Sinos de Água

Prof. Cassio Sigaud

2009/1

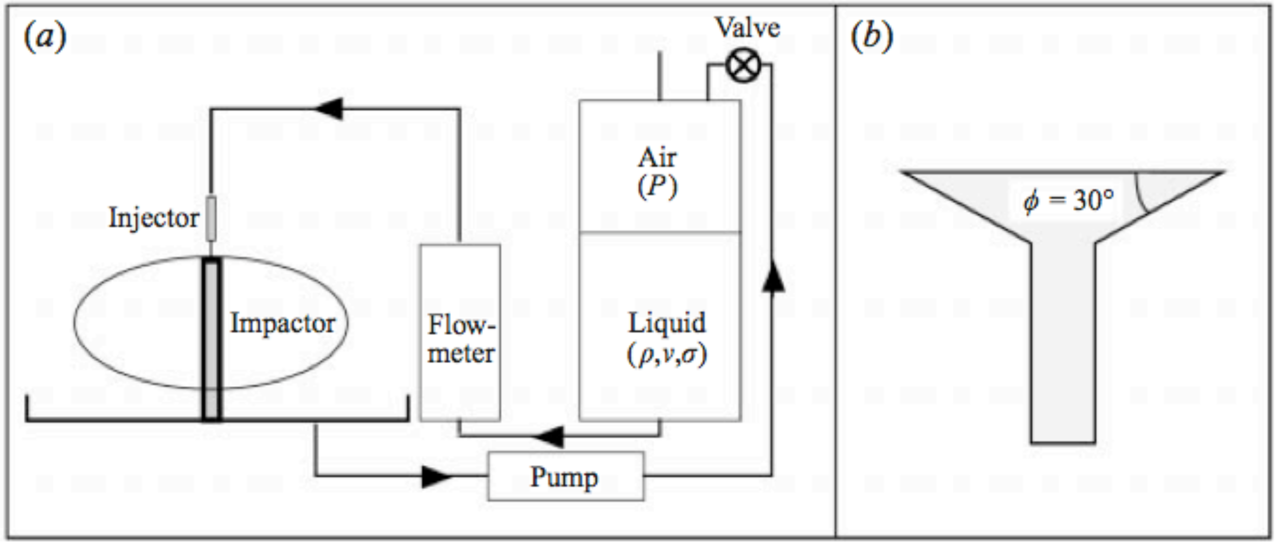

FIGURE 3. Presentation of the experimental set-up: (*a*) general view, (*b*) detail of the impactor.

J. Fluid Mech. (2001), *vol.* 430, *pp.* 111–147. Printed in the United Kingdom 111

Dynamics and stability of water bells

By CHRISTOPHE CLANET
Institut de Recherche sur les Phénomènes Hors Equilibre, UMR 6594,
CNRS et Universités de Marseille I & II, Service 252, Campus de St. Jérôme,
13397 Marseille Cedex 20, France

(Received 27 July 1999 and in revised form 23 August 2000)

VOLUME 85, NUMBER 24 PHYSICAL REVIEW LETTERS 11 DECEMBER 2000

Stability of Water Bells Generated by Jet Impacts on a Disk

C. Clanet
I.R.P.H.E., CNRS–Universités d'Aix-Marseille I & II, Campus Universitaire de St. Jérôme,
Service 252, 13397 Marseille Cedex 20, France
(Received 27 March 2000)

