Gerrard [9] by using three different methods to determine the length of the vortex formation region. The drag coefficient increased from 0.9 to 1.15 within the same Reynolds number range [14]. However, the reduction of the formation length and the increase of drag coefficient were also promoted at lower Reynolds numbers by attaching thin trip wires at 90 deg from the stagnation point [14]. It may be argued that the rise in Strouhal numbers observed by the present authors was produced by the shrink of the nearwake as triggered by the wall proximity. The confirmation of this argument appeared in the last statement of the conclusions by the authors.

The authors tried to compare their results with those reported by Goktun [15] and measured at $Re = 1.53 \times 10^5$. The smaller increase in Strouhal number, $f/f_0 = 1.04$, found by Goktun [15] at $\delta/D = 0.5$ had different physical origin. The upper end of the subcritical range led to the precritical beginning of transition to turbulence in the boundary layers. The latter started to displace the separation points on the cylinder in the downstream direction and the resulting narrower nearwake produced slight increase in the Strouhal number.

Finally I have two questions to the authors:

1. What was the actual value of the Strouhal numbers measured on isolated cylinders at the three Reynolds numbers tested?
2. Whether the departure between curves *b* and *c* in Fig. 10 was more pronounced when δ/D was decreased below one.

Additional References

13 Shaw, T. L., "Wake Dynamics of Two-Dimensional Structures in Confined Flow," *Proceedings 14th Congress IAUR*, 1971. Vol. 2, pp. 41–48.

14 Schiller, L., and Linke, W., "Pressure and Friction Drag of Cylinders at Reynolds Numbers 5,000 to 40,000 (in German)," *Zeitschrift fur Flugtechnik and Motorluftschiffahrt*, Vol. 24, No. 7, 1933, pp. 143–148.

15 Goktun, S., "The Drag and Lift Characteristics of a Cylinder placed near a Plane Surface," MSc thesis, Naval Postgraduate School, Monterey, Calif., 1975.

Authors' Closure

The authors wish to thank G. Buresti and M. M. Zdravkovich for their discussions.

The questions which have been formulated are mostly related to some aspects of the experimental procedure, so that the response will try to clarify each point separately.

- No appreciable variation of the Strouhal number with Re was detected for the isolated cylinders. In fact the differences were in the range of uncertainty of the velocity (±4 percent) and frequency measurements (0.7 ÷ 2 percent depending on the frequency value) and the values varied from 0.202 to 0.216.
- The upstream water velocity was controlled and no detectable variation could be found as a function of the gap size.
- The number of spectra to be averaged was chosen to be 16 because this was the minimum in order to achieve perfect repeatibility in relation to the amplitude and frequency resolution of the F.F.T. analyzer. The probe was positioned around $y/D = 0.5$ because this location was found to be the one where the peaks in the frequency spectra were the sharpest.
- No systematic variation of the bandwidth of the peaks was found (see Fig. 4 for an example).
- The authors did not perform systematic measurements on the maximum value of θ at values of d/D different from one. This was because the determination of each point was very time consuming, requiring the processing of data obtained after about 120 minutes of data acquisition.

Effects of Surface Solidification on the Stability of Multilayered Liquid Films[1]

F. I. P. Smith.[2] This paper extends the work of earlier papers the author had written conjointly. Here, the uppermost layer now has a solidified liquid-air interface which has the effect of stabilizing interfacial shear waves or destabilizing gravity-capillary waves associated with top-heavy stratification.

It would be of interest if the author had compared his result by taking $\beta = 0$ with that of Yih who found instability generated by viscosity variation in superposed layers flowing horizontally. Yih has a section on moving upper boundaries and concludes with a fairly detailed discussion on the various effects arising. Yih, C. S., "Instability due, to Variation of Viscosity," *Journal of Fluid Mechanics*, Vol. 27, 1967, p. 337.

(In the preprint examined an obvious error has crept into the second last sentence in the paragraph containing equation (6).)

Author's Closure

The author is grateful to Dr. Smith for pointing out an obvious error in the second to last sentence in the paragraph containing equation (6) of the original manuscript. The right sides of the inequality signs in this sentence should have been 1 instead of 0. As to the suggestion that we compare the results for $\beta = 0$ and $\gamma_2 = 1$ with that of Yih, we point out that there will be no flow when $\beta \rightarrow 0$ in our problem. While the present flow is driven by gravity the flow studied by Yih was driven by external shear force or pressure gradient.

Simple and Explicit Formulas for the Friction Factor in Turbulent Pipe Flow[1]

Don J. Wood.[2] It appears that this paper incorrectly claims the presentation of a significantly improved explicit friction factor formula. The statement that all the existing explicit equations are either simple and not accurate or accurate and not simple is refuted by the author himself in the paper. The equation presented by Swamee and Jain in reference [4] is certainly equivalent in simplicity to the one offered by the author and the claim of superior accuracy for the author's relation is simply not significant. The author states that his relation has maximum error of 1.5 percent compared to the Colebrook-White formula while the Swamee-Jain relation has a maximum error of nearly 3 percent. The author further states that Colebrook-White formula may be 3-5 percent or more in error compared to experimental results. Based on this reasoning it does not appear that the author contribution is of any great significance, since the Swamee-Jain formula is a more than adequate relationship. The author does present a formula for the smooth to rough transition which appears to represent the transitions well. However, it includes a factor *n*

[1] By S. P. Lin, published in the March, 1983 issue of the JOURNAL OF FLUIDS ENGINEERING, Vol. 105, pp. 119–121.

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[1] By S. E. Haaland, published in the March, 1983 issue of the JOURNAL OF FLUIDS ENGINEERING, Vol. 105, pp. 89–90.

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