Diffused light...

Aerial fog...

Diffracted / scattered light...

Parasitic light...

Veiling glare...

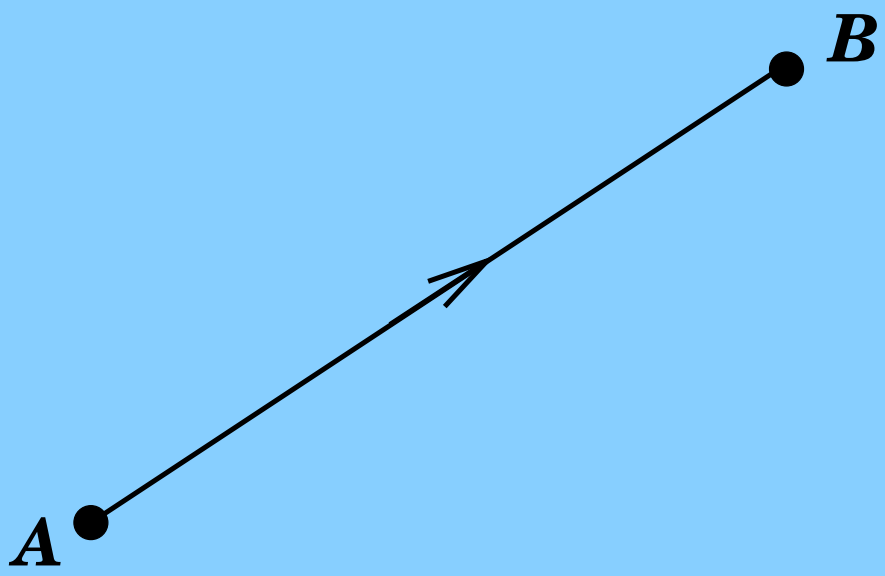
Gentle pets...

...or bugbears ?

Emmanuel Bigler

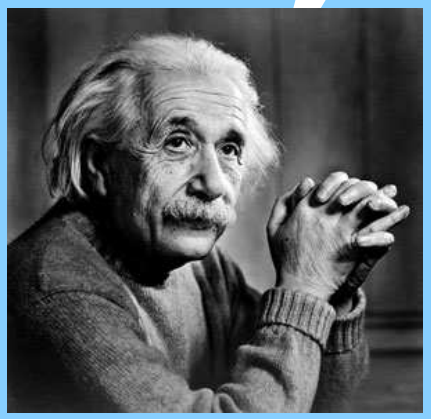
Galerie−Photo conference, Bourges, France, 10−11−12 October 2008

In the vacuum of Space, optics is simple.



« Light propagages along a straight line;
this fact is non negociable.»

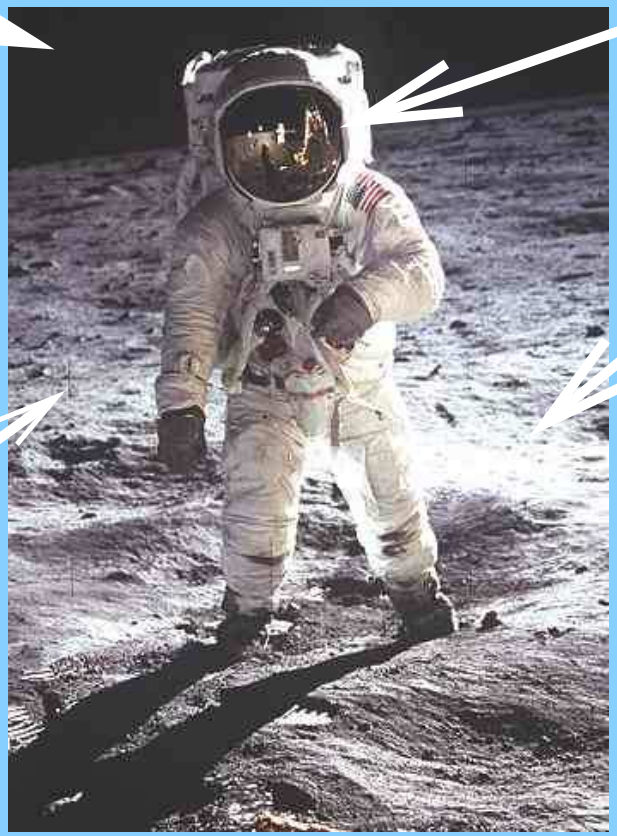
And if Space is curved ?



A.Einstein
(1879 – 1955)

On the Moon, things are less simple!

