

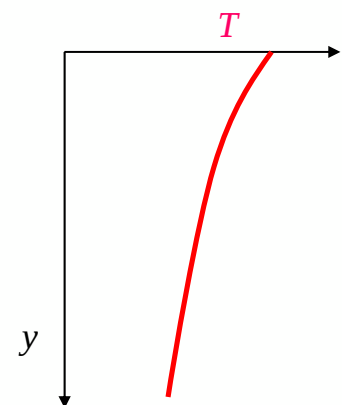
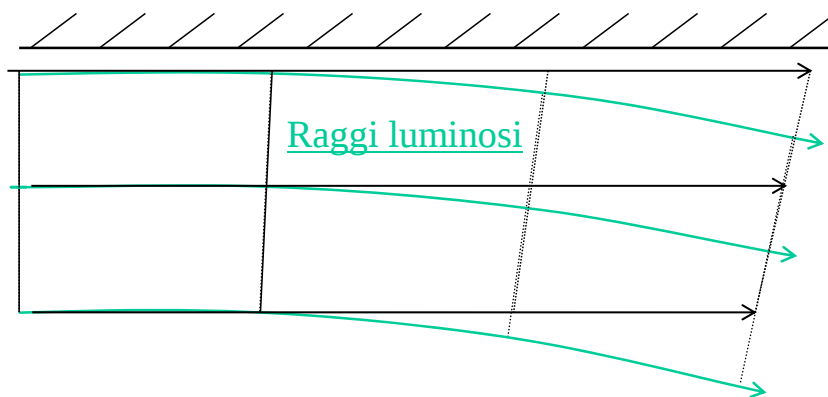
METODI OTTICI

→
Raggio luminoso

$$c = c_o/n$$

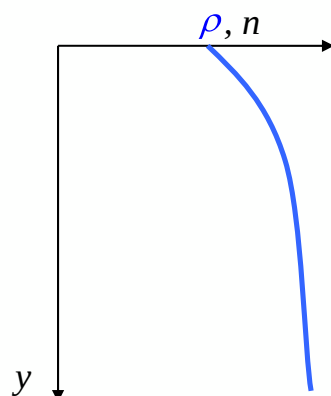
$$\text{Gladstone-Dale Law: } n - 1 = K \rho$$

