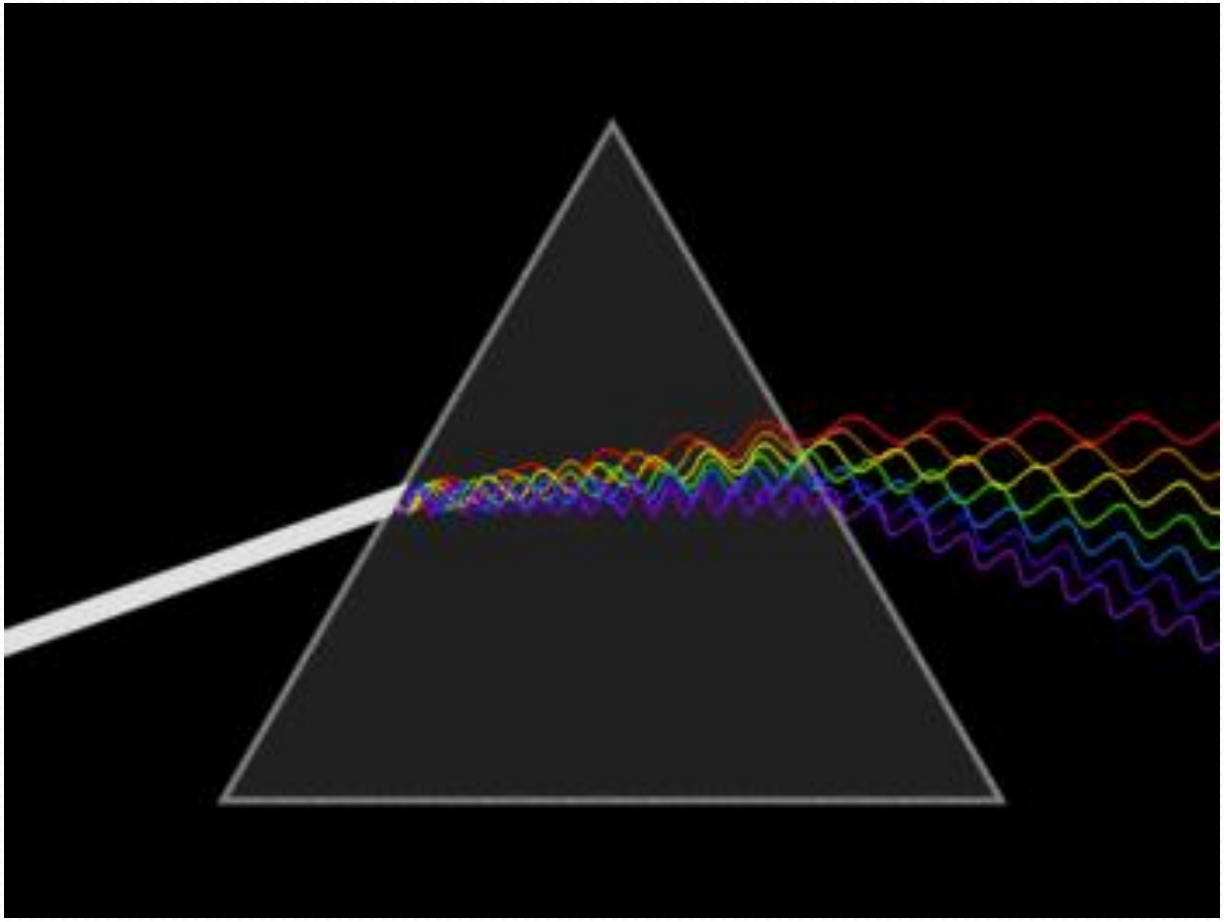
FAKULTAS TEKNIK ELEKTRO
SCHOOL OF ELECTRICAL ENGINEERING
TELKOM UNIVERSITY

Cahaya dan Propagasi Geometrik

1. Pengertian Cahaya
2. Hukum Snell
3. Hukum Fresnell

PENGERTIAN CAHAYA



Light is electromagnetic radiation within a certain portion of the electromagnetic spectrum. The word usually refers to **visible light**, which is visible to the human eye and is responsible for the sense of sight. Visible light is usually defined as having wavelengths in the range of 400–700 nm, between the infrared (with longer wavelengths) and the ultraviolet (with shorter wavelengths). This wavelength means a frequency range of roughly 430–750 THz.

