



## John Maynard Smith and evolutionary game theory

When John Maynard Smith passed away on April 19, 2004, most obituaries expressed the view that among the amazing wealth of his contributions to theoretical biology, the most significant was the introduction of game theoretical methods for the analysis of evolutionary problems. JMS would probably have agreed with this. In an essay entitled 'Evolution and the Theory of Games' (Maynard Smith, 1976a), he set out to trace the history of this idea. With his characteristic blend of generosity and objectivity, he made it clear that he was not the first to discover the usefulness of game theory in evolutionary biology. Nevertheless, it is right to view him as the father of evolutionary game theory.

A quip, which is widespread in mathematical circles says that theorems are usually named, not after the first, but after the last person who discovered them. It highlights the fact that the history of science can be quite unjust in her attributions. But a discovery which remains widely unknown, or neglected, is of little use for the march of science. The last discoverer is often the one who moves the idea into public awareness, making it impossible for anyone, after that, to discover the idea anew.

John Maynard Smith certainly made sure that no one, henceforth, could ignore the power of game theoretical thinking for all aspects of population biology. What Ernst Mayr called 'the greatest conceptual revolution in biology', namely, 'the replacement of typological thinking by population thinking' (Mayr, 1970), was transferred by John Maynard Smith into game theory.

The fact that John Maynard Smith was initially trained as an engineer had a significant impact on his biological work. In 1938, as an 18-year old graduate from Eton, he had visited his uncle, a British military attaché in Berlin, and witnessed a speech by Adolf Hitler. There was no need to know German to understand that war was imminent. Young Maynard Smith decided that the most useful thing to do was to become an aircraft engineer.

In 1947, he left his engineering job to enrol as a student of biology at University College, London—aircraft were too noisy for his taste, and he vastly preferred birds—but his training in applied mathematics

would prove of great help for his postgraduate work with J.B.S. Haldane. More importantly even, John Maynard Smith had learnt what it meant to work on design, and could appreciate the arguments from intelligent design, and all related issues of evolution, from the other side of the hill, as it were. Thus he could write on 'birds as aeroplanes' (Maynard Smith, 1953), and even on 'Machines that play games' (Maynard Smith and Michie, 1964). Many years later, he was to write (Maynard Smith, 1995):

Of course when thinking about the V2 rocket I was thinking about a product of human design, whereas a few years later, when I was thinking about the shapes of mammalian teeth, I was asking why mammals were better at chewing, and so left more descendants. But this difference had no effect on the way I thought about the two problems. Indeed, I have become increasingly convinced that there is no way of telling the difference between an evolved organism and an artefact designed by an intelligent being.

Designers have routinely to face the task of optimising structure, or function. Optimisation arguments are widespread in physics, for instance as principle of the least action, and have led to an elaborate mathematical theory, including variational calculus and dynamic programming. These tools are also used in economy, for instance to decide on an optimal bundle of goods. Some questions, including NP-hard problems like finding the shortest path joining 64 towns, can be extremely difficult to solve, but it is clear what is meant by a solution. This changes when economists have to consider the interaction of several decision-makers, all trying to maximise their income. Even the concept of a solution becomes problematic. The interdependence of the agents raises different questions needing new techniques.

In 1944, John von Neumann and Oskar Morgenstern introduced these techniques in their book 'The Theory of Games and Economic Behaviour' (von Neumann and Morgenstern, 1944) which met with a huge success in spite of being not exactly user-friendly. Originally, the authors had another title in mind: 'Theory of Rational

