INTRODUCTION

Because of the non-linear terms in the Navier-Stokes equations there are very few exact solutions to those equations. The solutions that do exist are for quite simple flows. These are of value not only because they have practical application but also because they provide an anchor and reference point for the more approximate solutions that occupy most of this book.

The exact solutions that we will outline in this series of sections fall into two categories. First there are the simple, Category 1 flows for which there are analytical, algebraic solutions. With one notable exception these are all flows which, in some standard coordinate system have a non-zero velocity in only one of those directions. There is also a second category of solutions, also for simple flows, in which the solution can be reduced to the numerical solution of an ordinary differential equation. These will be outlined in section (Bih).

The Category 1 solutions include

[A] The Couette flow and planar Poiseuille flows between two, infinitely long parallel plates.

[B] Axisymmetric Poiseuille flow in an infinitely long circular pipe.

[C] Planar and axisymmetric flow from a source or sink into an infinite domain of fluid.

[D] Planar radial flow due to a point vortex or surrounding a rotating cylinder in either an infinite domain of fluid or surrounded by a second concentric cylinder.

[E] Flows due to a flat plate bounding a semi-infinite domain of fluid and caused by motions of the flat plate in its own plane. Two of these flows, namely Rayleigh flow and Ekman flow, are particularly valuable.

[F] The remarkable and singular flow of a *Laminar Round Jet*.

Each of these will be detailed in the sections which follow. The Category 2 solutions will outlined in section (Bih).