Paper 3

This paper, as well as the following two, presents a model of how the brain can detect motion in the visual scene. From measurements performed by Hubel and Wiesel and others in the late fifties and early sixties, we know of the existence of neurons that react specifically to movement. In primates, these cells are located in the visual cortex at the back of the head.

The model presented in this thesis considers the fact that the processes in the brain operates in a noisy environment. Neurons do not remain silent in the absence of stimuli as one would expect, but are activated every now and then in what is called spontaneous activity. The idea that led to the model is that this noise might perform a function in cognitive processes.

An inspiration for this work has been the behaviour of social insects. In particular I studied some works on army ants who display very complex behaviours (e.g., Franks, 1989). These complex behaviours, however, only work as *group* behaviour. If one ant is isolated from the rest of the group, it easily becomes engaged in irrational behaviour leading to exhaustion and death. Even as large a group as 100 ants are unable to maintain themselves. Clearly, although the nest performs very complicated operations, the individual ant has no idea of its functional role.

In a similar way, one may expect that the individual neurons in our brains do not really know what they are doing. In the model presented here, this is very much so. Individually, the neurons are unable to perform any detection of motion. The detection behaviour emerges only when the neurons act cooperatively and in

the presence of noise. The noise is used to initiate a detection and the cooperation ensures that a detection that has been initiated is recognized for as long as the motion persists.

As the operation of this model is very novel, I think that the principles of the model is also interesting outside its motion detection context. Indeed, this was the model that gave birth to the evolutionary framework of the mind presented in the first paper. Nowadays, however, the model serves mainly as a concrete illustration of the somewhat more abstract ideas put forth in the evolutionary framework.