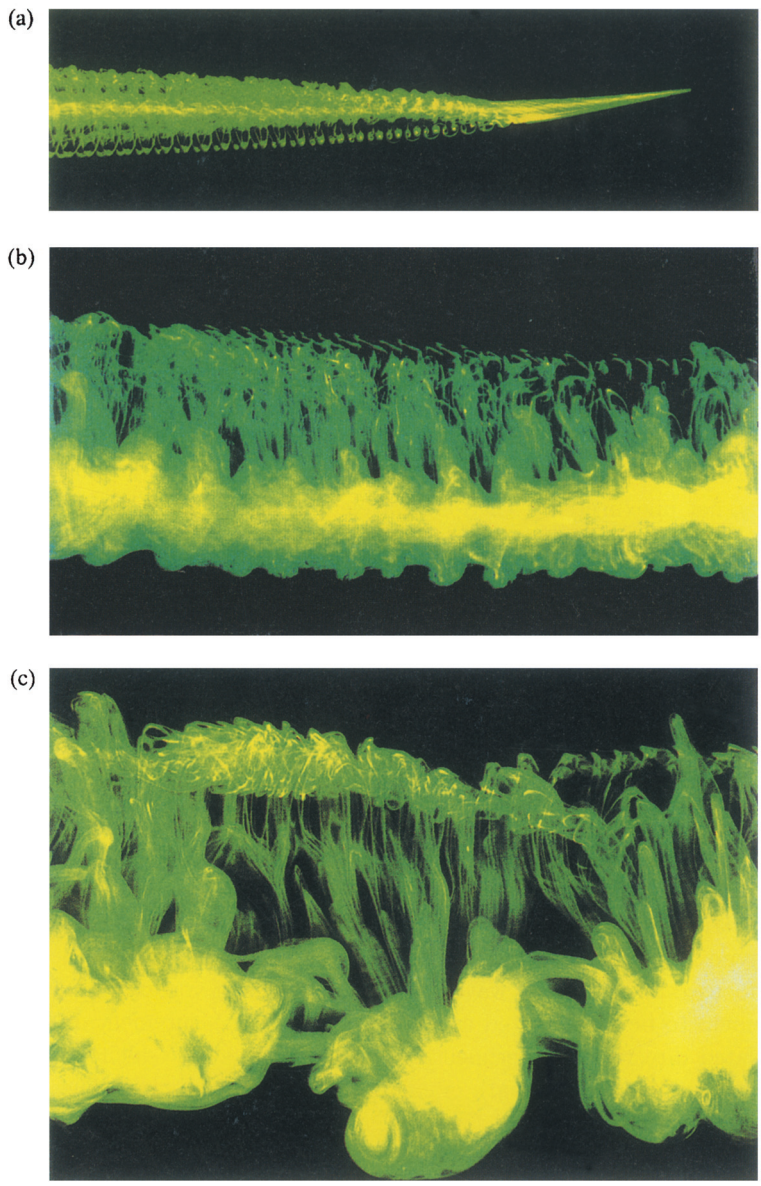

Figure 1. The wake of a delta wing in free-flight, showing three distinct instabilities. (a) The near wake involves a smallest-scale instability which scales on the wake velocity profile of the separating shear layers from the trailing edge of the wing. (b) Intermediate 'short-wave' instability, at 30 chordlengths downstream (left edge of photograph). (c) Far downstream 'long-wave' instability, at 70 chordlengths from the wing.

Figure 1 is available for download in colour from
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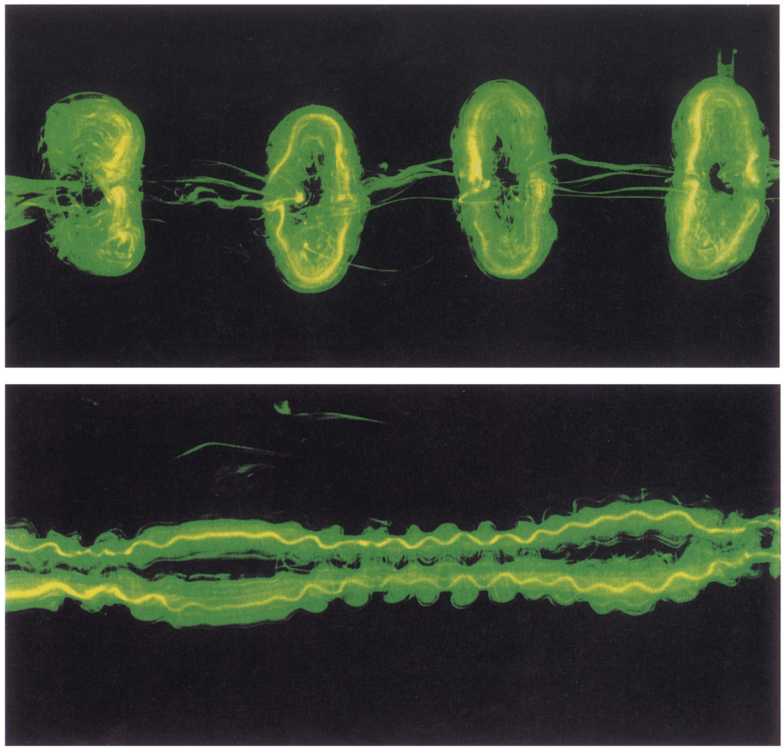

