THE SELFISH GENE

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THE GENE MACHINE

Survival machines began as passive receptacles for the genes, providing little more than walls to protect them from the chemical warfare of their rivals and the ravages of accidental molecular bombardment. In the early days they 'fed' on organic molecules freely available in the soup. This easy life came to an end when the organic food in the soup, which had been slowly built up under the energetic influence of centuries of sunlight, was all used up. A major branch of survival machines, now called plants, started to use sunlight directly themselves to build up complex molecules from simple ones, re-enacting at much higher speed the synthetic processes of the original soup. Another branch, now known as animals, 'discovered' how to exploit the chemical labours of the plants, either by eating them, or by eating other animals. Both main branches of survival machines evolved more and more ingenious tricks to increase their efficiency in their various ways of life, and new ways of life were continually being opened up. Sub-branches and sub-sub-branches evolved, each one excelling in a particular specialized way of making a living: in the sea, on the ground, in the air, underground, up trees, inside other living bodies. This sub-branching has given rise to the immense diversity of animals and plants which so impresses us today.

Both animals and plants evolved into many-celled bodies, complete copies of all the genes being distributed to every cell. We do not know when, why, or how many times independently, this happened. Some people use the metaphor of a colony, describing a body as a colony of cells. I prefer to think of the body as a colony of *genes*, and of the cell as a convenient working unit for the chemical industries of the genes.

Colonies of genes they may be but, in their behaviour, bodies have undeniably acquired an individuality of their own. An animal moves as a coordinated whole, as a unit. Subjectively I feel like a unit, not a

colony. This is to be expected. Selection has favoured genes that cooperate with others. In the fierce competition for scarce resources, in the relentless struggle to eat other survival machines, and to avoid being eaten, there must have been a premium on central coordination rather than anarchy within the communal body. Nowadays the intricate mutual co-evolution of genes has proceeded to such an extent that the communal nature of an individual survival machine is virtually unrecognizable. Indeed many biologists do not recognize it, and will disagree with me.

Fortunately for what journalists would call the 'credibility' of the rest of this book, the disagreement is largely academic. Just as it is not convenient to talk about quanta and fundamental particles when we discuss the workings of a car, so it is often tedious and unnecessary to keep dragging genes in when we discuss the behaviour of survival machines. In practice it is usually convenient, as an approximation, to regard the individual body as an agent 'trying' to increase the numbers of all its genes in future generations. I shall use the language of convenience. Unless otherwise stated, 'altruistic behaviour' and 'selfish behaviour' will mean behaviour directed by one animal body toward another.

This chapter is about *behaviour*—the trick of rapid movement which has been largely exploited by the animal branch of survival machines. Animals became active go-getting gene vehicles: gene machines. The characteristic of behaviour, as biologists use the term, is that it is fast. Plants move, but very slowly. When seen in highly speeded-up film, climbing plants look like active animals. But most plant movement is really irreversible growth. Animals, on the other hand, have evolved ways of moving hundreds of thousands of times faster. Moreover, the movements they make are reversible, and repeatable an indefinite number of times.

The gadget that animals evolved to achieve rapid movement was the muscle. Muscles are engines which, like the steam engine and the internal combustion engine, use energy stored in chemical fuel to generate mechanical movement. The difference is that the immediate mechanical force of a muscle is generated in the form of tension, rather than gas pressure as in the case of the steam and internal combustion engines. But muscles are like engines in that they often exert their force on cords, and levers with hinges. In us the levers are known as bones, the cords as tendons, and the hinges as joints. Quite a lot is known about the exact molecular ways in which muscles work,