1

How could unselfish behaviour evolve at all ?

1.1 *Why does a sheep want to be in the middle of the herd?*

'A sheep kept alone on a farmstead is not a proper sheep at all,' says my son who has been working as a shepherd for several years. 'It will become neurotic and get a disturbed personality structure. Sheep are herding animals. They only feel well when there are other sheep to their right and left.'

I sometimes watched my son leading his herd to the pasture. The sheep graze hastily, as if somebody were hurrying them. All of them are pressing forward, wanting to be in the first row where they can get grass not yet trodden down. Occasionally one or two of them stop at some dainty morsel – to grab some climbing plants from the bushes for instance. But as soon as the others have proceeded a few metres, the stragglers are turning their heads towards them. The tasty morsel can no longer hold them. As if drawn by an irresistible force, they follow the others and push themselves into the middle of the group. They could, one might think, advance to the fringe of of the herd in order to reach the first row and good fresh grass as soon as possible. But no, they crowd in amongst the others where they must push hard and make great efforts to get to the front.

Why does the sheep want to be in the middle of the herd? 'It calls for explanation when a herd animal wants at all costs to be near a lot of other members of its own species', writes the Austrian ethologist Konrad Lorenz (1963/66, p. 140). 'The justification for this question will immediately be apparent if we consider the obvious disadvantages of big herds; for instance, the difficulty of finding enough food for so many animals, the impossibility of concealment, the increased predisposition to disease, and many other factors.'

If herd animals are to the smallest degree capable of defence against predators, Lorenz continues (*ibid*, p. 141), it is understandable that there should be safety in numbers. Indeed many species that live in herds have well-organized defence systems. The young are kept in the middle surrounded by older and stronger individuals, but even a fully grown animal is much safer in a group than alone.

In species in which only females and their young form herds whereas the adult males live solitarily or in loose groups, the strongest females bear the brunt of defence. In elephants this is mainly the 'matriarch', the oldest female of the herd and hence the largest and strongest, since elephants continue growing past maturity. 'The matriarch is exceptionally altruistic,' writes the well-known zoologist Edward O. Wilson of Harvard University in his standard work *Sociobiology – the New Synthesis* (1975, p. 494). 'She is ready to expose herself to danger while protecting her herd, she is the most courageous individual when the group assembles in the characteristic circular defense formation.'

In mixed groups of males and females, as formed by musk-oxen, buffaloes and many monkey species, defence is mainly a male job. In the Amboseli National Park in Kenya, Jane and Stuart Altmann (1970) observed the attack of a leopard on a group of yellow baboons at the edge of a water hole: 'The baboons sprang away, then turned on the leopard, barking loudly . . . Faced with this mass attack, the leopard turned and ran.' On the other hand the Swiss ethologist Hans Kummer has observed cases of baboons fleeing before wild dogs and relinquishing one of their females, though the males would have been well able to ward off the predators. 'If I were a baboon female,' he told me when I visited him at his institute in Zürich in 1980, 'I would not rely on the males to defend me in any case.'

This episode is an example of a phenomenon to which we will return again and again in this book: generalizing claims that members of a certain species 'always' behave in a certain way, are not usually correct. Animals are not pre-programmed automatons. Their behaviour is variable within certain limits.

A herd of sheep too is capable of self-defence. Mother sheep in particular can be very aggressive when trying to defend their lambs. They even do not hesitate to face the shepherd's dog which does not know how to behave in such a situation.

But why do herding animals crowd densely even if it does not

serve common defence? 'What advantage does close herding together bring to the completely defenseless, such as herrings or small birds in enormous flocks?' asks Lorenz (1963/66, p. 142). 'I can think of only one explanation and I offer it tentatively because it seems scarcely believable that a single, small, but widespread weakness in predators could have wrought such far-reaching consequences in the behaviour of their prey: this weakness lies in the fact that many, perhaps all, predators which pursue a single prey are incapable of concentrating on one target if, at the same time, many others are crossing their field of vision.'

Actually predators prefer hunting single animals that have lost contact with their group. Some birds of prey, like falcons, even carry out sham attacks and all sorts of manoeuvres to isolate some of their prey from the flock. The response of the hunted is to draw close together in case of danger, for, according to Lorenz, even as formidable a predator as a lion or a tiger tries to avoid obtaining its prey from a dense crowd.

When it does attack a herd, a predator has the best chance if it can concentrate on a certain animal that is conspicuous by its size (e.g. a young animal), its different behaviour (e.g. a sick animal) or its colour. Field ecologists have repeatedly noted that the marking of some individuals of a herd with coloured patches or bright collars greatly reduces their chances of survival (Wickler and Seibt, 1977, p. 150).