KECEPATAN CAHAYA

Di hampa udara

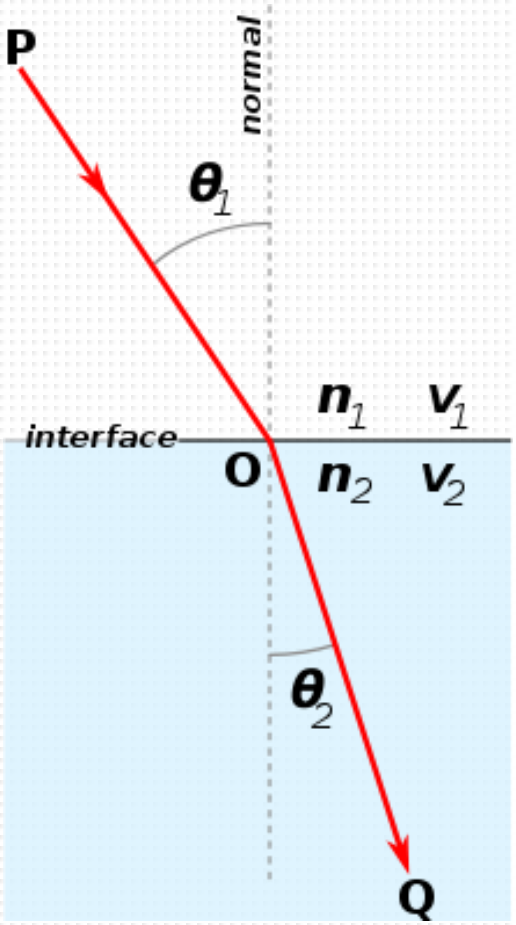
$$c = \frac{1}{\sqrt{\varepsilon_o \mu_o}} = 299.792.458 \text{ m/s} \approx \mathbf{3 .10^8} \text{ m/s}$$

Di medium lain

$$v = \frac{c}{n}$$

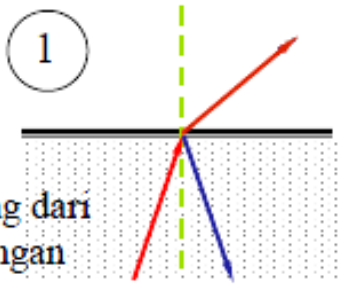
Keterangan:
n : Indek bias medium
μ_o : Permeabilitas hampa udara = $4\pi \times 10^{-7}$ $N\ s^2\ C^{-2}$
ε_o : Permitivitas hampa udara = $8{,}85 \times 10^{-12}$ $C^2\ N^{-1}\ m^{-2}$

HUKUM SNELL



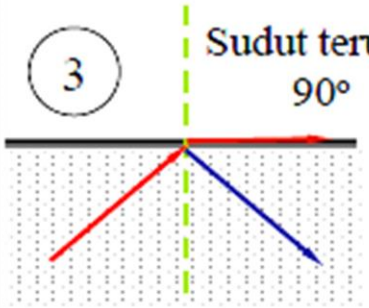
$$n_1.\sin\theta_1 = n_2.\sin\theta_2$$

TOTAL INTERNAL REFLECTION (TIR)