black sky @0%



Horrible parasitic reflections

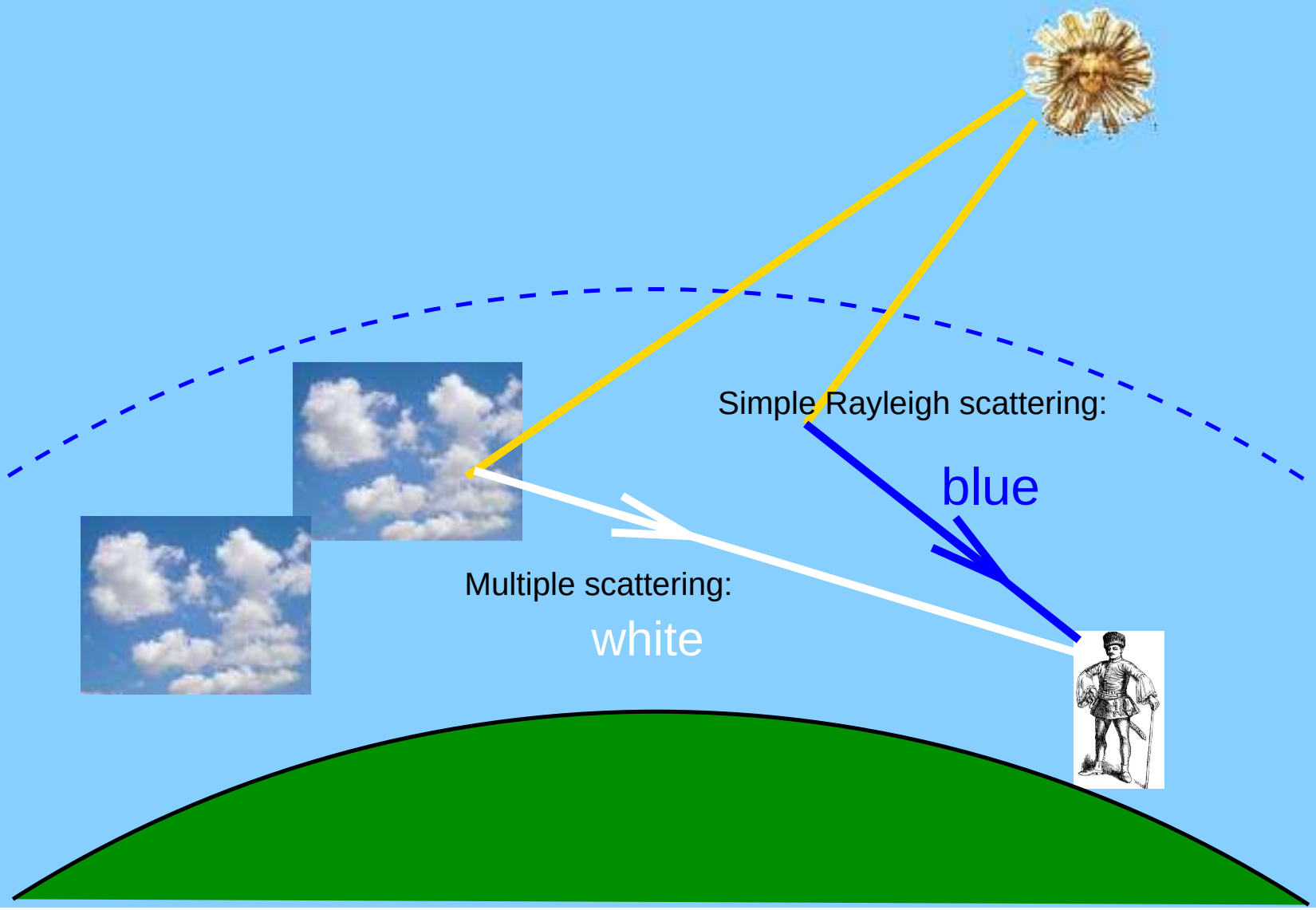
Grossly overexposed

Don’t know why!

Grey card @7−8% (non standard)

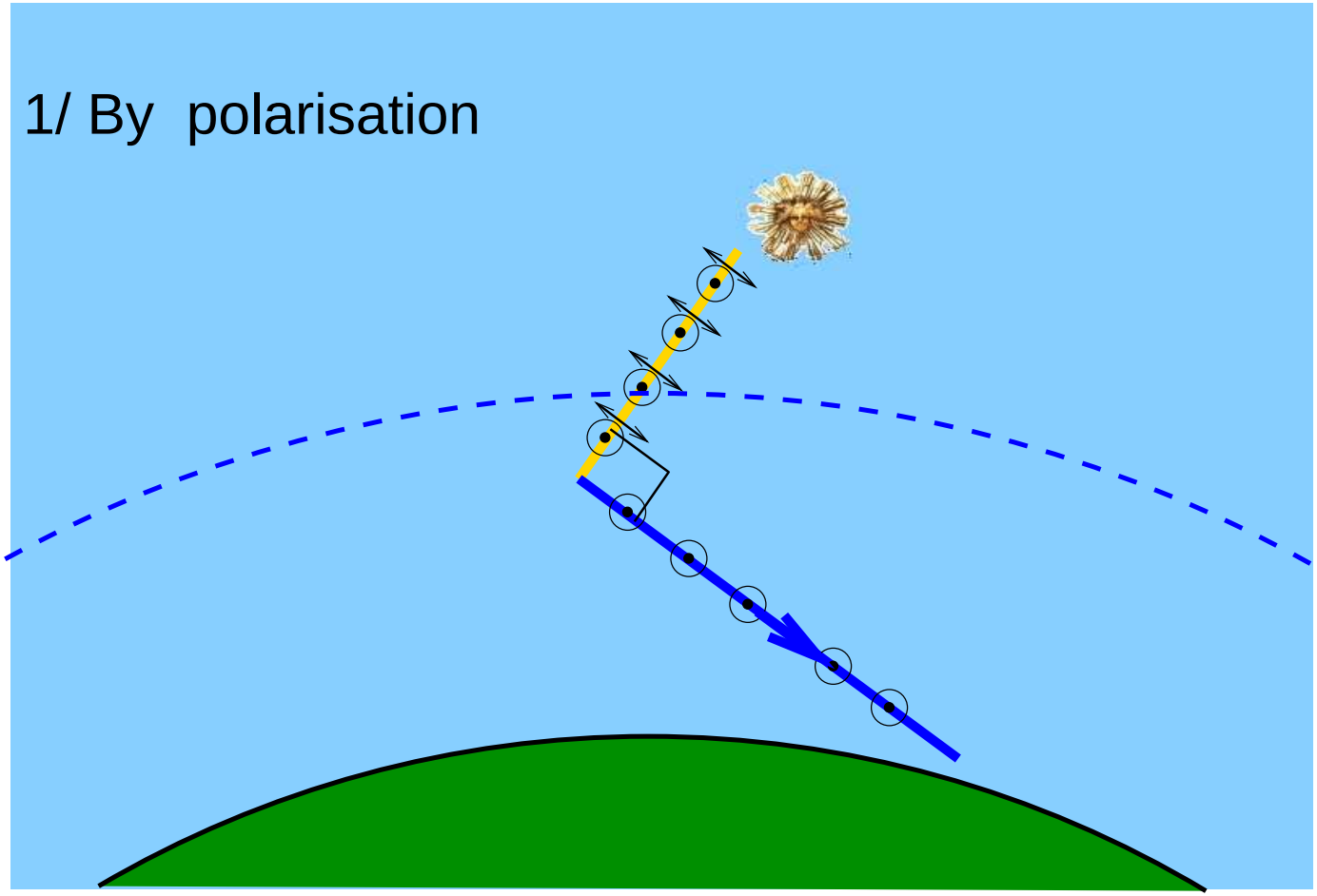
I told you !
always take the
UV−filter OFF
before shooting !