Thus, Lorenz's conjecture that predators have considerable difficulty in singling out prey from a dense and hastily moving crowd is well founded. Yet, it seems that he himself is not quite satisfied with this explanation. And indeed, as we shall see, it is only part of the answer to the question of why animals form herds.

For sociobiology, a behaviour pattern as common as the formation of herds, flocks, or schools evidently deserves attention. In the above-mentioned standard work of E. O. Wilson one can find a lot of pertinent material. The author is an entomologist, fascinated especially by the social insects, and he began to search for comparable phenomena in other animal species to understand better the mechanisms of evolution of social behaviour. His voluminous publication was a landmark in the establishment of sociobiology as a discipline in its own right.

Wilson has studied an immense amount of literature. The

bibliography of his main work comprises no less than 65 very large pages and contains more than 2500 references. Evidently he tried to collect as much material as possible and to arrange it in a systematic way. This alone was a very useful contribution, highly valued even by biologists who do not share all of his views. For it turns out that many questions more or less answer themselves if one merely collects all the available evidence.

The reasons for sham attacks on falcons, for instance, are more substantial than the mere inability of the predator to concentrate on one victim within a flock. Already in 1951 Nicolas Tinbergen, the Dutch ethologist who received the Nobel prize in 1973 together with Konrad Lorenz and Karl von Frisch, had given a much more precise answer. A falcon normally takes prey stooping at great speed, and only its talons are constructed for such a harsh collision. If he would try to catch his victim out of a large flock he would risk colliding with other birds and fracture his own bones. It seems that starlings 'know' about that. When above a hawk – and hence out of danger – they fly in lose formation, but they draw together into a tight flock when they are below the enemy (see also Mohr, 1960).

A further advantage of the group is that the common attention of its members is much more efficient in detecting predators than the efforts of a solitary animal. Observations of many species have shown that a predator may successfully stalk an isolated animal, but hardly ever a group (Wilson, 1975, p. 38). Even in a species as mighty as the lion which joins in groups mainly for better hunting success and for warding-off 'thieves' like jackals, hyenas or vultures from the prey, the community provides better protection for the cubs against leopards than a solitary mother could give (Schaller, 1972).

The presence of mates gives all group members the opportunity to relax a bit from their guarding against predators, and increases their efficiency in other activities. Observations of wood-pigeons have shown that the birds collect food at a lower rate when alone than when in flocks, because they spend more time looking around (Murton, 1968).

Whilst Lorenz assumes that a big herd might be easier detected by a predator than a solitary animal or a small group, Wilson holds to the contrary. According to his guess the average distance between the schools increases when the prey population coalesces into larger

and larger schools; hence there is a corresponding decrease in the frequency of detection by a randomly moving predator. A problem like this can be formulated in a mathematical way. V. E. Brock and R. H. Riffenburgh (1960) using a computer model have formally proved that Wilson's assumption is correct for schools of fish as well as for flocks of birds or herds of land animals – unless one makes some additional assumptions, e.g. regular use of migratory paths known to the predators.

In any case a predator, or even a pack of predators, cannot consume at once more than a certain fixed amount of prey, and if a group consists of many more individuals their sheer numbers over-saturate the predators and provide good chances of survival for at least the vast majority of the group members. Thus, as long as the individual manages to stay amidst its mates and can avoid being isolated it is fairly safe. In this way the elementary instinctive impulse to be in the middle of the herd is easily explained.

Even the assumption – plausible at a first glance – that it must be easier for a solitary animal to find sufficient food than for a large group is not correct in many cases – especially if the food is distributed patchily or concentrated at certain places. A starling or a baboon following his group utilizes the accumulated knowledge of the most experienced group members who know where to find food in harsh times, and how to get there safely (Kummer, 1968; Hamilton and Gilbert, 1969).

The possibility of mutual grooming is another important advantage when forming groups. If one wanders about in the jungle one neccessarily collects ticks, writes the German ethologist Hubert Markl (1971). Whoever has removed the impressive collections of these irritating blood-suckers after a day spent in a tropical forest will be able to appreciate the importance of social grooming for monkeys and apes.

As for their social structure, the diverse groups of animals mentioned in this chapter are very different and in no way comparable. A fish school is what Lorenz calls an 'anonymous crowd', a conglomeration of hundreds, thousands, or even millions of individuals of approximately the same age and with no observable social organization at all. It seems to be mere chance who swims in front, and if

the school changes direction the individuals formerly at the flank assume the lead (Wilson, 1975, p. 439); whereas in a herd of sheep there are certain animals, well known to the shepherd, that always are in the front row. Even more conspicuous is the strict social structure in a troop of baboons – one of the most highly organized communities within the whole animal kingdom. Yet it holds true for all these species that belonging to a group confers advantage to *all* group members.

