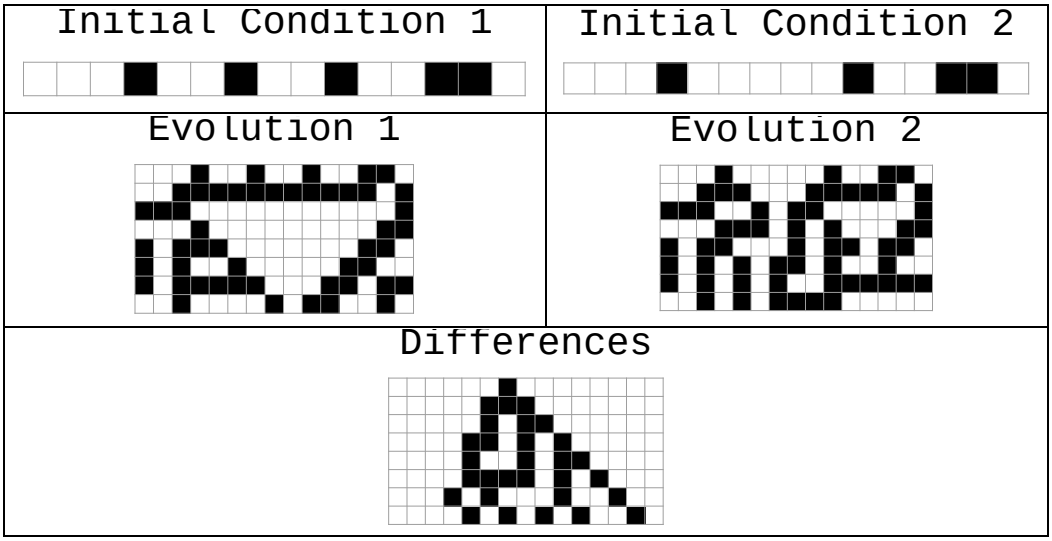
Informational Fracture Points

Kovas Boguta

Wolfram Research

Basic Experiment Concept



Difference Patterns for Elementary Cellular Automata

```
Grid[Partition[Table[With[{init = (SeedRandom[24]; RandomInteger[1, 130])},
    ArrayPlot[BitXor[CellularAutomaton[r, init, 130], CellularAutomaton[r,
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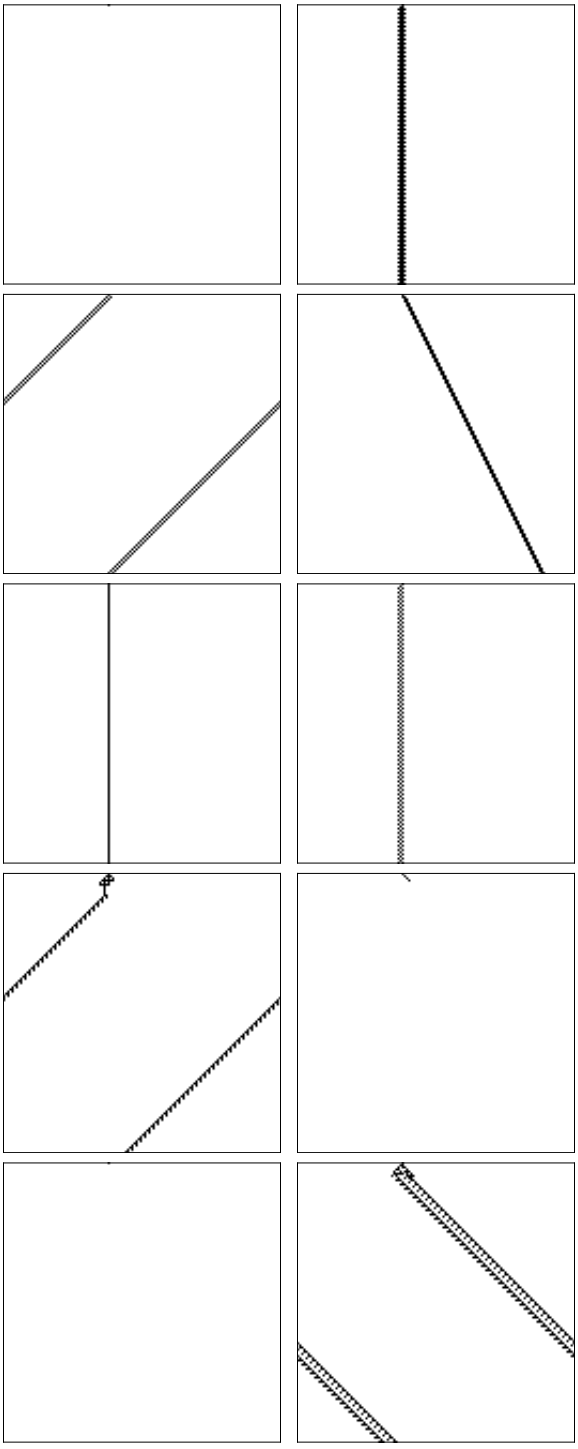
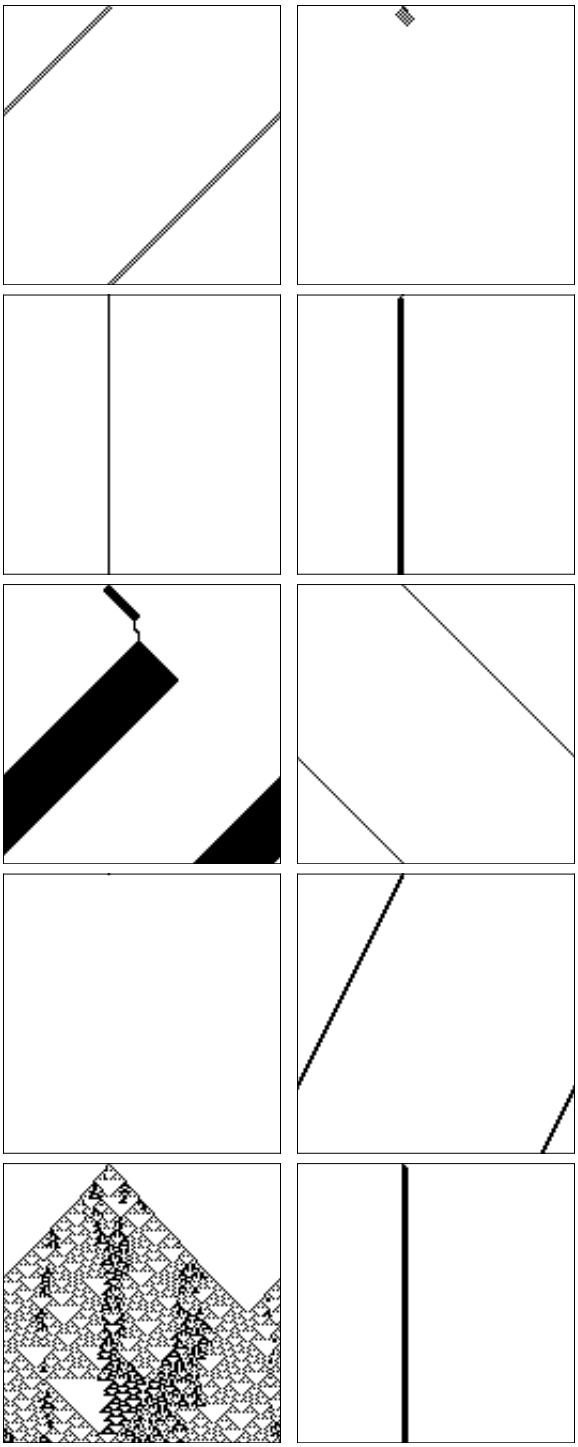
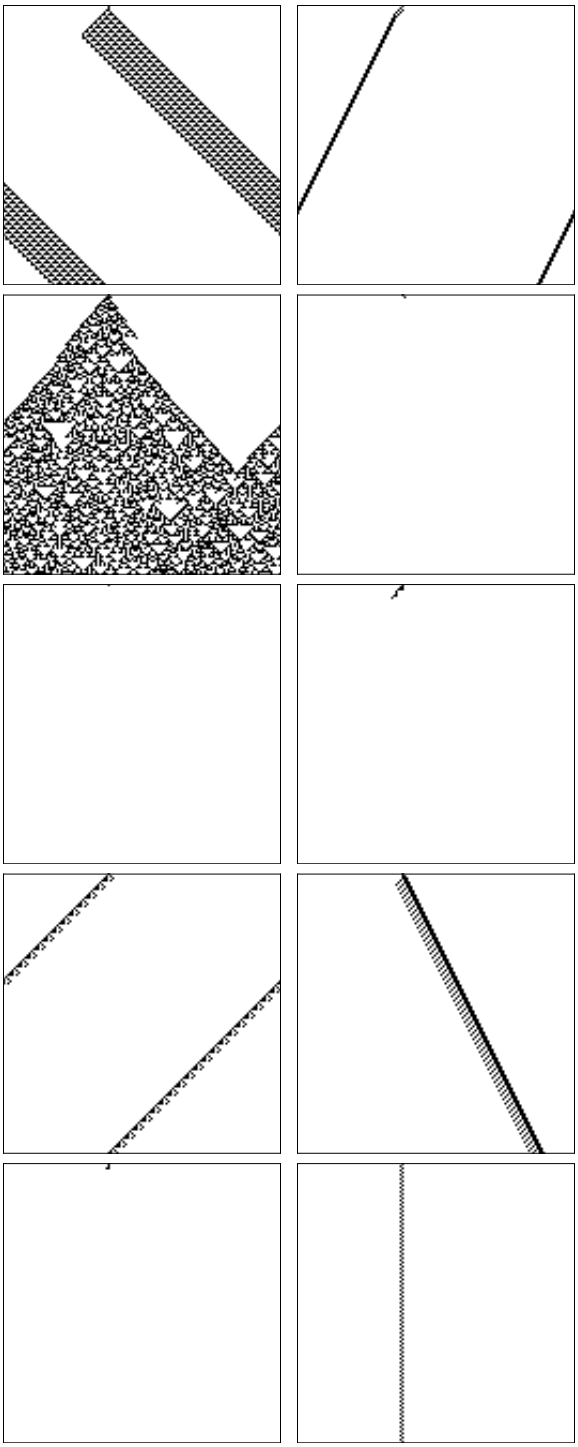
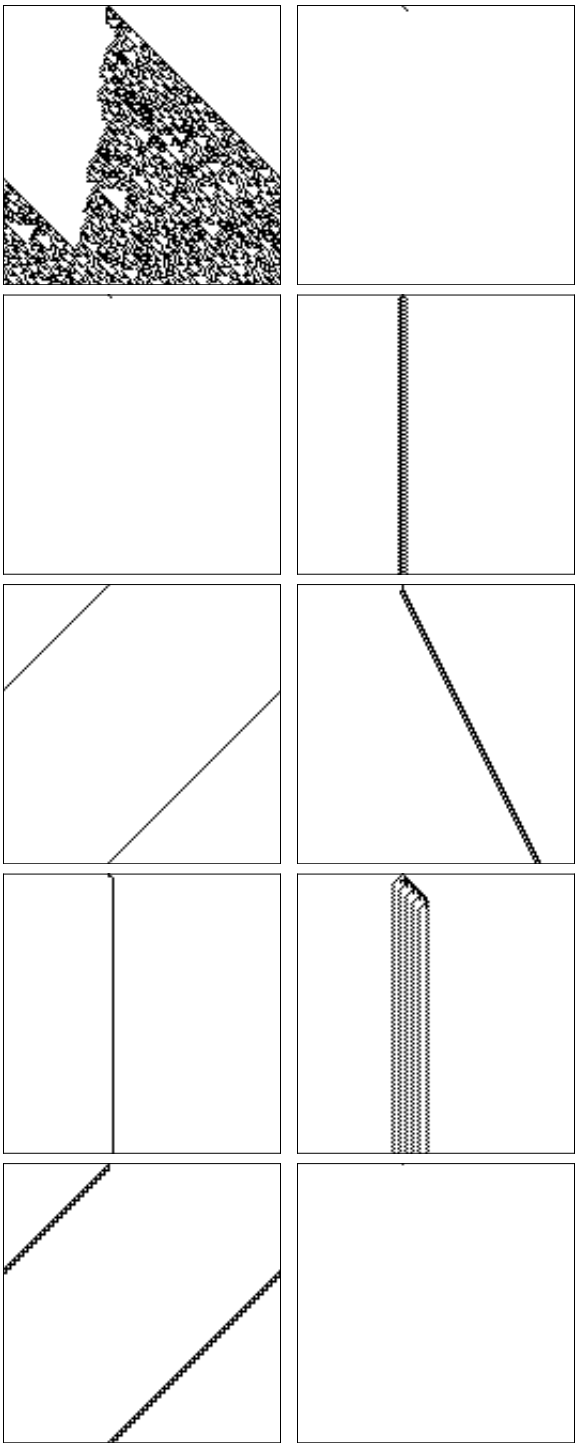
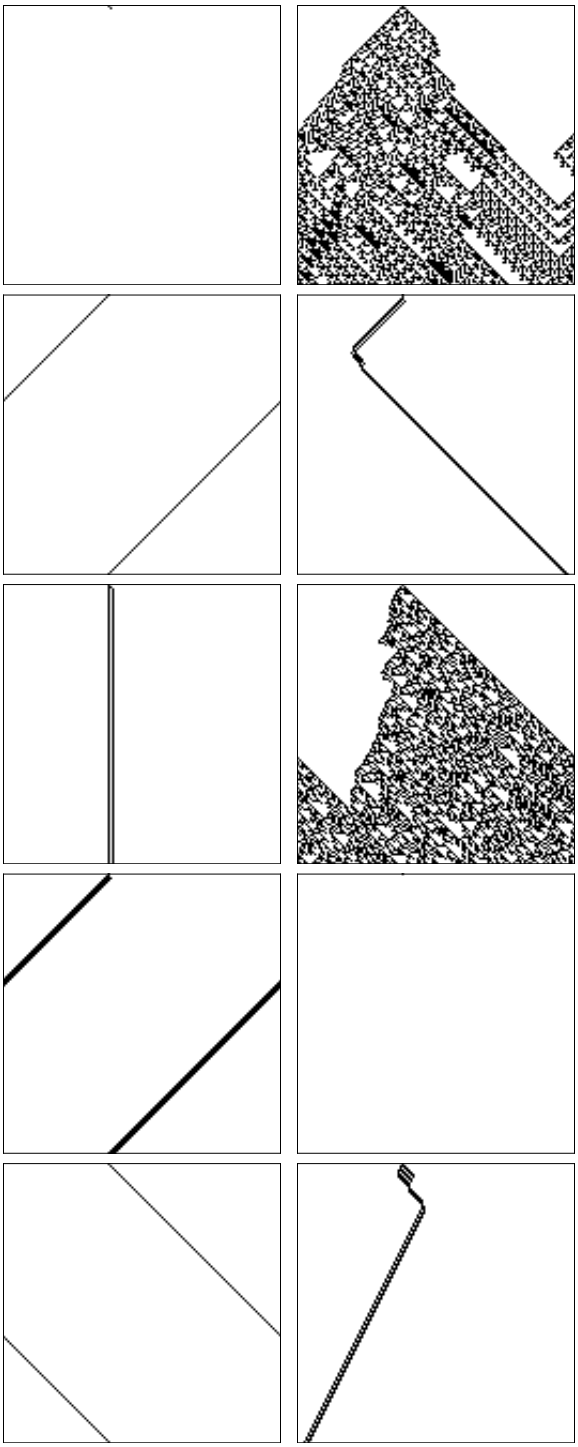
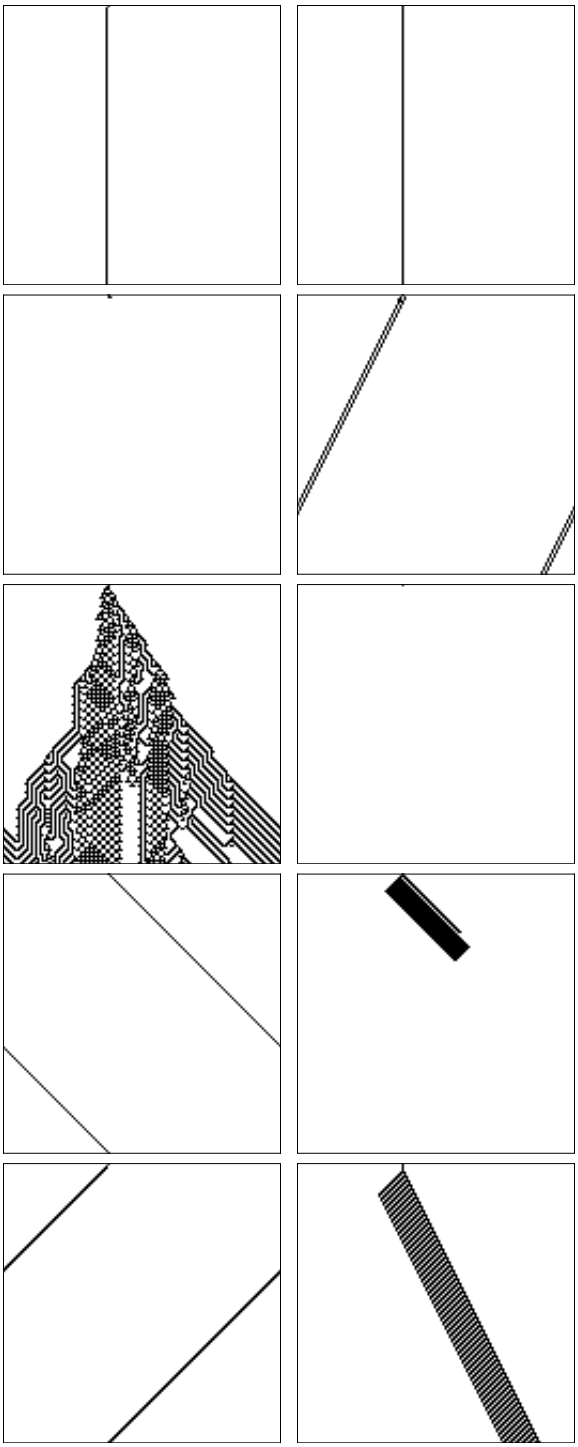


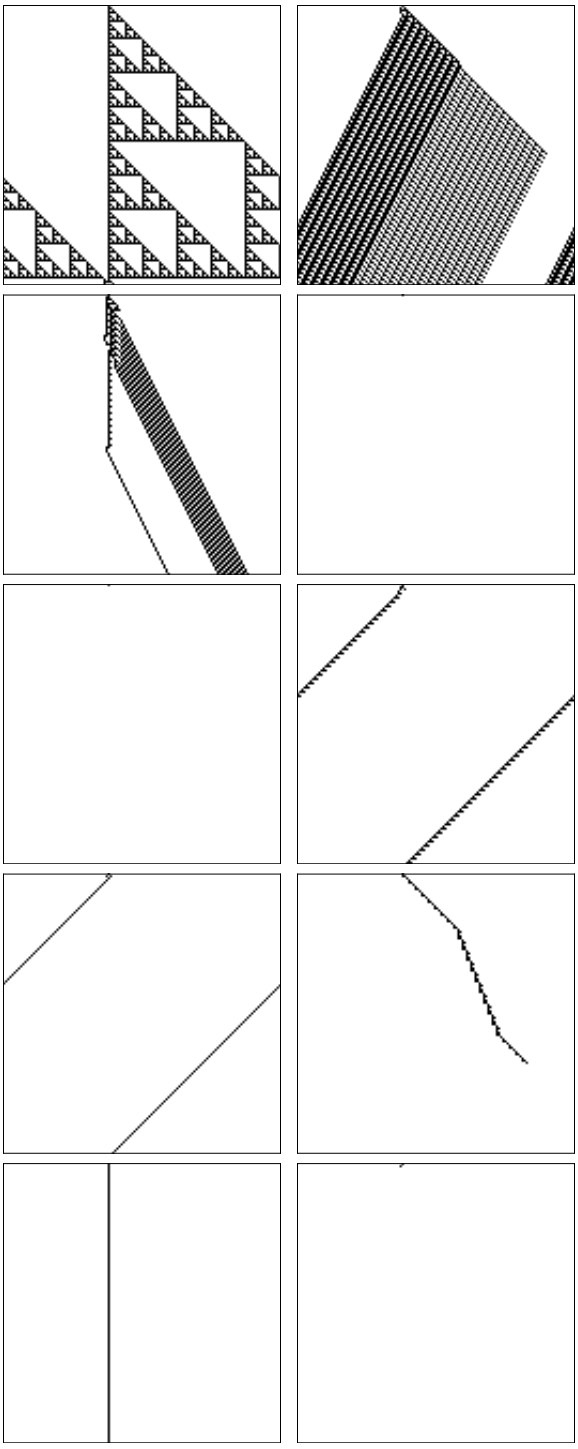


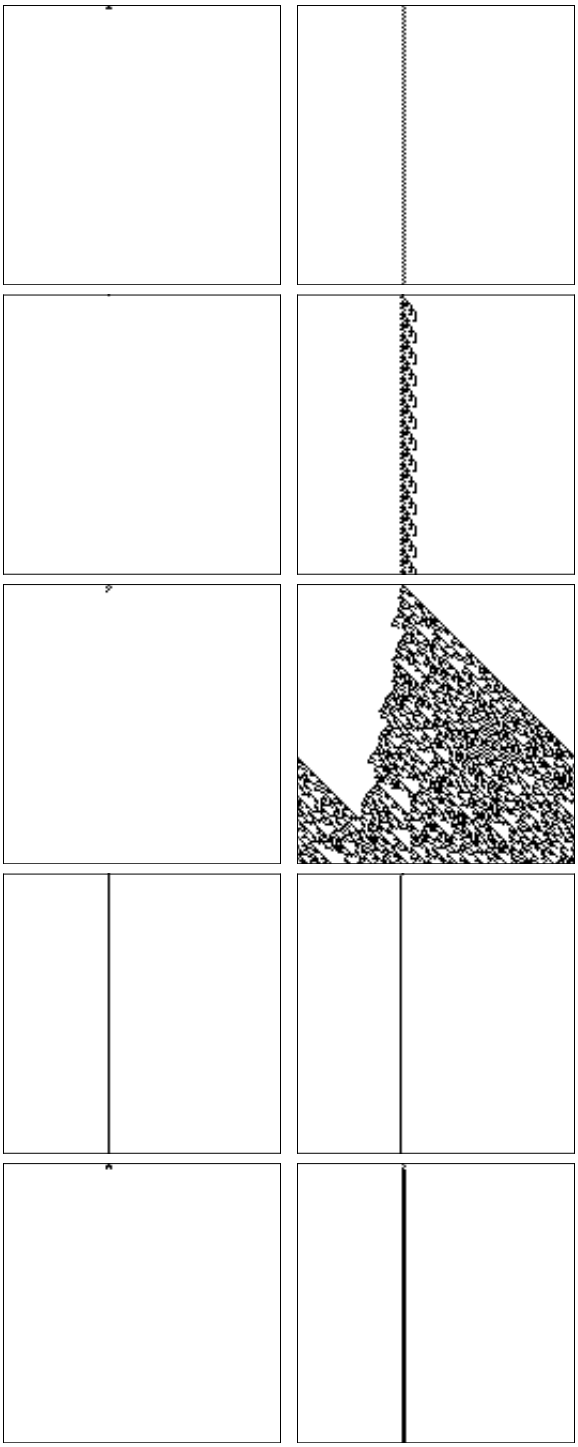


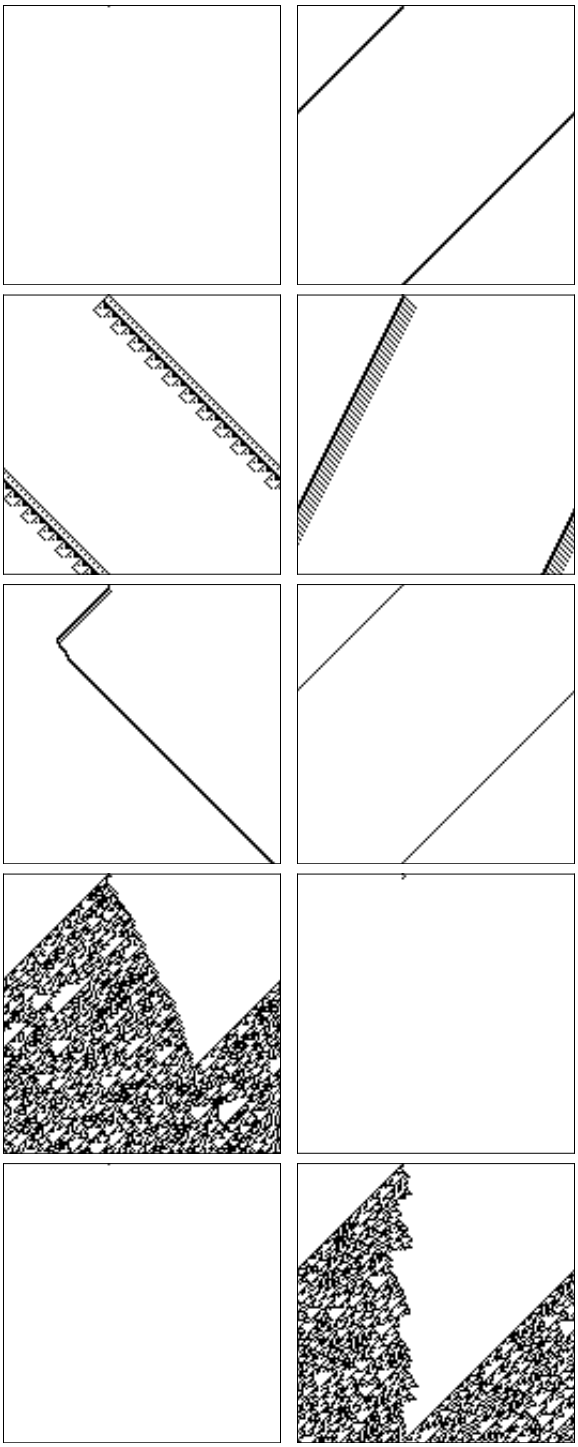


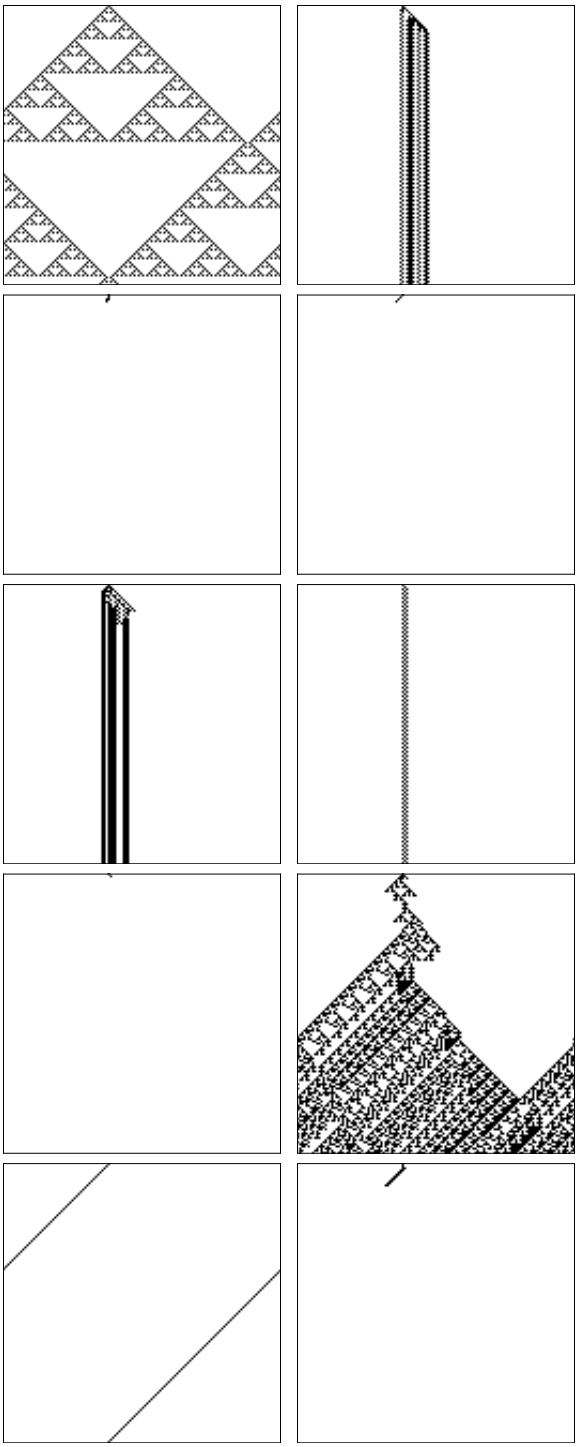


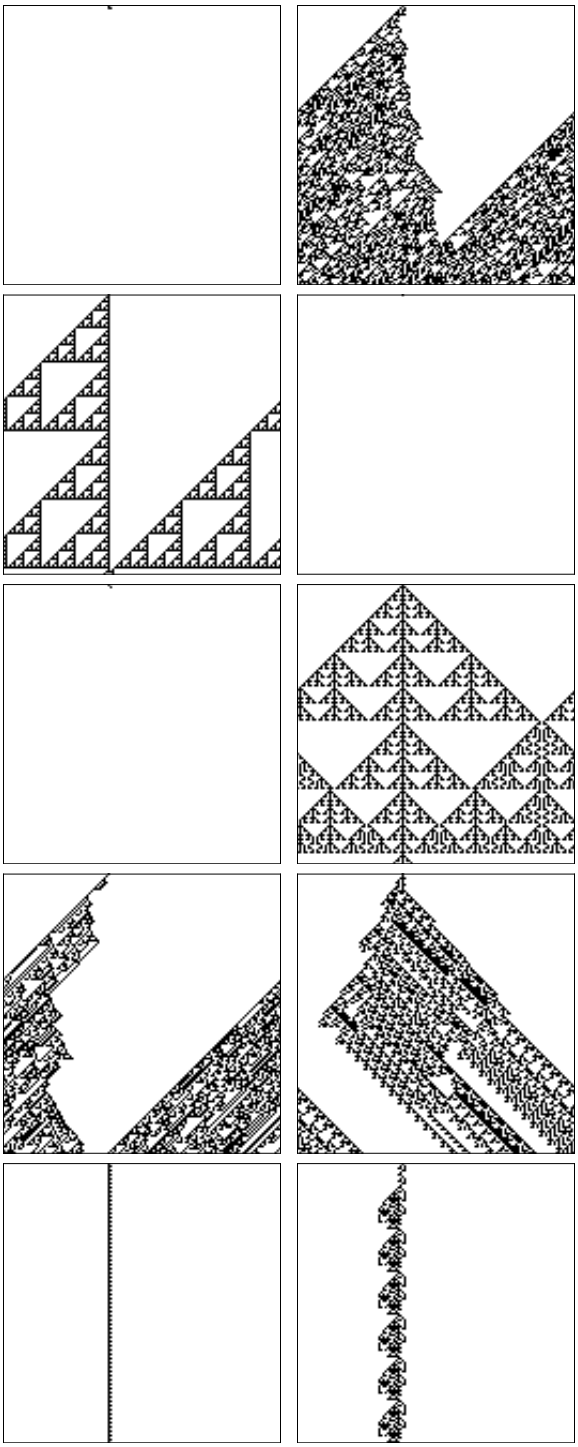


