that the boy was under arrest. The sympathies of the crowd were clearly with him, prompted no doubt by the nearness of Christmas,

yet from the little I saw it could be presumed that there had been reason to arrest him, and that the restraint being imposed on him by the policemen put him in the category of the 'tough guy'. The youth's reaction to all this was to cry bitterly and call for his mother. Had she been there to hear him she could have had no hope of rescuing him; and had he stopped to think he would have known this, as certainly as I did. But this was the sort of moment when neither human beings nor animals stop to think and, as a consequence, reveal deeply embedded instincts.

This crying for help, whether help is possible or not, whether by a hedgehog trapped or a pseudo 'tough guy' in similar plight, has a uniformity of pattern. In the case of a human being, we know from the words used that it is a harking back to infancy, to the time when the slightest cry of distress will be speedily answered, by one person or another, and especially by the mother. We can only suppose, therefore, that the pattern is the same in the hedgehog, but is less obvious only because the animal lacks the power of speech, of framing words.

It is not only the half-grown hedgehog or the youth who cry out in this way. The octogenarian, surrounded by her grown family, anxious and ready to help, will cry out in her death-bed agonies to a mother dead fifty years ago. Clearly, the instinct as we call it to cry out for the maternal parent is uppermost in infancy, becomes more or less submerged in the mind with the attainment of the adult state, but is never completely lost.

There is another side to this picture: the response of the mother to such calls. Many a man must have had the experience of having been partly awake in the night, not fully conscious perhaps, but sufficiently awake to know that his wife is in a deep sleep. Suddenly she has jumped out of bed, fully awake, and on being asked the cause of this sudden disturbance, has indicated that she has heard their child, in an adjacent room, cry out. Yet the father has not heard this subdued call from his offspring. There are no statistics, so far as I am aware, on this and it may be that not all fathers are alike—or mothers for that matter. At all events, I have had this experience on many occasions. And it is not a question of being hard of hearing. And so far as I can gather my experiences are not unique.

There is another experience that must be almost as common, although possibly its significance usually passes unnoticed. It runs as follows. The child is asleep in the bedroom during, say, the afternoon. The mother is in the garden talking with a group of visitors. Suddenly

she makes her excuses and hurries into the house. Through the hubbub of conversation she has heard her child cry out, not necessarily in distress, merely cry out as a child will do on awaking and finding itself alone. In all probability, as she goes away from the group, the conversation dies down, yet even then the father cannot hear the child's cries. Although this is recounted here in general terms, it is something I have myself noted particularly on several occasions. Again, it is not a question of inferior powers of hearing on the part of the father.

These two kinds of experience may, as I suggest, be common enough. They may also be due to a misinterpretation. It may be that there are as many times when a mother jumps out of bed because she thinks her child is crying, or rushes into the house to find it is a false alarm, but that we remember only those occasions when she has done one or other of these when there was real cause for her doing so. We need to be as sure as possible on this point, for its implications are fundamental to our argument. In other words, are we to believe that a mother is so extraordinarily sensitive to the call of her offspring, or do we delude ourselves? As I say, there are no statistics to guide us, the experience of any one person is limited in this matter, and therefore the conclusions each of us will draw will be based somewhat on individual experience, and to that extent upon uncertain grounds. I, myself, am convinced that there is some truth in the belief that a maternal parent is so much more *en rapport* with her offspring, that she has a sensitivity which, as a rule, the paternal parent does not possess.

My belief goes even further. There is the instance, for example, of a friend of mine going out to dinner and leaving her baby in the charge of a sitter-in. Everything went according to plan and quite normally until the waiter was actually serving the food, when she suddenly jumped up and declared that she must go home because something was wrong. It transpired that, on reaching the house, she found the sitter-in neglecting her charge, and the room in which the baby was sleeping beginning to fill with smoke from clothing that had accidentally fallen against the gas-fire. It is certain that there are other such experiences. On the other hand, it may be that many mothers have had such presentiments of danger, have rushed back to the house only to find everything normal. As I have said, and must repeat, these things are not sufficiently documented and so we can believe or not according to taste.

