

ANOMALOUS SAFFMAN–TAYLOR FINGERING

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These three photographs show the evolution of the shape of the interface when air is injected at the center of a Hele–Shaw circular cell and forces oil to recede. The overall aspect of the pattern is similar to that first observed by Paterson. However, these photographs show that a local disturbance of the tip of one of the growing fingers can change drastically its regime of growth. The disturbance can be caused by a groove etched in the glass plates, by a thin thread stretched radially in the cell, or (as in the present photographs) by the presence of a small isolated bubble located at the tip of the finger. In all these cases the finger grows faster, its tip becomes parabolic, then it is affected by periodic side branching so that it becomes similar in shape to certain crystalline dendrites.⁵

It is a classical result that in a linear geometry the Saffman–Taylor finger tends to invade a fraction $\lambda = 0.5$ of the width of the channel. This result was interpreted recently as the selection by surface tension of a discrete set of solutions. Conversely we showed⁶ that the disturbance of the tip leads in the linear geometry to a different regime of growth. The selection of the discrete set of solutions is removed and all the continuum of solutions with $\lambda < \frac{1}{2}$ can then be reached.