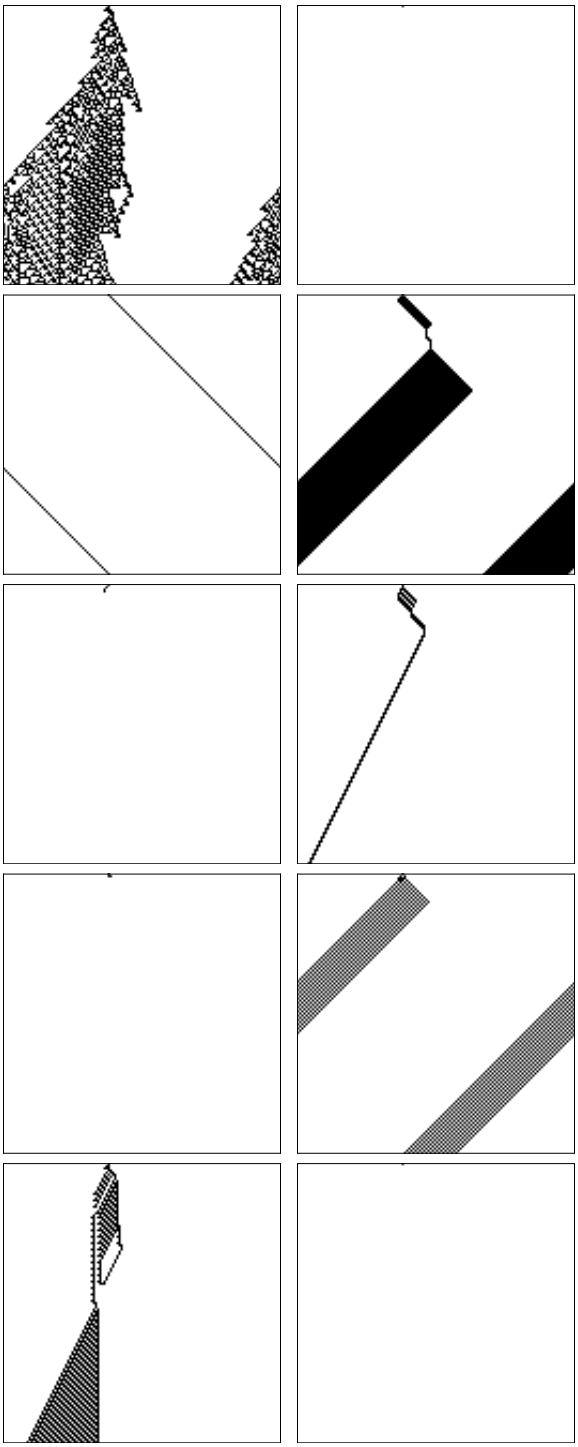


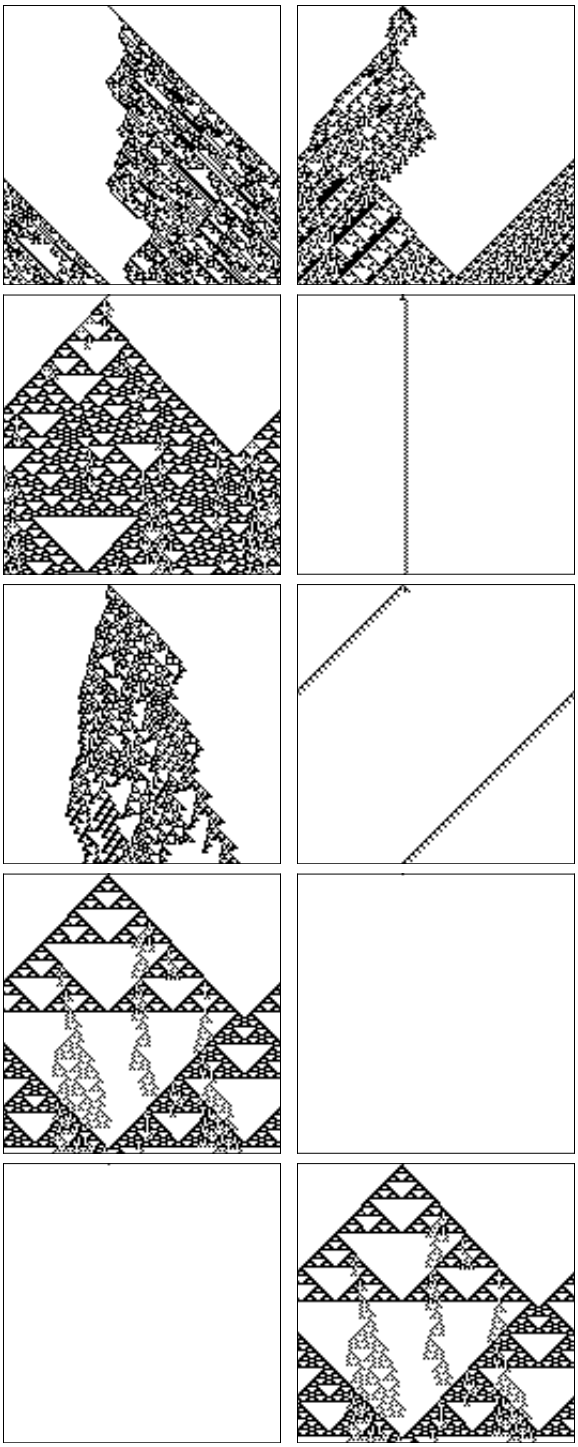


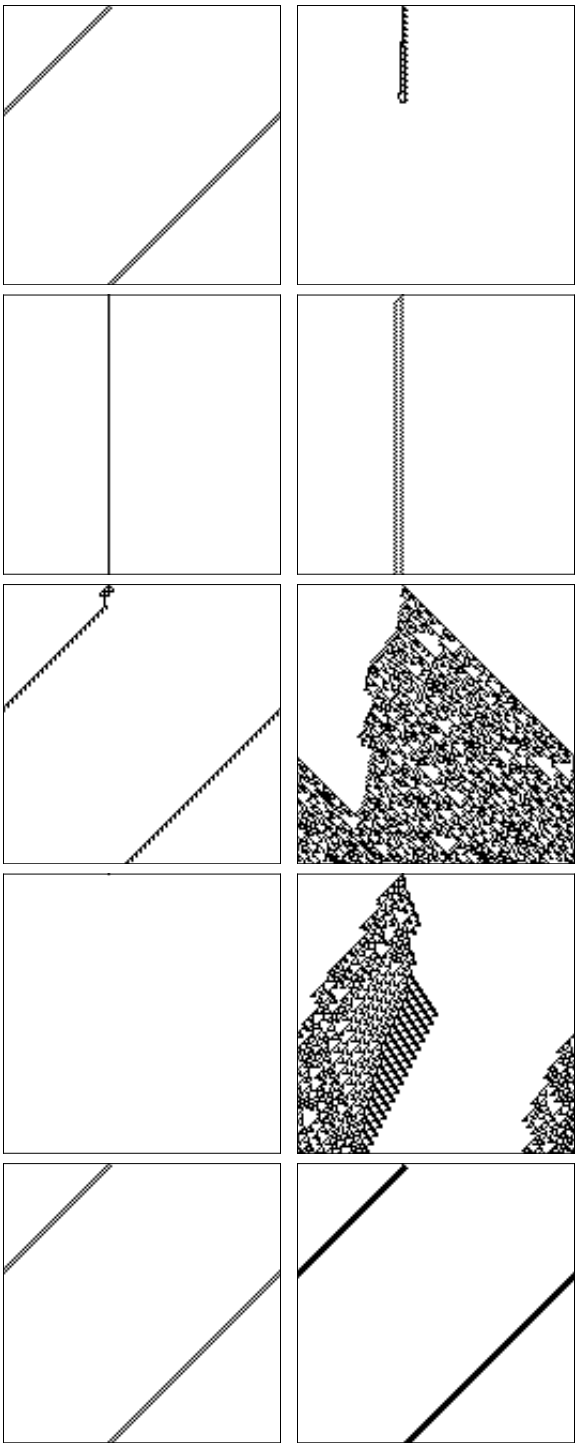


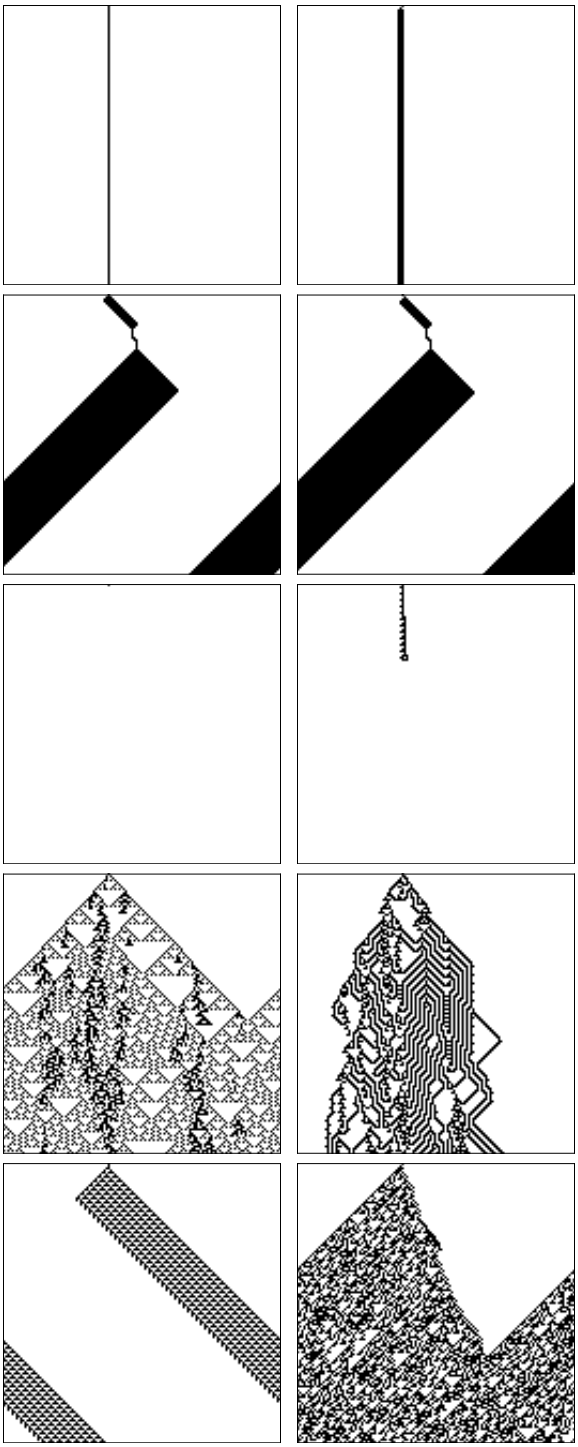


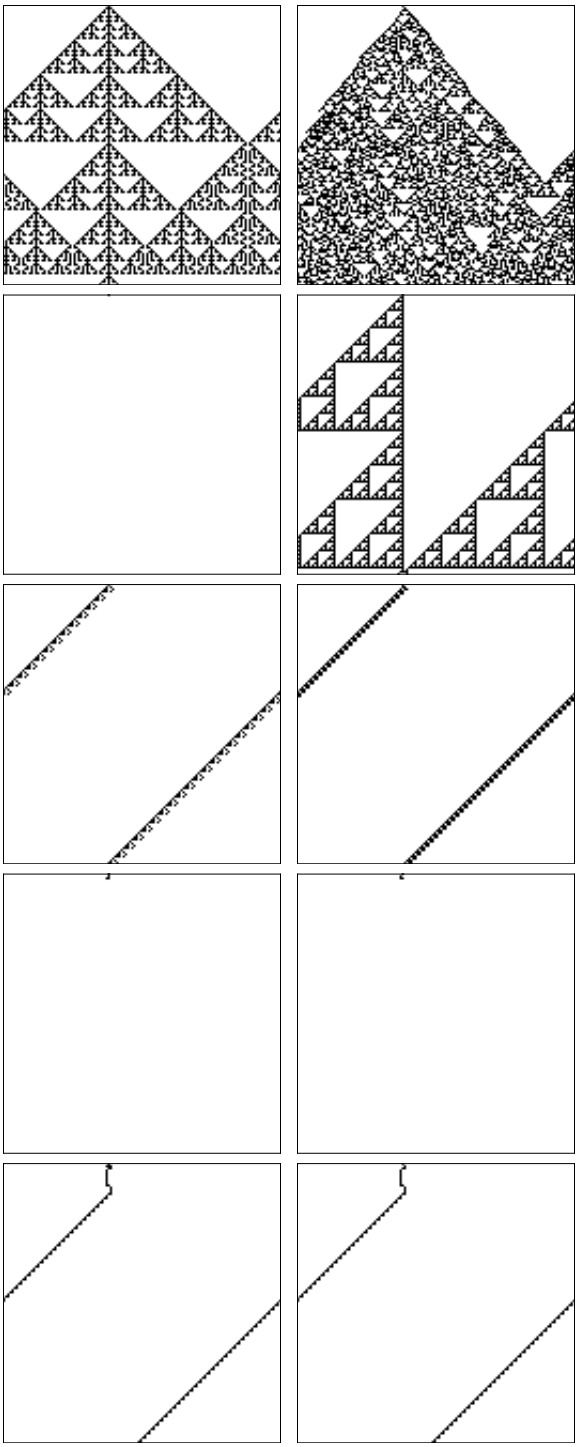


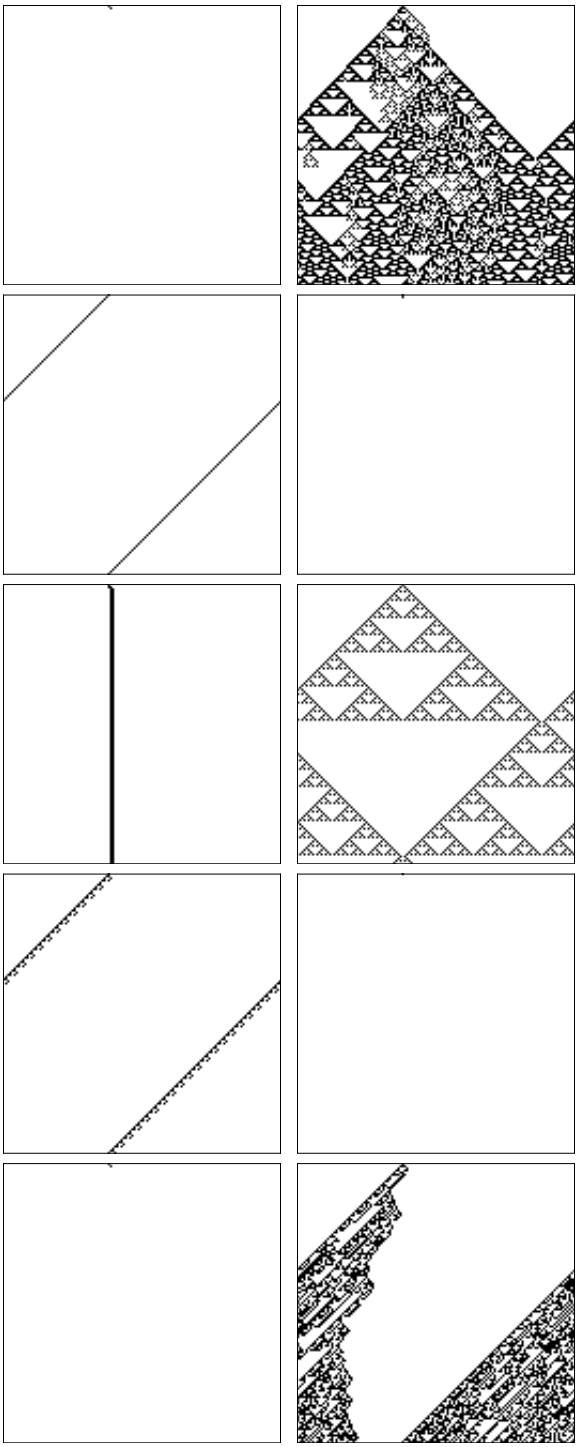


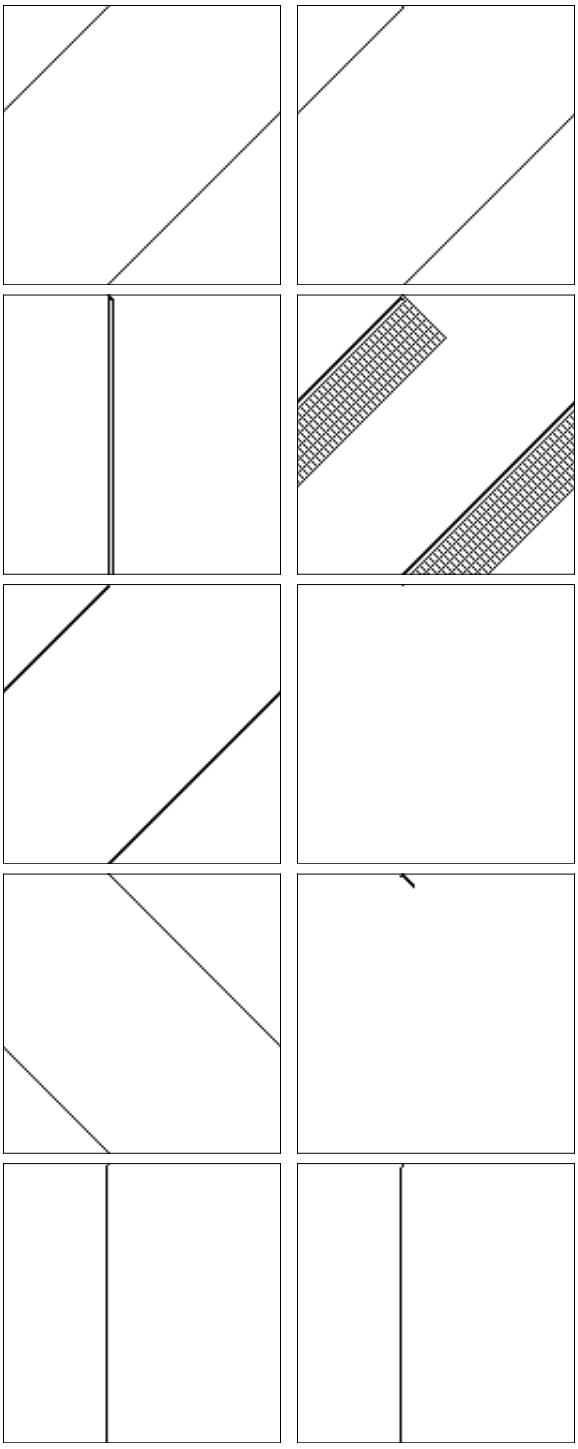


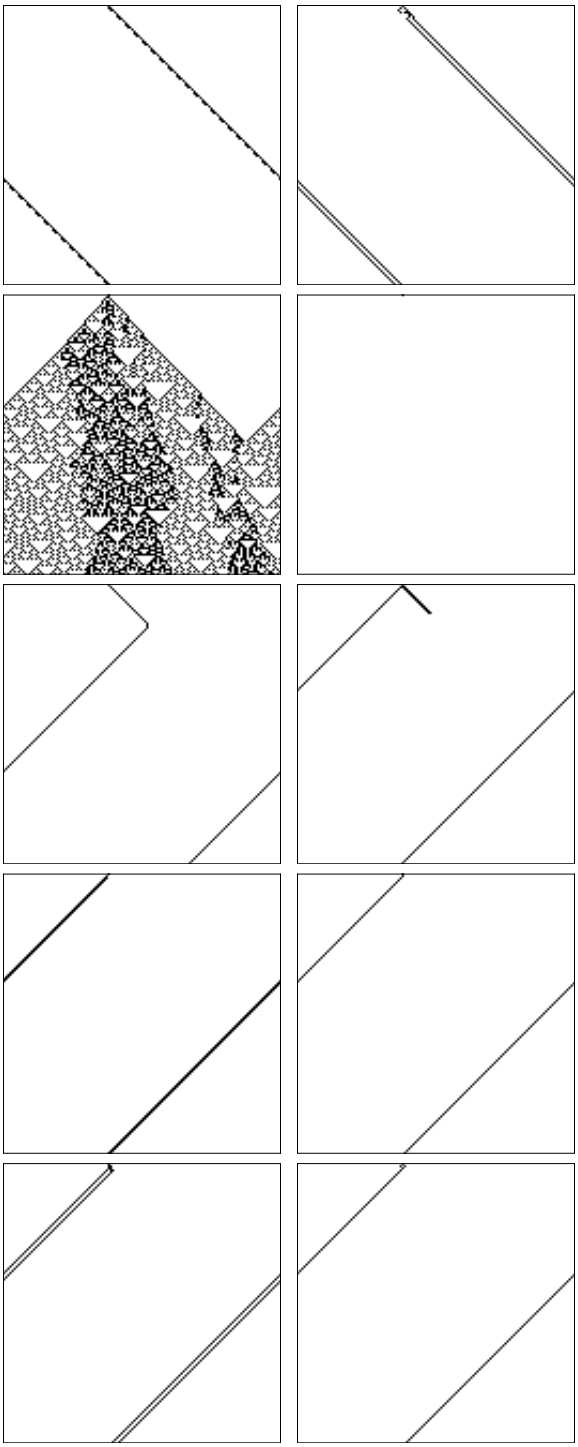


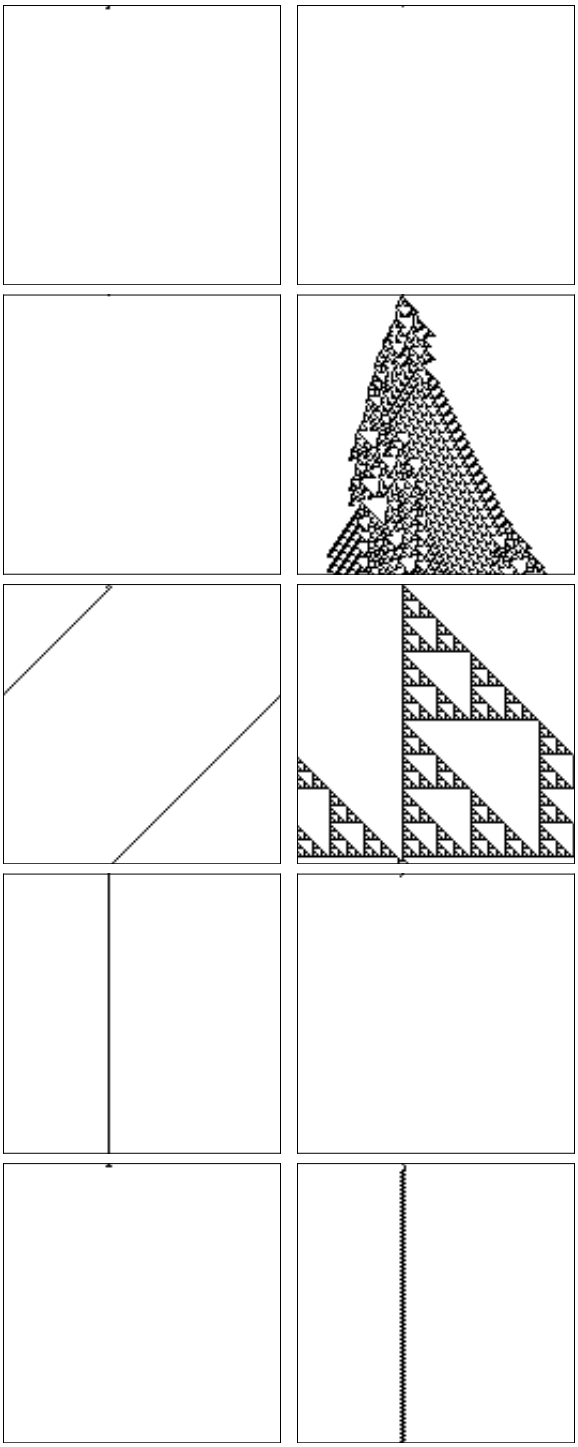


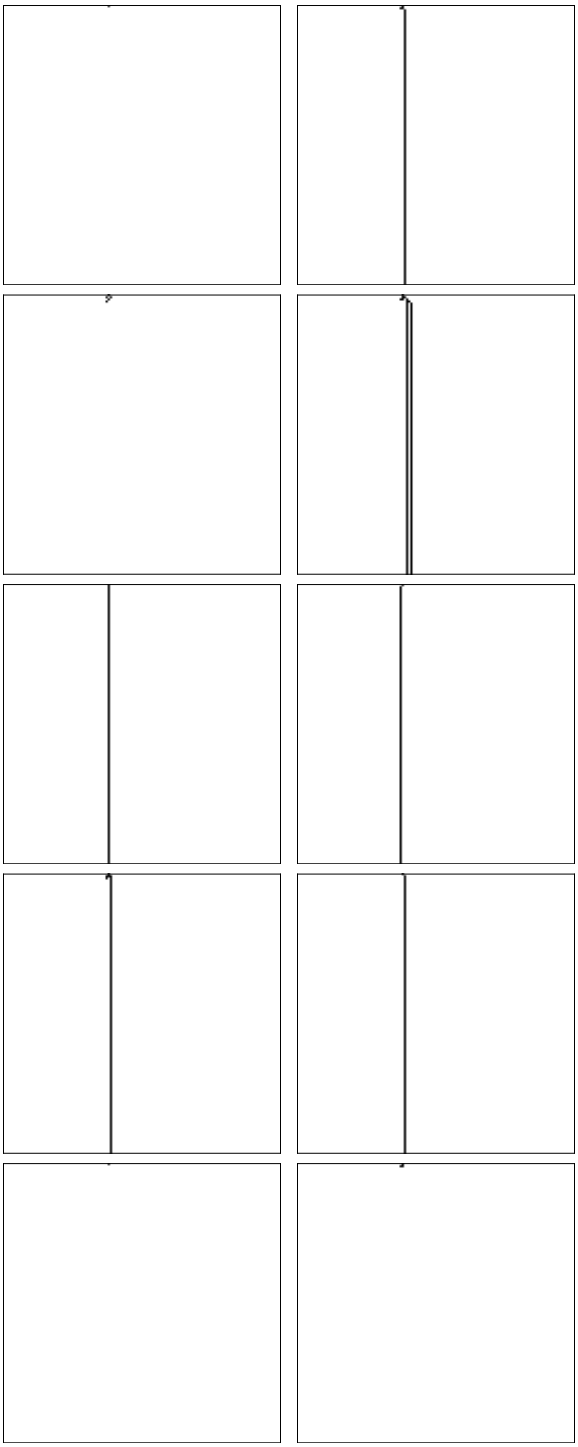


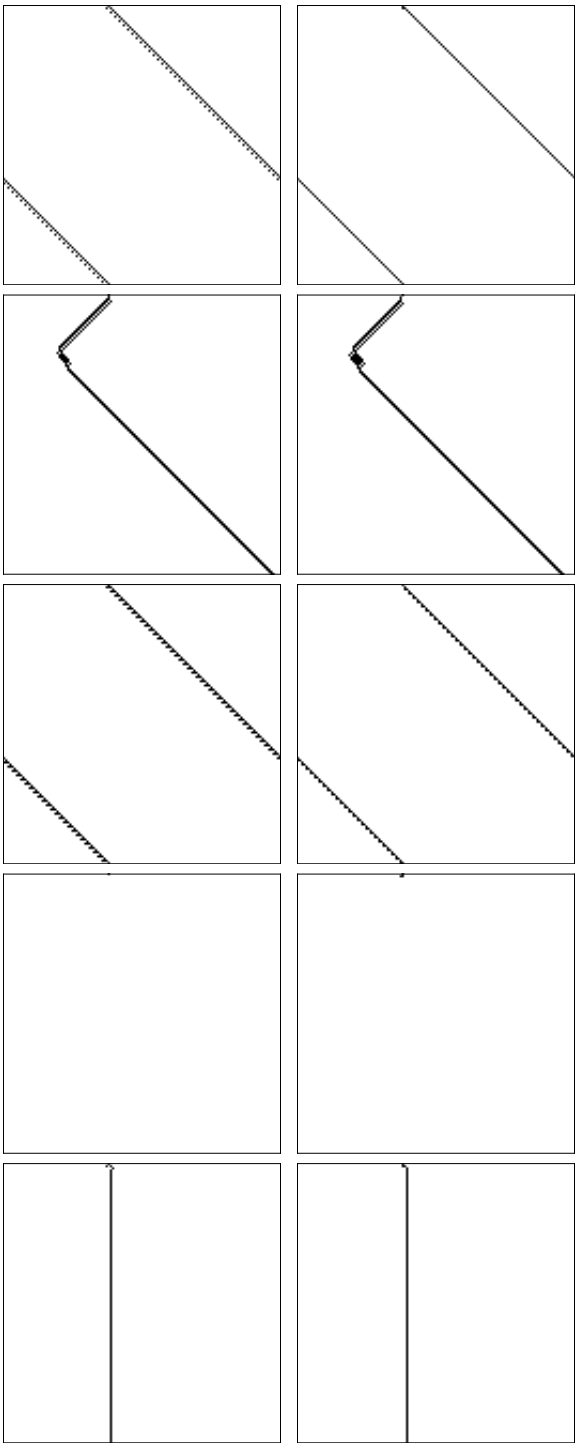


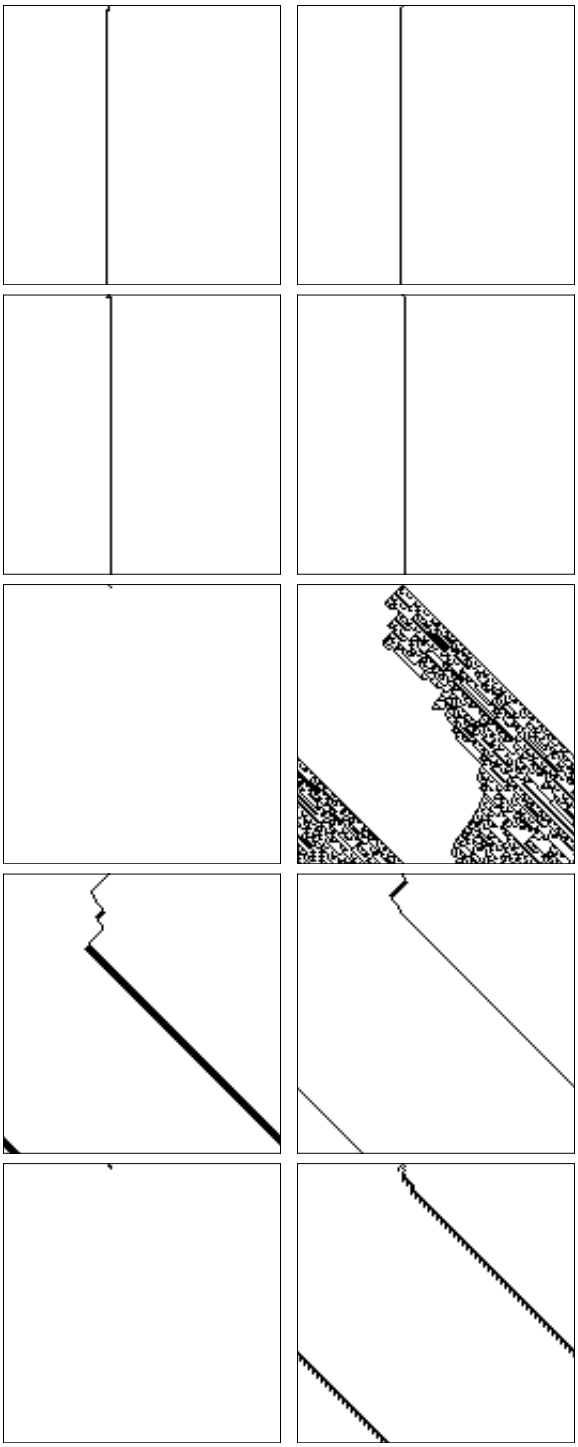


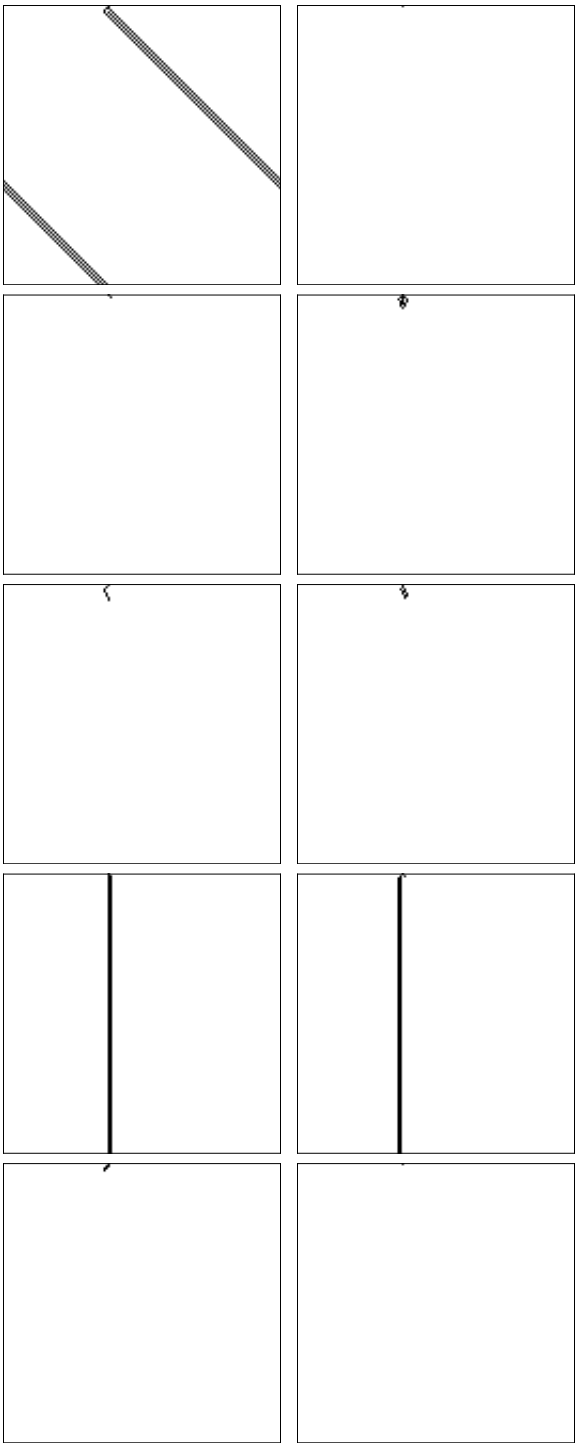


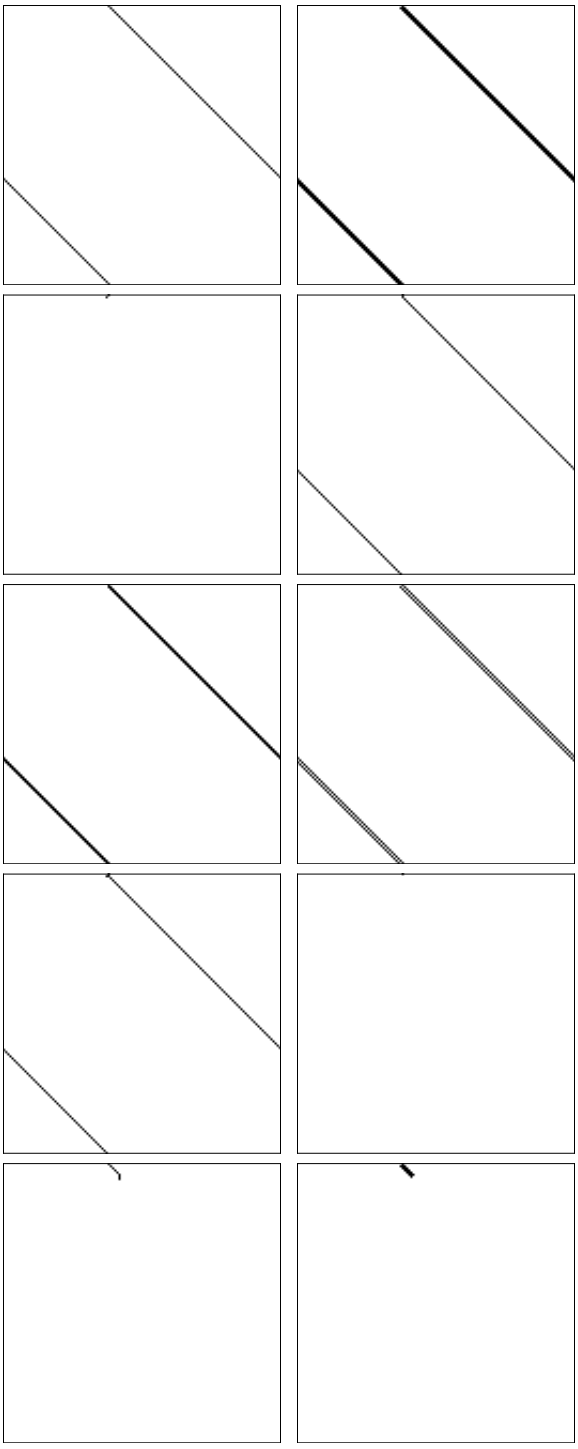


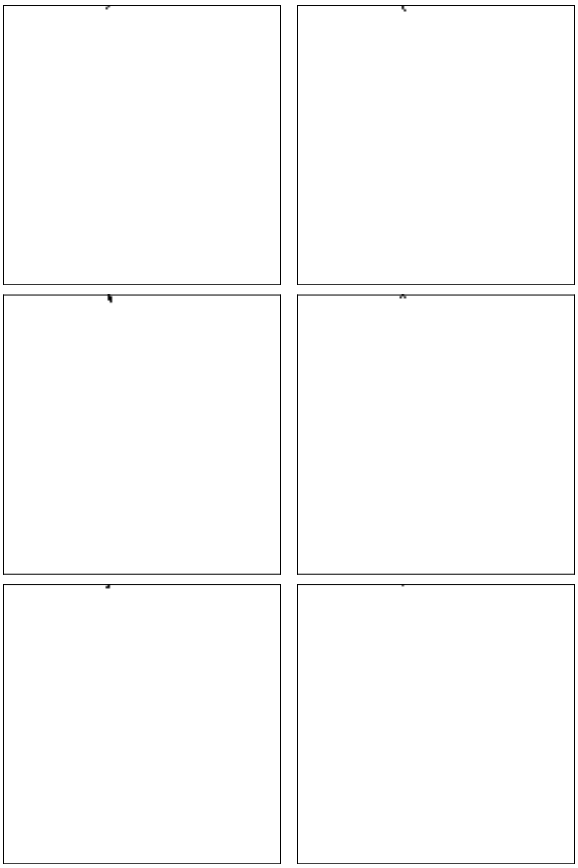










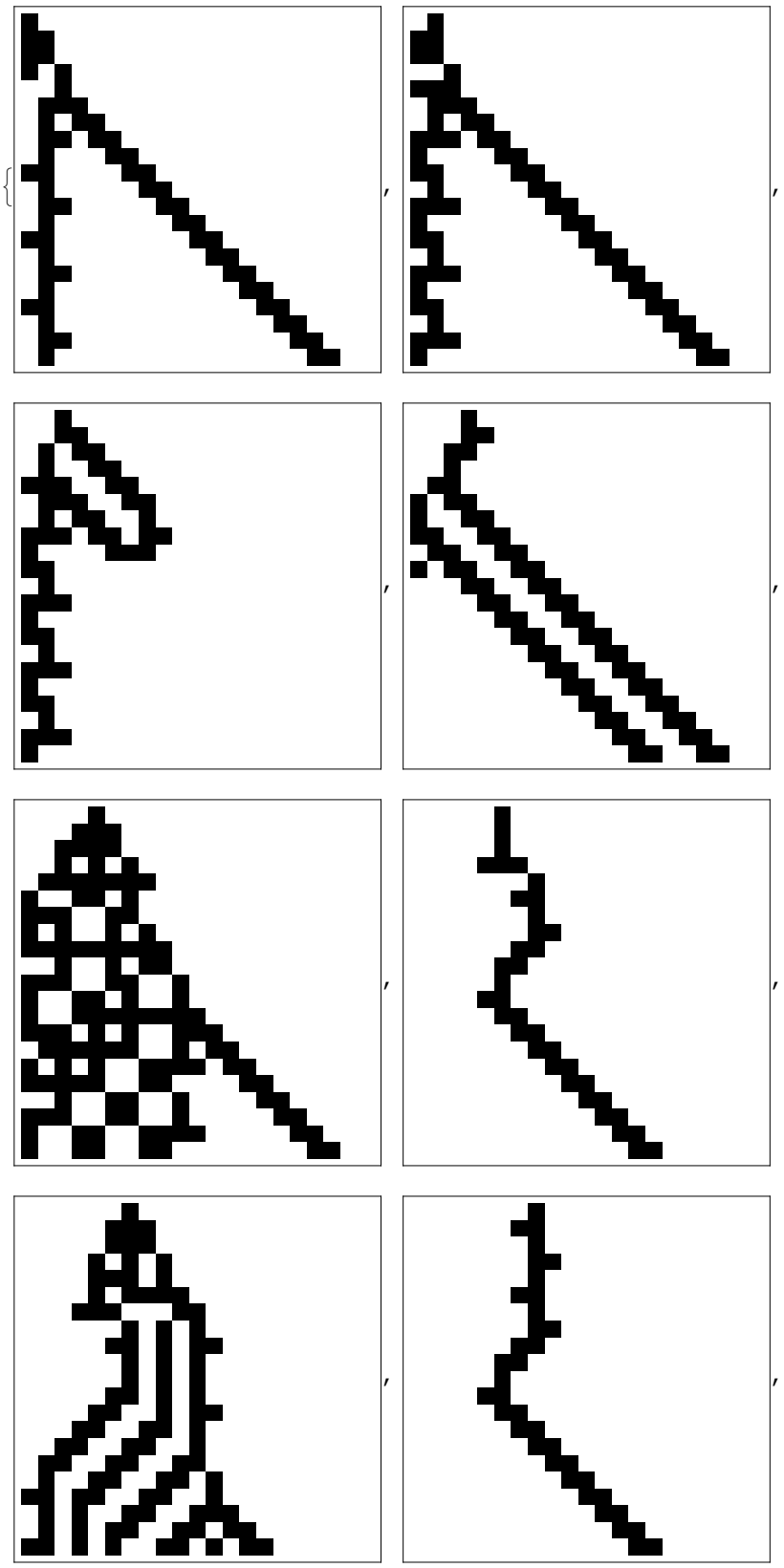


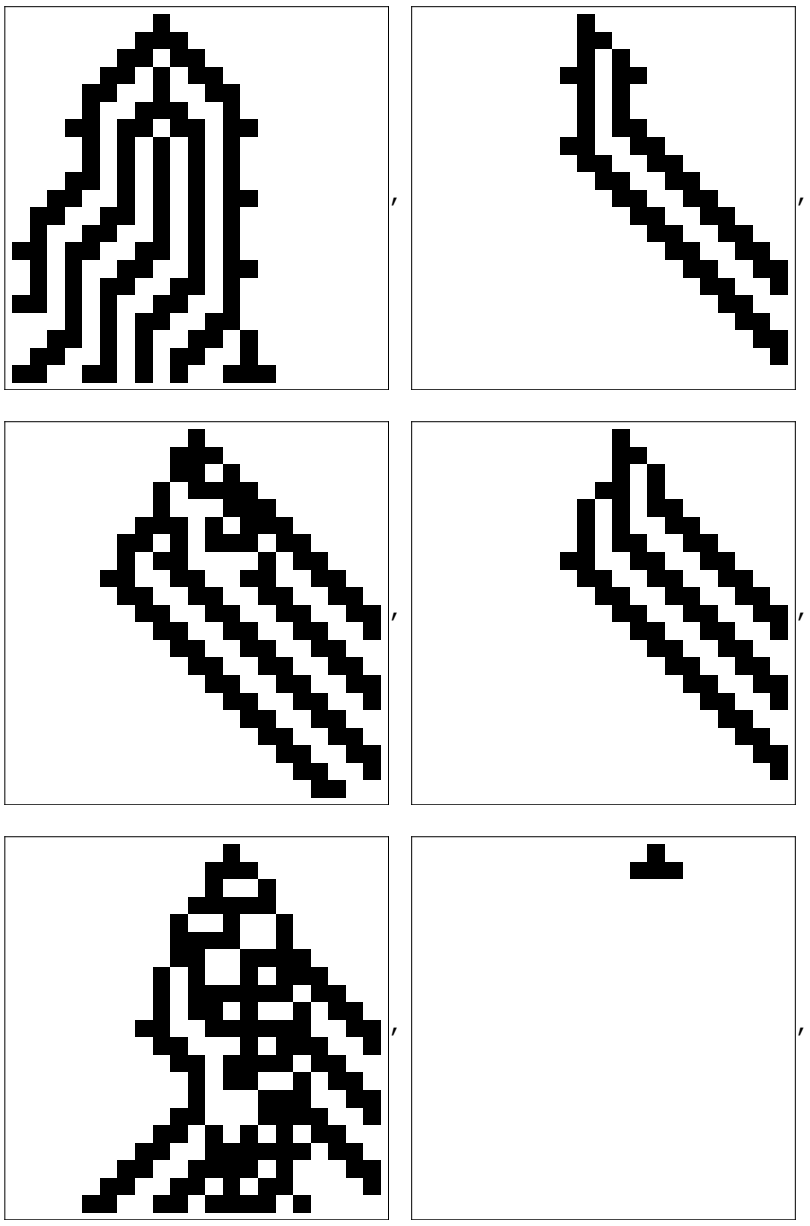
Moving the Perturbation

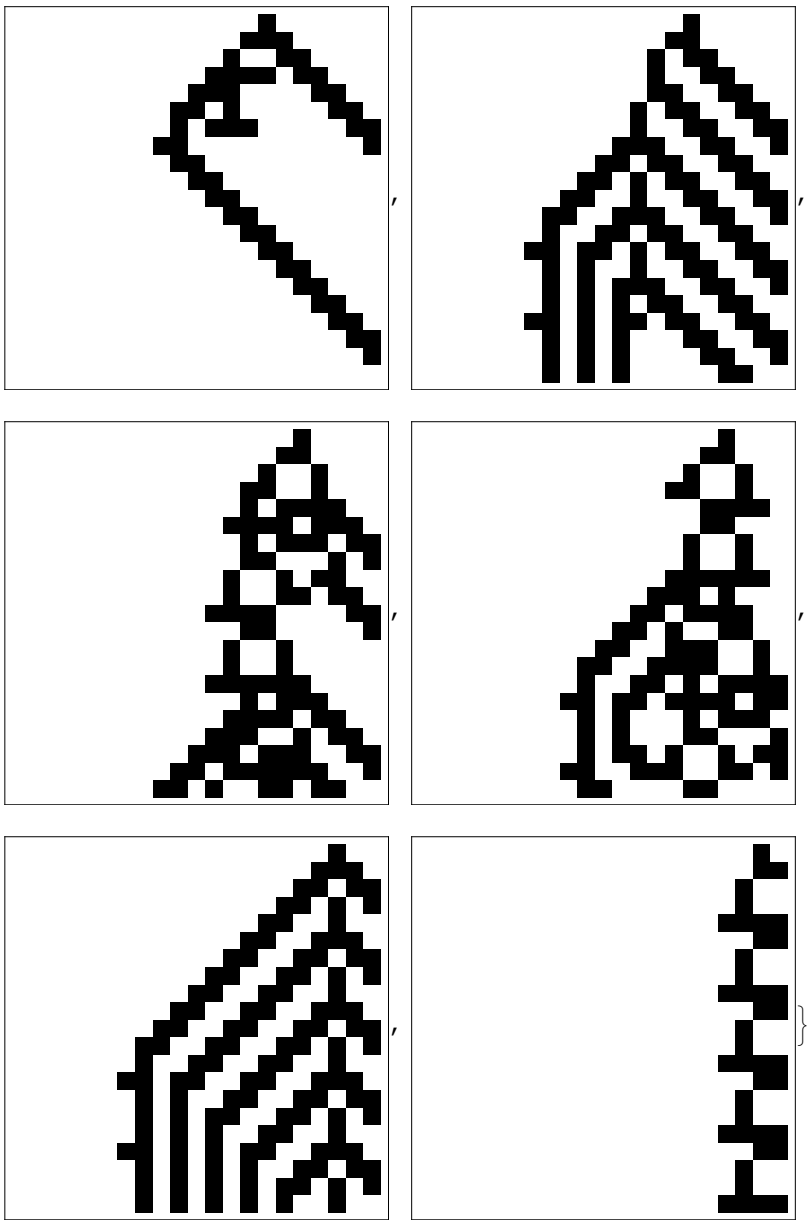
```
Manipulate[Module[{evol1, evol2, init}, init = (SeedRandom[1]; RandomInteger[1, width]);