There is yet a third category of experience, one to which I can again most usefully contribute from personal knowledge. At the end of World

War I, I found myself at Namur, whence I came home on leave. I had been expecting this for several weeks, but in wartime leave is so frequently cancelled, even at the last moment, that I scrupulously avoided giving any hint in my letters home that there was any hope of my returning. Without labouring the point, it can be taken for granted that nobody at home could have any reason to suppose that on Christmas Eve, 1918, I was setting out in the usual horse-truck, across Belgium and France, *en route* for London. We arrived at Calais on the Boxing Day, and for a while there was some doubt whether we should make the crossing that day. We sailed at dark, and by the skin of my teeth I caught the last train to London from Dover. At no point throughout the journey, therefore, could I myself have had any certain knowledge that I should arrive home at about midnight on that Boxing Day. Less still could any of my people have known, first that I was on my way, and secondly, that I should arrive home during the course of that evening (that is, before midnight).

It had been our custom, as a family, for as long as I could remember, to spend the evening of Boxing Day with my godfather and his family. Even in the disturbances of war, with members absent from both families, the custom had been maintained. On this particular occasion, my mother had obstinately refused to go, had equally obstinately refused to give any reason, and, as the others were setting out, and not until then, she remarked casually that they must not be surprised to find me home on their return. Which proved to be the case. This has always struck me as a remarkable thing. I can still recall how I entered the room unannounced to be greeted, after the absence of a year, as naturally and with no surprise on my mother's part, as if I had been away only for a day. I can picture her now, sitting smiling contentedly at me as I opened the door and looked into the room.

During the intervening years, I have many times recounted this story, on appropriate occasions, and as often as not have found my hearer respond with one from his own experience which closely paralleled my own. In all the stories I have heard it has always been the mother that showed this uncanny pre-knowledge, not the father.

I must repeat, that stories of this kind are convincing only to those who have experienced them, that there is in them always an element of doubt that appearances may have been deceptive, that we may be reading into them more than is justified. And, in any case, they do not constitute scientific evidence, in the strict sense. Indeed, the scientist is usually contemptuous of their use in arriving at solid conclusions.

Their common occurrence, relatively speaking, the similarity of their pattern, and many other features, do suggest, however, that they cannot be entirely dismissed as fanciful. They are, indeed, the only evidence we have on the point I wish to make. At the least, they suggest some means of communication between parent and offspring, and more especially the maternal parent, which is independent on occasion of normal means of communication, even independent of the normal senses; and on other occasions, they seem to afford evidence of a sharpened sensitivity in the mother outside that of the normal senses where the welfare of the offspring is concerned.

The case for acceptance of such a suggestion rests, as I say, and would stress, on an insecure foundation, on hearsay rather than scientific evidence, but more especially upon premises that cannot be tested in the laboratory. It is presented here because it poses a question to which a satisfactory answer is not possible without exploring as much as possible what is known of infancy, and the relations between parent and offspring, from conception to the severing of the offspring's dependence upon the parents, or even beyond. It challenges a comparison between what we ourselves know by experience of human infancy and its ramifications, with what we have been able so far to observe, deduce or otherwise investigate of infancy in animals. The examination of data and statistics, of simple reactions and responses, provides stimulating mental exercises but in so far as they are not related to deeper problems they are largely purposeless.

There is yet another human experience which can be profitably recalled. It illustrates not only the close physical bond between parent and child in the pre-natal stages but also the changed mentality of the mother. I refer to a letter that appeared in one of the daily papers during the London blitz. It was written by a woman to show the effect of a pregnancy on her attitude to the air-raids. In it, she remarked that even during the heaviest air-raids she was less afraid than on previous occasions since her thoughts were more on the new life within her than on the prospect of death. The same or similar comments were made by other women at that period. This evidence is, to my mind, particularly valuable. We can divide human behaviour into that which is rational and that which is unreasoned—not necessarily irrational—and which, for want of a better word, we can call intuitive. There is no clear line of demarcation between these two forms of behaviour, but few will deny that it is at times of extreme danger that the non-reasoned or intuitive behaviour is markedly in the ascendant. At such times, actions and

