



Branch initiation by global control

6.1 Branch formation: the trigger of backwards waves

Branch formation is a dominating pattern element of *Oliva porphyria* (Figure 6.1). Considering that the shell patterns resemble space-time plots, it is obvious that the formation of a branch is based on the sudden initiation of a backward-running wave. In the view of the normal behavior of waves in excitable media, this is a very unusual event. A new wave must spread into a region that should be refractory due to the primary wave. That regions are also refractory in *Oliva porphyria* after the passing of a wave is evident from the many \vee -like pattern elements: colliding waves annihilate each other in the usual way; the waves do not enter regions made refractory by the counter wave.

In the view that pigment deposition into the shell could resemble some sort of waste disposal, it appears reasonable to assume that a mollusk keeps the total number of traveling waves under control. Since with each collision the number of traveling waves becomes smaller, mechanisms must be at work that generate new waves to compensate for this loss. Wave splitting by the initiation of backwards waves is one possibility. Wave splitting is then expected to occur whenever the number of traveling waves became too low. By such a control, the average rate of waste disposal would remain approximately constant.



Figure 6.1. (a) Shell of *Oliva porphyria*. Branching occurs simultaneously at distant positions. (b) In the model, branching is regulated by a rapidly distributed hormone (green) that is produced by all activated cells. It is a measure of how many traveling waves are actually present in the mantle gland. Whenever the number of waves and, therefore, the hormone concentration becomes too low (light green regions) a temporary transition into a steady-state occurs that can cause the trigger of new waves; for details see Figure 6.2. (c) Distribution of the substances at the end of the simulation shown in (b). [S61; S62 displays the distributions shown in (c) in a movie-like manner]