All this, of course, does not 'prove' that Lorenz' objections against the formation of groups are completely unfounded. Actually the formation of herds, flocks or schools is *but one* of several strategies available to animals liable to be hunted by predators. Other species evolved according to other strategies (camouflage, large number of offspring, etc.) which are successful as well. Nevertheless it must be explained how an instinct manifested as strongly as the herding instinct of sheep and many other animals did *evolve*.

An animal trying hard to be in the middle of the herd has the best chances of survival; and the costs of such a behaviour are rather small compared to its benefits. One of the basic concepts of sociobiology is that such a behaviour pattern – or the ability to learn it quickly and easily – is, at least in part, *influenced by inborn (genetic) dispositions*. The individual keeping successfully its place in the centre of the herd (flock, school) evidently has a better chance to bestow this hereditary disposition on following generations than an animal not conforming to this behaviour pattern; the latter probably would soon be a victim of predators – maybe before it had any chance of procreation. Thus natural selection will favour animals with a strong inborn tendency (an instinct) to crowd in herds – or, for that matter, to perform any other successful behaviour pattern. Hence the instinct will get stronger within the species as long as there are no countervailing selective pressures, for instance increased vulnerability to epidemics in large herds.

1.2 *How does a cuckoo know it is a cuckoo?*

'Are you really sure that the herding instinct is *inborn* in sheep? Might it not be that young lambs *learn* it by imitating the adults?' The question came from a friend, a young physicist, when I told him about my intention to write this book.

'You are quite right,' I replied. 'As a rule behaviour is the result of a combination of learnt and inborn factors. However it certainly is *possible* that rather complicated behaviour patterns are inherited.'

'Inherited like blue eyes?' The question sounded rather incredulous.

'Well, not quite like blue eyes. Presumably behaviour patterns are influenced, as a rule, not just by a single gene but by the combined effect of a number of genes. Nevertheless, how does a cuckoo know that he is a cuckoo?'

'And how do you know he does?' Evidently my friend had not understood the meaning of my question.

The cuckoo, I continued, is something like an experiment of nature. It is brought up by foster parents. In its childhood it might never have seen another cuckoo, and when it hears one the call is just a background noise like the song of other birds. But when grown up it will be able to utter just that particular characteristic call though it certainly did not learn this in the nest where it was reared. The cuckoo does not 'assume' that it is a song bird like its foster parents, but mates with another cuckoo brought up like itself in the nest of another species.

As far as I could find out nobody seems to be sure of whether the cuckoo knows its characteristic call quite 'by itself' or whether it must hear the call beforehand. But at least it must be inborn to answer *just this call* and no other. And the young female cuckoo that never knew her mother and had no chance to learn something from her by imitation 'knows' by instinct that she must observe the nest of some small bird and wait for a moment when it is not guarded to put her egg with the others. A complicated repertoire of behaviour patterns must be inborn in this case.

Actually all this is not at all unique, although one might think so at the first glance. Amongst birds needing considerable parental care the cuckoo is an exception. There are however very many species of insects, fish, reptiles and other animals which just lay their eggs somewhere and leave them. The young animals never know their parents. A water turtle digs a hole with great effort in the sand of beaches, puts in a few dozen eggs, covers them with sand again and leaves the rest of the job to the sun. When the youngs are hatching they 'know' that they are not supposed to crawl subterraneously

like a mole or an earthworm, but that they must get out of the sand to the surface and then into the water as quickly as possible. They 'know' more or less what they are supposed to feed on though there may be some learning processes as well. When they are grown up they find a mate of their own species and the females 'know' that they have to hide their eggs in the sand of beaches, as did their mothers they never knew.

Thus all species with no parental care – and that is the great majority of all animals – must have a certain basic repertoire of inborn behaviour patterns. But such inborn behaviour is rigid, and the possibilities to learn by experience are limited. Animals growing up with their mother or within a larger community can learn by imitation or they can purposely be *taught* by their mother and others. In this way a much larger and more flexible behavioural repertoire can be learned enabling an individual to react differently in different or changing situations. Yet, even the most intelligent species right up to man do have behaviour patterns that are carried out, as it were, instinctively, *even if they are evidently irrational.*

This again is an assertion which my young friend rejects at first. I could tell him that the description of shockingly irrational 'instinctive' behaviour of lovers has been one of the standard themes of world literature for millennia. However, since he is a scientist, I rather propose to him a simple experiment: 'Invite somebody to go with you by car and drive slowly on a path where twigs are hanging down touching the wind-screen. You will notice that the person sitting at your side - and maybe yourself too, in spite of having been told beforehand – will instinctively lower the head, close the eyes or make some evading movements when approaching a twig – in spite of the fact that both of you know very well that you are protected by the wind-screen.'