Back to Earth!



Blue skies, aerial fog,

Can we get rid of them?



2/ By filtering : Ultra−Violet (UV)−filter, Infra−Red (IR)−filter

−> UV light is more efficiently scattered than visible light;

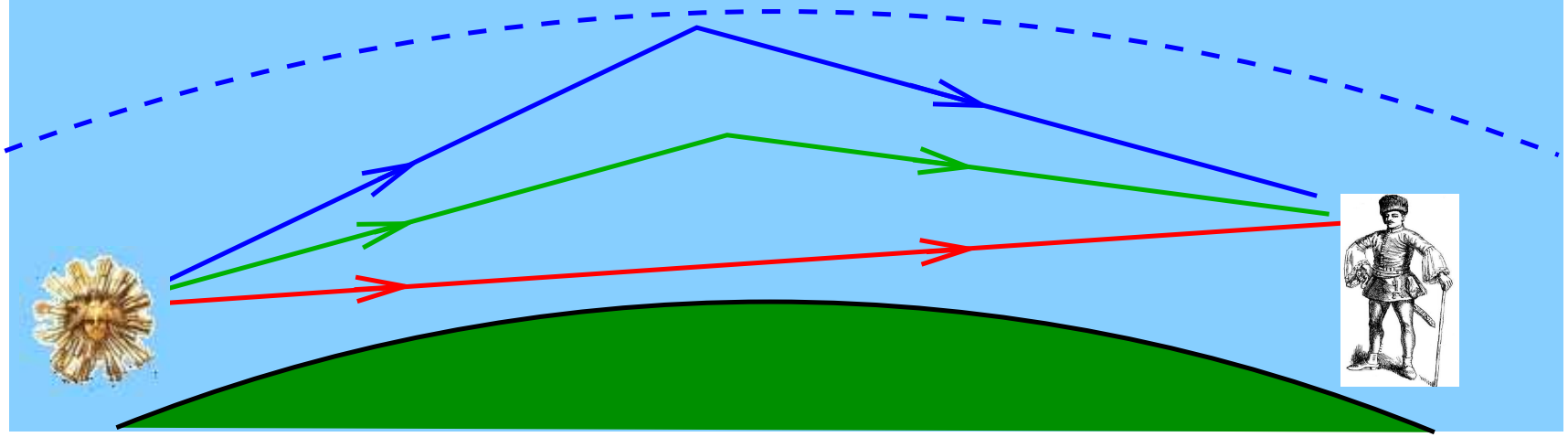
−> visible light is more scattered than infra−red (IR)

Let’s be really creative! No more postcards!

Let’s definitely probibit scattered light!

1/ Prohibit simple scattering!

Down with red sunsets above the Adriatic sea!



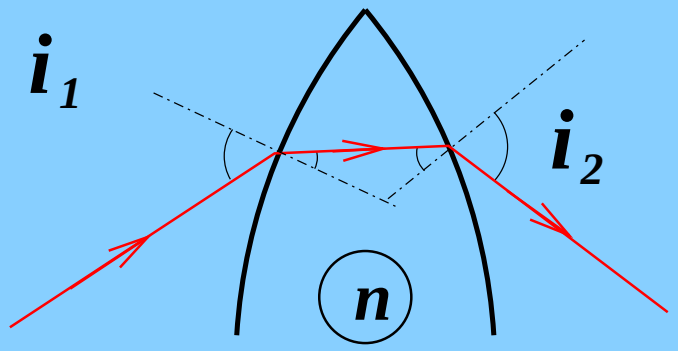
2/ Prohibit multiple scattering!

No more annoying white clouds in the landscape!

Stop with white foam in waterfalls pictured with long exposure times!

In order to achieve good images,

you need good lenses.

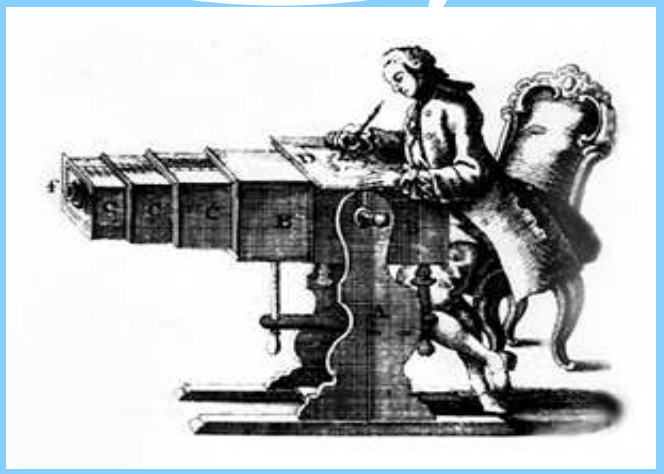


Light kindly agrees to go where
Mr. Descartes requires it to go,
and nowhere else

My laws explain everything!

R. Descartes
(1596 − 1650)

Pinhole AND mirror!
You need BOTH!



Plagiarists!