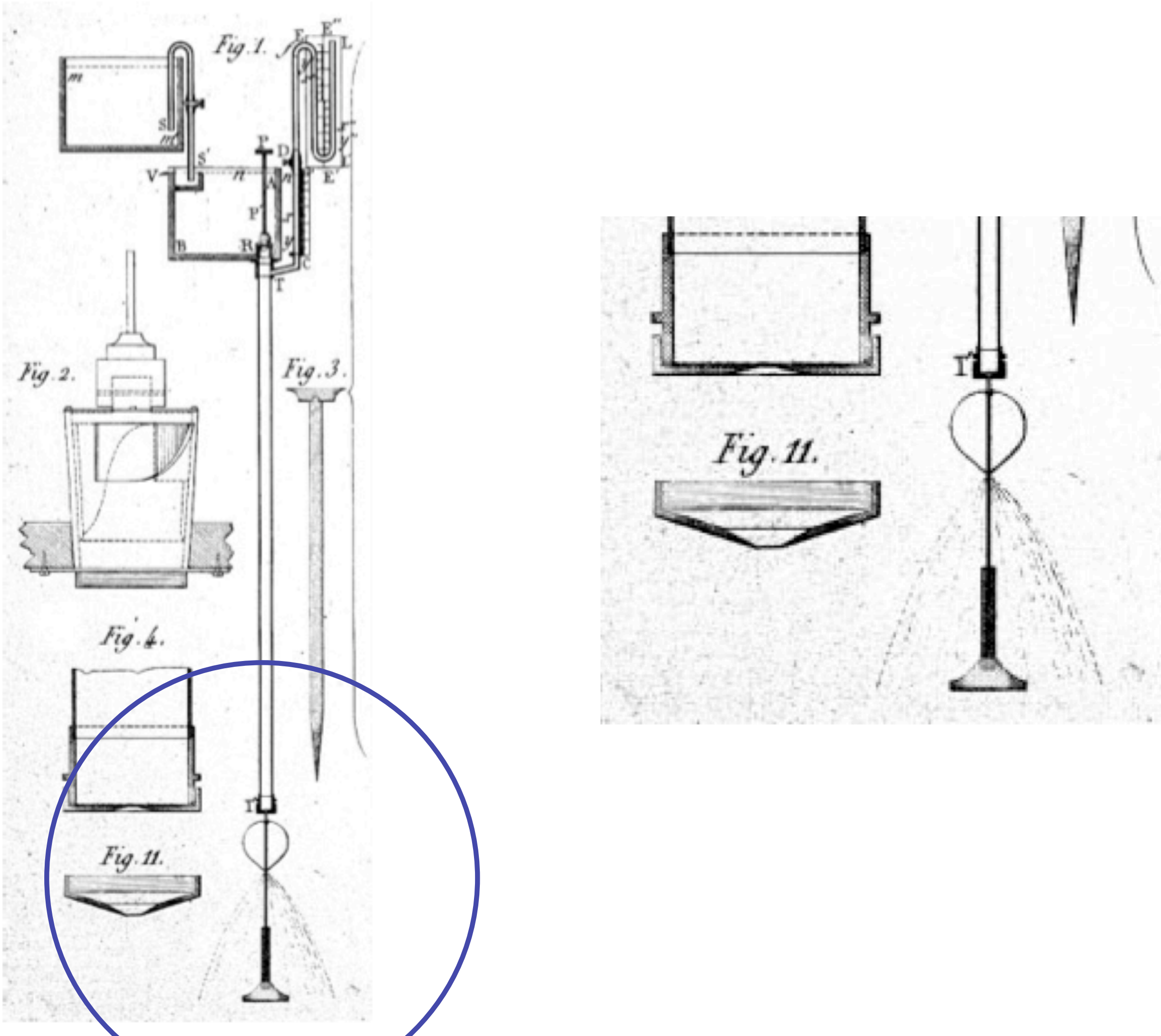

FIGURE 4. Experimental setup used by Savart (from Planche 4 of Savart's 1833 papers).

