EMERGENCE OF RNA EDITING IN A LONG TERM EVOLUTION EXPERIMENT. A. S. W. Lai[1,2] and A. M. Poole [1,2,3], [1]Biomolecular Interaction Centre, [2]School of Biological Sciences, [3]Allan Wilson Centre for Molecular Ecology and Evolution, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand (alicia.lai@pg.canterbury.ac.nz), (anthony.poole@canterbury.ac.nz).

Introduction: RNA editing has evolved multiple times independently, and some have suggested that RNA editing may have been a feature of early, low-fidelity biological systems. Covello and Gray [1] have proposed a convincing general model for the emergence of RNA editing, but this model has yet to be tested experimentally. In this model, RNA editing activity pre-exists but there is no substrate for an editing activity to act upon. Subsequently, mutation creates editable nucleotide sites, which may be fixed by genetic drift. RNA editing is now required for function, and thus becomes indispensable for gene expression. We sought to test this model by asking whether slippage-type editing can evolve under lab conditions favouring genetic drift.

We previously showed that, in the bacterial endosymbiont *Buchnera*, polymerase slips at long tracts of As or Ts, leading to stochastic incorporation or removal of As or Us in the nascent messenger RNA. This results in a heterogeneous population of mRNAs[2]. Slippage-type editing can thus restore the open reading frame at the mRNA level in cases where the open reading frame has acquired a frameshift mutation at the gene level. This in turn leads to the expression of functional proteins but slippage may also reduce expression efficiency of in-frame genes[2].

In a long term evolution experiment using *Escherichia coli*, we subjected 10 lines to daily single-cell bottlenecks. Following 50 days of bottlenecking, 1 of the 10 lineages showed an observable reduction in growth rate. Genome sequencing revealed the emergence of 38 frameshift mutations that, genomically, appear as pseudogenes. For these genes to be functional, slippage-type editing would have to occur. We present data on the impact of slippage-type editing on gene expression, and on protein production.

To our knowledge, this is the first demonstration of the emergence of RNA editing process under laboratory conditions. Our results are consistent with the constructive neutral evolution model of Covello & Gray. Furthermore, our results indicate that under conditions favouring genetic drift, editing may readily emerge. This in turn suggests that RNA editing could well have been a feature of early biological systems.

References: [1] Covello, P.S. & Gray, M. W. (1993) On the evolution of RNA editing. *Trends Genet.*, 9(8), 265-268. [2] Tamas, I. *et al.* (2008) Endosymbiont gene functions impaired and rescued by polymerase infidelity at poly(A) tracts. *Proc. Natl. Acad. Sci.*, 105**,** 14934-9.