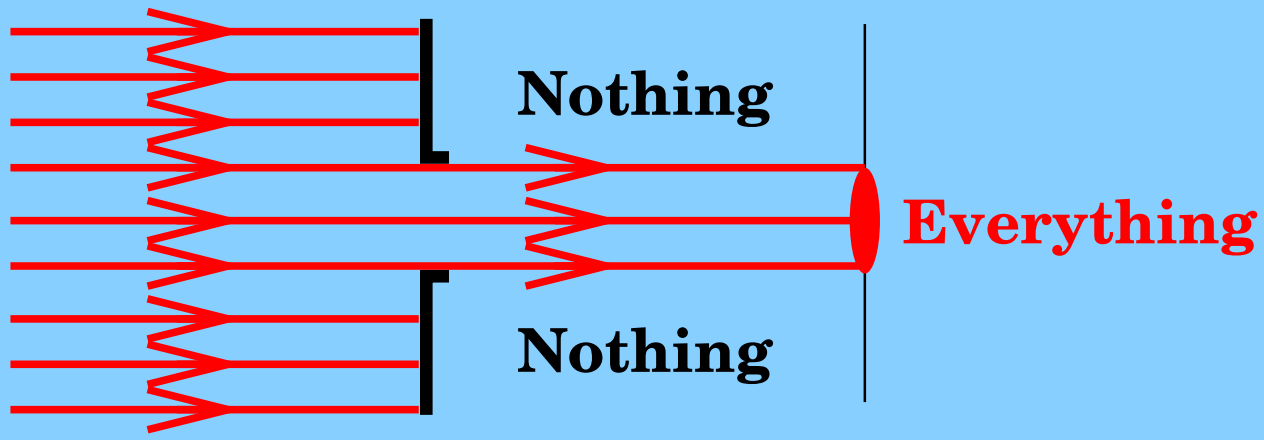
Ibn Sahl (940 − 1000)
Ibn Haitam (965 − 1040)

Plagiarist!

W. Snellius
(1580 − 1626)

Good lenses are made

of perfectly absorbing materials



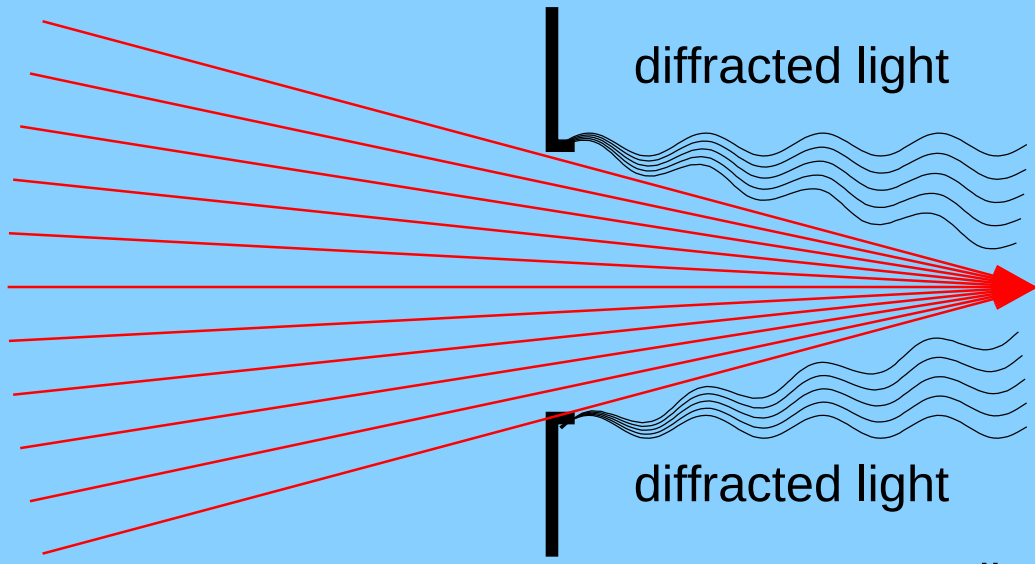
Good diaphragms/iris made of good opaque leaves

Good solid mounts machined in really black, non−reflective metal parts

Good black paint absorbing all reflected light

Nature is facetious,

for example, she has invented diffraction!



A nice opaque iris/diaphragm

Surrounding the geometrical image, a small amount of light falls, more and more when the f−stop closes down.

J. von Fraunhofer (1787 − 1826)

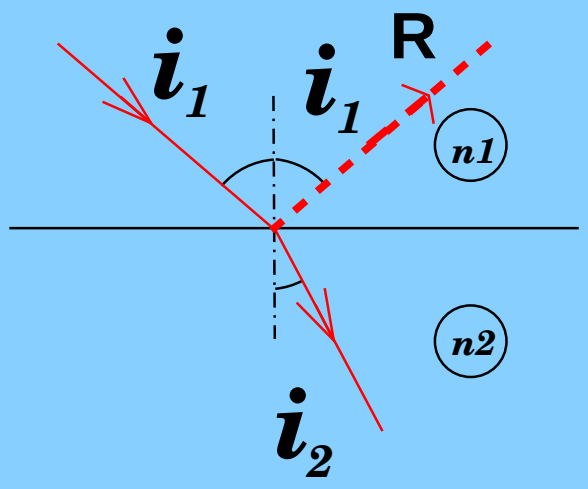
Nature is facetious,

for example, she has invented Fresnel

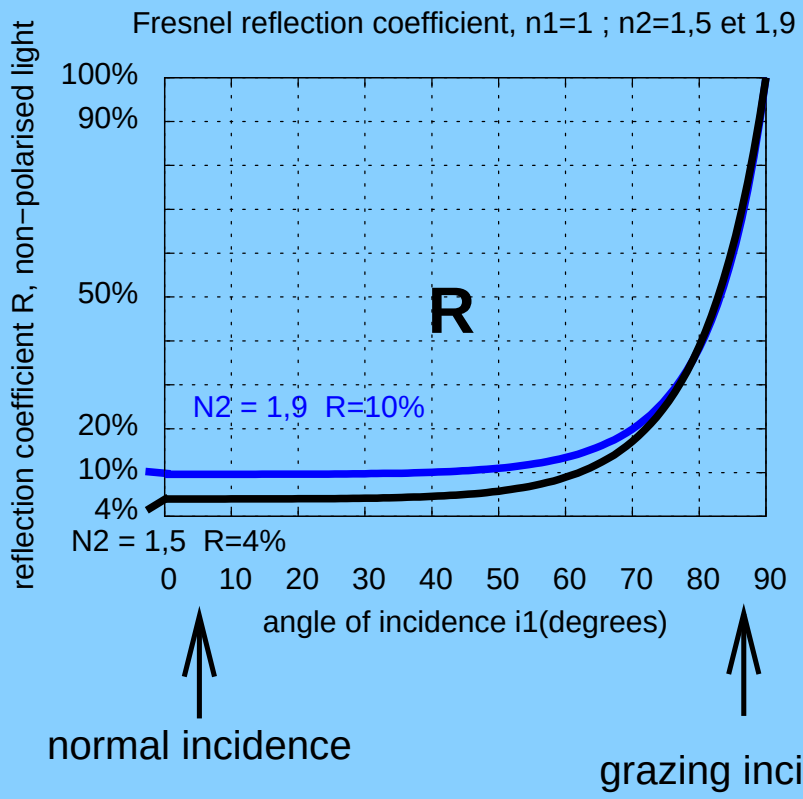
de reflection coefficients!

air−glass : 4% of reflection, normal incidence

reaches 100% in grazing incidence!