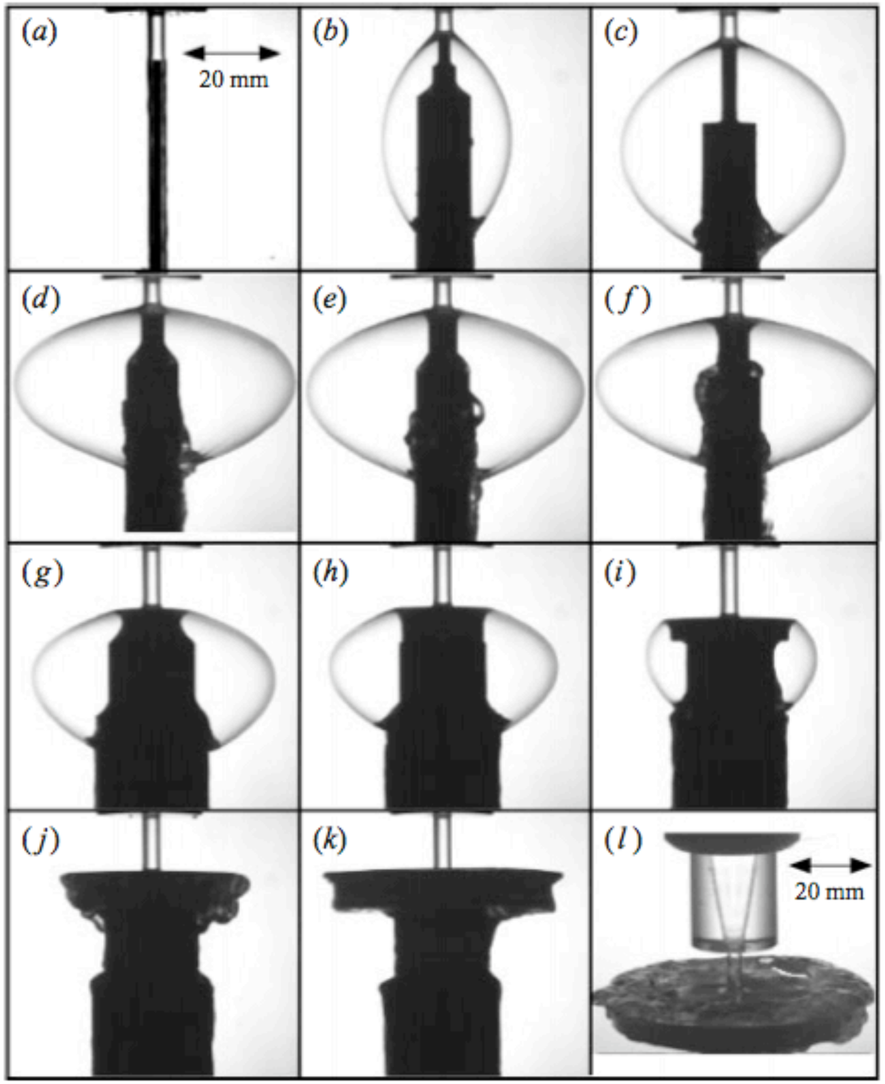

FIGURE 5. Influence of the impact diameter, D_i, for $D_0 = 3$ mm, $U_0 = 2.08\,\mathrm{m\,s^{-1}}$, $Re = 6240$, $We = 178$: (*a*) $D_i = 1.18$ mm, (*b*) 3.0 mm, (*c*) 4.0 mm, (*d*) 5.44 mm, (*e*) 7.33 mm, (*f*) 9.87 mm, (g) 13.3 mm, (*h*) 17.81 mm, (*i*) 24.13 mm, (*j*) 32.51 mm, (*k*) 43.79 mm, (*l*) 58.99 mm.