  evol1 = CellularAutomaton[r, {init, 0}, {50, {0, Length[init]}}]; evol2 =
   CellularAutomaton[r, {MapAt[Abs[# - 1] &, init, {i}], 0}, {50, {0, Length[init]}}];
  Grid[{{ArrayPlot[evol1, ImageSize → Medium], ArrayPlot[BitXor[evol1, evol2],
      ImageSize → Medium]}}]], {{r, 41, "rule"}, 0, 255, 1},
 {{i, width / 2 // Ceiling, "position"}, 1, width, 1},
 {{width, 40, "width"}, 10, 100, 1}, SaveDefinitions → True]
```

Collecting the Perturbations

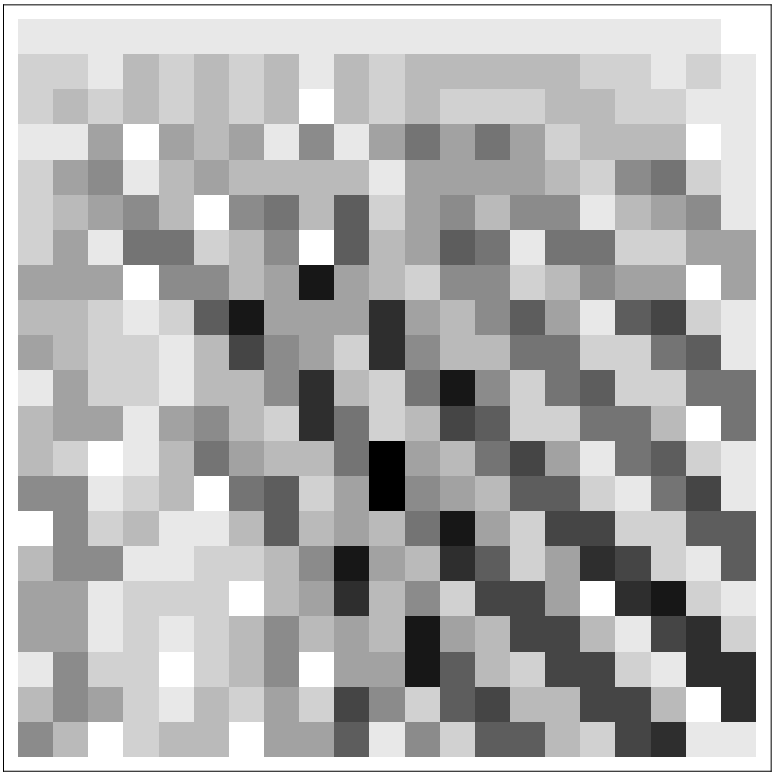
```
ArrayPlot /@ With[{width = 20},
  Table[Module[{evol1, evol2, init}, init = (SeedRandom[1]; RandomInteger[1, width]);
    evol1 = CellularAutomaton[54, {init, 0}, {20, {0, Length[init]}}];
    evol2 = CellularAutomaton[54, {MapAt[Abs[# - 1] &, init, {i}], 0},
      {20, {0, Length[init]}}]; BitXor[evol1, evol2]],
   {i,
    1,
    20}]]
```





