CORRIGENDUM

A family of steady, translating vortex pairs with distributed vorticity

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In our discussion of the behaviour of the limiting vortex pair boundary near the front stagnation point, we demonstrated that there are no solutions to the Euler equations in the half-plane $x > 0$ consisting of a region of constant non-zero vorticity separated from a region of irrotational flow by a straight-line boundary; from this we argued that the limiting vortex boundary must have a cusp where it contacts the negative y axis (see p. 137). However, a cusp is not the only kind of singular behaviour possible near the stagnation point. Prof. P. G. Saffman has pointed out to us that if the curvature of the boundary is allowed to become infinite at the stagnation point, the case of contact angle $\theta_0 = \frac{1}{2}\pi$ cannot be precluded, and further that such a solution can be found to leading order. In the rotational region we choose a stream function

$$\psi_{\mathrm{II}} = -\tfrac{1}{2}r^2(\sin^2\theta + \cos 2\theta) + \tfrac{1}{2}\pi(r^2 \log r \sin 2\theta + \theta r^2 \cos 2\theta) + O\left[\frac{r^2}{\log r}\right]$$

so $\nabla^2\psi_{\mathrm{II}} = -1$ and $\psi_{\mathrm{II}}(\pi) = 0$. In the irrotational region we take

$$\psi_{\mathrm{I}} = \tfrac{1}{2}\pi(r^2 \log r \sin 2\theta + \theta r^2 \cos 2\theta) + O\left[\frac{r^2}{\log r}\right]$$

so $\nabla^2\psi_{\mathrm{I}} = 0$ and $\psi_{\mathrm{I}}(0) = 0$. It is then easily shown that to leading order

$$\psi_{\mathrm{I}} = \psi_{\mathrm{II}} = 0$$

and $\partial_\theta\psi$ is continuous on the curve defined by

$$\theta = \tfrac{1}{2}\pi - \tfrac{1}{4}\pi\left(\frac{1}{\log r}\right) + O\left[\frac{1}{(\log r)^2}\right].$$

This curve meets the y axis at a right angle, but has infinite curvature there. Although the numerical results suggested the existence of a small cusp at the stagnation point, we do not believe they are of sufficient accuracy to reliably differentiate between a small cusp and a right-angle contact.