thoughts tend to be abnormal, the veneer of civilization or education tends to fall away, and deep-seated primitive behaviour gains the upper hand. At such times, the boundary between man and the brute becomes even more ill-defined, so that we may have a fair confidence that what takes place in the body or mind of a human being at such time can be matched by similar events in the bodies and minds of animals, and especially of those highest in the animal scale. Indeed, we may go further and argue that while a woman may bring reason to bear in her care of her child, the impulses and springs of conduct during parenthood are more under the control of the non-thinking parts of the brain than is the case for any other department of human activity, except perhaps love-making or quarrelling. It is precisely these which are so difficult to analyse. And if they are difficult to analyse where we ourselves are the subjects, how much more so will they be where the lower animals are concerned.

CHAPTER XIX

DAWN AND TWILIGHT

WE have examined the relationships between the young animal and its parents, with illustrations from both birds and mammals. This has served to emphasize one thing especially, that the actions of young animals, and indeed of their parents, are to a large extent predetermined and beyond the control of the individual. As we have seen, the lives of birds are characterized first by simple reactions to external stimuli, nearly as automatic as the working of a machine when a coin is inserted. Then, as growth proceeds, more and more of these inner mechanisms emerge, all finely adjusted to the needs of living, and all having a similar automatic character though slightly more flexible and adaptable. The cumulative effect of these is to produce an organism which, when it leaves the shelter of the parent's care, is already largely capable of a full and independent life. All this is accomplished by unfolding of potentialities contained within the body of the animal itself, with little or no teaching on the part of the parent. If education there be it must be mainly by the environment, for we have seen with the young rabbits and squirrels—and the same is true for hand-reared birds, provided they receive adequate food and shelter—there is no obstacle to their full and complete development. But the forces of the environment have no power in themselves except in so far as they serve to draw out what is already latent within the living organism. Were this not so, then the lifeless pebble lying beside or beneath the bird's nest, and therefore subject to the same environment, would develop similar potentialities to the young bird lying within the nest.

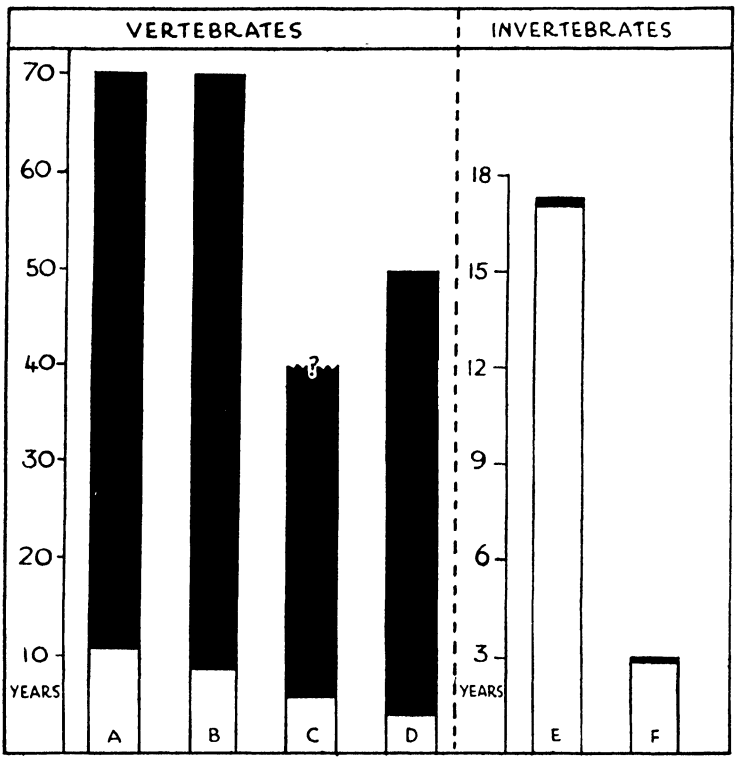
Herein lies, perhaps, the true meaning of infancy: that the young animal develops, as a tree unfolds, from a minute seed to mature growth, drawing upon the surrounding world for the substance of its body. Infancy is, then, a time of rapid growth, expressed especially in the increasing size of the body. It is also, though less obviously to the eye, a period of rapid growth of the mind, if by mind we mean the complex of reflexes and reactions, of emergent skills, of skills developed by imitation, habit and trial-and-error learning. But all these things take place in any animal, whether it be the young jellyfish, worm, crab