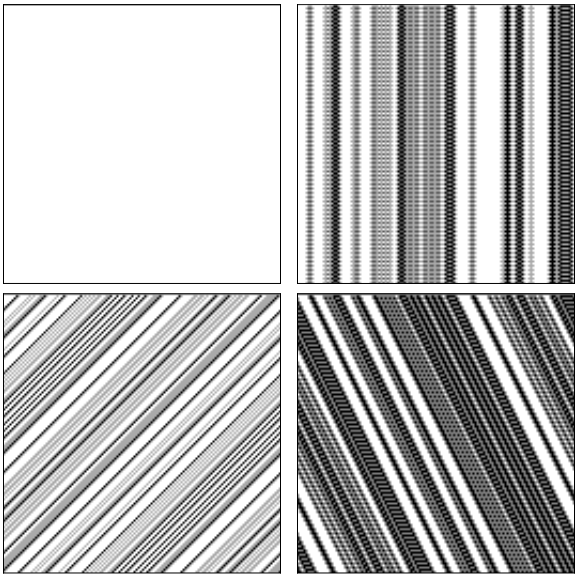


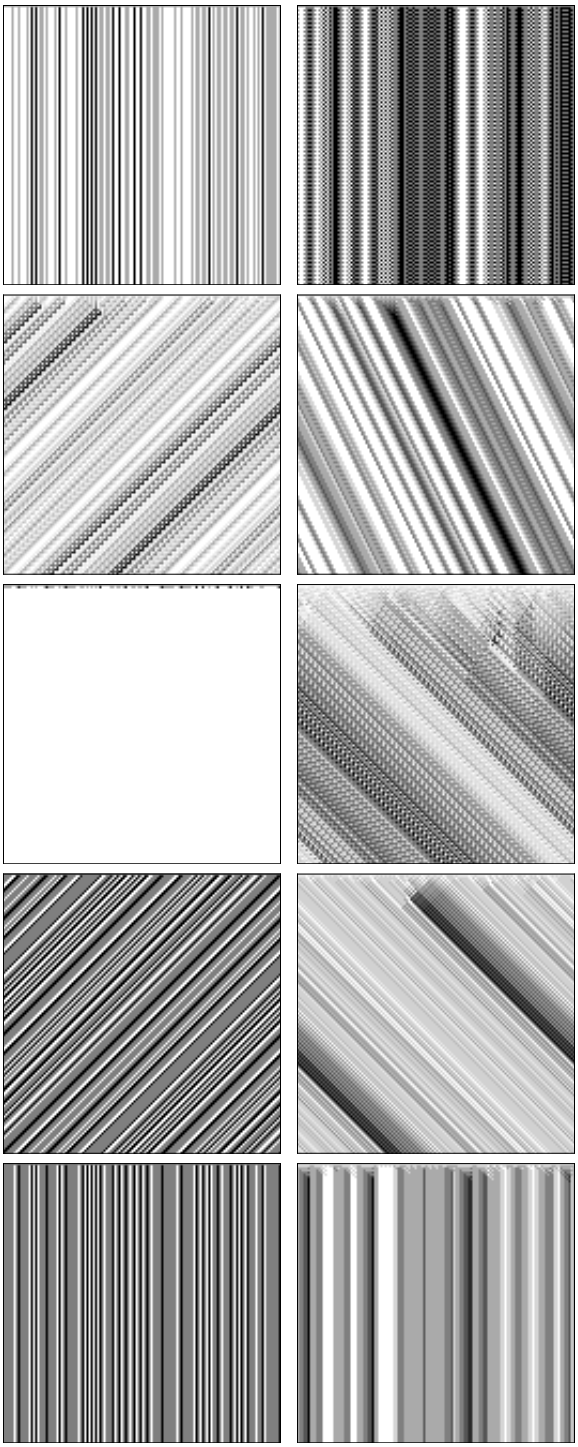
```
ArrayPlot@Total[With[{width = 20},
   Table[Module[{evol1, evol2, init}, init = (SeedRandom[1]; RandomInteger[1, width]);
     evol1 = CellularAutomaton[54, {init, 0}, {20, {0, Length[init]}}];
     evol2 = CellularAutomaton[54, {MapAt[Abs[# - 1] &, init, {i}], 0},
       {20, {0, Length[init]}}]; BitXor[evol1, evol2]],
    {i,
     1,
     20}]]]
```

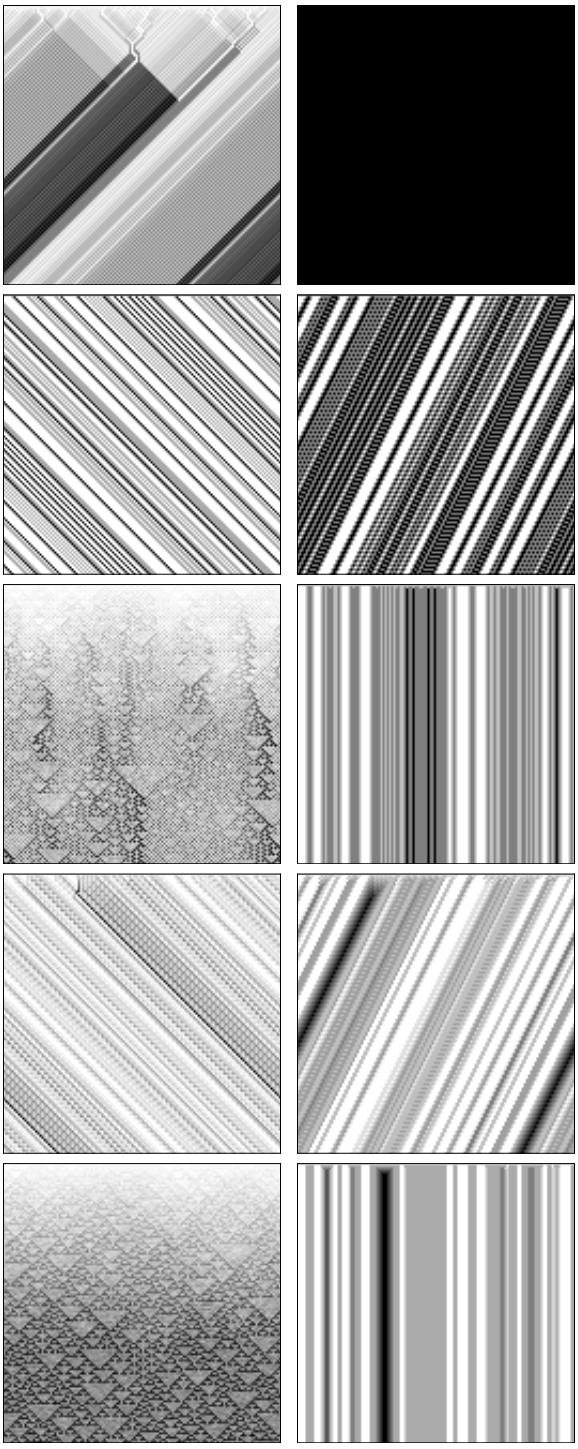


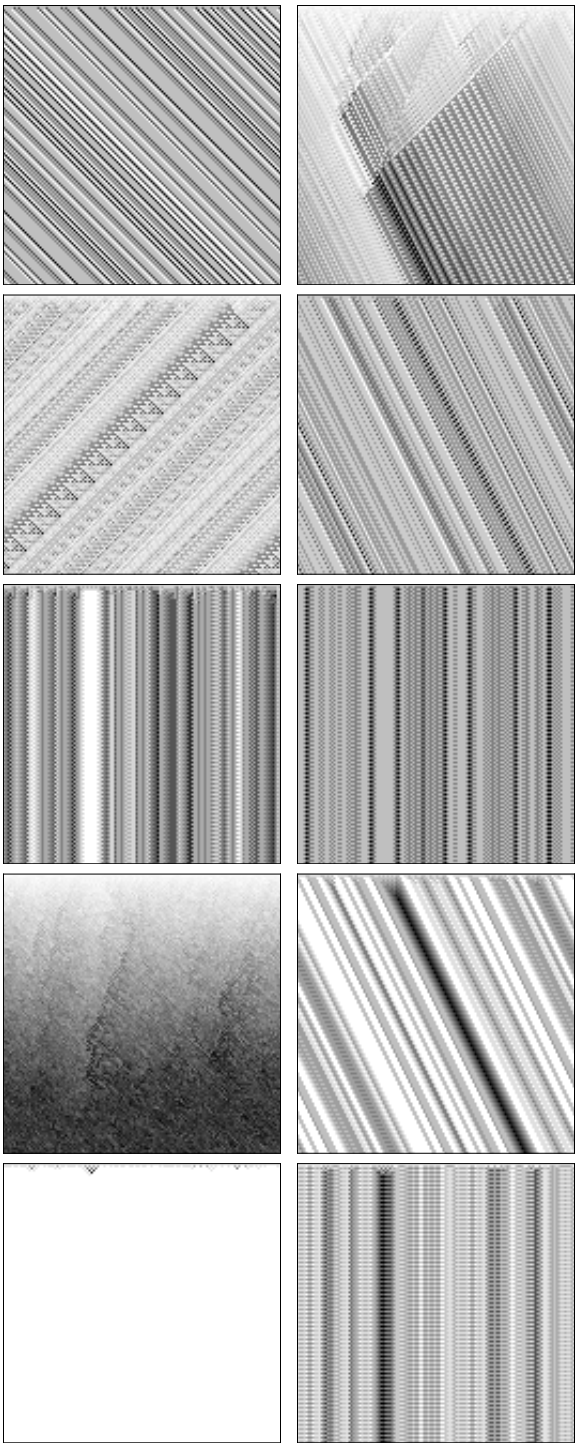
Collecting the Perturbations

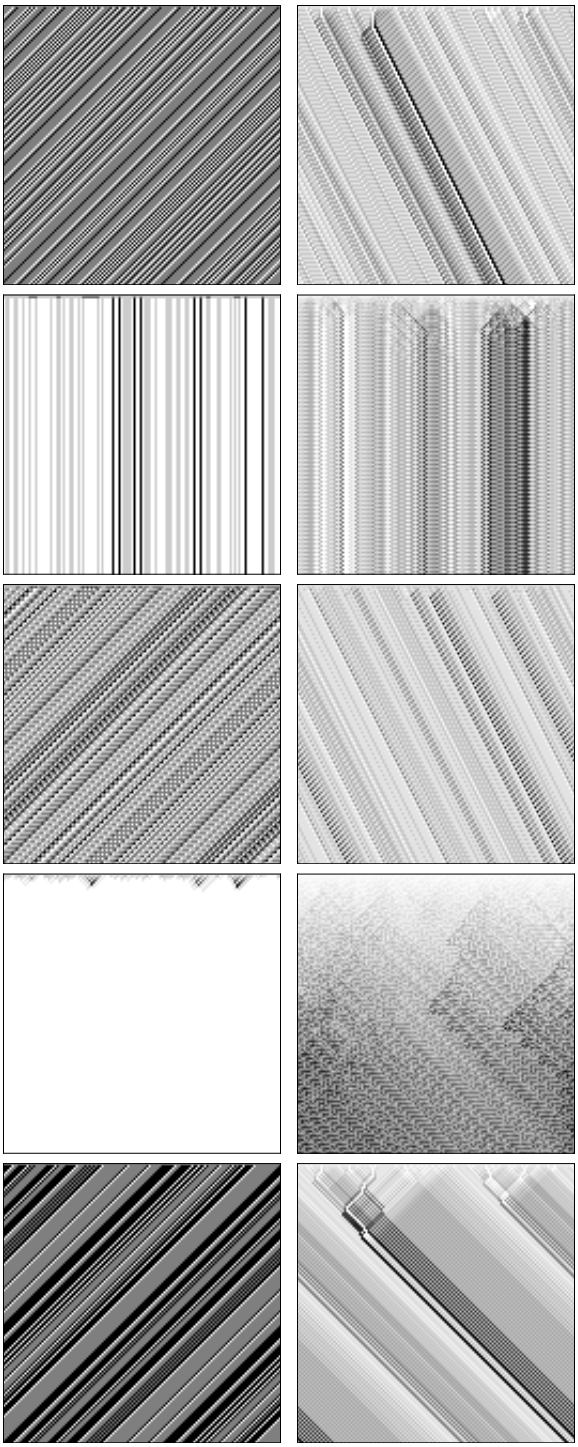
```
Grid[Partition[
  Table[With[{init = (SeedRandom[24]; RandomInteger[1, 130])}, ArrayPlot[Total[With[
       {width = 20}, Table[Module[{evol1, evol2}, evol1 = CellularAutomaton[r, init, 130];
         evol2 = CellularAutomaton[r, MapAt[Abs[# - 1] &, init, {i}], 130];