I know this from personal experience, since we must use such a path to reach our weekend house. My wife and I laughed at ourselves more than once when we made such involuntary evading movements. And once, while my wife was sitting at the wheel, I resolved that as a rational being I ought to be able to suppress this 'ridiculous' evading behaviour. I found that to do so required much more concentration and effort than I had expected. As soon as my wife started talking to me, distracting me from the self-imposed task, I noticed that I relapsed into those silly, instinctive, evading motions.

Of course one can suppress such a habit by systematic training after one has recognized it and laughed about it. Today my wife and I no longer make bows before every twig when driving to our weekend house. Instincts are not *absolute* rulers of our behaviour. Their influence can be constrained – to some extent – by reason, training, and experience.

Animals, too, can be trained – within limits – to behave in ways not corresponding to their instincts. The shepherd's dog controls my son's herd by using what might be called 'limited aggression', but he has been taught that he must not treat his sheep as prey. Other dogs without such a training do not have similar inhibitions; they will gladly kill a lamb and devour it if they have the chance.

The higher the position of an animal on the ladder of evolution the more flexible is its behaviour. It is however a basic notion of modern ethology that there are inborn *tendencies* in every animal to behave in certain ways characteristic for its species. Owing to these inborn inclinations *it can learn certain things very easily and others only with great difficulty or not at all.* There is no reason to believe that man is an exception to this general rule (Maynard Smith, 1978*a*).

As a rule inborn as well as acquired factors contribute to the individual development of behaviour, forming, as it were, a new synthesis. According to the English ethologist Patrick Bateson, director of the Department of Animal Behaviour at the University of Cambridge, behavioural development may be compared with the baking of a cake. 'The flour, the eggs, the butter, and all the rest react together to form a product that is different from the sum of the parts', he writes (1976, p.11). 'The actions of adding ingredients, preparing the mixture, and baking all contribute to the final effect. The point is, that it would be nonsensical to expect anyone to recognize each of the ingredients and each of the actions involved in cooking as separate components of the finished cake.'

But, to stick to the metaphor, this does not exclude that *when comparing two cakes* one might be able to tell that the difference in taste is mainly, or even entirely due to the presence or absence of one particular spice – or, in another case, to the difference in preparing and baking the same ingredients. Similarly when comparing behavioural development in different species one can find striking differences in how inborn and acquired factors interact

to form what seem to be rather similar and comparable behaviour patterns.

While animals without parental care, and also the cuckoo, need to have an inborn ability to recognize a conspecific when looking for a mating partner, others must *learn* to which species they belong. Geese and some other birds are 'imprinted'. The young gosling will follow the first moving object it sees in the first hours after hatching. As a rule this is the mother goose, but if it is a man, it will follow him on land–and in water, if the man should be swimming. Such a young goose apparently 'thinks' that it is a man itself, and later has considerable difficulty in integrating into goose society and finding a conspecific mate.

A gosling imprinted on humans will refuse to follow a goose even if it sees one later on. But immediately after hatching it will not be able to differentiate between a small slender girl and a big old man with a beard. Two days later it has learned to recognize its parents personally and, under natural conditions, will follow only them and never mistake another pair of geese for them, even if they are leading a flock of young of the same age (Lorenz, 1965, p. 57).

Genetically the goose is pre-programmed to learn something very special at a certain point in its development. Imprinting is an extreme case of such pre-programmed learning, but it is a rather general rule that an animal can learn certain things in a certain age period much easier than before or later. Pedagogues know very well that such periods of specific learning ability for certain tasks exist in man too.

Not only the cuckoo but also many birds growing up 'normally' with their parents have an inborn ability to utter their species-specific calls or songs. The chaffinch, on the other hand, must *learn* it from older conspecifics. When reared in isolation it only achieves an inarticulate stammering. However *it can only learn the song of its own species* and nothing else, whilst a parrot or a starling can imitate calls of other species and even human language. They have an inborn talent of imitation which the chaffinch has not.

What an animal can learn is not only a question of intelligence but also dependent on many other genetic (inborn) preconditions. A badger is by no means silly, but lives an extremely solitary life; and *for this reason* it cannot be trained like a dog. It is impossible