and all the rest, even if their lives are less complex. The word 'infancy' could therefore be used in a wider sense to denote the early development of any animal. If, however, we have chosen to restrict the word to the early stages in the lives of warm-blooded animals, it is because with them the parent forms a conspicuous and ever-present part of the offspring's environment, especially equipped to respond to the offspring's signals and itself capable of signalling back.

The tie between infant and parent is so close as to constitute, as we have seen, a form of parasitism. This is the more obvious in the early life of a young mammal within the maternal womb and feeding at the expense of the mother. As in all such forms of parasitism, the parasite not only feeds at the expense of the host but induces changes in the body and the behaviour of that host. This is also true for birds where the parasitism is less direct. The injury-feigning of ground-nesting birds is one example of the change in behaviour. The belligerence of nesting birds, otherwise shy and timid, in the defence of the nest or young is another. There must be many and more subtle expressions of it. In fact, as we know only too well from our experience of fellow human beings, the onset of parenthood is marked by physical and mental changes from which there is no return.

There is another aspect of infancy which if not novel is at least not so readily expounded. The female mayfly lays her eggs and within a day or two at most of doing so is dead. The larvae hatching from the eggs live for three years before changing into pupae. Within a very short time they emerge as full-grown insects. The larval life is therefore three years, the adult life at most three days. Which then is the insect, the larva or the adult? In fact, the adult mayfly represents no more than the reproductive stage, the stage necessary for the continuation of the species. The larva which, if our definition of infancy were extended to include the immature stages of all animals, is the infant insect, represents the whole of the life cycle of the species except for a very brief period necessary for the continuation of the species. The ratio between the length of the larval life and that of the adult mayfly is not exceptional. Plenty of other examples can be found among insects. The most remarkable is seen in a cicada, the so-called seventeen-year locust of North America, of which the larva lives for seventeen years under the ground. At the end of that time it pupates and quickly emerges as an adult to spend its time singing and reproducing.

Throughout this book it has been assumed that infancy is that period during which an individual is dependent upon its parent or parents.



Infancy and adult life compared. In vertebrates the period between first maturity and death far exceeds the span of infancy, the reverse being true for invertebrates

A. Man. *B.* Indian elephant. *C.* Dolphin. *D.* Cockatoo. *E.* Seventeen-year locust. *F.* Stag-beetle

Now we seem able to take this a step further and divide the lifetime of a vertebrate into two distinct phases, an infancy and a reproductive phase, like those of the mayfly and the cicada but with the ratios between the two reversed. We can, therefore, quite arbitrarily, accept infancy as the period of close parent-offspring relationship, even to a period slightly beyond it, and, if only for purposes of argument, regard the life-span of vertebrates, and of birds and mammals in particular, as divisible into these two main phases, infancy and the reproductive stage. If we assume this, is there any justification for supposing that vertebrate infancy bears any comparison with the larval life of the seventeen-year locust? In both it is a period of intensely rapid growth.

but the comparison seems to end there. In the higher animals we have been considering it is a period of very rapid learning, during which the senses are functioning at their maximum. It is the heyday of life, when play is most spontaneous, when the organism is blossoming forth to reach its prime with the onset of maturity or adulthood. Thereafter, there is a decline, gradual at first, but soon becoming more marked as the normal reproduction phase wanes and finally draws to a close to merge into the onset of a senility foreshadowing the end. This is a somewhat depressing summary which forces us to two interesting speculations having the appearance of fairly solid conclusions. The first of these is that this prolongation of the reproductive phase in the vertebrates is a necessary corollary of many of the things in which the vertebrates contrast with the invertebrates. It also suggests that when we speak of a second childhood we are, in fact, nearer the truth than we normally suppose, except that there is a marked loss of vitality as compared with the first childhood.