         BitXor[evol1, evol2]],
        {i, 1, 130}]]], PixelConstrained -> 1]], {r, 0, 255}], 2]]
```

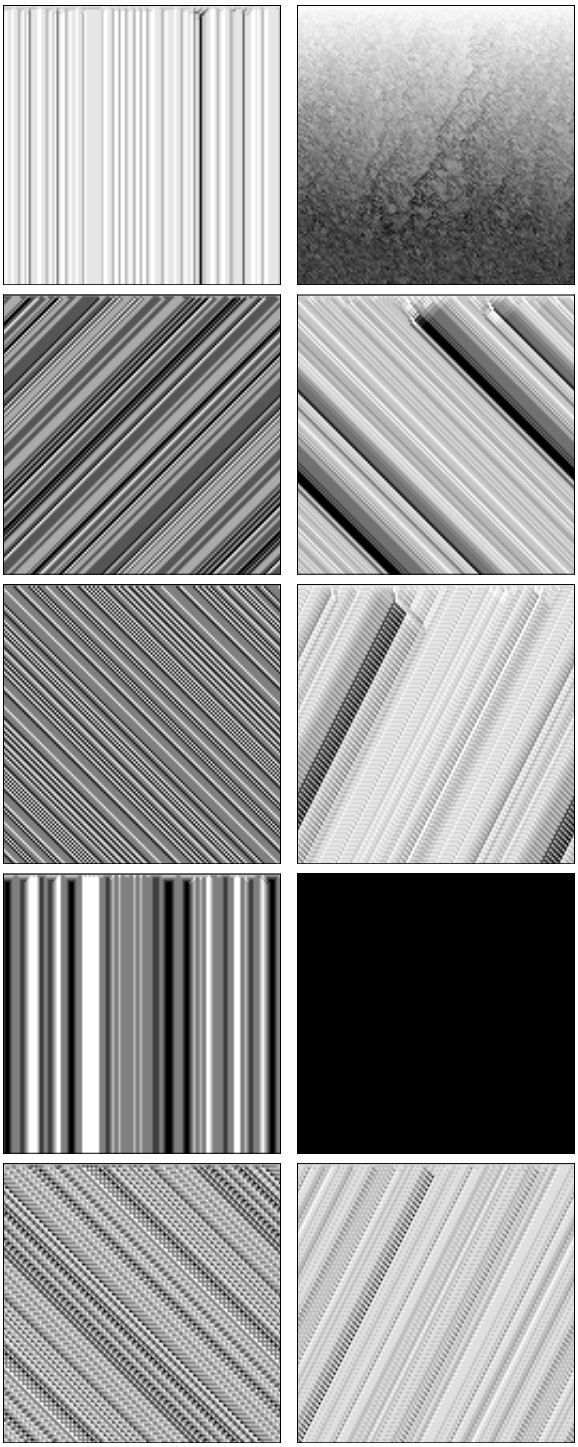


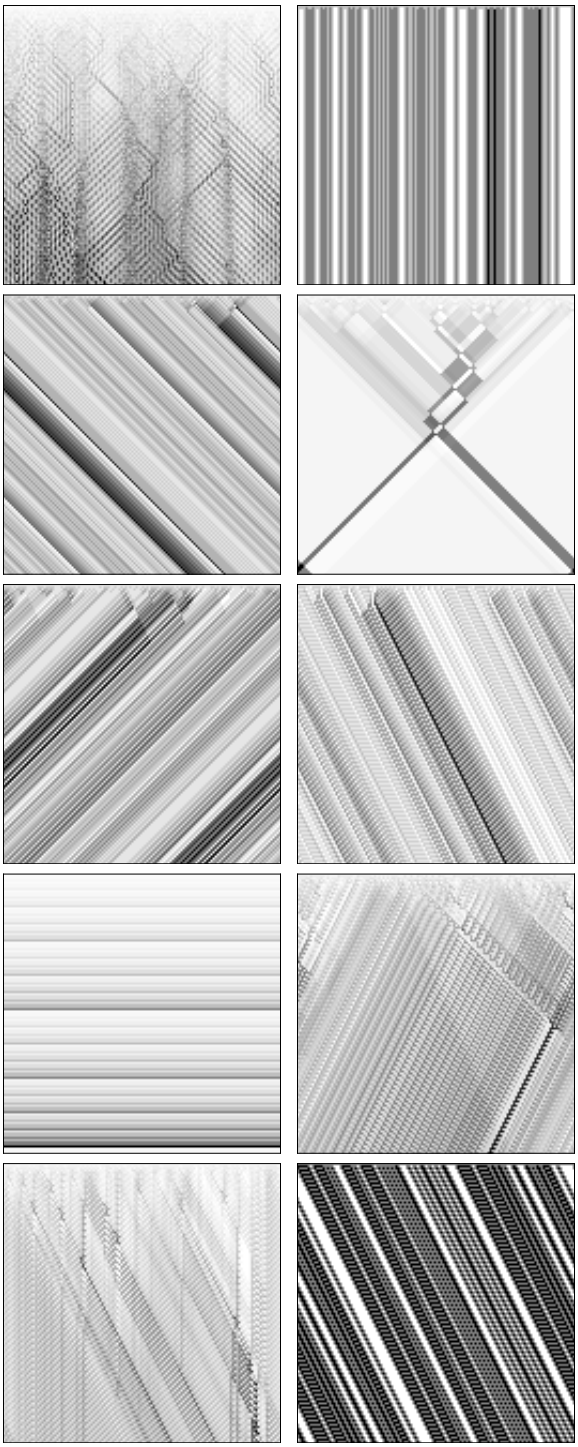


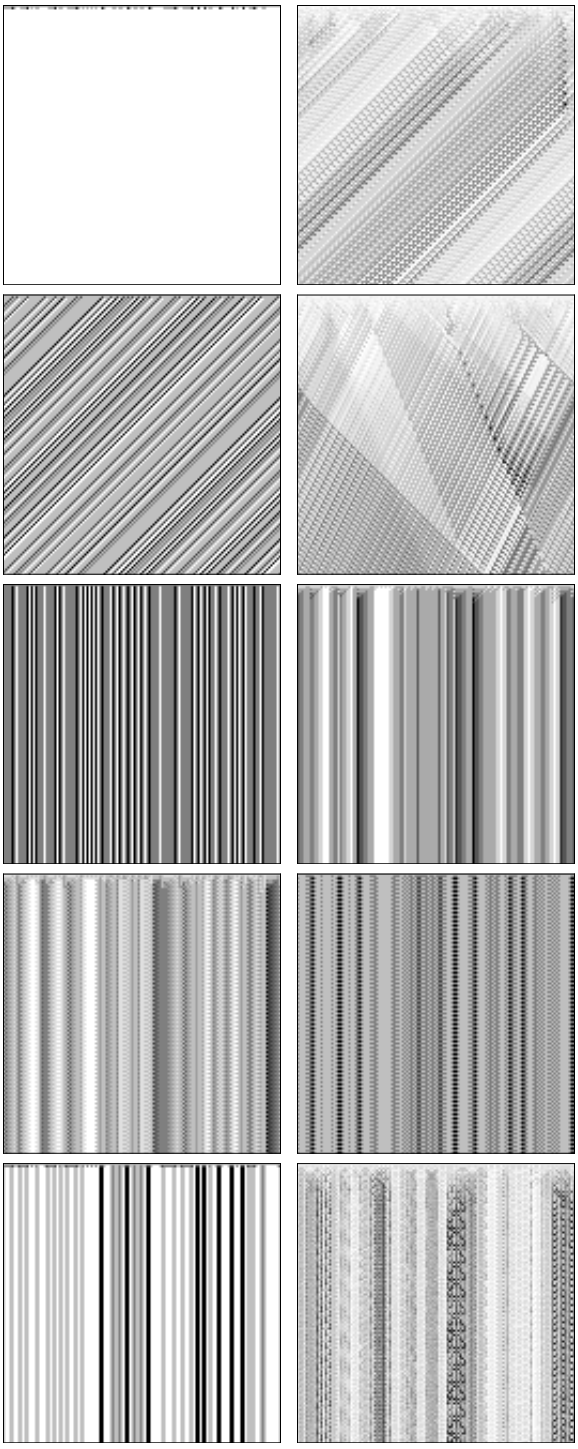


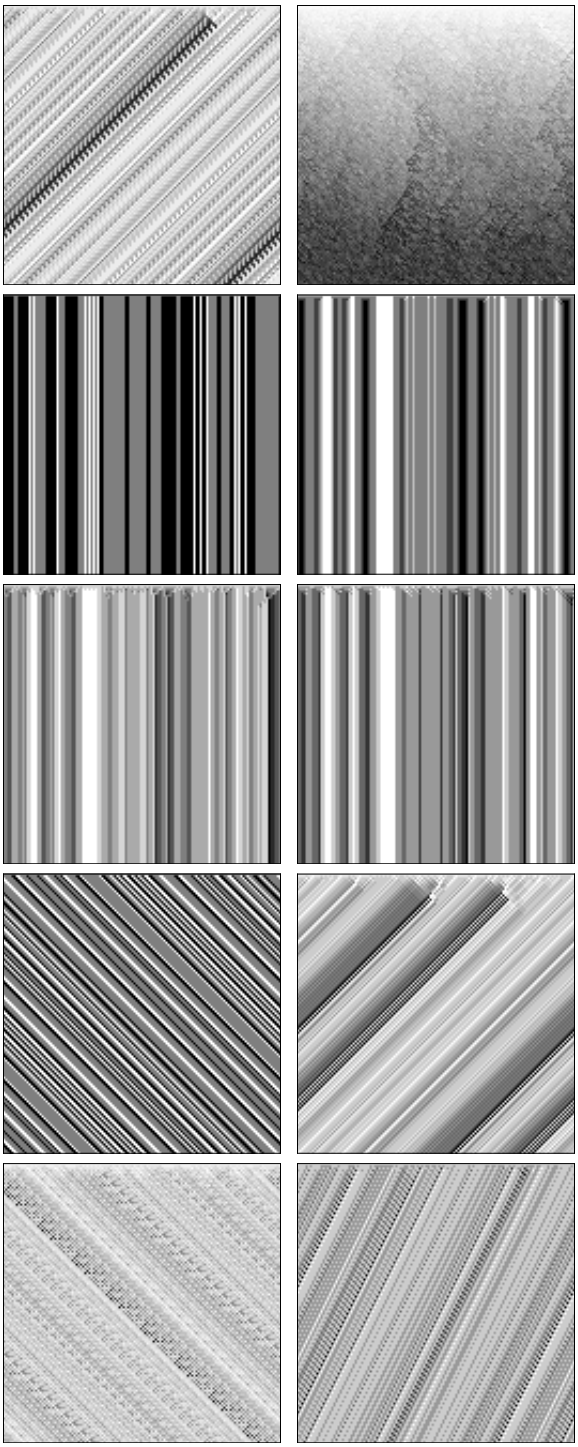


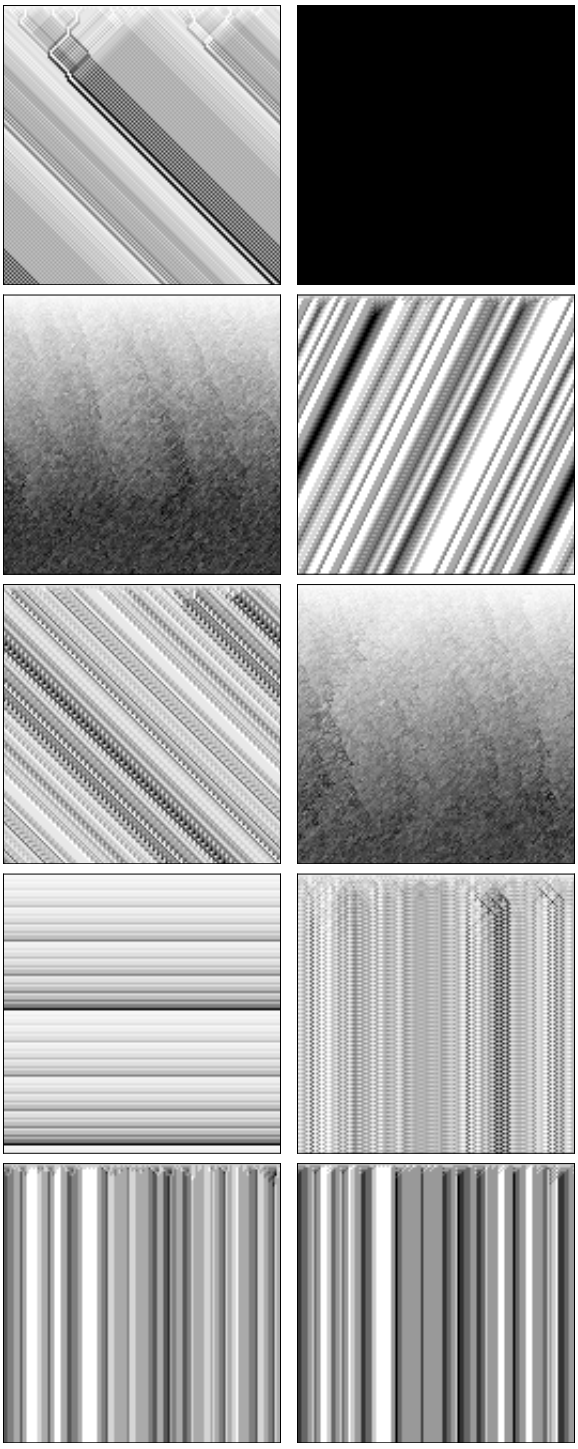


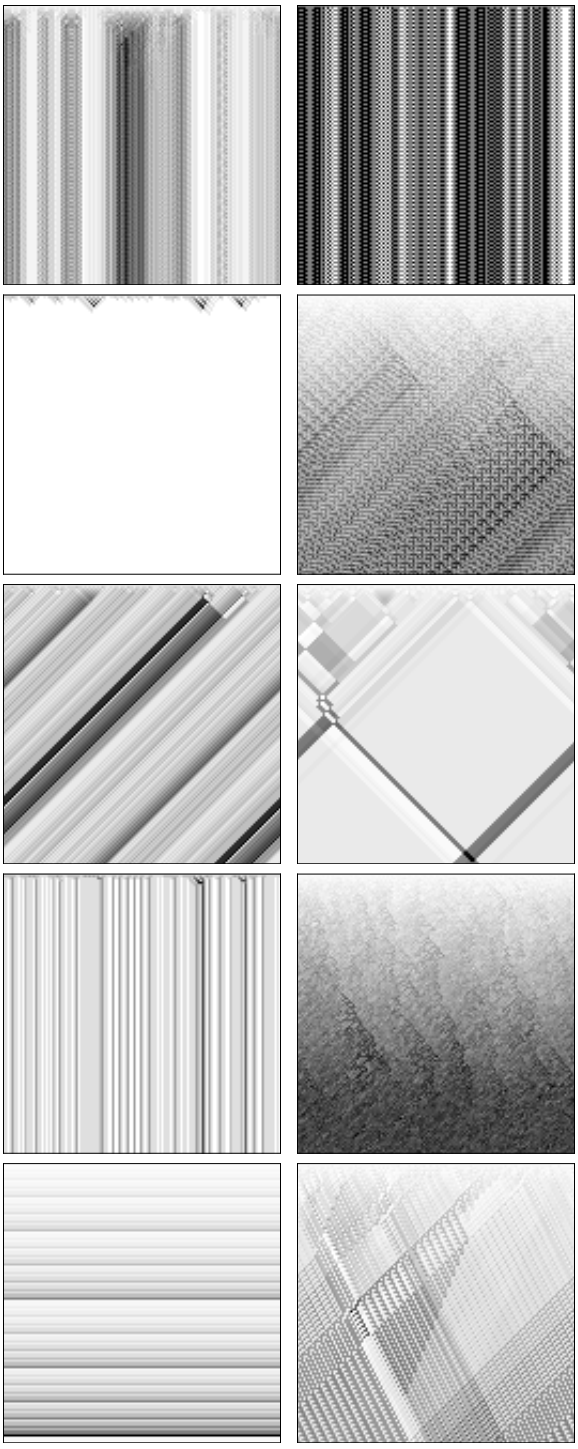


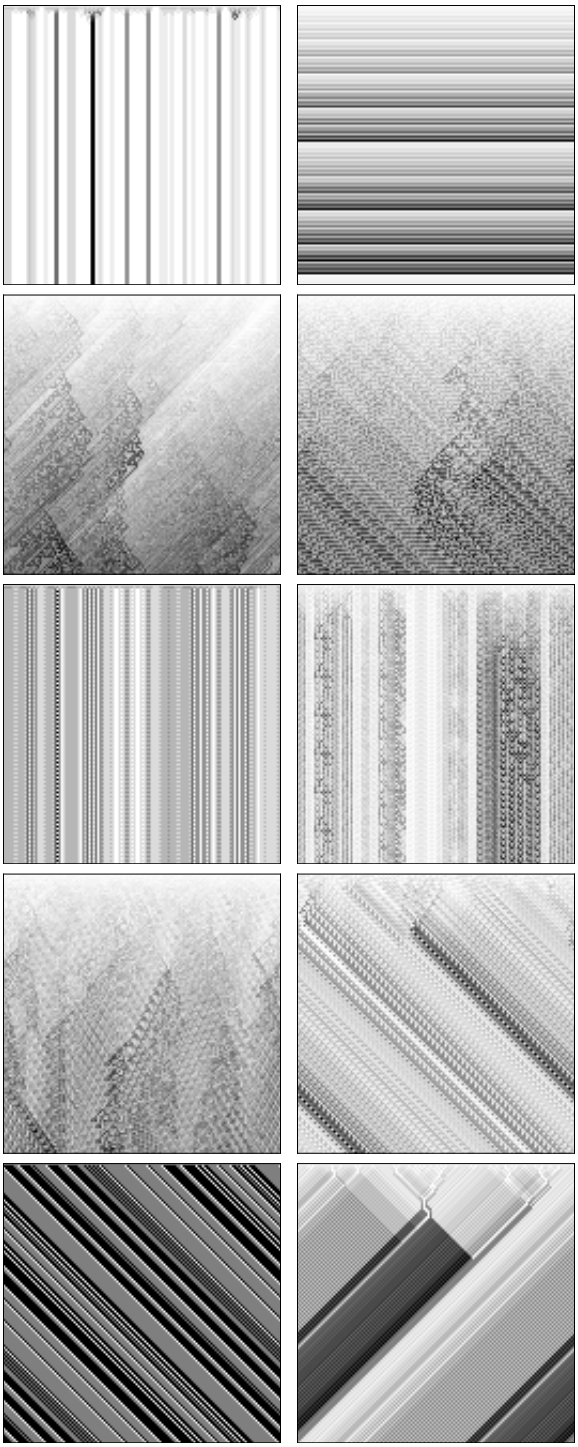


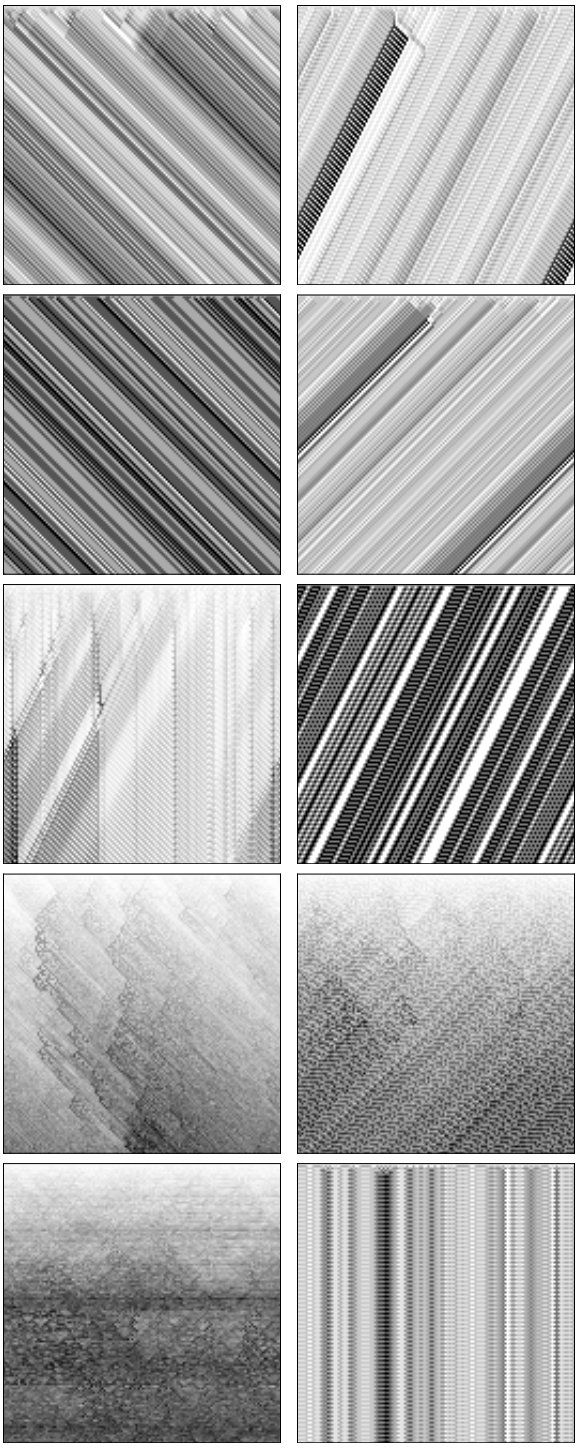


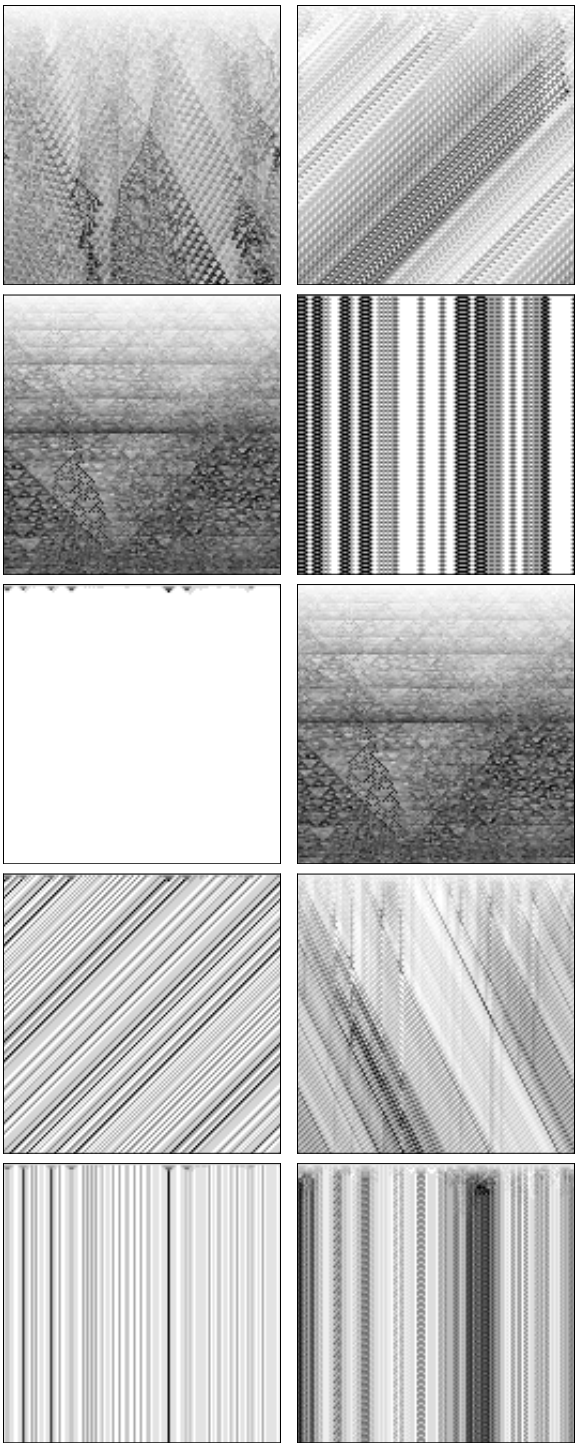


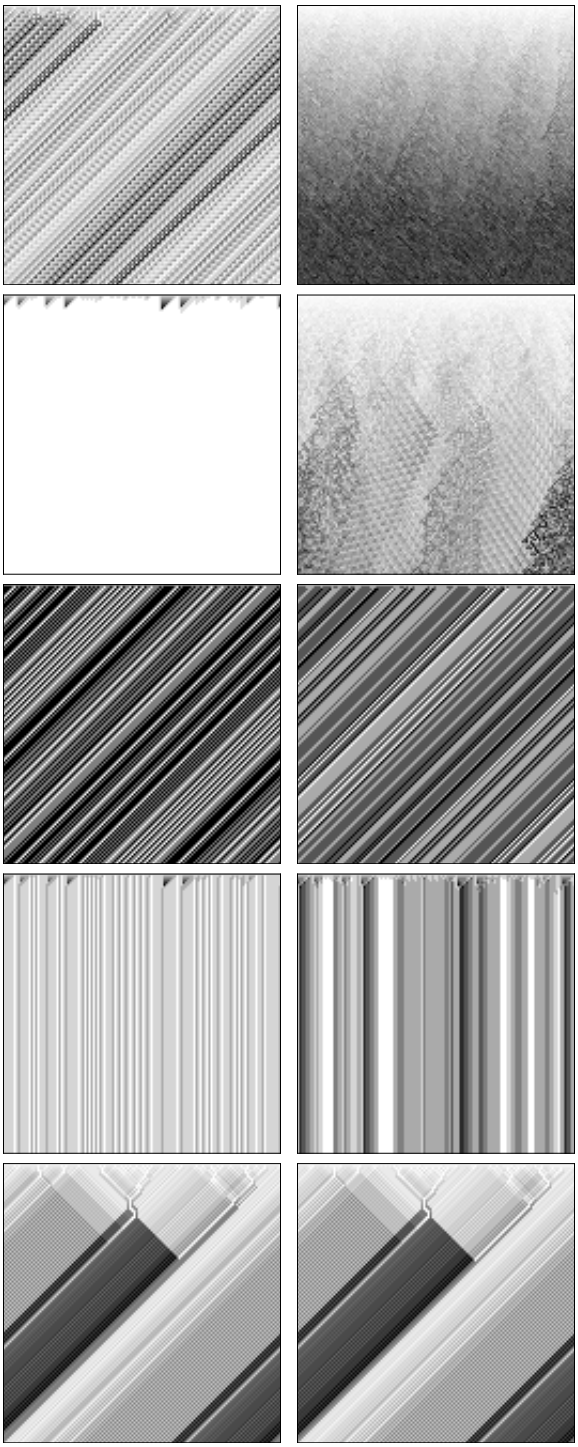


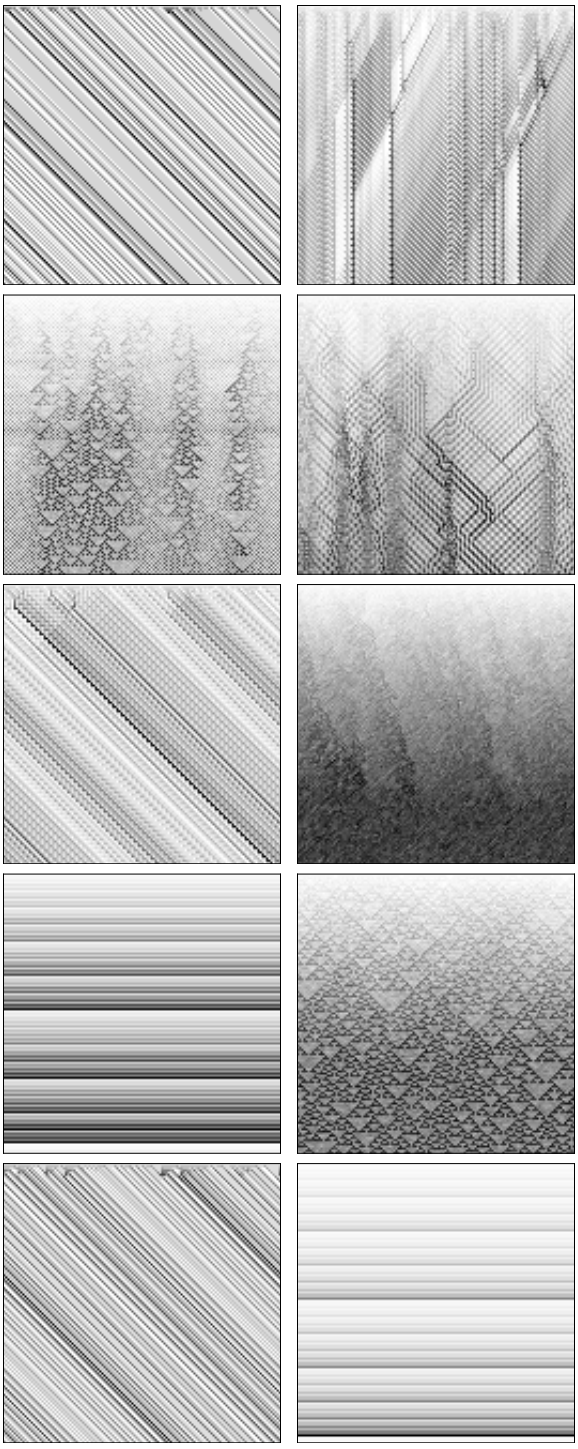


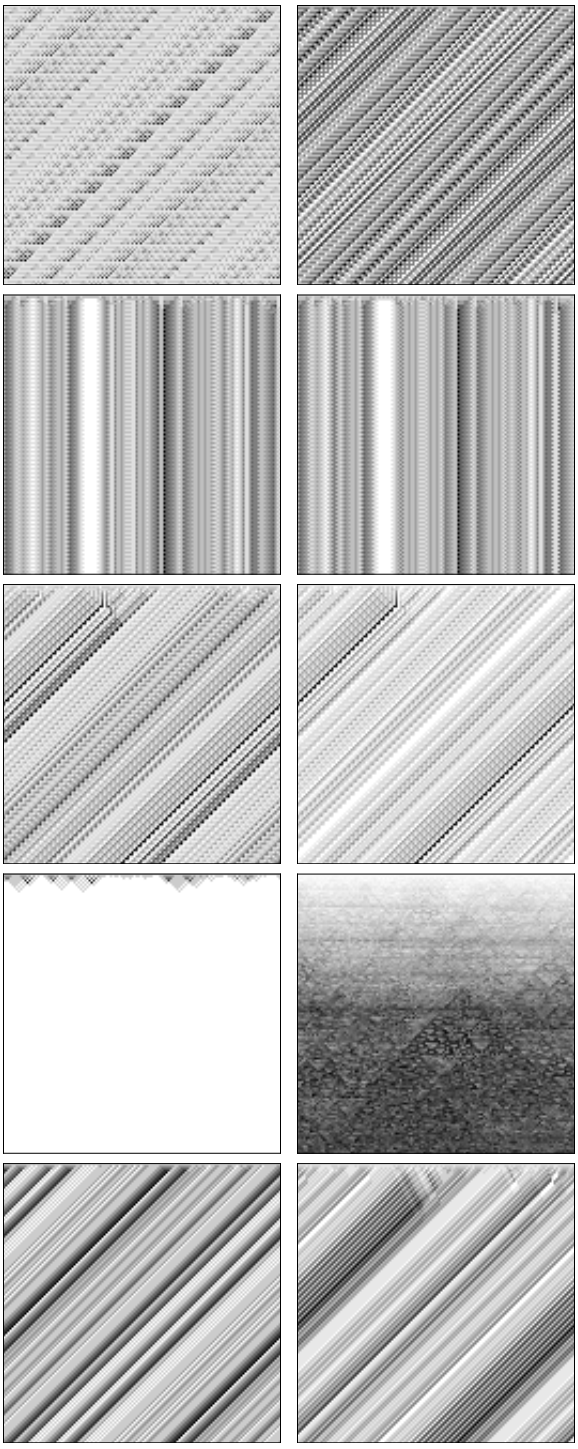


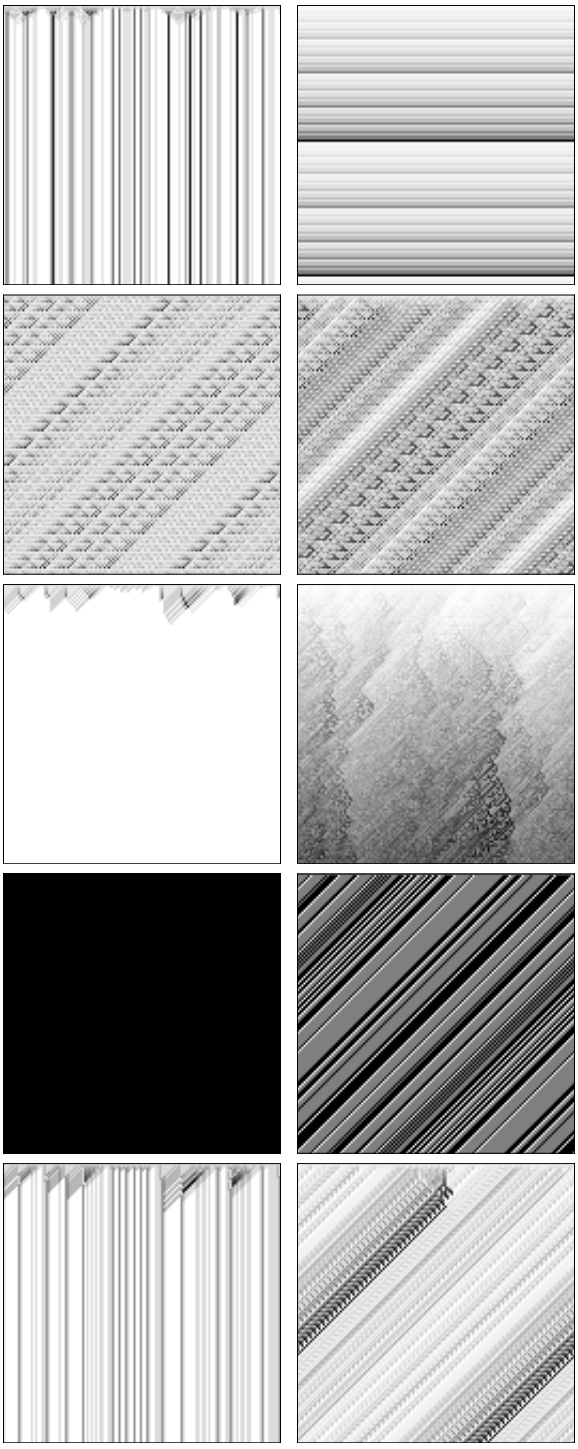


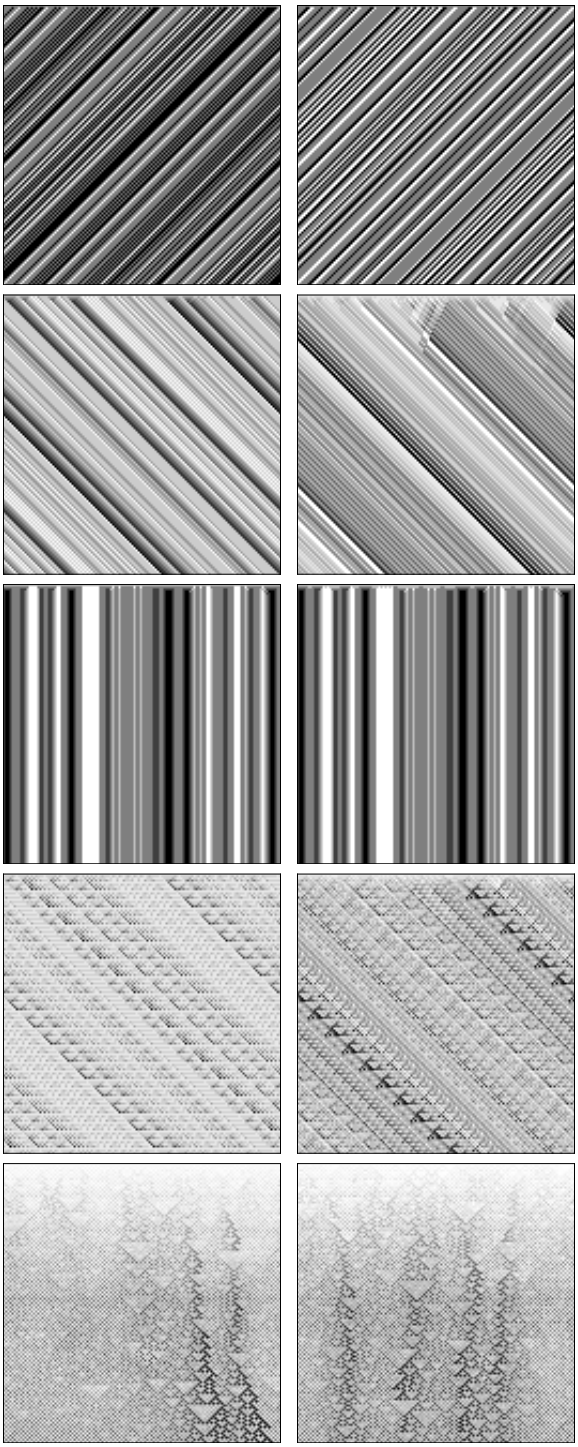


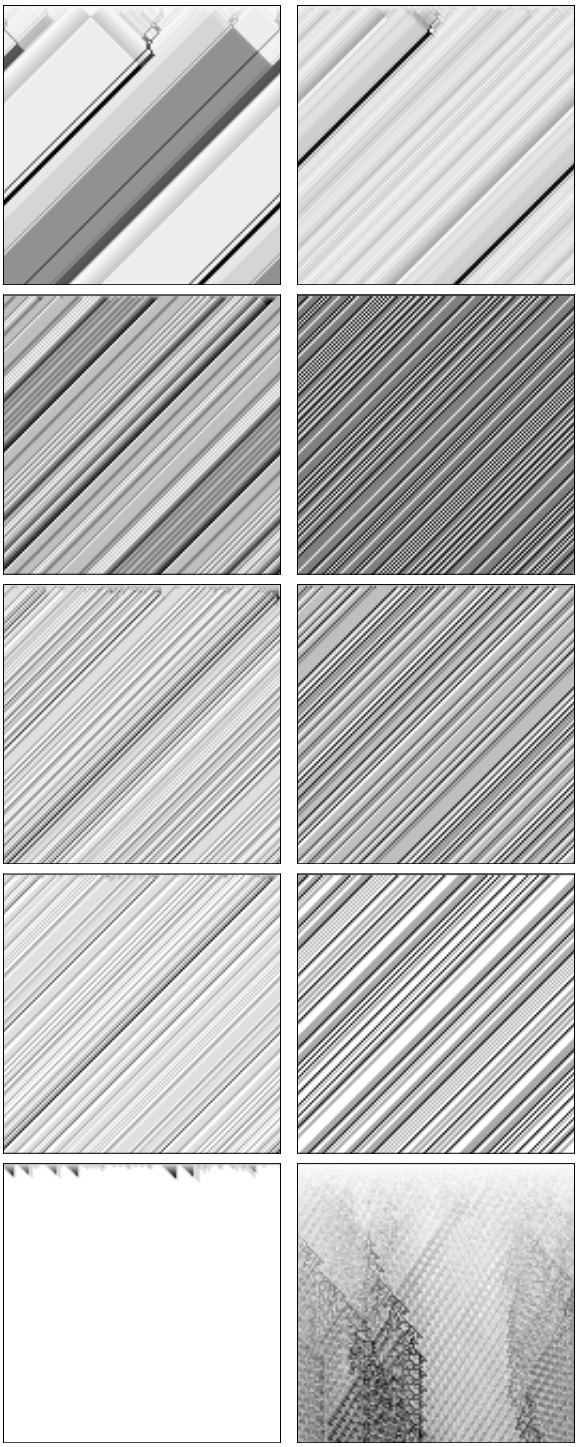


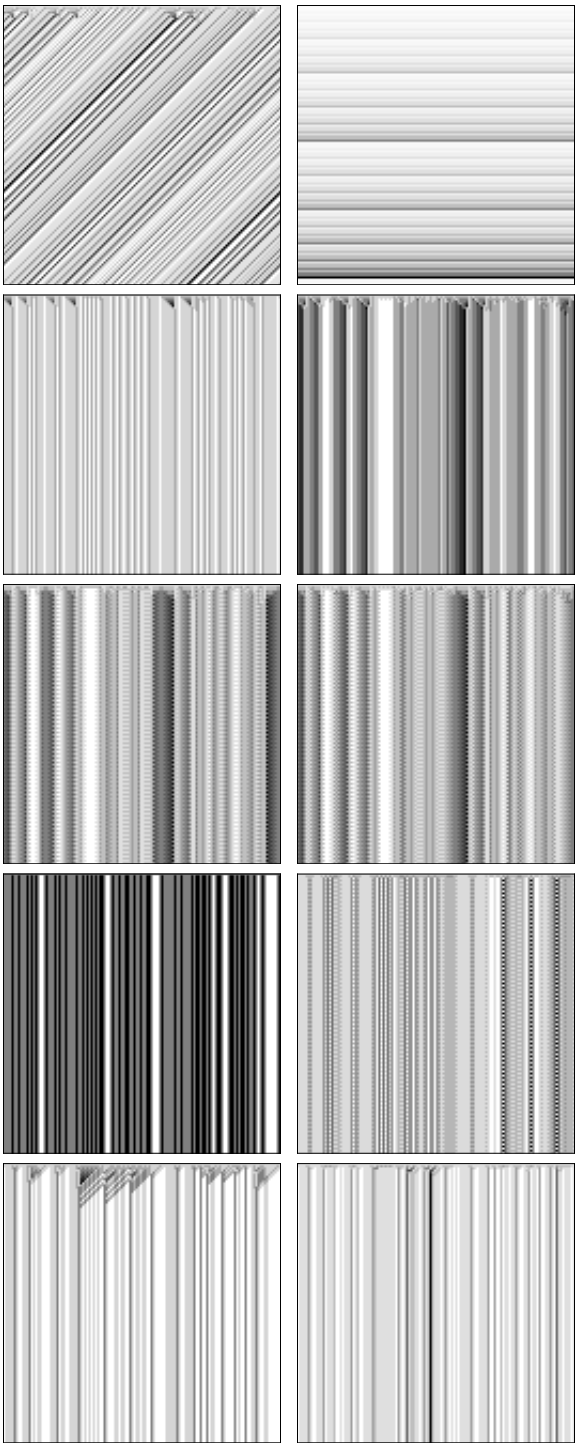


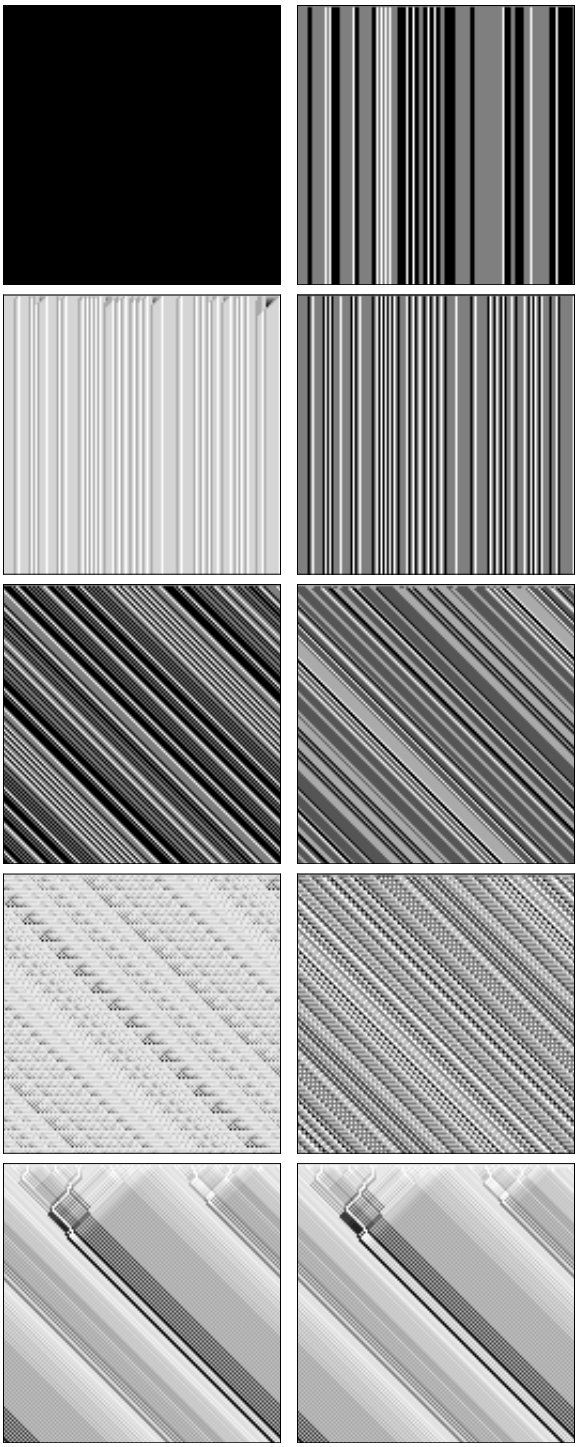


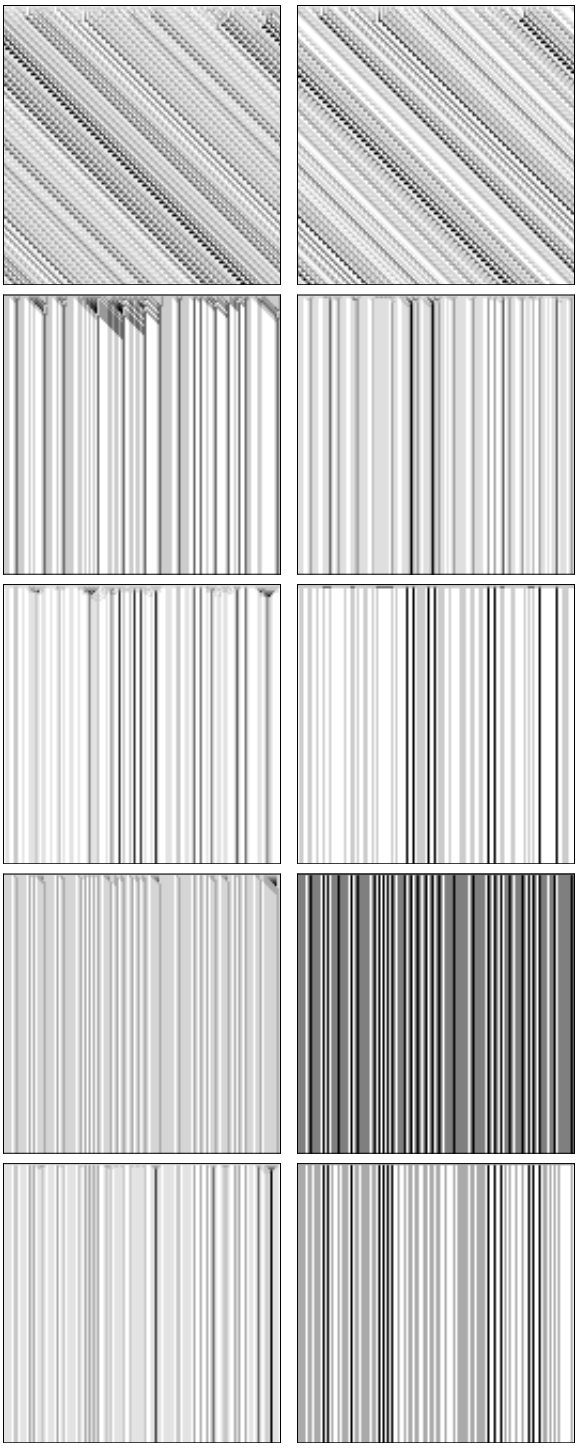


