

Figure 1(a)

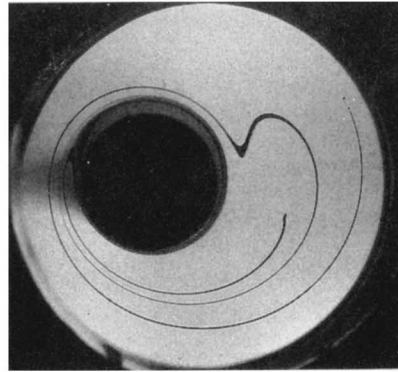


Figure 1(b)

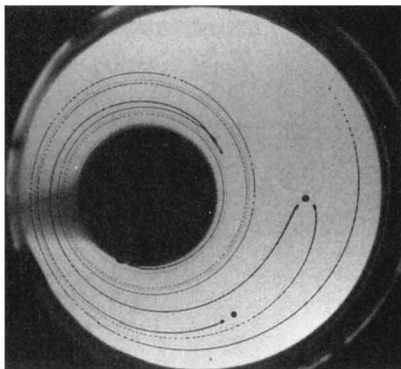


Figure 1(c)

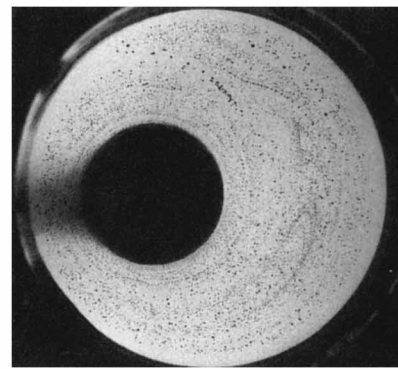


Figure 1(d)

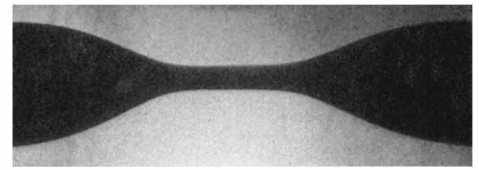


Figure 2(a)

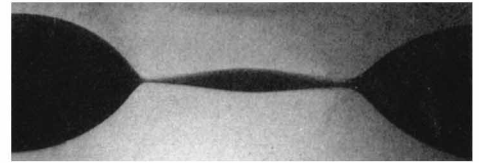


Figure 2(b)

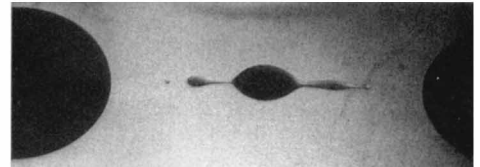


Figure 2(c)

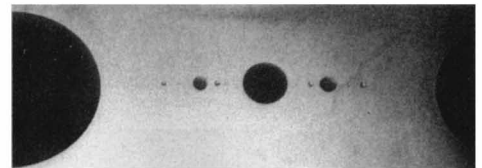


Figure 2(d)

BREAKUP AND DISPERSION OF HIGHLY STRETCHED DROPLETS IN A CHAOTIC FLOW FIELD

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These photographs show the time evolution—stretching and breakup—of immiscible drops in a two-dimensional time-periodic flow.⁷ The initial condition in Fig. 1(a) is a drop of pale oil immersed in corn syrup ($\mu = 38\,000$ cps) filling the gap between the two eccentric cylinders. The viscosity ratio between the drop fluid and the bulk fluid is about 0.38 and the interfacial tension is 9.5 dyn/cm. The typical Reynolds number for a drop of radius 0.1 cm is $O(10^{-4})$; the Reynolds and Strouhal numbers of the macroscopic flow are $O(10^{-2})$ and $O(10^{-1})$. The flow is induced by moving the inner ($r_{in} = 1$ in.) and outer cylinders ($r_{out} = 3$ in.) periodi-

cally, in clockwise and counterclockwise directions, respectively. The total displacement of each cylinder during a period is kept the same, i.e., $\theta_{in} r_{in} = \theta_{out} r_{out}$, and the wall velocity of each cylinder is 1.0 cm/sec. Figures 1(a)–1(d) correspond to $\theta_{out} = 2\pi$. At the end of one period the flow is stopped; the first drops form at the end of the filament and at the folds; concurrently, in $O(10$ sec), capillary instabilities grow and lead to total fragmentation [Fig. 1(c)]. The process is repeated and the remaining “larger” drops undergo further breakup [Fig. 1(d)]; note that the large fold in Fig. 1(c) is also recognizable in Fig. 1(d). Figures 2(a)–2(d) show a magnification of a small segment of filament undergoing breakup; the asymmetry is probably due to small variations in the radius of the thread.

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