n grande, c piccola

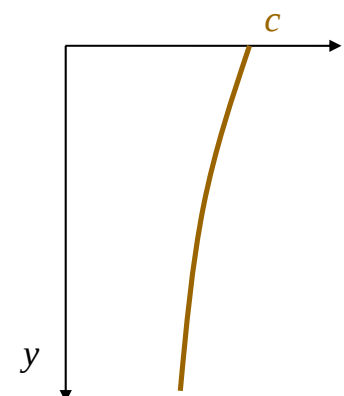


$$\rho = p/RT$$

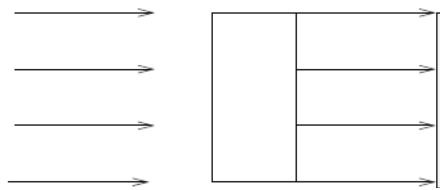
$$n = 1 + K \rho$$



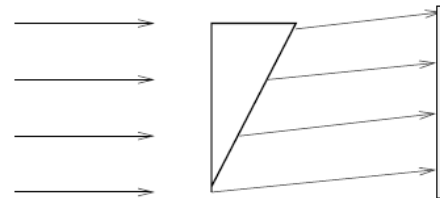
$$c = c_o/n$$



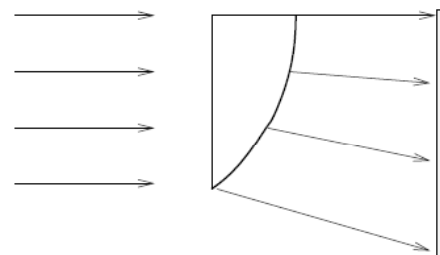
Deflection of light rays