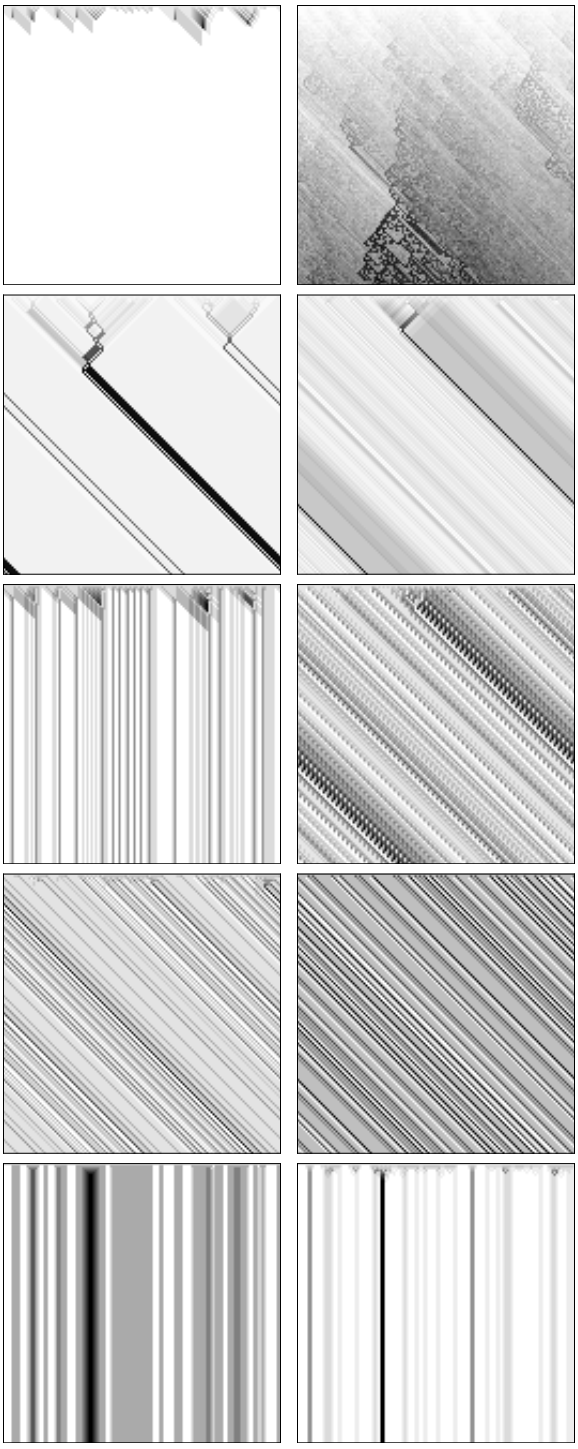


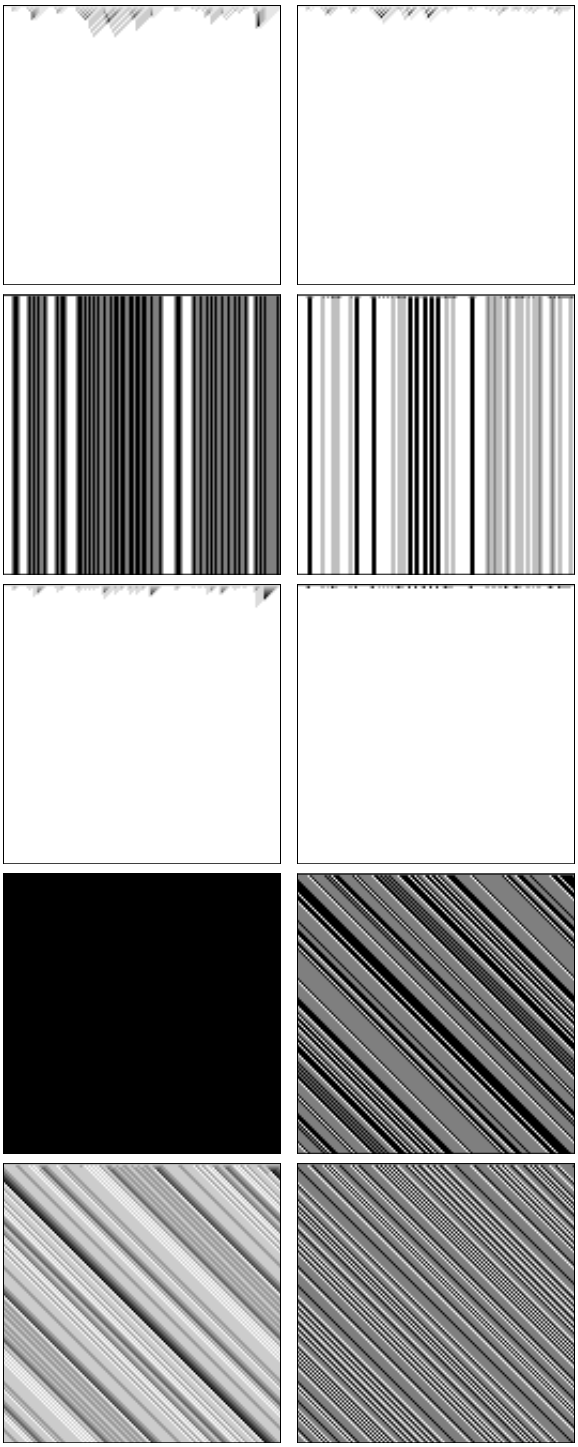


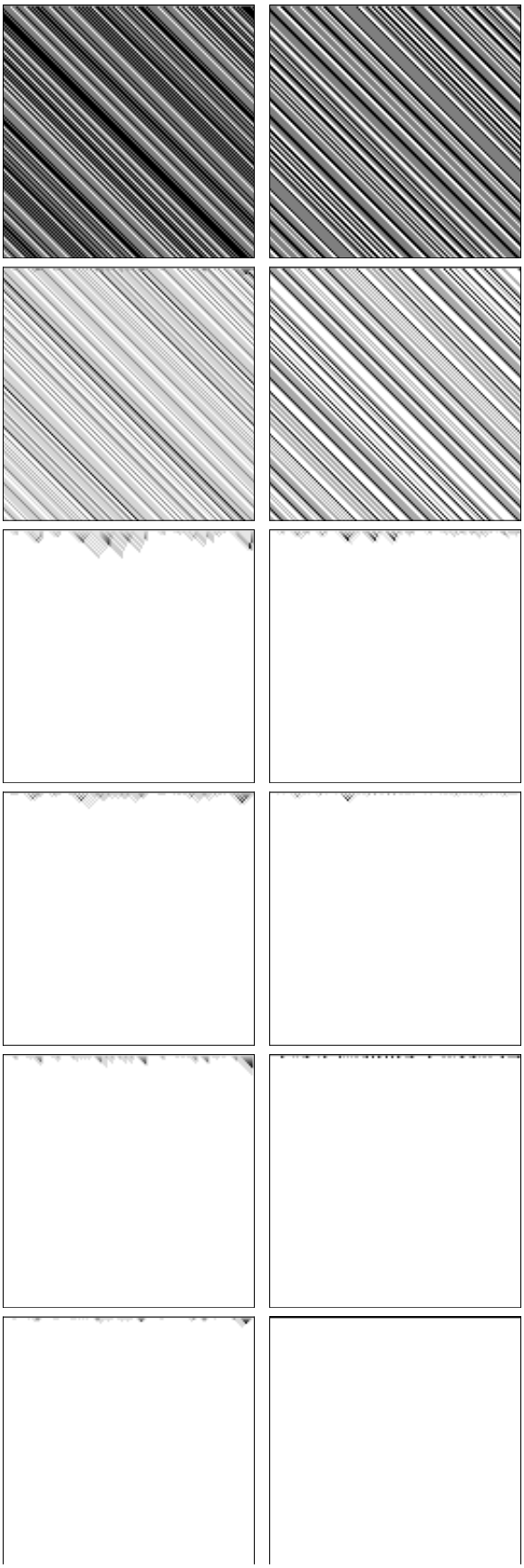






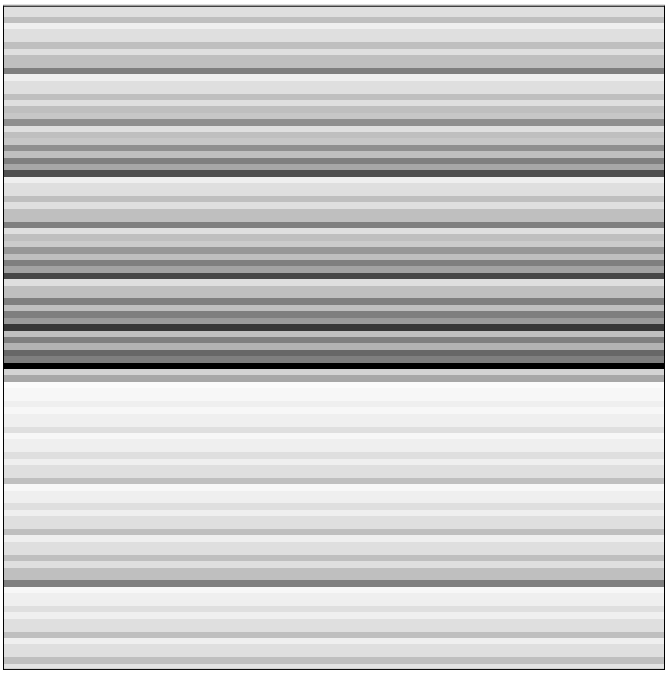






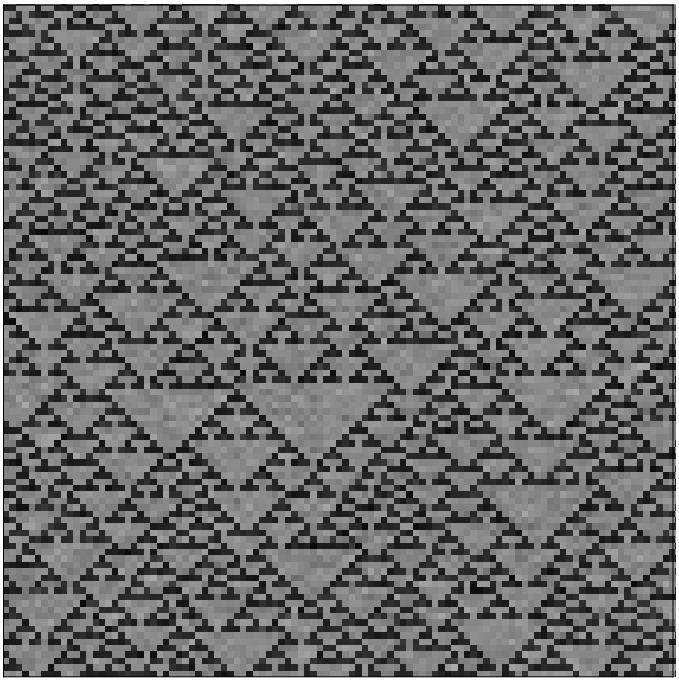
Specific Rules

```
With[{init = (SeedRandom[24]; RandomInteger[1, 300])}, ArrayPlot[Total[With[{width = 20},
    Table[Module[{evol1, evol2}, evol1 = CellularAutomaton[90, init, 300]; evol2 =
       CellularAutomaton[90, MapAt[Abs[# - 1] &, init, {i}], 300]; BitXor[evol1, evol2]],
     {i, 1, 300}]]], PixelConstrained -> 3]]
```

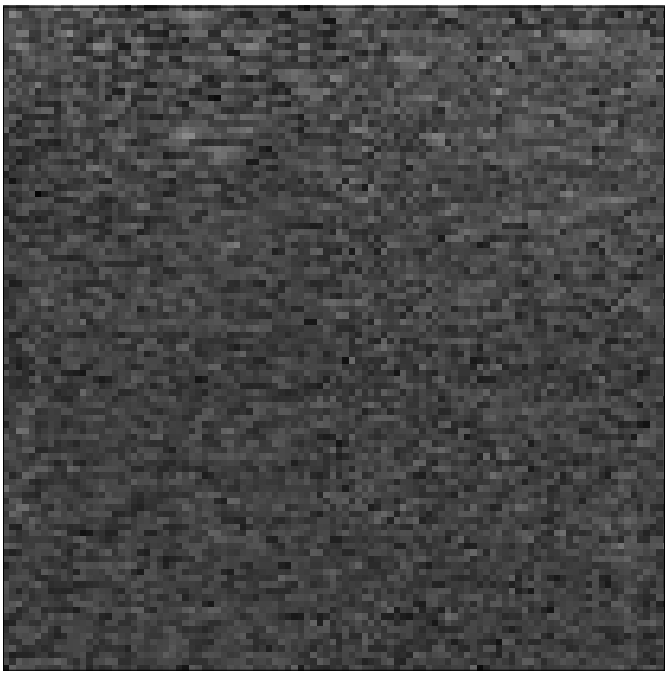


```
With[{init = (SeedRandom[24]; RandomInteger[1, 300])}, ArrayPlot[Total[With[{width = 20},
    Table[Module[{evol1, evol2}, evol1 = CellularAutomaton[30, init, 300]; evol2 =
       CellularAutomaton[30, MapAt[Abs[# - 1] &, init, {i}], 300]; BitXor[evol1, evol2]],