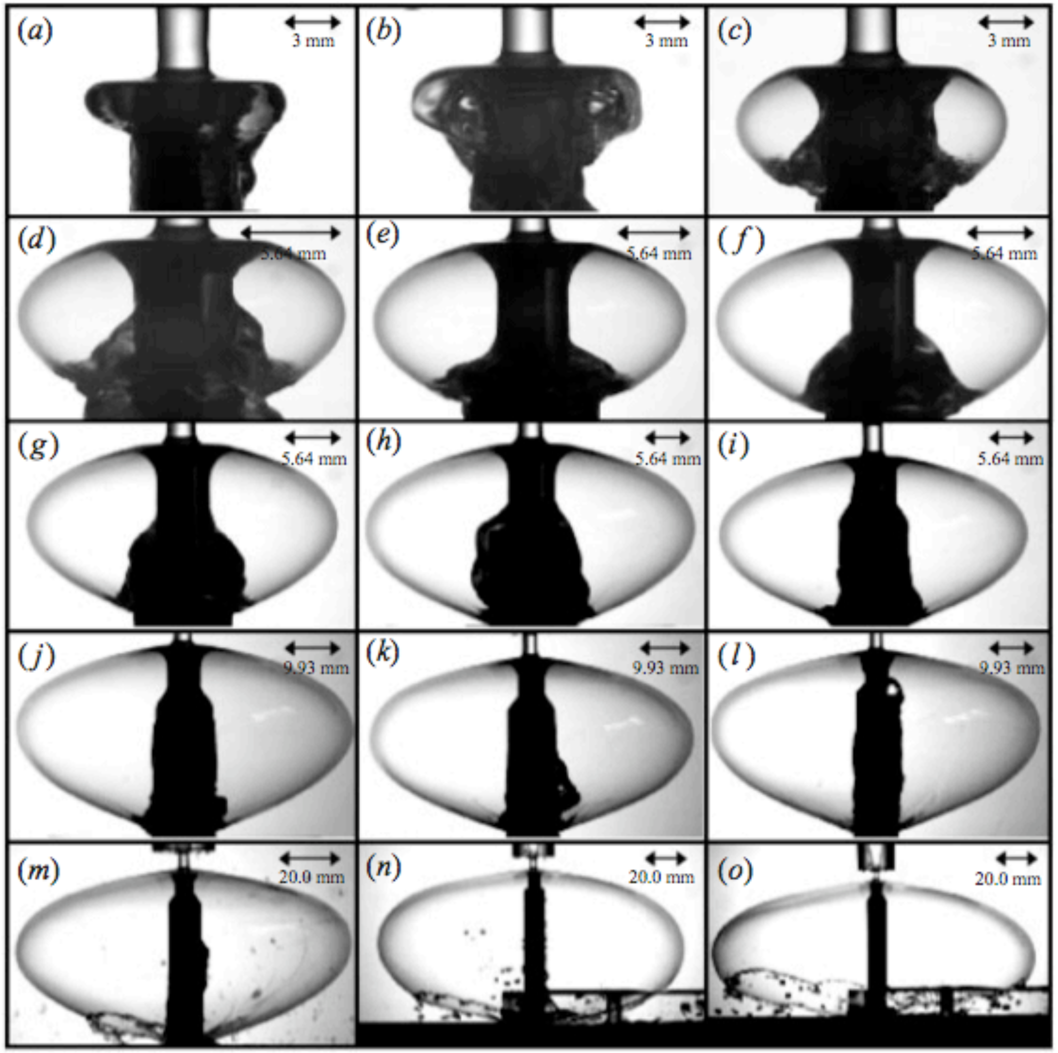

FIGURE 7. Influence of the impact velocity U_0 for $D_0 = 3\,\mathrm{mm}$, $D_i = 9.87\,\mathrm{mm}$: (*a*) $U_0 = 0.63\,\mathrm{m\,s^{-1}}$, (*b*) $1.0\,\mathrm{m\,s^{-1}}$, (*c*) $1.08\,\mathrm{m\,s^{-1}}$, (*d*) $1.2\,\mathrm{m\,s^{-1}}$, (*e*) $1.42\,\mathrm{m\,s^{-1}}$, (*f*) $1.57\,\mathrm{m\,s^{-1}}$, (*g*) $1.68\,\mathrm{m\,s^{-1}}$, (*h*) $1.87\,\mathrm{m\,s^{-1}}$, (*i*) $2.08\,\mathrm{m\,s^{-1}}$, (*j*) $2.25\,\mathrm{m\,s^{-1}}$, (*k*) $2.42\,\mathrm{m\,s^{-1}}$, (*l*) $2.65\,\mathrm{m\,s^{-1}}$, (*m*) $2.88\,\mathrm{m\,s^{-1}}$, (*n*) $3.43\,\mathrm{m\,s^{-1}}$, (*o*) $3.67\,\mathrm{m\,s^{-1}}$.

