Collective animal behaviour: marching locusts, homing pigeons and pecking chickens

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Abstract

In recent years, the concept of self-organisation has been used to understand collective behaviour of animals. The central tenet of self-organisation is that simple repeated interactions between individuals can produce complex adaptive patterns at the level of the group. Inspiration comes from patterns seen in physical systems, such as sandpile avalanches and spiralling chemical waves, which arise without complexity at the level of the individual units of which the system is composed. The suggestion is that biological structures such as termite mounds, ant trail networks and even human crowds can be explained in terms of repeated interactions between the animals and their environment, without invoking individual complexity. I show how two of the key features of self-organised systems---that (1) the system is more than the sum of its parts and that (2) collective structure emerges through amplification of random fluctuations---are seen across many different types of animal groups. Examples include the sudden ordering of marching by locusts; the emergence of ant pheromone trails; the in flight decisions of pairs of homing pigeons and the aggregation of chickens at food. All of these complex phenomena can be understood in terms of a few simple rules. The challenge for the future is to identify other key features of self-organised systems---in particular properties of systems near phase transition---and link them to the evolution of animal groups.