     {i, 1, 300}]]], PixelConstrained -> 3]]
```

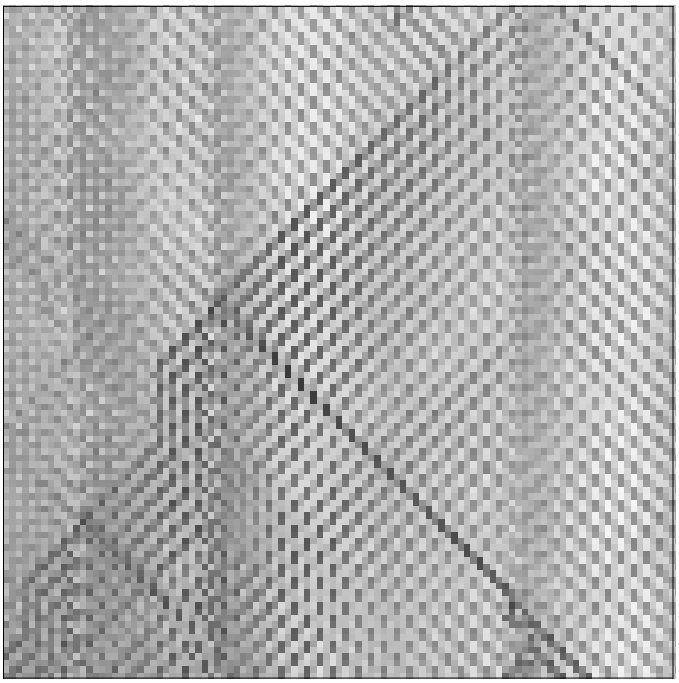
```
With[{init = (SeedRandom[24]; RandomInteger[1, 300])}, ArrayPlot[Total[With[{width = 20},
    Table[Module[{evol1, evol2}, evol1 = CellularAutomaton[22, init, 300]; evol2 =
       CellularAutomaton[22, MapAt[Abs[# - 1] &, init, {i}], 300]; BitXor[evol1, evol2]],
     {i, 1, 300}]]], PixelConstrained -> 3]]
```



```
With[{init = (SeedRandom[24]; RandomInteger[1, 300])},
 ArrayPlot[Total[With[{width = 20}, Table[Module[{evol1, evol2},
      evol1 = CellularAutomaton[126, init, 300]; evol2 = CellularAutomaton[
        126, MapAt[Abs[# - 1] &, init, {i}], 300]; BitXor[evol1, evol2]],
     {i, 1, 300}]]], PixelConstrained -> 3]]
```



```
With[{init = (SeedRandom[24]; RandomInteger[1, 300])}, ArrayPlot[Total[With[{width = 20},