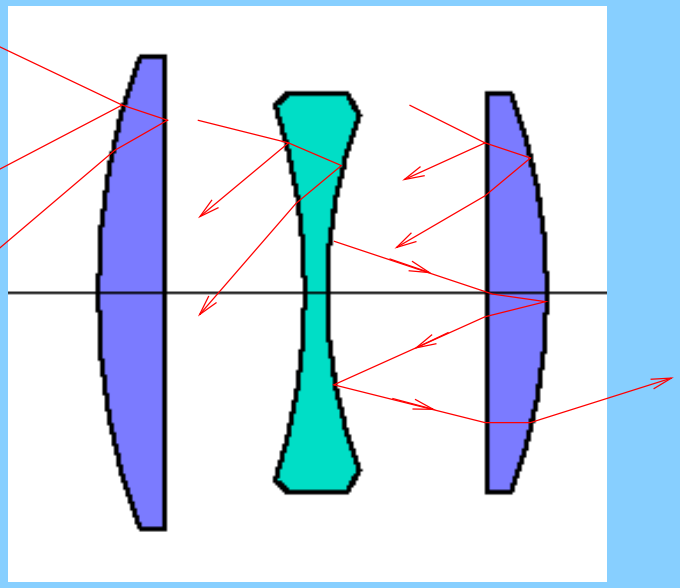
$$R(i_1 = 0) = \frac{(n_1 - n_2)^2}{(n_1 + n_2)^2}$$



A. Fresnel
(1788−1827)

4% per diopter !

One triplet lens = 6 diopters

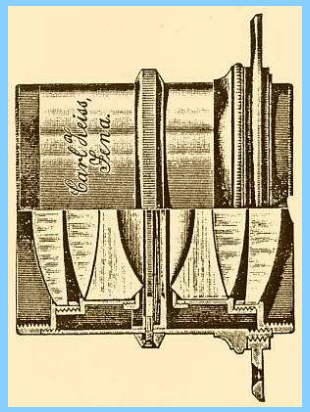


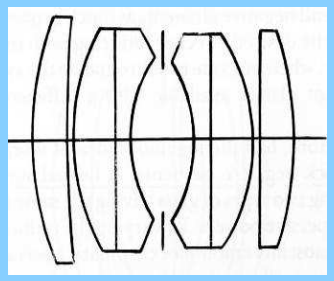
0.96 x 0.96 x 0.96 x 0.96 x 0.96 x 0.96 = 0.78

i.e. about 20% of light losses...

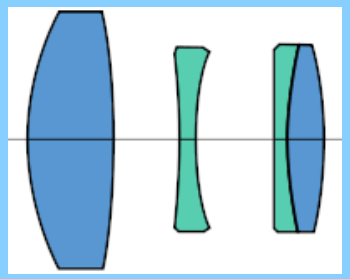
not taking into account ghost images of the iris!

When the Tessar beated the Planar!



