Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Nonlinear Dynamos in Helically Symmetric Pipes JONATHAN MESTEL, Imperial College London, LESZEK ZABIELSKI, Warsaw University of Technology — Steady, helically symmetric, pressure-driven flow of a fluid down a helical pipe is considered. Helical symmetry is a generalisation of axisymmetry, and the resulting motion has some similarity with Dean flow. It has been successfully used to model blood flow around three-dimensional arterial bends in the body. If the fluid is electrically conducting, it is shown here that these flows can drive a **dynamo**, *i.e.* a magnetic field can be spontaneously generated. This is the only known example of a laminar, pressure-driven dynamo. The growth rates of the field are computed assuming the most unstable mode to be also helically symmetric. Appropriate parameter ranges for the pipe geometry and the magnetic and hydrodynamic Reynolds numbers are identified. Strong field-stretching occurs near the stagnation points in the cross-pipe flow; precisely those low shear regions identified as possible sites for atherosclerotic development in the haemodynamic context. The calculation is continued into the non-linear regime, when the magnetic field reacts back upon the driving flow. Periodic quenching is observed. The field first decays, as the favourable flow conditions are destroyed, but it then regrows as the flow is re-established on a viscous time-scale.

Jonathan Mestel
Imperial College London

Date submitted: 01 Aug 2005 Electronic form version 1.4