

出典: <https://www.youtube.com/watch?v=LcLKQSQGlCU>

2つの物質がある条件のもとで  
化学反応を起こしながら拡がるとき  
物質の濃淡の波ができる

### チューリングの文献

THE CHEMICAL BASIS OF MORPHOGENESIS  
By A. M. TURING, F.R.S. *University of Manchester*  
(Received 9 November 1951—Revised 15 March 1952)

$$\left. \begin{aligned} \frac{dX_r}{dt} &= f(X_r, Y_r) + \mu(X_{r+1} - 2X_r + X_{r-1}) \\ \frac{dY_r}{dt} &= g(X_r, Y_r) + \nu(Y_{r+1} - 2Y_r + Y_{r-1}) \end{aligned} \right\} (r = 1, \dots, N).$$

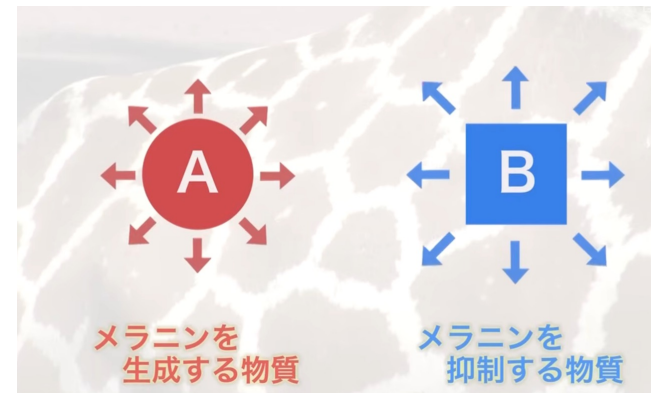
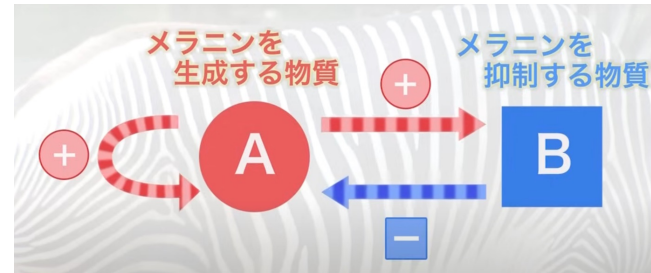
### ベロウソフ・ジャボチンスキー反応



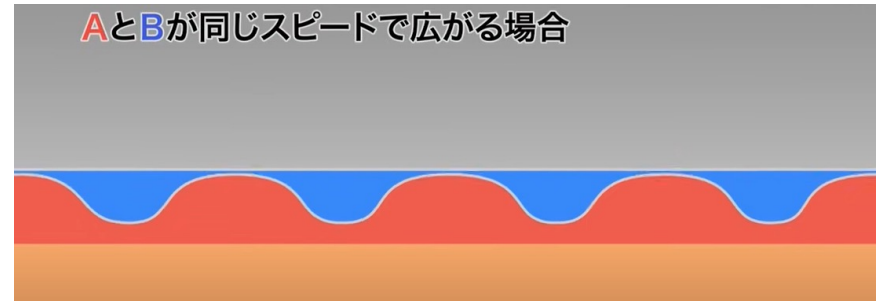
反応拡散方程式

$$\frac{\partial u}{\partial t} = D_A \left( \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right) + f(u, v)$$
$$\frac{\partial v}{\partial t} = D_B \left( \frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} \right) + g(u, v)$$