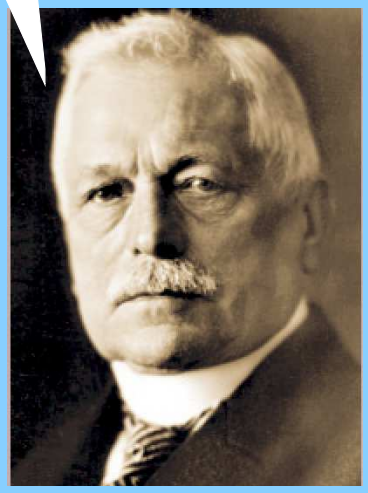


Original
Planar
1896
6 elements / 4 groups



Tessar
1902
4 elements / 3 groups

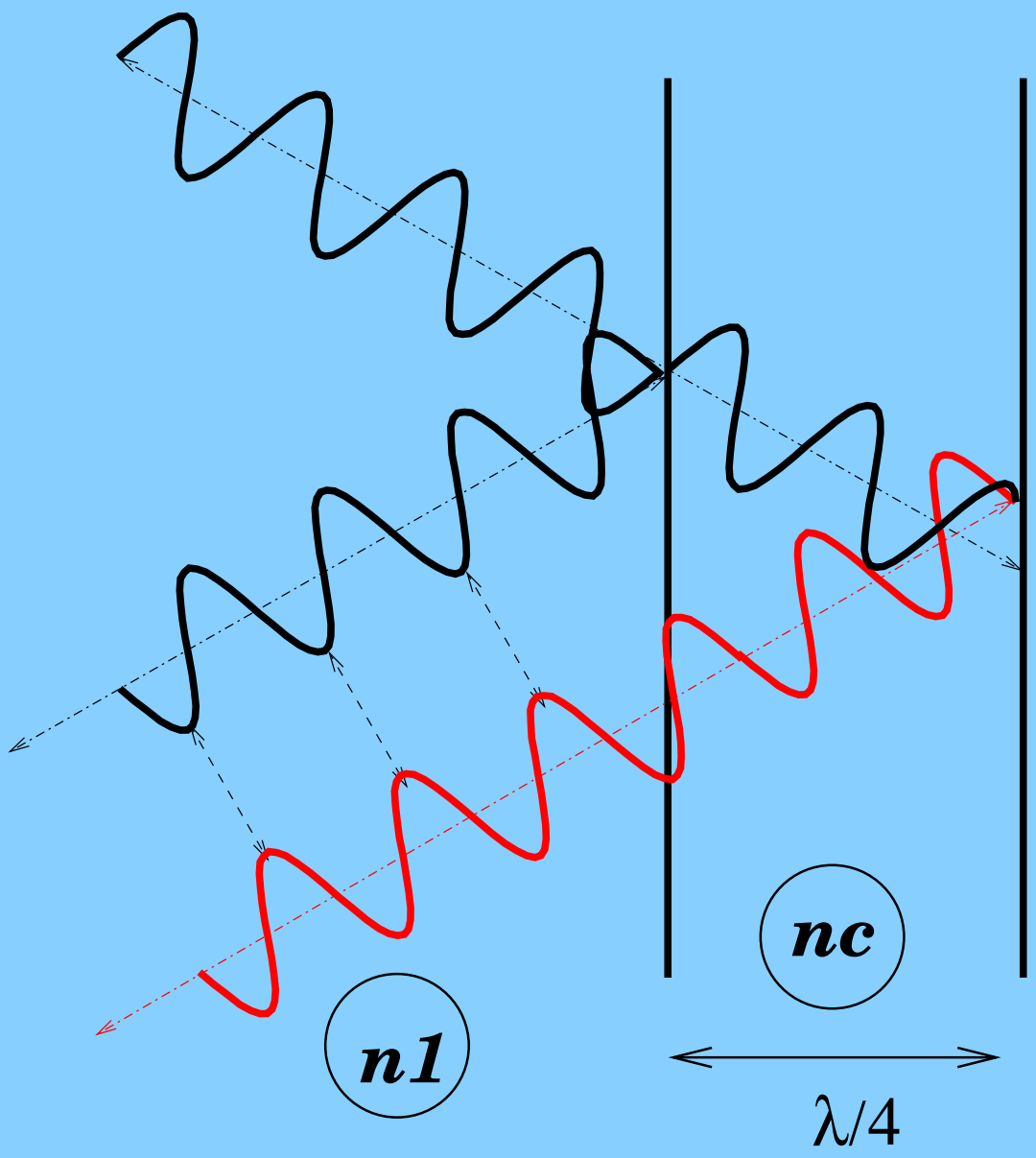
Sie müssen beide haben !



P. Rudolph
(1858 – 1935)

means less diopters and less parasitic light

1935: the first anti−reflection coating

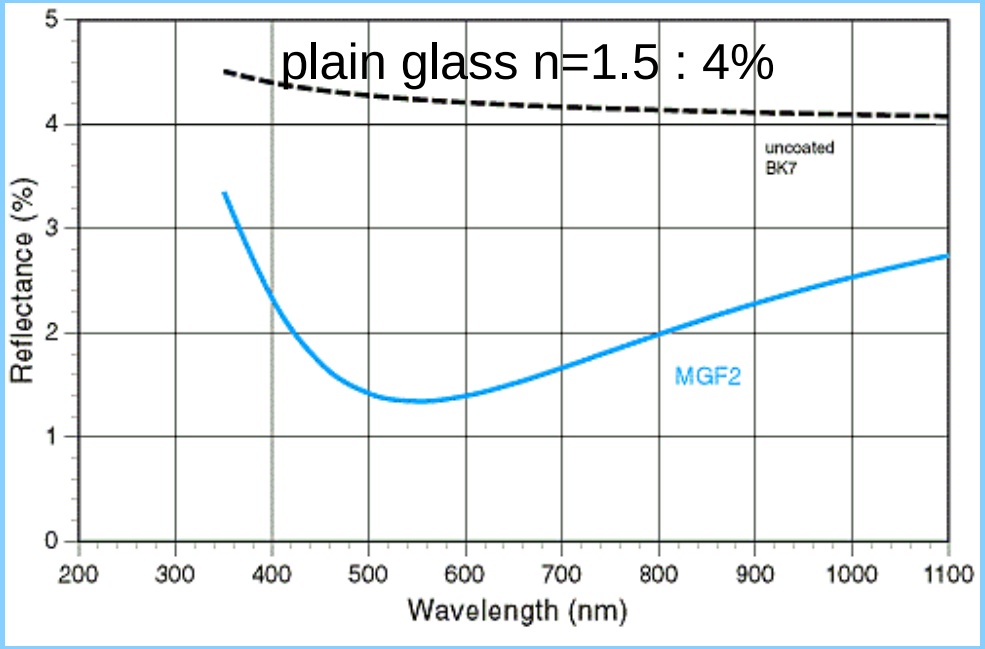


$$n_c = \sqrt{n_1\, n_2}$$

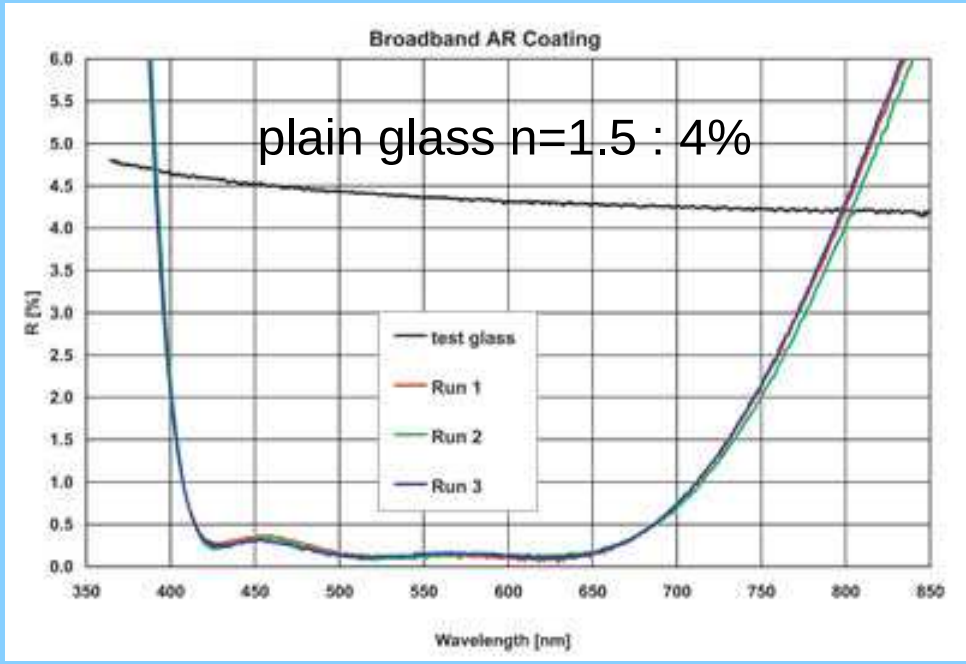
$$n_1 = 1 \; n_2 = 1,5 \rightarrow n_c = 1,2$$