    Table[Module[{evol1, evol2}, evol1 = CellularAutomaton[54, init, 300]; evol2 =
       CellularAutomaton[54, MapAt[Abs[# - 1] &, init, {i}], 300]; BitXor[evol1, evol2]],
     {i, 1, 300}]]], PixelConstrained -> 3]]
```

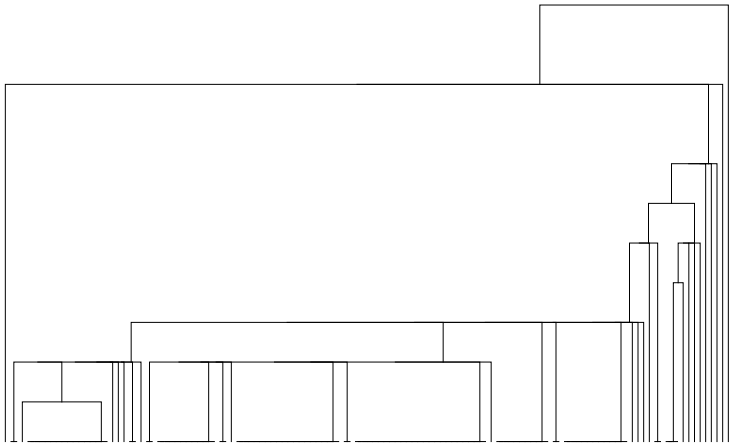


Isolating the "Fractures"

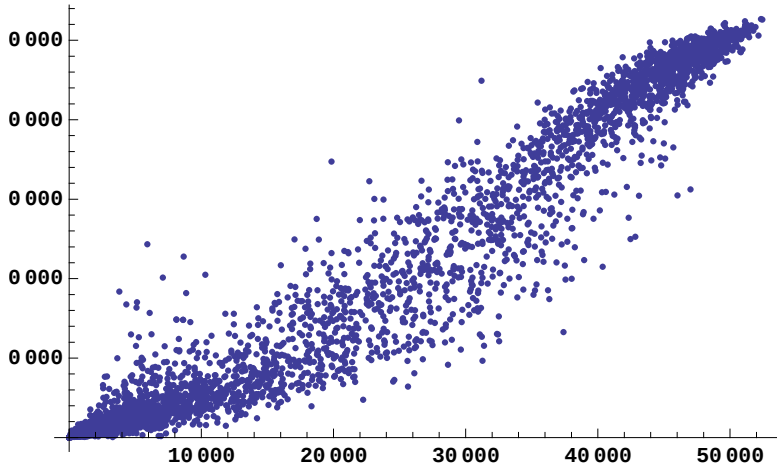
In[157]:=

```
Manipulate[
 ArrayPlot[With[{ev = Overlap[r, pos1, pos2, 60]}, ColoredArray[ev, GetComponents2[ev]]],
  ColorRules → {0 → Black}, ColorFunction → (Hue[Random[]] &),
  ColorFunctionScaling → True, PixelConstrained → 10],
 {pos1, 1, 40, 1}, {pos2, 1, 40, 1}, {r, 0, 255, 1}, SaveDefinitions → True]
```

Fracture Relationships



Related Topic: Growth Rates



Why we care?

Biology

Nanocomputing

Nanotechnology

Future work

More methods for isolating the fractures

Better understanding of the relevant statistical techniques

Run searches!!