turbulent velocities in the wake of a towed slender axisymmetric body (fineness ratio=11.75) were conducted for positions along the wake axis (3< x/D<432) in a towing tank. The Reynolds number based on the body speed U and the body diameter D was $3x10^4$. The effect of the body shape and slenderness on the turbulent wake structure has been determined to be important. The effect of stratification on the turbulent wake structure was investigated by conducting wake experiments of the towed slender body in a stratified fluid of constant density gradient. The internal Froude number F_D was 31, where $F_D = U/(ND)$ and N is the Brunt-Vaisala frequency in cycle/sec. The mean and turbulent longitudinal velocities in the stratified wake decay, respectively, as $x^{-1/3}$ and $x^{-1/2}$ which show slower decay rate than $x^{-2/3}$ observed in the nonstratified wake. The turbulent density fluctuations decay as $x^{-2/3}$ for $70 < x/DC_D^{1/2} < 300$, but this decay rate decreases somewhat for $x/DC_D^{1/2} > 300$.

*Work supported by Navy Prime Contract No. N00017-72-C-4401, APL/JHU Subcontract No. 341827.

EB6 Turbulent Wake of a Propeller-Driven Slender Body in Stratified and Nonstratified Fluids*. JUNG-TAI LIN, YIH-HO PAO, and SCOTT D. VEENHUIZEN, Flow Research, Inc.--Measurements in the wake of a propeller-driven slender body were conducted for a nonstratified fluid in a towing tank. The Reynolds number was 3×10^4. The experimental results show that the wake grows as $x^{1/4}$ and the turbulent velocity fluctuations decay as $x^{-3/4}$ in agreement with the theoretical predictions. The effect of stratification was investigated for the turbulent wake in stratified fluids of constant density gradient. The decay of the longitudinal turbulent velocity fluctuations is not significantly affected by stratification until $x/DF_D > 3$, but, the vertical turbulent velocity fluctuations in the stratified wake decay at a faster rate ($\sim x^{-1}$) than that in the nonstratified wake. The measurements of the mean and turbulent density profiles indicate a stronger mixing in the wake of a propeller-driven slender body than that in the wake of a towed slender body. The turbulent density fluctuation decays as x^{-1}.

*Work supported by Navy Prime Contract No. N00017-72-C-4401, APL/JHU Subcontract No. 600106.

EB7 Internal Waves Generated by a Moving Body with Sinusoidal Heaving Motion in a Stratified Fluid of Finite Depth*. MARTHA SMITHMEYER and ROBERT E. ROBINS,† Flow Research, Inc.-- A linearized theoretical analysis predicts the internal waves generated by this body motion in a stratified fluid of constant Brunt-Vaisala frequency. An explicit equation is found for the vertical displacements in the far field. The vertical displacements in the flow field have been computed. In addition to the steady state wave pattern, the waves caused by the sinusoidal motion are fluctuating rather than steady and always contain both transverse and divergent waves. These fluctuating waves are usually confined to a narrow region, but under some conditions propagate upstream. The wave amplitude of these fluctuating waves is proportional to the amplitude of the heaving motion, and is approximately proportional to the square of the ratio of heaving frequency to Brunt-Vaisala frequency. In comparison with the amplitude of the steady state waves, the amplitude of these fluctuating waves ranges from small to the same order.

*Work supported by Navy Prime Contract No. N00017-72-C-4401, APL/JHU. Subcontract No. 600106. †Submitted by James J. Riley.

WEDNESDAY MORNING, 27 NOVEMBER 1974
142 KECK AT 10:15 A.M.
Isadore Rudnick, presiding

GENERAL FLUID MECHANICS

EC1 Flow Forces on a Bluff Cylinder Near a Wall or Near Another Cylinder.* A. ROSHKO, V. CHATTOORGOON† and A. D. STEINOLFSON, Calif. Inst. of Tech. --Measuring mainly pressure distributions, it has been found that as a cylinder of bluff cross section approaches a wall its drag decreases and a side force away from the wall develops, increasing monotonically until it touches the wall. When, instead, the cylinder approaches another like cylinder, the development of forces is qualitatively the same but different in magnitude. There are also some hysteresis effects, not observed in the wall interaction.

*Supported by Office of Naval Research, Contract No. N00014-67-A-0094-0001.
†Now at the University of Toronto.

EC2 A Mechanism of Vorticity Segregation* H. ROGLER, Case Western Reserve U. -- The unsteady interaction between a potential vortex in a uniform steady flow and a semi-infinite plate causes a segregation or separation of vorticity in the sense that vortices with opposite signs of circulation ultimately end up on opposite sides of the plate, no matter what the initial trajectory, mean speed, or circulation strength. A "zero-strength vortex" convects with the mean flow, but nonlinear coupling between the plate and non-zero strength vortices effects a deviation from this linear path. The trajectories of some vortices will turn around downstream of the leading edge, and the vortex propagates upstream as driven by the image vortex. The disturbance pressures range from $O(\rho q^2)$ far from the leading edge to $O(\rho U_\infty q')$ in the vicinity of the leading edge. If the plate is finite, however, the segregation process may not be completed before the vortex is convected past the trailing edge. Analogous trajectories obtained by conformal mapping for potential flows past blunt bodies indicate that a similar mechanism arises. In the region of the stagnation point, high velocity fluctuations result when a vortex, initially convected away from the stagnation point, reverses direction and passes over the stagnation point.

*Supported by AFOSR.

EC3 The Gorter-Mellink Scale and Critical Velocities in Liquid Helium II Counterflow.* P. E. DIMOTAKIS, Calif. Inst. of Tech. -- It is found that, in liquid helium II pure counterflow, the dimensionless number $\mathcal{A} = \rho_s A \overline{w} \ell$, where A is the Gorter-Mellink constant, $\overline{w}$ is the mean relative velocity between the two fluids and ℓ is a characteristic dimension of the geometry, scales the mutual friction between the two fluids. Critical relative velocities in cylindrical channels are shown to be correlated by the rule $\mathcal{A}_c = \rho_s A \overline{w}_c \pi d \simeq 1$.

*Submitted by H. W. LIEPMANN

EC4 Reflection of a Spherical Cavity after Collapse.* MAURICE HOLT and ADEBOWALE FALADE, U. of California, Berkeley -- The collapse of a gas filled spherical cavity in water is treated by perturbation of similarity solutions in Holt.[1] At the moment of collapse the gas is confined to an infinitesimally small sphere and the imploding shock