Constant density



Constant density gradient

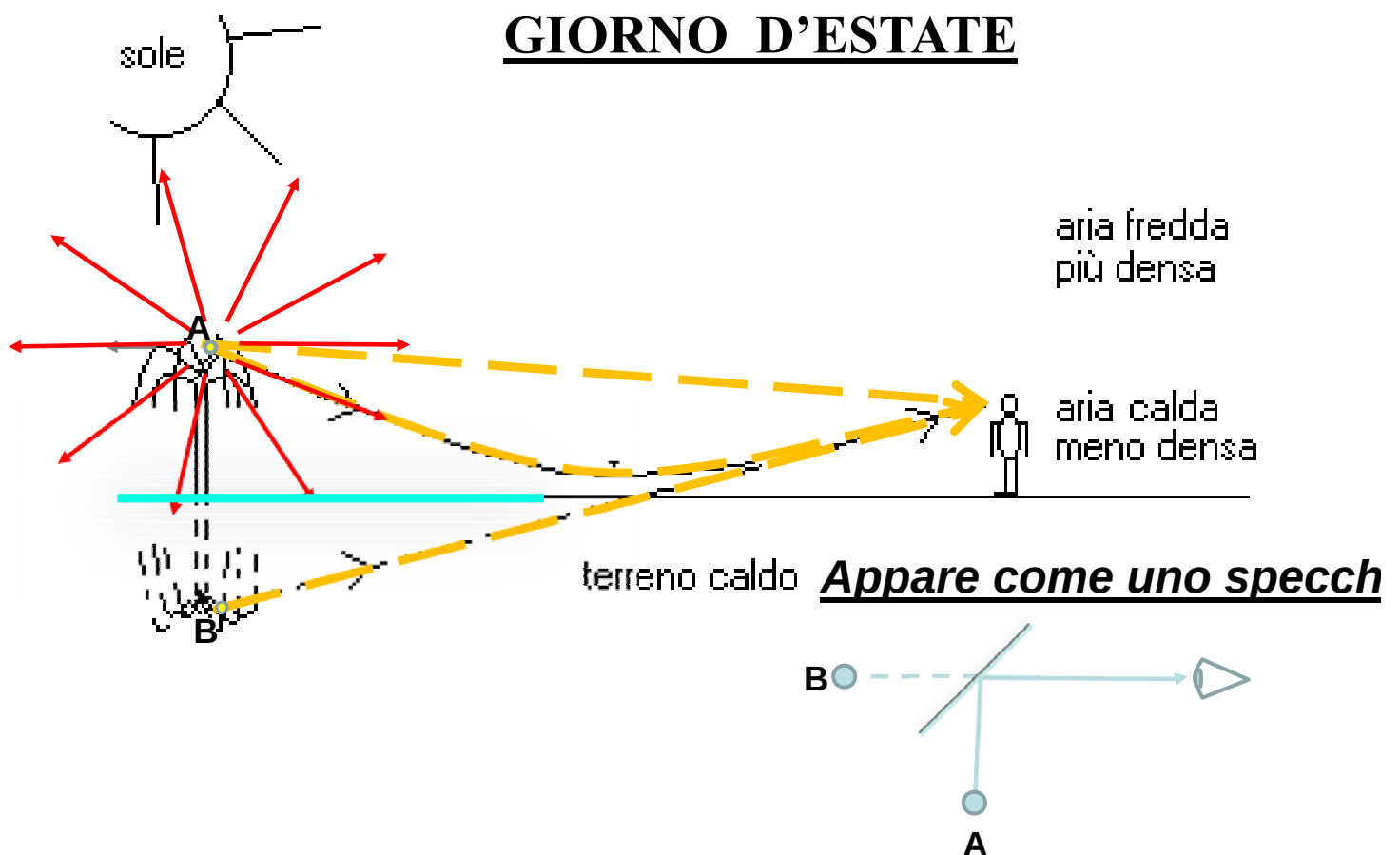


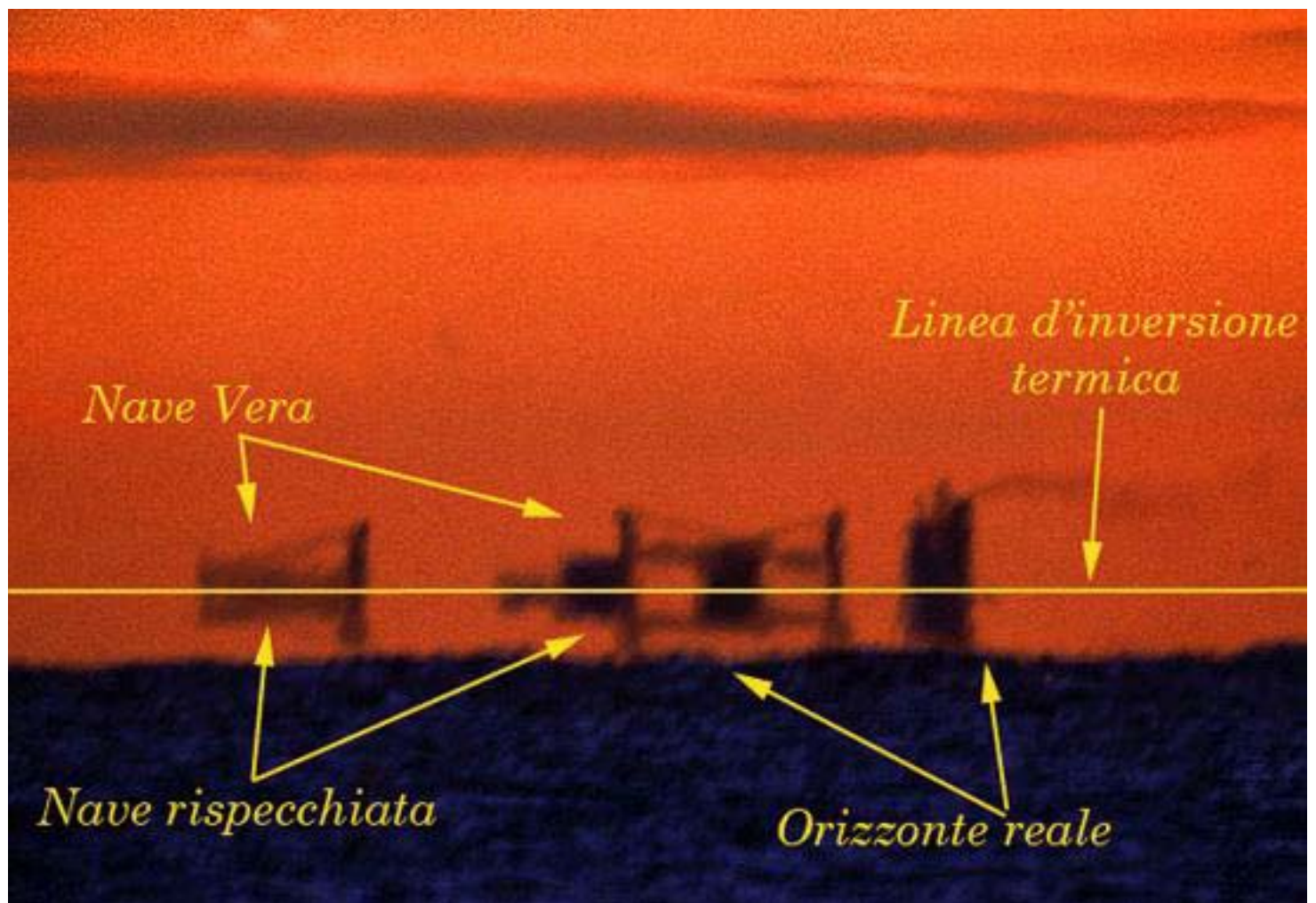
Constant second derivative

see Merzkirch [1974]

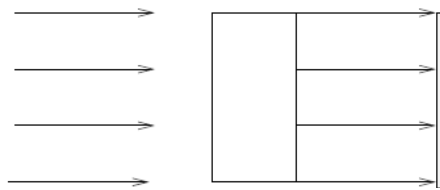
$$\text{Gladstone-Dale Law: } n - 1 = K \rho$$

