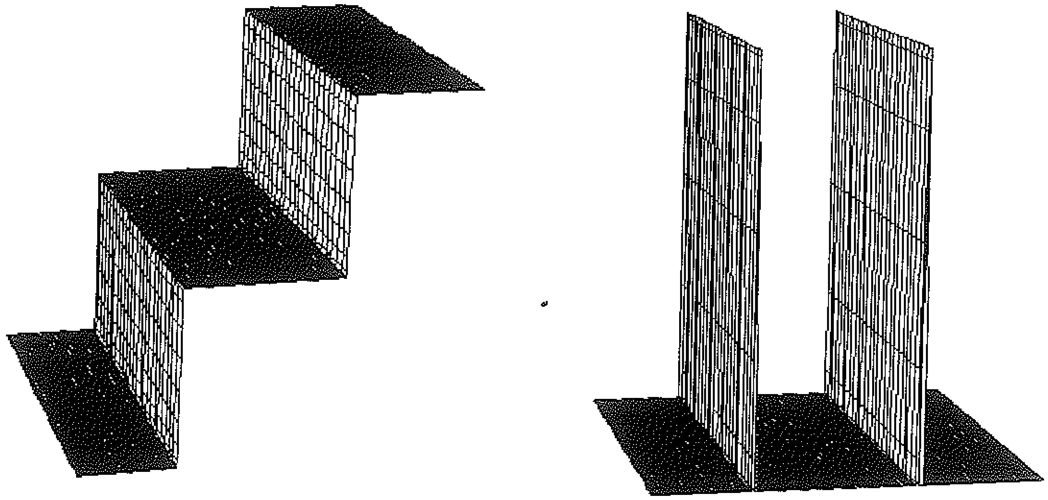

FIGURE 12.18: Behavior of the entire system for the simulation with an ordered initial configuration, Figure 12.16. Time goes from left to right, block number from front to back, and the vertical axis is position (left figure) or velocity (right figure). The time span here is $t = 0$ to 500, the same as that covered in Figure 12.16.

not a simple straight line. However, a 25-block system intuitively seems to be a bit too small to be a good model for an entire fault line. We might imagine that such a small number of blocks would artificially restrict the possible event magnitudes and perhaps affect the number of large earthquakes. It is therefore worthwhile to consider larger systems, and results for simulations with 100 and 500 blocks are also shown in Figure 12.20. All three simulations exhibit the same type of deviation from the Gutenberg-Richter law, as all show an excess number of large events.[21] It is interesting to note that there is actually a regime of intermediate $\mathcal{M}$ where $P(\mathcal{M})$ does vary approximately linearly with $\mathcal{M}$. For example, over the range $\mathcal{M} \sim -2$ to $+2$ the 500-block system exhibits an approximate power law, as indicated by the solid line in Figure 12.20. This line is just a plot of the Gutenberg-Richter law (12.2) with $b \approx 0.7$. Hence, over this rather limited range, the system does appear to at least roughly follow the Gutenberg-Richter law, although the value of b is a little lower than that exhibited by nature. While our simulations thus approximate nature to some degree, the excess number of events at large $\mathcal{M}$ and the rather low value of b suggest that the model is lacking an important ingredient.

The simulations we have described above have been only partially successful

[21] There is also an excess number of events at very low $\mathcal{M}$ in the lowest bin of the distribution, but this is less troubling than the problem at high $\mathcal{M}$, for the following reason. There will be a minimum earthquake size corresponding to the motion of a single block for one time step, and this will result in a pile-up of events of some minimum size. The difficulty is thus with the numerical approach and is not an intrinsic property of the model.