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**Return of the Quantum Cellular Automata: Episode VI**[1] LINCOLN D. CARR, LOGAN E. HILLBERRY, Colorado Sch of Mines, PATRICK RALL, NICOLE YUNGER HALPERN, NING BAO, Caltech IQIM, SIMONE MONTANGERO, Univ. of Ulm — There are now over 150 quantum simulators or analog quantum computers worldwide. Although exploring quantum phase transitions, many-body localization, and the generalized Gibbs ensemble are exciting and worthwhile endeavors, there are totally untapped directions we have not yet pursued. One of these is quantum cellular automata. In the past a principal goal of quantum cellular automata was to reproduce continuum single particle quantum physics such as the Schrodinger or Dirac equation from simple rule sets. Now that we begin to really understand entanglement and many-body quantum physics at a deeper level, quantum cellular automata present new possibilities. We explore several time evolution schemes on simple spin chains leading to high degrees of quantum complexity and nontrivial quantum dynamics. We explain how the 256 known classical elementary cellular automata reduce to just a few exciting quantum cases. Our analysis tools include mutual information based complex networks as well as more familiar quantifiers like sound speed and diffusion rate.

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