GIORNO D'ESTATE

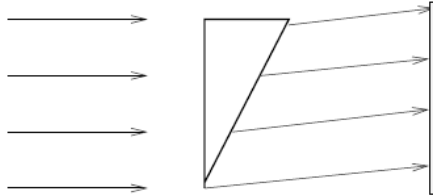




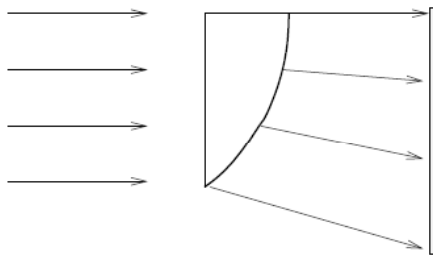
Deflection of light rays



Constant density



Constant density gradient



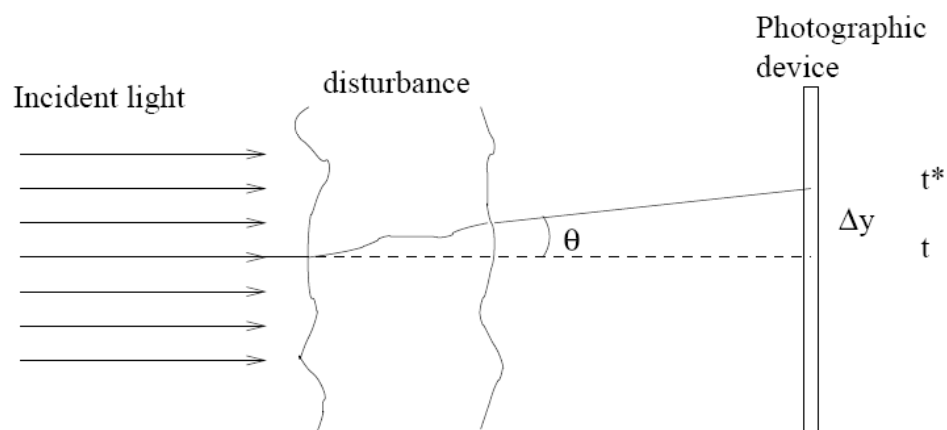
Constant second derivative

see Merzkirch [1974]

Legge di Gladstone-Dale: $n - 1 = K \rho$

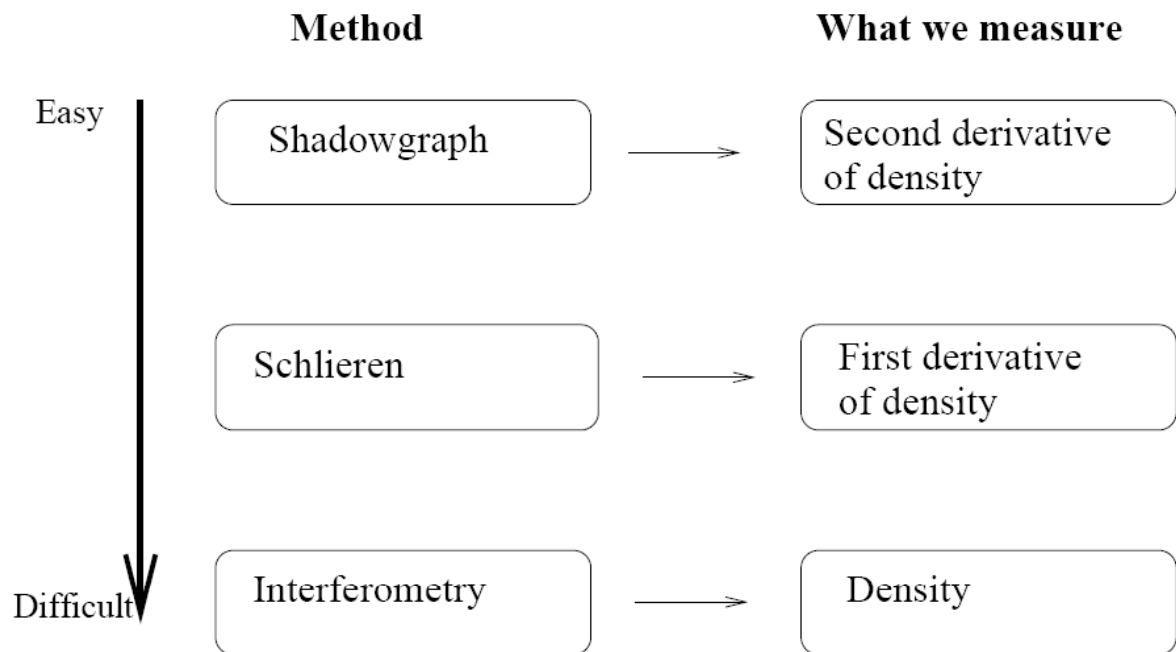
What do we see?