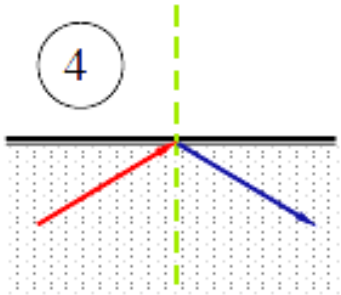


Cahaya datang dari medium dengan indeks bias yang lebih tinggi

Sudut datang semakin besar, cahaya yang terus makin menjauhi normal

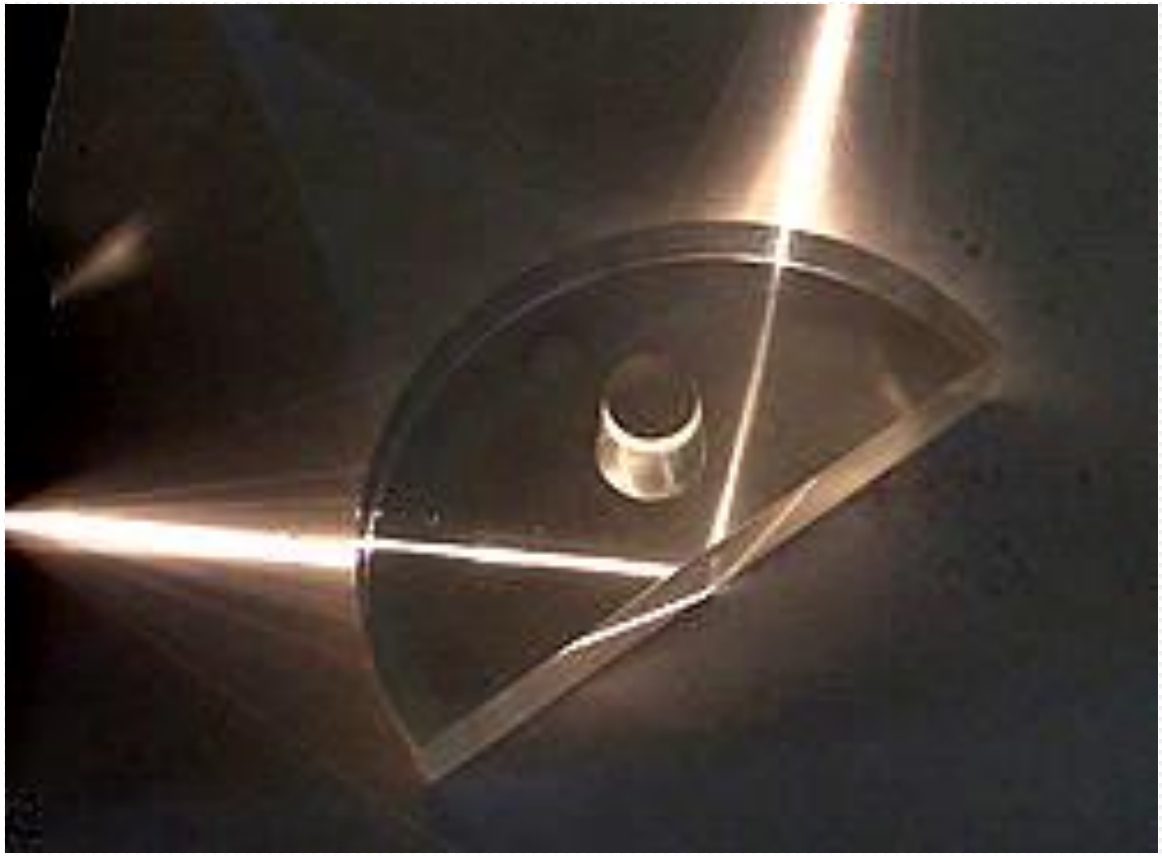


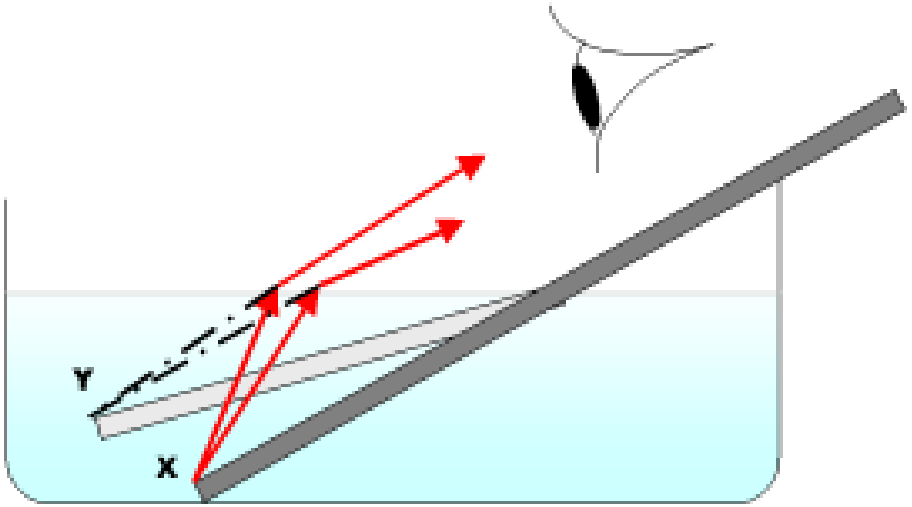
Kondisi ini sudut datang disebut sudut kritis



