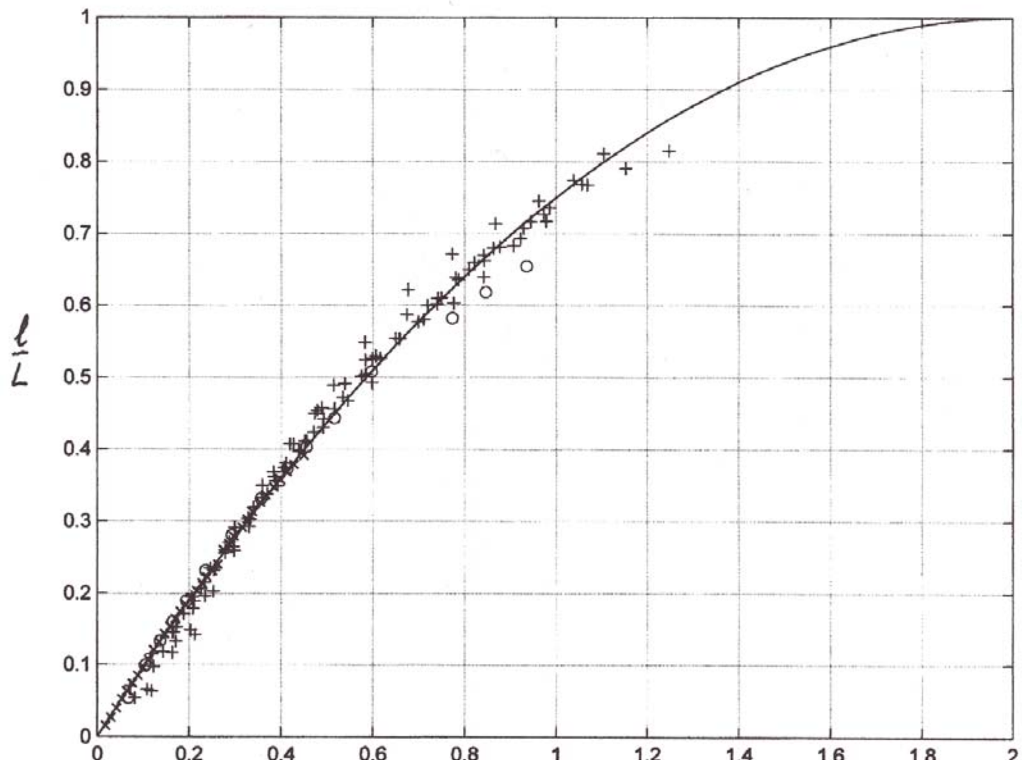
**Extended Summary**

**The growth and structure of double-diffusive cells adjacent to a side-wall in a salt-stratified environment.** O. M. Phillips, Department of Earth & Planetary Sciences, The Johns Hopkins University, Baltimore, MD 21218, USA, L. Malki-Epshtein and H. E. Huppert, Institute of Theoretical Geophysics, Centre for Mathematical Sciences, University of Cambridge, CB3 0WA, UK.

Observations and measurements are reported on the patterns and the rates of growth in time of the doubly-diffusive cells that form adjacent to a cooled side-wall in a salt-stratified environment. Fluid near to the wall is cooled and sinks a distance $h$ where its density, increased by cooling, matches that of the salt-stratified ambient. It is observed to separate from the wall, moving outwards as a cool, fresher layer beneath a warmer, more saline region. This leads to growing double-diffusive cells that advance outward at a rate, found by dimensional reasoning to be proportional to $Nh$, where $N$ is the stability frequency in the cell and $h$ is its vertical thickness. Near the wall at the top of each cell, the sinking colder fluid is continually replaced by selective withdrawal from the ambient 'far field'. The fluid being withdrawn from the ambient is always the least dense in the cell, and as the experiment proceeds, the straining of the fluid in the ambient region reduces the stratification. The vertical density gradient inside the cell relaxes by continuous hydrostatic adjustment (CHA) to match the ambient and the speed of advance reduces proportionately. Measurements of the rate of advance of the cell nose were made in tanks of different lengths $L$ with a range of initial salinity gradients and cell heights $h$. A simple model is developed to describe the rate of extension of the cells and the internal density gradient as functions of time in which the tank length appears as an important parameter throughout each experiment. This effect does not seem to have been recognized previously. The rates of evolution in each run involve the time scale $\tau = L(C_H h N_0)$, where $L$ is the tank length, $C_H \approx 10^{-2}$ is a heat transfer coefficient, and $N_0$ the initial stability frequency. The mean length of the cells $\bar{l}(t)$ and the internal stability frequency are given by

$$\frac{\bar{l}(t)}{L} = \frac{t}{\tau} - \left(\frac{t}{2\tau}\right)^2 \qquad \text{and} \qquad N = N_0(1 - t/2\tau)$$

Inversion of the first of these expresses $1 - \left\{1 - (\bar{l}/L)\right\}^{1/2}$ as a linear function of time with slope $(2\tau)^{-1}$. The measurements from individual runs when plotted in this way, do produce remarkably accurate straight lines as the model predicts, from which $C_H$ is found. This should be approximately the same for each run; the mean over all runs was found to be $9.29 \times 10^{-3}$ with standard deviation $1.77 \times 10^{-3}$.




A summary plot of the experiments, showing $l(t)/L$ vs $t/\tau$ , incorporating results from tanks of three different lengths: + $L$ = 48.2 cm; o $L$ = 116.5 cm, and x $L$ = 147 cm. The last set of points, difficult to see, is clustered close to the origin.