In infancy, then, there is a period of rapid growth and rapid development of the mental faculties. The tissues are in their prime, metabolism proceeds at a high rate. The more prolonged the period of parental protection the greater are the opportunities for the emergence not only of reflexes and innate reactions, but also of innate skills as well as learning, whether by imitation of the parents, by trial-and-error or by play. Under these circumstances the conditions are favourable for the exploitation of a more specialized brain. What this means can best be seen by comparison and contrast. A reptile hatching from an egg and thereafter having to make its way unaided in the world could not make full use of higher and more adaptable mental powers. Its need is for the maximum endowment of automatic behaviour so that its responses to the hazards of living come instantly. A wide plasticity in behaviour, without the security afforded by an experienced guardian, could lead to great dangers. The young animal is naturally inclined to take greater risks in the experimentation of living. The better its brain, and the wider its range of behaviour, the more the dangers if it has no parent to guide or protect it. In short, a reptile is not ripe for the use of a better brain, and for any reptile to be born with the brain of a mammal would be like putting a jet engine into a Bleriot aeroplane. Disaster would soon follow.

Although birds are warm-blooded, so that the way to a higher brain is now more open, there is the drag imposed by egg-laying. We have seen in our story of the yellow-hammer the disadvantages of

incubation and nest-feeding to the parent. The situation can be described expressively if not fully accurately by saying that any bird with a finely-developed brain would die of sheer boredom through the monotony of incubating and nest-feeding. The internal development of the young and the feeding by suckling confer on mammals numerous advantages which have laid the way open to advance and specialization in every way, and more especially in the direction of mental abilities. In them we have the high-powered engine fitted to a fuselage that can stand up to it. It has its disadvantages too, of course. The higher or more complex an organism, the more vulnerable it is. The simpler and more primitive forms of life have in many cases a better chance of survival in the world today.

The mere lengthening of the period of infancy is not the whole story. Platypus is still hampered to some extent by egg-laying but it has the advantage of suckling its young. This has reached a further stage in the remaining mammals in which egg-laying has entirely disappeared and the young are either carried in the pouch or in the womb. The next important step lies in the reduction of the number of young at a birth. A parent with but one infant at a time to care for is able to give full attention to that one; on the other hand a litter has advantages, since the several members of it learn from each other and by contact with each other. The maximum benefits are where the two types of family are combined. This is when the first-born remains with the parent after the birth of the second and even the third, giving rise to a family life. This condition is found in porpoises, elephants and man, to mention merely three, and these are among the socially more successful species of mammals.

In the wild, animals are rarely permitted the luxury of dying of old age. Conditions are too rigorous, and the onset of senility is usually marked by violent death or death from starvation. Captive and civilized animals on the other hand can run the full cycle, and in them we see that life ends with shadowy similarities to the way it began. In the human species, the one with which we are all most familiar, the infant is born without teeth, with unseeing eyes, with non-functional hearing, usually with no more than a scanty covering of hair on the head. It is helpless in every way, needing to be fed, incontinent of bowel, and in every way requiring attention and petting. Extreme old age was summed up by Shakespeare: ". . . Sans teeth, sans eyes, sans taste, sans everything." And he could have added, "sans the vitality which an infant has in abundance".