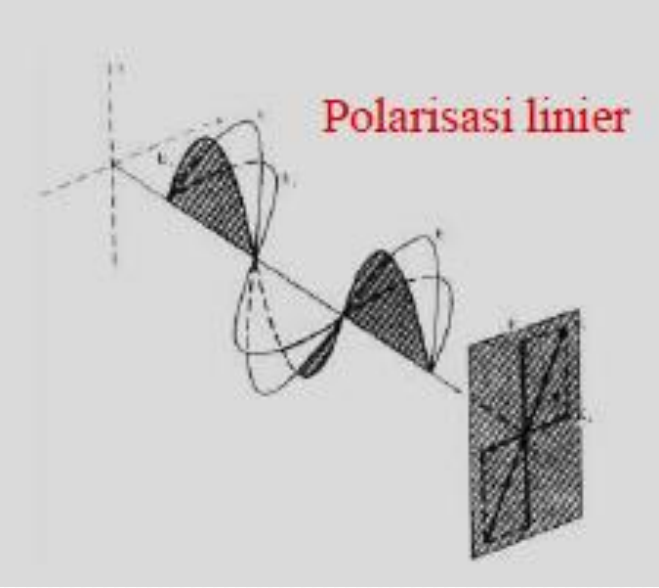
Bila sudut datang > sudut kritis terjadi TIR

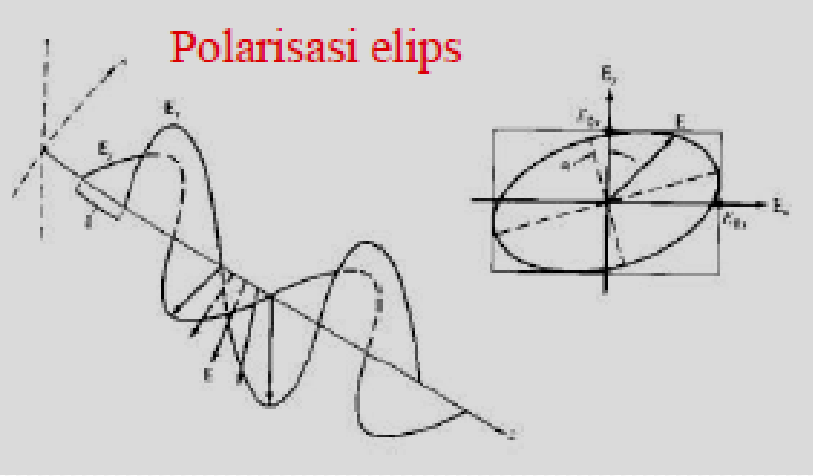
TOTAL INTERNAL REFLECTION (TIR)

