



Figure 13. Construction of a mesotonic branching pattern by a growing set of turtles with counting capabilities. Numbers indicate the states of the turtles at their current and past positions.

8 Multiple blind agents with infinite memory

In nature, one observes not only basitonic, but also *mesotonic* and *acrotonic* structures, characterized by extensive development of the middle or upper parts of the plant, respectively. These structures are counterintuitive in the sense that higher branches, although produced by lateral apices that have been created more recently than the bottom ones, are nevertheless longer than the lower branches. It has been shown that (potentially infinite) mesotonic and acrotonic structures cannot be generated by a population of autonomous meristems with finite memory, located at the apices of the axes as observed in real plants.^{5,30} Consequently, several more powerful mechanisms have been proposed in the literature. Specifically, Lück *et al.*¹⁷ described a model in which the meristems can count. As shown in Figure 13, the apex of the main axis counts the segments that it has created so far, and assigns the resulting values to the counters associated with the newly created lateral apices. These apices count down as they create new segments, and stop at zero. Consequently, the length of each fully developed lateral axis is equal to its position on the main axis (measured in the number of internodes), yielding a mesotonic structure. (It is not acrotonic because of the juvenile axes of decreasing length at the top.) Biologically, the counter values might be represented by concentrations of substances, which accumulate in the apices and can be dissipated by them.

In the above example, each agent has only one counter. In contrast, the autonomous turtle with infinite memory that created the zig-zag pattern described in Section 3 (Figure 6) required the use of two counters. Apparently, the addition of one counter does not increase the computing power of a single autonomous agent with finite memory, but increases the power of a set of such agents.

9 Multiple sighted agents

In the case of curves created by a single agent, we have observed a tradeoff between memory size and the input information available to the agent. For example,