There is neither profit nor enlightenment to be obtained in pressing this point further, but in contemplating this rough similarity we can see the life of any individual, fortunate enough to run the full span, as a rise and a decline, the end being a return to something approaching the same point as life began. In the decline the conditions characterizing the rise (i.e. the infancy) are approximately reversed. This enables us to express the life-span of the individual in the form of a diagram, with infancy marked by a rapid rise in all the faculties, maturity or the onset of the reproductive phase continuing the rise for a brief period before beginning again to fall, the fall continuing and accelerating as the reproductive phase draws to its close, and, finally, a sharp decline as senility leads to the inevitable end. In such a diagram we can draw a horizontal line at the peak of infancy, and the continuation of this line should emerge somewhere near the point at which the decline due to senility begins. The area below this line could then be regarded as the foundation of the individual's life; that above it is the parasitized stage, the part concerned with the perpetuation of the species. This latter is in a sense superimposed. It is not necessary to the individual as such, since life can be lived without giving rise to offspring. During it the individual is exploiting and no more the solid foundation of physical strength and mental development bequeathed by infancy. The main characteristics of infancy and the heritage of infancy persist throughout, although masked and overlaid by the adult characters. Some may be dormant, but in the main they are the solid foundation to the wall of life, and when the wall finally totters and collapses the foundations are once more revealed. So can we explain, if somewhat crudely, the similarity old age bears to infancy. So also can we understand, what is an observable fact in humans, that the memories of youth return with renewed and unhampered vigour in old age while the more recent memories of adulthood tend to recede.

So far as infancy of animals itself is concerned our knowledge resolves itself into a fairly solid substratum of the study of instinctive actions surrounded by a vague aura of other knowledge. So it is possible often to do no more than speculate, guided by straws of information, or to speak in the most general and the crudest of terms concerning familiar everyday phenomena. To have confined ourselves here to those things known for certain would have allowed us no more than a very restricted field in which to manœuvre. This alone justified speculation beyond the realms reached by systematic science.

Perhaps the most fascinating thought revealed by what we do know

of infancy is that within the confines of a single cell of microscopic proportions, the fertilized ovum, there should be contained the potentialities for the most remarkable unfolding of individual life. If the present germ of knowledge we possess is capable of similar development the full story to be revealed in the distant future will be entrancing beyond our present dreams.

NOTES ON FURTHER READING

FOR those who wish to take this subject further there are three books of general reading devoted particularly to the subject. Otherwise there are the highly technical volumes and the scattered notes in books and scientific periodicals. These three are:

The Childhood of Animals. By P. Chalmers Mitchell (Heinemann), 1912.

The Infancy of Animals. By W. P. Pycraft (Hutchinson), 1912.

Embryos and Ancestors. By G. R. de Beer (Oxford University Press), 1940.

The following yield additional information of a miscellaneous nature:

Zoo Life, Volume 7, No. 4, 1952 (a number specially devoted to young animals).

Snow White: the story of a Polar Bear Cub. By Jan Vlasák and Josef Seget (William Hodge), 1949.

A History of British Mammals. By G. E. H. Barrett Hamilton (Gurney and Jackson), issued in parts from 1912 onwards. (This gives much information on breeding seasons, habits, etc.).

British Mammals. By L. Harrison Matthews (New Naturalist, Collins), 1952. (With notes more especially on the physiology of breeding and infancy.)

The Study of Instinct. By N. Tinbergen (Clarendon Press), 1951. (With technical analyses of the principles underlying behaviour, more especially in the herring gull, much of which is repeated in *The Herring Gull's World*, by the same author (New Naturalist, Collins), 1954.

The Way Birds Live. By Edward A. Armstrong (Lindsay Drummond), 1943. (A simply written account of the biology of birds, with much valuable information.)

Maternal Behaviour in the Rat. By Bertold P. Wiesner and Norah M. Sheard (Oliver and Boyd), 1933. (A monographic account of nesting and retrieving behaviour.)

The Lore of the Lyrebird. By Ambrose Pratt (Robertson and Mullens), 1933. (A readable account of lyre-birds, including their young.)

The Handbook of British Birds. By H. F. Witherby (H. F. and G. Witherby), first published in 1940. (In the five volumes are given comprehensive details of nesting, eggs and juvenile plumage.)

The following volumes of the New Naturalist Monographs published by Collins are worth consulting for special studies:

The Badger. By Ernest Neal, 1948.

The Yellow Wagtail. By Stuart Smith, 1949.

The Redstart. By John Buxton, 1950.

The Greenshank. By Desmond Nethersole-Thompson, 1951.

Squirrels. By Monica Shorten, 1954.

The reference to Douglas Spalding's work (on page 56) is from J. B. S. Haldane, *British Journal of Animal Behaviour*, Vol. 2 (No. 1), 1954.

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