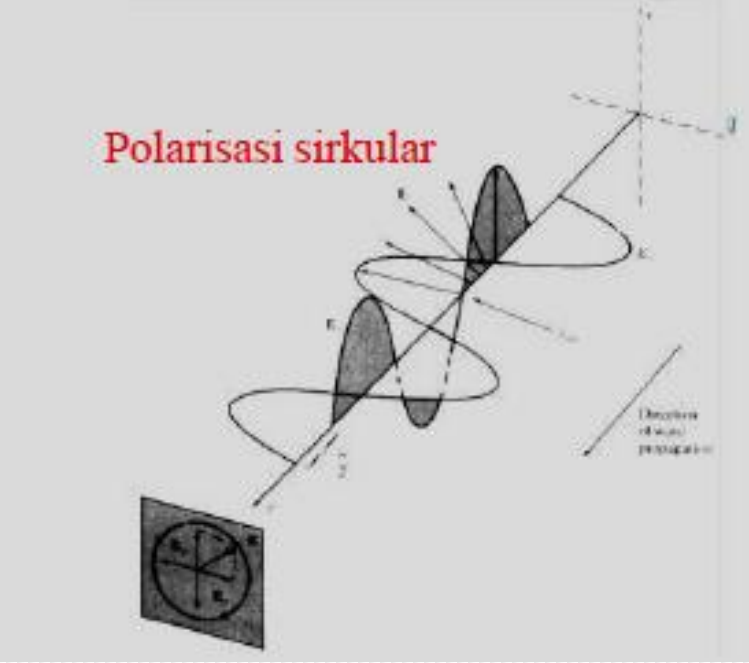



Y
X

POLARISASI





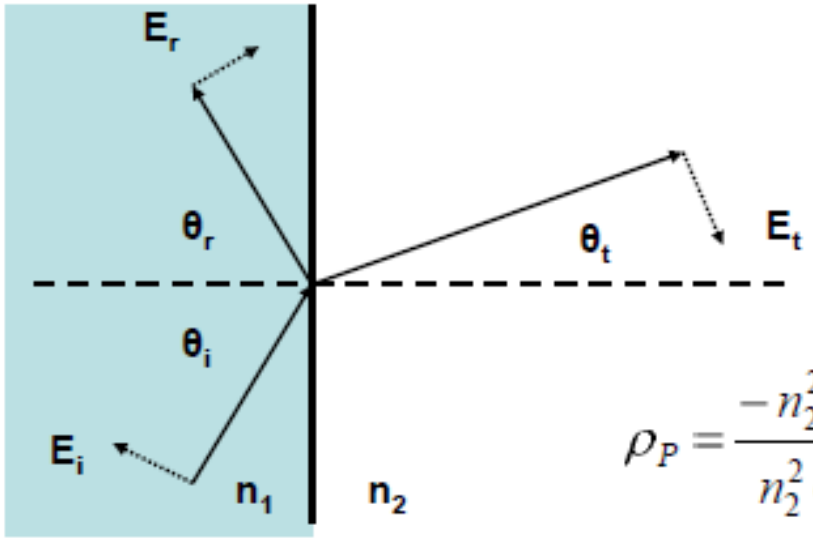


HUKUM FRESNEL

Bidang datang: bidang tegak lurus terhadap bidang batas dan melalui arah perambatan cahaya.

Vektor medan listrik tegak lurus arah perambatan cahaya

Polarisasi sejajar bidang datang :

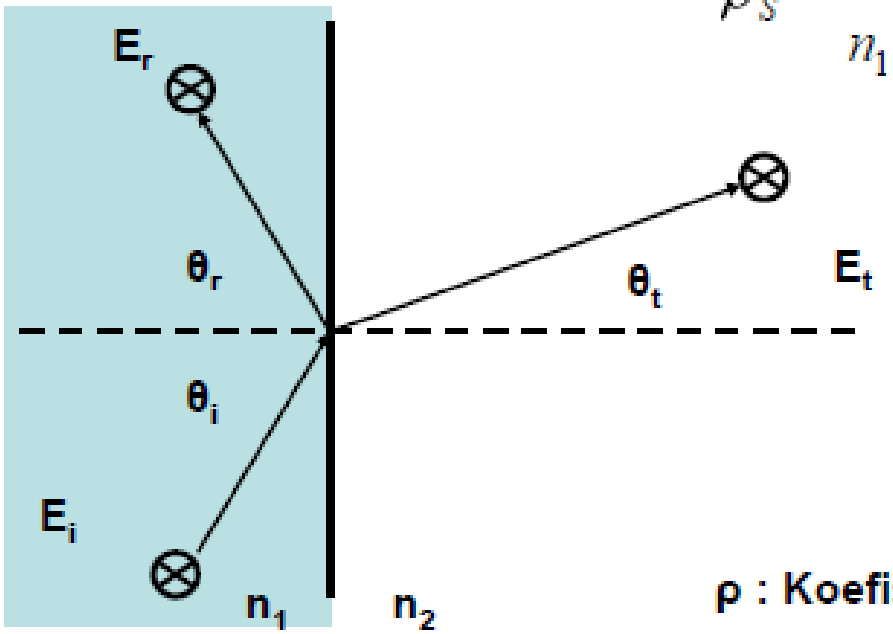


$$\rho_P = \frac{-n_2^2 \cos\theta_i + n_1\sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}{n_2^2 \cos\theta_i + n_1\sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}$$

HUKUM FRESNEL

Polarisasi tegak lurus bidang datang :

$$\rho_S = \frac{n_1 \cos\theta_i - \sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}{n_1 \cos\theta_i + \sqrt{n_2^2 - n_1^2 \sin^2\theta_i}}$$