Looking through a fluid



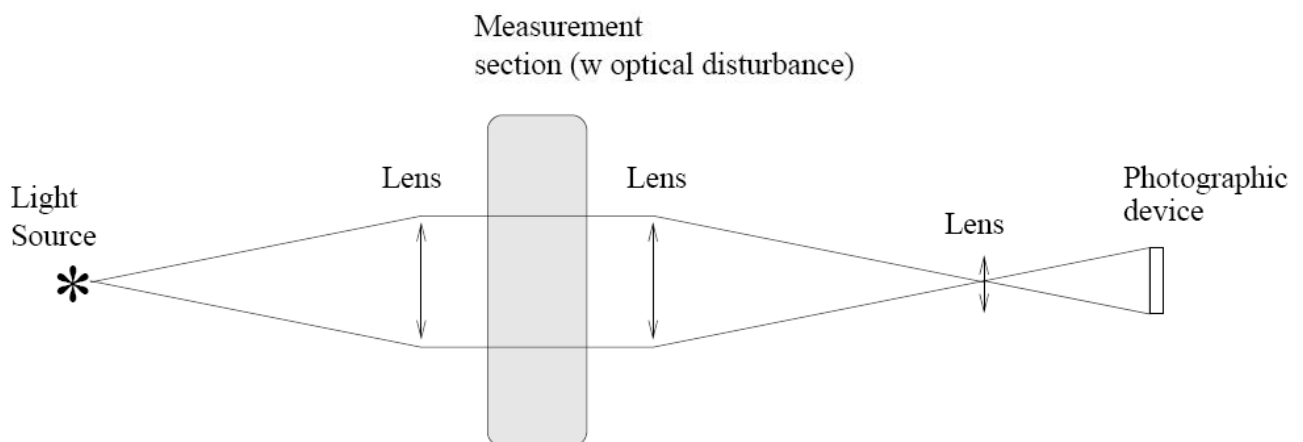
- Shadowgraph - measure Δy
- Schlieren - measure Θ
- Mach-Zendner Interferometer - measure phase-shift
 $\Delta\omega = 2\pi(t^{-1} - t_*^{-1})$

See the light



Shadowgraph

🔴 Pionered by Dvorak (1880)



Shadowgraph

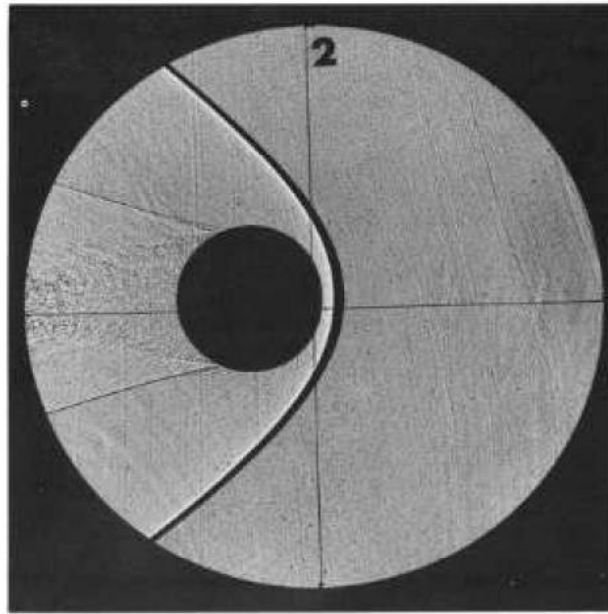


Fig. 3.10 Shadowgraph of a sphere flying at a Mach number of $M = 1.7$. (From Stalp, 1968.)