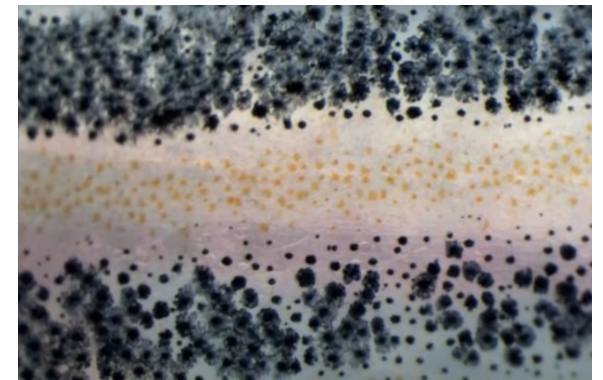
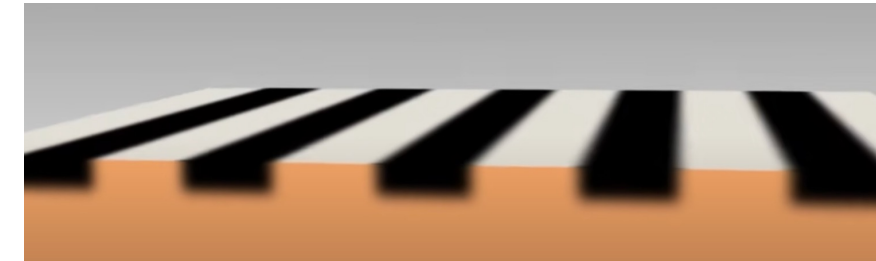
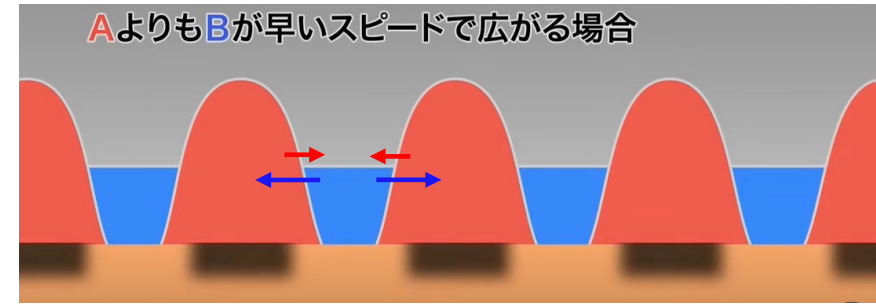
$f, g$ はAとBの化学反応項  
 $D$ は拡散係数



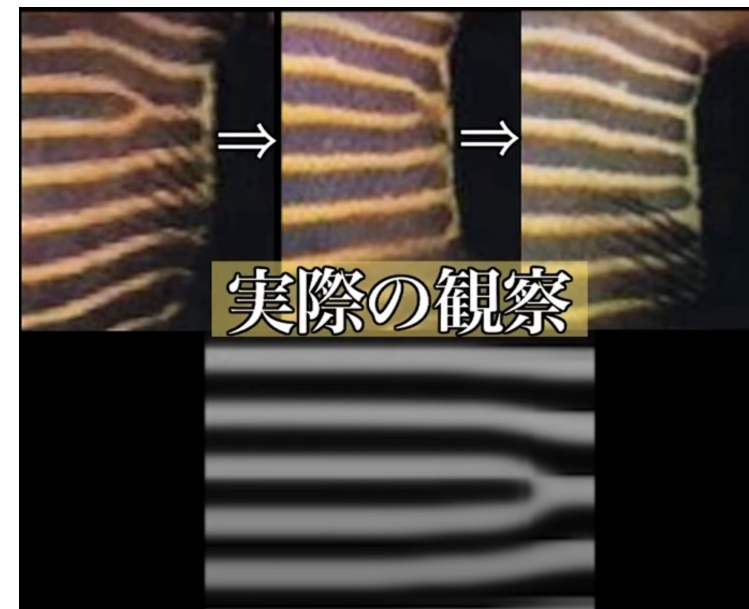
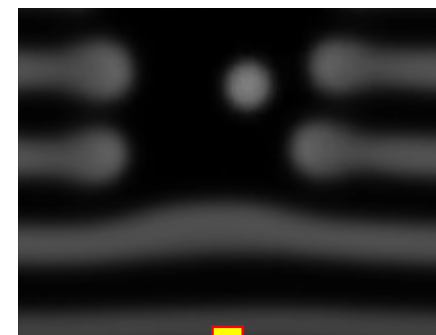
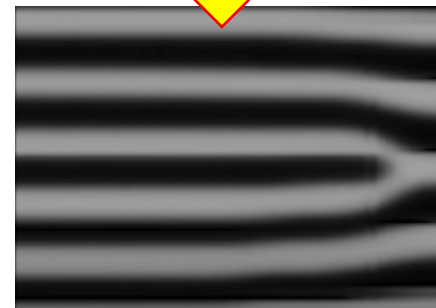
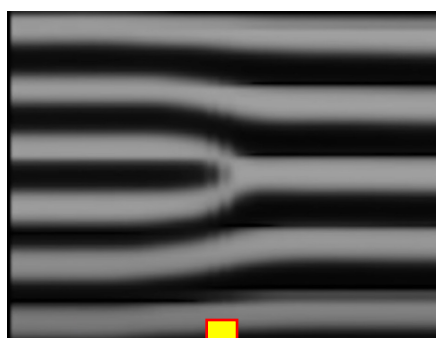
BとAの拡散速度が同じ場合 → 黒くなる



Bの拡散速度がAの拡散速度が速い場合



Bの拡散速度を変化させると模様が変わるシミュレーション



レーザーでメラニンを除去すると  
下の縞が湾曲して広がる