Figure 7. Overview of the long and short wave instabilities in a vortex pair. In these photographs, the vortex pair is convecting towards us, showing the long-wavelength instability (upper picture), and the short-wave instability coexisting with the long-waves (lower picture).

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compared with the characteristic time found from simulations (e.g., by Melander & Hussain, 1989). Interestingly, the threads that remain connecting the vortex rings after reconnection, actually contain a noticeable fraction of the initial circulation. Further details of the reconnection process are described in Leweke & Williamson (1998b).

The linear growth rate of the long-wave instability was measured for different axial wavelengths l, which could be imposed by very slight modulation of the vortex-generating plate edges. The measured growth rates in Figure 9 are compared with the theoretical predictions, which may be derived from the theories of Crow (1970) and Widnall *et al.* (1971) for the present conditions. This prediction involves precise information about the initial ve-

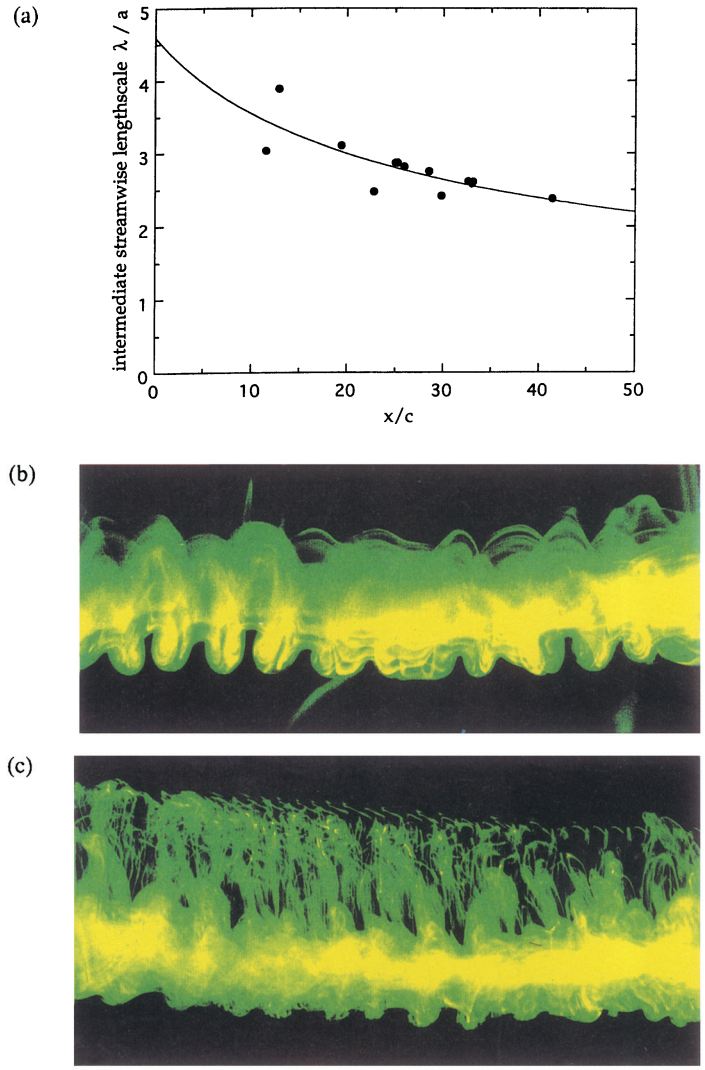

Figure 12. (a) Downstream evolution of short-wave instability wavelength, normalized by local core radius, a. (b) A vortex pair travelling downwards, showing the leading-edge miniscule vortex pairs that are arranged perpendicular to the primary pair (2 per wavelength of the elliptic instability). (c) Similar perpendicular miniscule vortex pairs are found for the delta wing trailing vortices at intermediate distances downstream, suggesting that it is also subject to a distinct phase relationship for the short-wave disturbances in each vortex.

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