Picture copied from Merzkirch (1974)

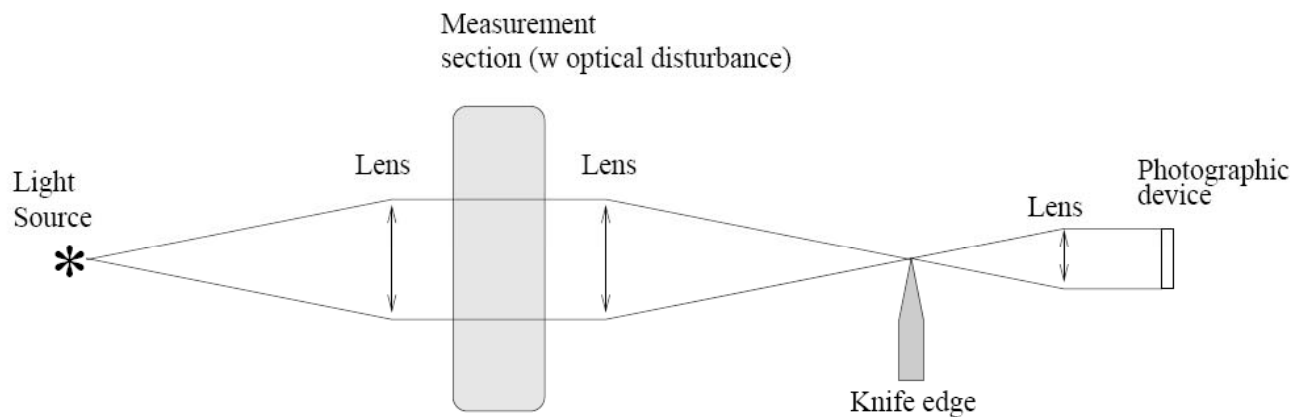
Schlieren

- Attributed to Focault (1859) and Toepler (1864) (dep. on national preference)
- Used by Focault to check quality of lenses and mirrors
- Elaborated by Toepler

Now often referred to as the “Toepler method”

Schlieren

- Idea: Introduce knife edge at focal point
 - light bent down is removed → darker-spots
 - light bent up is kept → brighter-spots
- Direction of density gradient known



Schlieren - example

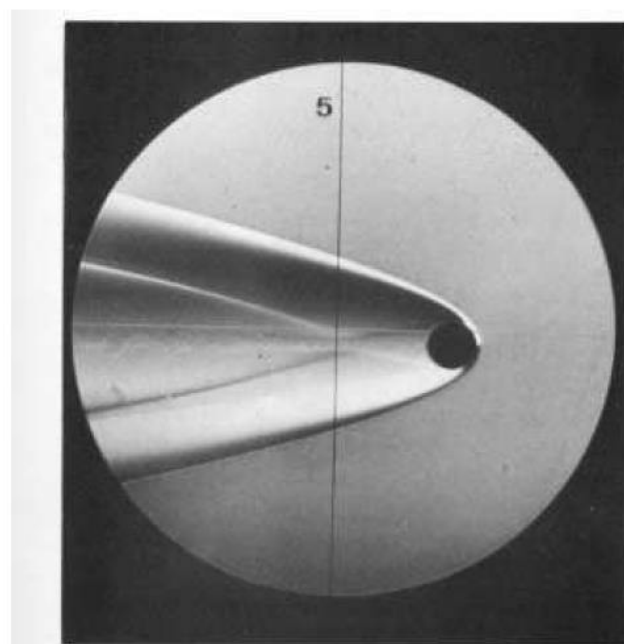


Fig. 3.18 Schlieren photograph of the flow field around a sphere flying at hypersonic speed. (From Sülp and Merzkirch, Ernst-Mach-Institut, Freiburg, Germany.)