54[V].—WALLACE D. HAYES & RONALD F. PROBSTEIN, *Hypersonic Flow Theory*, Volume 5 of Applied Mathematics and Mechanics, Academic Press, New York, 1959, xiv + 464 p., 24 cm. Price $11.50.

The term "hypersonic" distinguishes aerodynamic problems at speeds far greater than sound from associated problems at moderately supersonic speeds. The new features of hypersonic flows can be divided into hydrodynamic characteristics (associated with high Mach numbers) and physical or chemical characteristics (associated with high temperatures arising because of high velocities). The subject matter of the book is devoted primarily to the hydrodynamic features.

The chapter headings are:

I. General Considerations
II. Small-Disturbance Theory
III. Newtonian Theory
IV. Constant-Density Solutions
V. The Theory of Thin Shock Layers
VI. Other Methods for Blunt-Body Flows
VII. Other Methods for Locally Supersonic Flows
VIII. Viscous Flows
IX. Viscous Interactions
X. Free Molecule and Rarefied Gas Flows

Chapter I gives an excellent qualitative description of the general features of hypersonic flow fields for both blunt and slender bodies. The shockwave patterns, the characteristics of the flow in the vicinity of the body (Mach number, temperature, pressure, etc.), and the characteristics of the flow in the wake are described. This qualitative description leads naturally to a categorization of the assumptions upon which various hypersonic theories for inviscid flow are based. These assumptions depend on shape of the body and the freestream flow as follows:

A.	$M_\infty \gg 1$	"Basic Hypersonic"
B.	$\sin \theta_b \ll 1$	"Slender Body"
C.	$M_\infty \sin \theta_b \gg 1$	"Strong Shock"
D.	$\epsilon \ll 1$	"Small Density Ratio"
E.	$M_\infty \sin \theta_b \ll 1$	"Linearization"

where M_∞ = freestream Mach number
θ_b = inclination of body surface to the freestream flow
ϵ = density ratio across the shock wave

The authors indicate the assumptions which apply to the several inviscid theories developed in a very orderly way in Chapters II through VII.

The theories considered in Chapters II through V are indicated by the headings. Additional methods for blunt body flows given in Chapter VI include stream-tube continuity methods, method of integral relations, and relaxation techniques. Chapter VII covers shock-expansion theory for locally supersonic flows and tangent-wedge and tangent-cone methods.

In addition to the thorough treatment of inviscid flow theories, the book is an excellent reference for hypersonic viscous effects which can be treated with boundary-layer theory (Chapters VIII and IX).

Chapter X gives a very complete qualitative discussion of the general features of rarefied gas flows, covering the gamut from low Reynolds number continuum flow to free molecule flow. For the free molecule flow regime, results for forces and heat transfer are given.

Robert E. Wilson

Naval Ordnance Laboratory
White Oak, Silver Spring,
Maryland

55[V, X].—Charles J. Thorne, George E. Blackshaw & Ralph K. Claassen, *Steady-State Motion of Cables in Fluids, Part I., Tables of Neutrally Buoyant Cable Functions*, NAVWEPS Report 7015, Part 1 NOTS TP 2378, China Lake, California, 1962, xxxii + 400 (approx.) unnumbered pages, 22 cm.

An approximate solution for the shape and tension of a neutrally buoyant flexible cable in a stream is expressible in terms of the functions

$$\tau = \exp\left(\frac{F}{R}\cot\phi\right), \qquad \xi = \int_{\phi}^{\pi/2} \tau \cot\phi \csc\phi \, d\phi, \qquad \eta = \int_{\phi}^{\pi/2} \tau \csc\phi \, d\phi$$

where $R/F = 45$. A brief table of these functions was given by Landweber and Protter (*Jour. Appl. Mech.*, 1947). In the present work these functions are tabulated for much smaller increments of the variable. Various combinations of these functions that are useful in solving certain types of cable problems are also tabulated.

Since the assumed laws of the forces on a cable are empirical and approximate, it is interesting to observe that by a slight alteration in the physical assumptions, due to R. K. Reber of the Navy Department, Bureau of Ships, the differential equations can be made integrable. Assuming that, instead of a constant tangential component, there is a constant force F per unit length in the downstream direction, the differential equations (5) and (6) in the book would be replaced by

$$\frac{dT}{ds} = F\cos\phi$$

$$T\frac{d\phi}{ds} = -R\sin^2\phi - F\sin\phi$$

It is readily verified that the functions corresponding to ξ and η obtained from these differential equations are exactly integrable. This has the obvious advantage of enabling neutrally buoyant cable problems to be solved with the aid of trigonometric tables.

Louis Landweber

State University of Iowa
Iowa City Iowa

56[X].—Charles Andersen, "The Ruler Method, An Examination of a Method for Numerical Determination of Fourier Coefficients," *Acta Polytechnica*