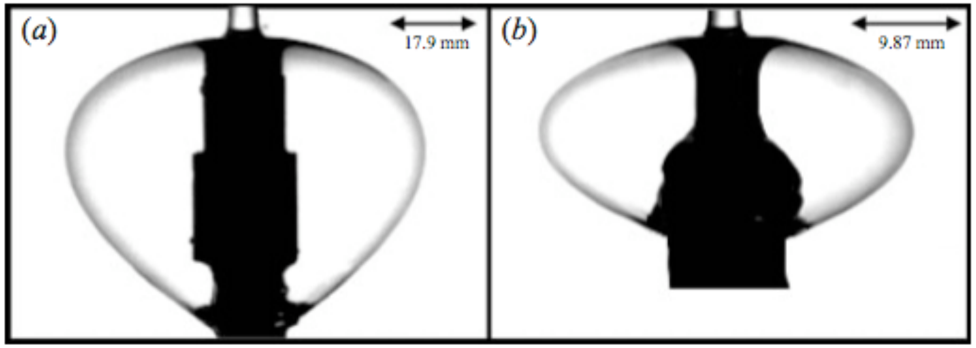

FIGURE 8. Influence of the jet diameter D_0: (*a*) $D_0 = 6\,\text{mm}$, $D_i = 17.91\,\text{mm}$, $U_0 = 1.19\,\text{m}\,\text{s}^{-1}$, $\psi_0 = 73.8^\circ$, $X = 2.985$, $We = 116$ and $Re = 7140$; (*b*) $D_0 = 3\,\text{mm}$, $D_i = 9.87\,\text{mm}$, $U_0 = 1.68\,\text{m}\,\text{s}^{-1}$, $\psi_0 = 72.2^\circ$, $X = 3.29$, $We = 116$ and $Re = 5040$.