$$\mathrm{MgF_2} : \mathrm{n} = 1{,}38$$

Anti−reflection coating, single layer and multi−layer

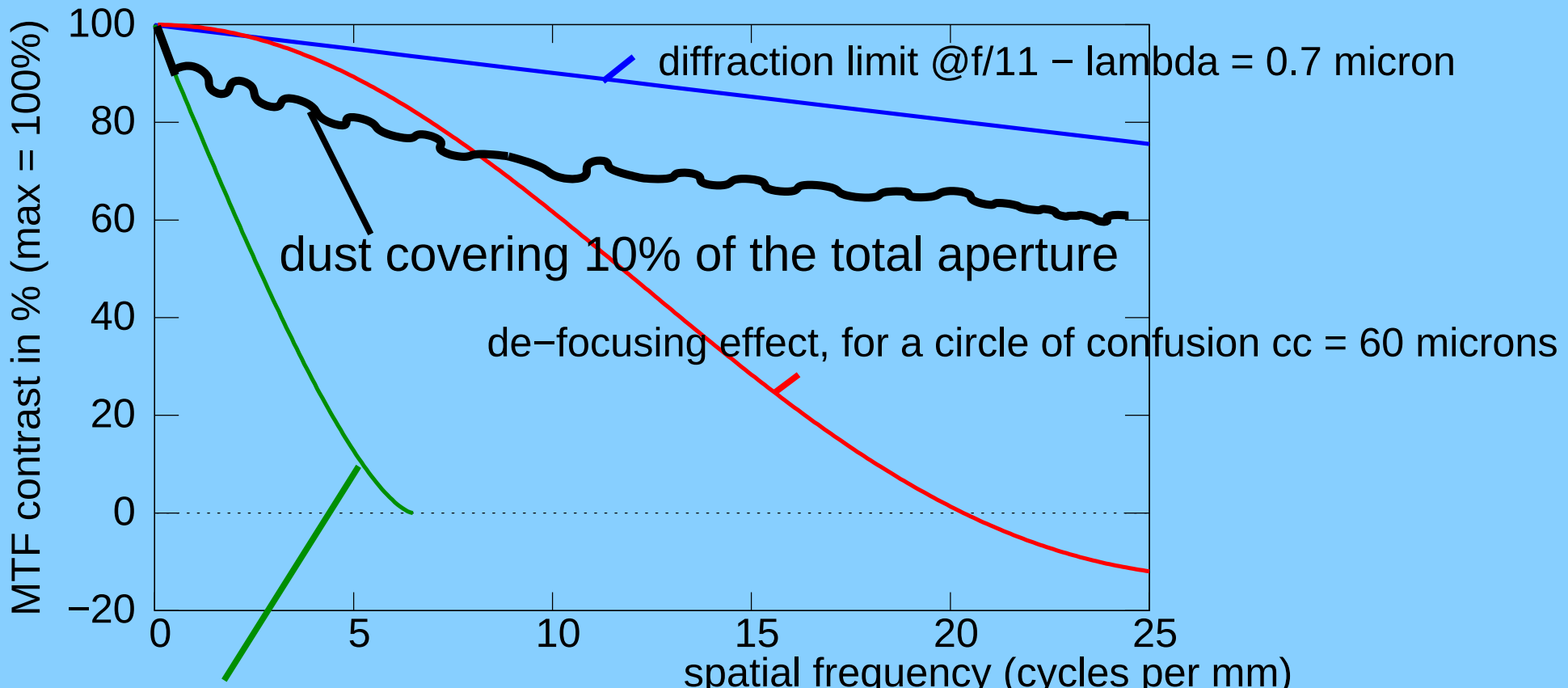


Single MgF2 layer



An example of multi−layer coating

Influence of dust deposited on the lens pupil considered as small opaque diffractive discs located at random



limit MTF of a multi−pinhole diaphragm located at random

pinhole diameters = 1/20−th of the aperture

Sharpness and contrast: two intricated notions

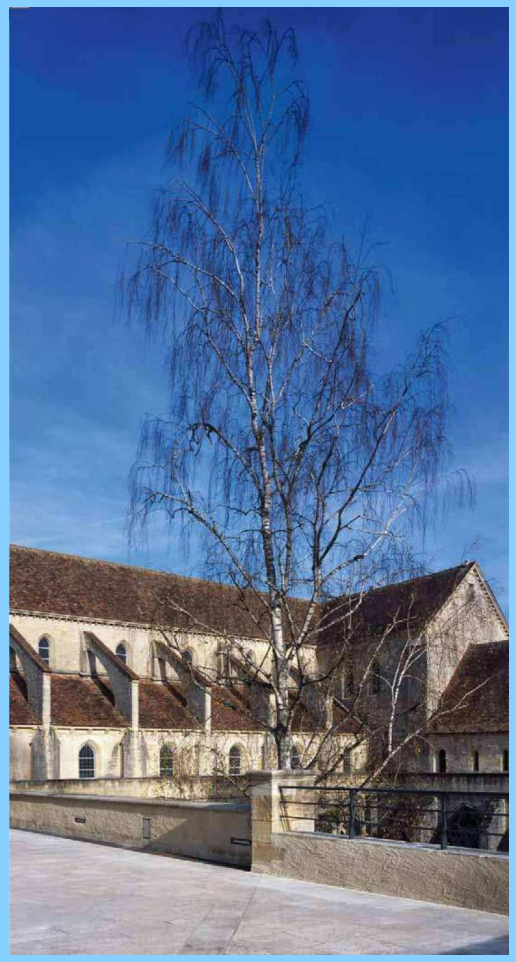
An analogy with music:

Sound pitch	Frequency of the fundamental Spacing between harmonics
Timbre of an instrument	Harmonic contents Attack of the notes and transients

Dans une image :

Sharpness of the image	Total MTF curve lens + image detector Edge sharpness Noise level and type of image noise
Contrast of the image	Maximum density amplitude Saturation of colours Micro−contrast of fine details

Global contraste: it is as important as micro−contrast of fine details!