ρ : Koefisien refleksi

Reflektansi : $R = |\rho|^2$

$$\rho_P = 0 \Longrightarrow R = 0 \Longrightarrow \tan\theta_B = \frac{n_2}{n_1}$$

θ_B : Sudut BREWSTER

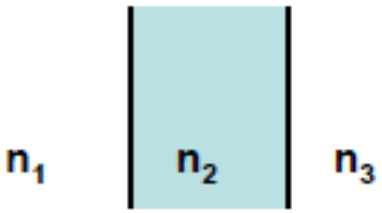
Sudut Kritis :

$$\sin\theta_C = \frac{n_2}{n_1}$$

$$\theta_i > \theta_C \Longrightarrow \sin\theta_i > \sin\theta_C \Longrightarrow n_1^2 \sin^2\theta_i > n_2^2 \Longrightarrow R = |\rho|^2 = 1$$

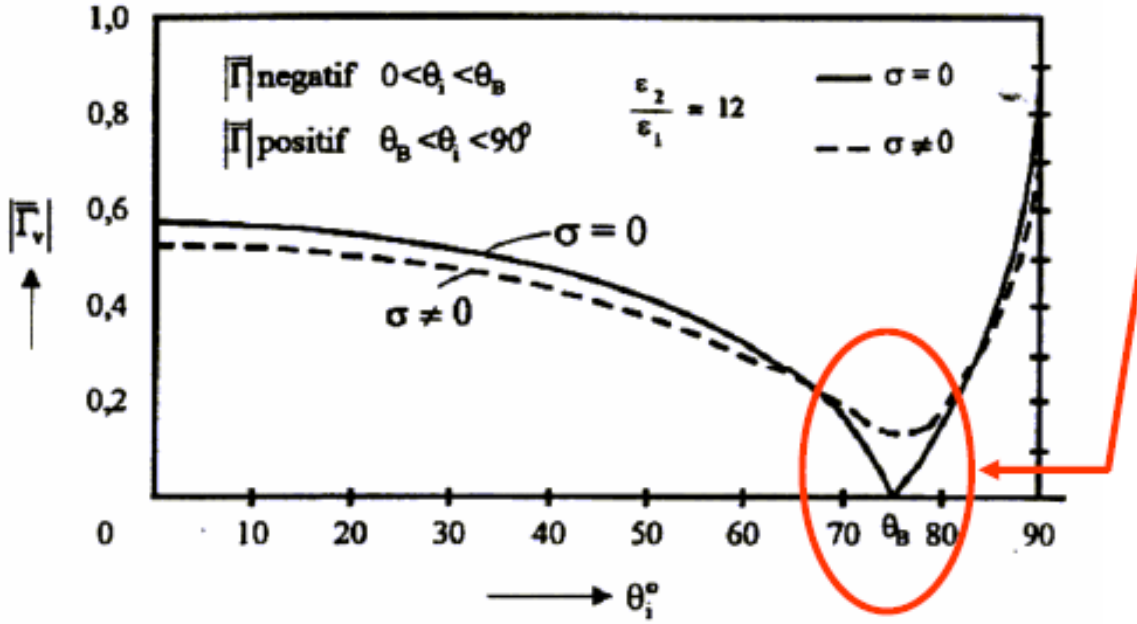
$$n_2^2 - n_1^2 \sin^2\theta_i = 0 \Longrightarrow |\rho_P| = |\rho_S| = 1$$

Anti refleksi :



$$R = \frac{[n_1 n_3 - n_2^2]^2}{[n_1 n_3 + n_2^2]^2}$$

$$R = 0 \Longrightarrow n_2 = \sqrt{n_1 n_3}$$



Sudut Brewster

- Sudut datang ketika koefisien pantul **minimum !!**
- Fasa akan berubah tanda setelah sudut Brewster

Soal Latihan

- Suatu berkas cahaya memiliki polarisasi sejajar bidang datang menjalar dari media pertama dengan indeks bias 1,48 ke media ke dua.
  - Hitunglah besarnya indeks bias media ke dua agar memiliki reflektansi 0,5 pada sudut datang 40^0.
  - Sesuai hasil perhitungan sdr tsb, hitunglah besarnya sudut Brewster.