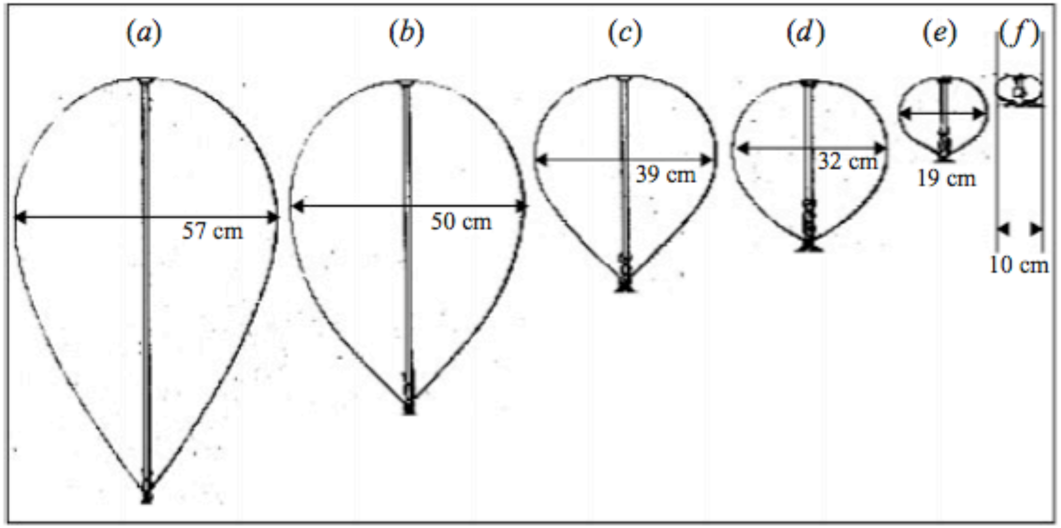

FIGURE 9. Savart's observations of the influence of the jet diameter: (*a*) $D_0 = 14.4\,\mathrm{mm}$, $U_0 = 2.06\,\mathrm{m\,s^{-1}}$, (*b*) $D_0 = 12\,\mathrm{mm}$, $U_0 = 2.15\,\mathrm{m\,s^{-1}}$, (*c*) $D_0 = 9.6\,\mathrm{mm}$, $U_0 = 2.54\,\mathrm{m\,s^{-1}}$, (*d*) $D_0 = 7.2\,\mathrm{mm}$, $U_0 = 2.67\,\mathrm{m\,s^{-1}}$, (*e*) $D_0 = 4.8\,\mathrm{mm}$, $U_0 = 3.16\,\mathrm{m\,s^{-1}}$, (*f*) $D_0 = 2.4\,\mathrm{mm}$, $U_0 = 5.66\,\mathrm{m\,s^{-1}}$.

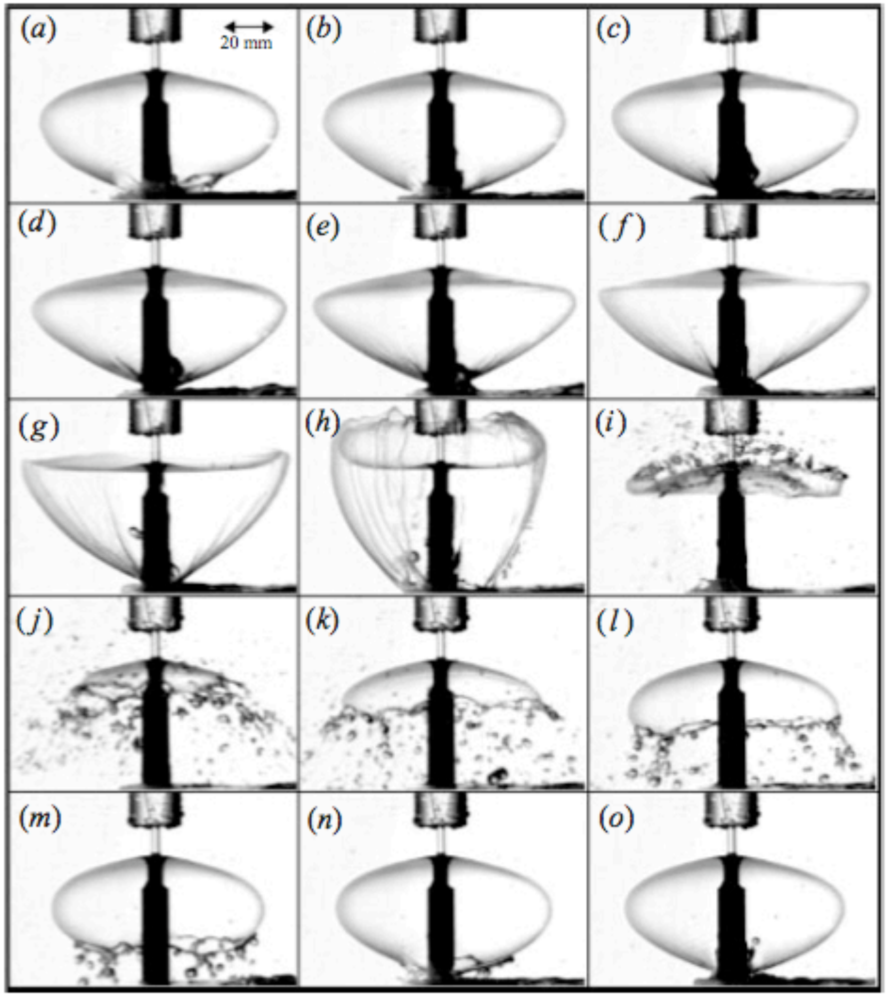

FIGURE 16. Instability of a closed water bell triggered by a pressure perturbation, observed with $\psi_0 = 77°$, $D_0 = 3.0$ mm, $D_i = 9.87$ mm and $U_0 = 2.7$ m s^{-1}. Time increases from (*a*) to (*o*) with the time step $\Delta t = 35.5$ ms.

