Testing Turing

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Its been 61 years since Alan Turings groundbreaking paper, The Chemical Basis of Morphogenesis, in which he showed a general mechanism for how a set of identical cells could differentiate into distinct species. Particularly notable was his counterintuitive discovery that diffusion can interact with chemical kinetics to generate temporally stationary, spatially periodic structures (Turing patterns), which spawned a plethora of efforts to model biological patterns (e.g. zebra stripes, leopard spots). What is less well appreciated is that it took four decades for the first experimental demonstration of Turings predictions, that clearcut experimental evidence of Turing patterns remains rare, and that Turing proposed several other modes of pattern formation. I will introduce the Turing model and describe an experimental reaction-diffusion system ideally suited for testing all of Turings ideas. It consists of a microfluidically produced two-dimensional array of diffusively coupled droplets containing the constituents of the oscillatory Belousov-Zhabotinsky chemical reaction. We find a remarkable variety of oscillatory and stationary examples of chemical and physical morphogenesis, some predicted by Turing, others not.

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