Non-Equilibrium Thermofluid Dynamics of Two-Phase Flows with Phase Change

Most of this work is concerned with fairly fundamental studies of non-equilibrium condensing two-phase flows. At the time, the main justification in the engineering world was the importance of steam turbine technology for power generation but the research was really aimed at getting a better physical understanding of fundamental flow behaviour and clarifying the mathematics, more so than providing methodology for particular applications. The subject area has since expanded considerably to include nucleation and droplet growth in chemical engineering and environmental applications, and aerosol flows in general. A host of interesting problems, some of them very difficult, still remain to be tackled. There are publications on the following topics and more details are provided in the review *Wet-Steam Research at Cambridge, 1980-1995* :

- Analysis of vapour-droplet flow and entropy production [1984a, 1995b].
- Prediction of homogeneous condensation in nozzles [1976, 1982].
- An analytical approach for homogeneous nucleation in high speed flow [1996].
- Thermal choking in two-phase flow [1978, 1984b].
- Structure and formation of shocks in vapour-droplet flows [1990, 1991a].
- Periodically oscillating condensation zones in transonic flow [1991b].

Bakhtar F, Young JB. 1978. A study of choking conditions in the flow of wet steam. *Proc. Instn. Mech. Engnrs.* 192: 237-242.

Bakhtar F, Young JB. 1976. A comparison between theoretical calculations and experimental measurements of droplet sizes in nucleating steam flows. *Trans. Inst. Fluid Flow Machinery (PIMP, Poland)*, 70-72: 259-271.

Young JB. 1982. The spontaneous condensation of steam in supersonic nozzles. *Physico-Chemical-Hydrodynamics (PCH)*. 3: 57-82.

Young JB. 1984a. Semi-analytical techniques for investigating thermal non-equilibrium effects in wet steam turbines. *Int. J. Heat & Fluid Flow*. 5: 81-91.

Young JB. 1984b. Critical conditions and the choking mass flowrate in non-equilibrium wet steam flows. *ASME. J. Fluids Eng*. 106: 452-458.

Guha A, Young JB. 1990. Stationary and moving normal shock waves in wet steam. *Adiabatic Waves in Liquid-Vapour Systems*. Edited by Meier GEA, Thompson PA. Springer-Verlag. 159-170.

Young JB, Guha A. 1991a. Normal shock-wave structure in two-phase vapour-droplet flows. *J. Fluid Mech*. 228: 243-274.

Guha A, Young JB. 1991b. Time-marching prediction of unsteady condensation phenomena due to supercritical heat addition. *Instn. Mech. Engnrs. European Conference on Turbomachinery*. Paper C423/057. 167-177.

Young JB. 1995b. The fundamental equations of gas-droplet multiphase flow. *Int. J. Multiphase Flow*. 21: 175-191.

Huang L, Young JB. 1996. An analytical solution for the Wilson point in homogeneously nucleating flows. *Proc. Roy. Soc.* A452: 1459-1473.