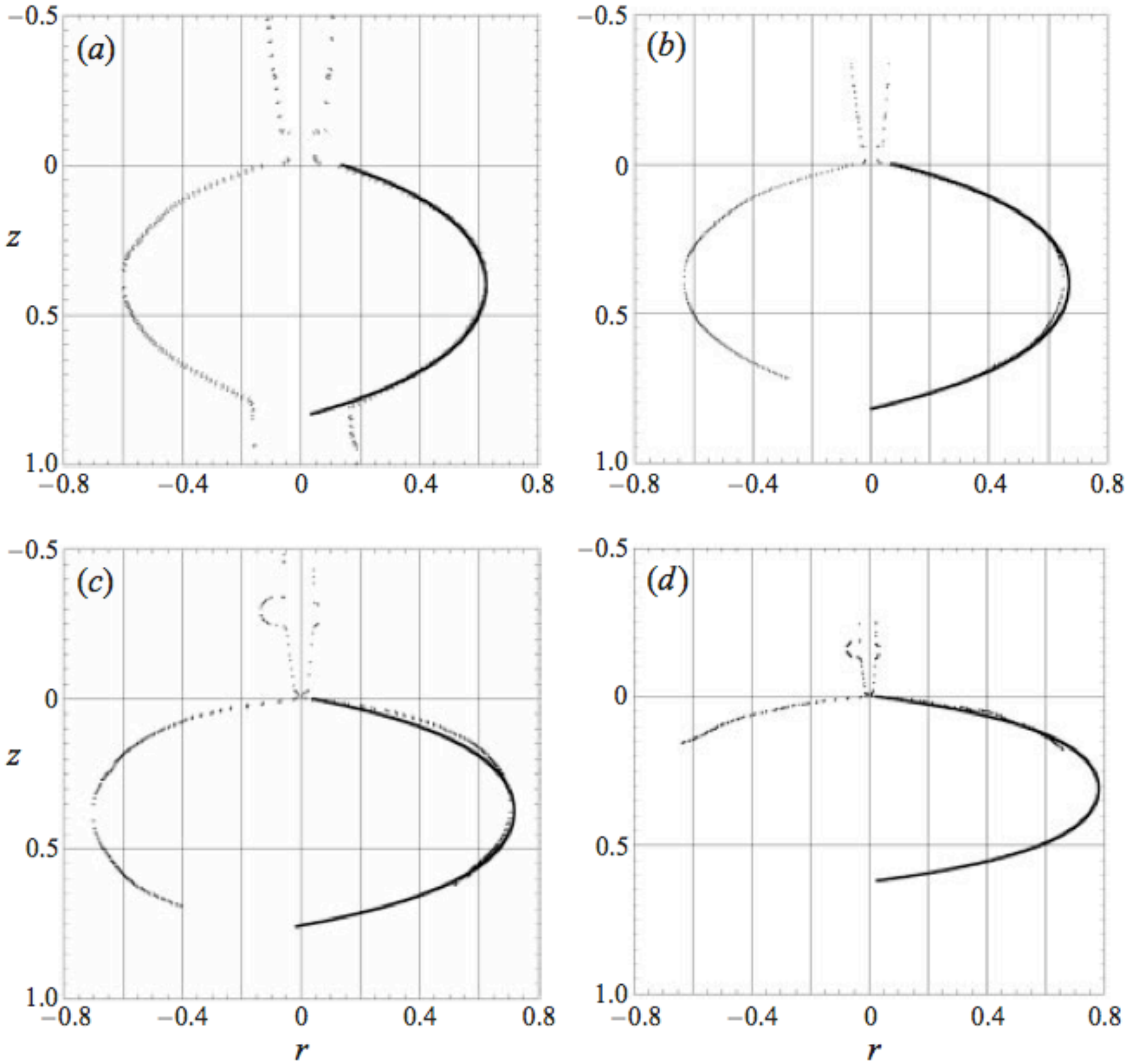

FIGURE 22. Comparison between the measured bell shape and the theoretical catenary: (*a*) $u_e = 0.84$, $r_i = 0.139$, $\psi_0 = 72^\circ$; (*b*) $u_e = 0.86$, $r_i = 0.071$, $\psi_0 = 76^\circ$; (*c*) $u_e = 0.88$, $r_i = 0.040$, $\psi_0 = 79^\circ$; (*d*) $u_e = 0.89$, $r_i = 0.022$, $\psi_0 = 82.5^\circ$.

terms of X and Y, by integrating $\tan\phi = \mathrm{d}Y/\mathrm{d}X$ using (I 11)

$$X = \cos\phi_0[\cosh^{-1}(\sec\phi_0) - \cosh^{-1}\{(1-Y)\sec\phi_0\}]. \qquad \text{(I 12)}$$

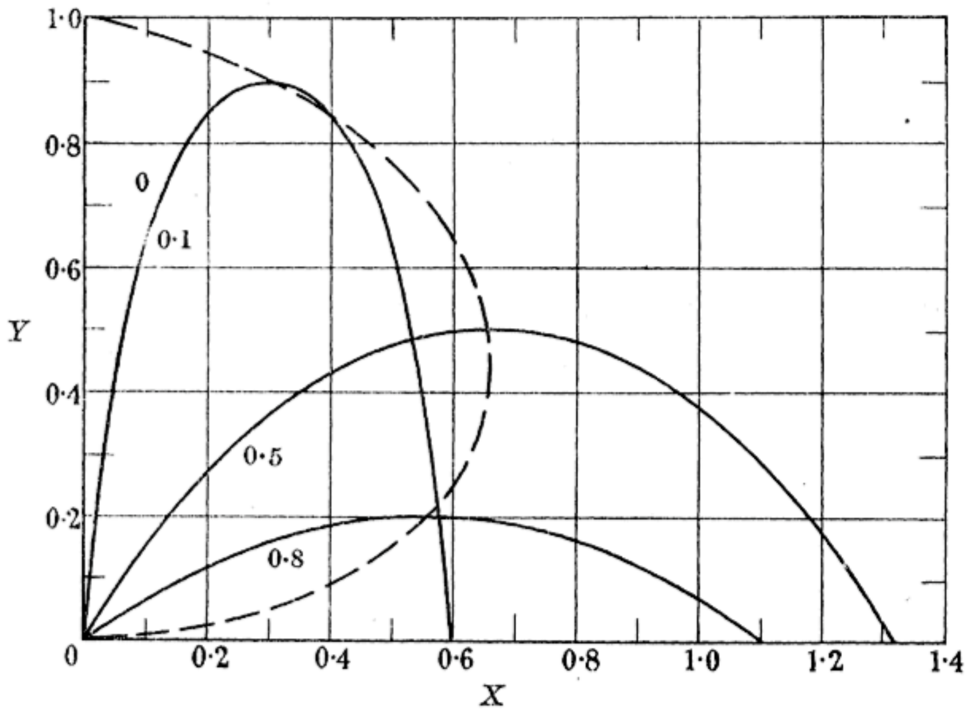

FIGURE I1. Calculated meridian sections of water bells. The numbers give the values of $\cos\phi_0$.

Expression (I 12) applies in the range $0 < x < \cos\phi_0\cosh^{-1}(\sec\phi_0)$. At the upper limit $1-Y = \cos\phi_0$ and $\mathrm{d}Y/\mathrm{d}X = 0$ but $\mathrm{d}^2Y/\mathrm{d}X^2$ is finite. The solution can be

The dynamics of thin sheets of fluid
I. Water bells

BY SIR GEOFFREY TAYLOR, F.R.S.
(With an appendix by L. HOWARTH, F.R.S.)

(*Received* 28 *May* 1959)

[289] Vol. 253. A. (15 December 1959)