In both cases MTF curves (lens + film) are the same!

Definition of diffuse / parasitic light / veiling glare:

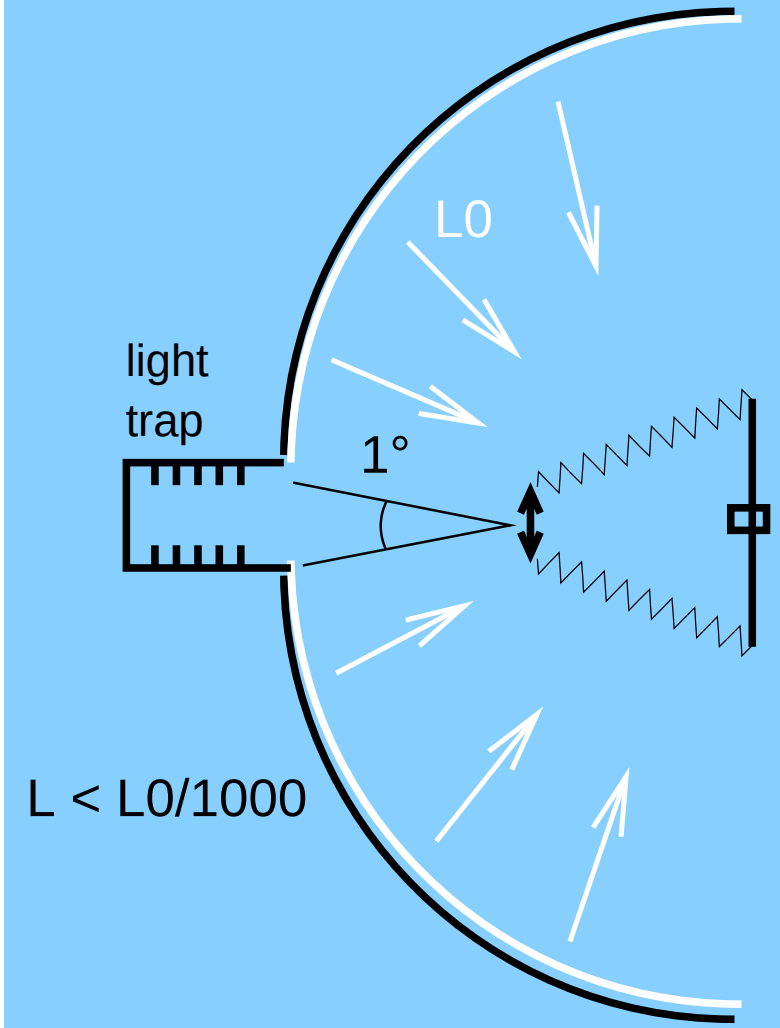
Everything limiting the global contrast in the image

- not related to aerial fog,
- not related to direct diffraction effects by the iris / diaphragm
- not related to residual aberrations.

Many factors remain:

- parasitic reflections between the diaphragm and lens elements,
- parasitic reflections in lens mounts or on the edges of lens elements,
- parasitic reflections inside the camera, bouncing inside the bellows,
- parasitic reflections between the image detector (film, digital sensor) and the inside of the camera!

Measurement of parasitic veiling glare rate (PVGR) according to the ANSI standard PH3.615.1980



PVGR	un−coated optics	multi−layer coating
0,5 à 0,65 %	never seen	outstanding
0,65 à 0,80 %	never seen	outstanding
0,95 à 1,1 %	never seen	good
1,3 à 1,6 %	never seen	poor
1,8 à 2,1 %	good	extremely poor
> 2,4 %	poor	« direct−to garbage can »**

*** certain garbage cans in Moisenay (France−77) are worth a visit*

Source : B. Leblanc, Le Photographe 1640, May 2006

Link between the Parasitic Veiling Glare Rate (PVGR) and the loss of contrast between the subject and the image

Contrast loss factor = (contrast of subject) / (contrast of image) > 1

		multi−coated lens −>		excellent	not so bad!	very poor
	contrast of subject	type of subjet	range of f−stops	PVGR = 0.8%	PVGR = 1.2%	PVGR = 1.9%
Slide film? −>	1 à 32	very low contrast	5 f−stops	1,26	1,38	1,61
	1 à 125	normal	7 f−stops	2	2,5	3,37
CCD sensor −> ?	1 à 250	contrasted	8 f−stops	3	4	5,75
Color negative −> ? film ?	1 à 1000	very high contrast	10 f−stops	9	13	20
				Contrast loss factor		

Source : B. Leblanc, Le Photographe 1640, May 2006

The unexpected benefits of diffuse parasitic light

- acts like a contrast compensation

- " max 5 f−stops in coulour slides, photography would not be easy with colour slides in outdoor shots, without this unexpected help" (according to B. Leblanc)

- in the present state of silicon sensors (dynamic range still less broad than a colour negative film) this compensation is also welcome in digital photography.

Conclusions − 1 −

− Diffuse light is an essential element of the landscape;
being politically correct, we have to respect scrupulously
this bio−diversity of natural light.

− As soon as it enters the camera, like any wild beast becomes
a nuisance coming too close from human beings,
diffuse parasitic light becomes the photographer’s enemy.

− As a consequence :
scientists, engineers, technicians, all skilled workers & craftsmen
have been fighting against the beast for centuries.

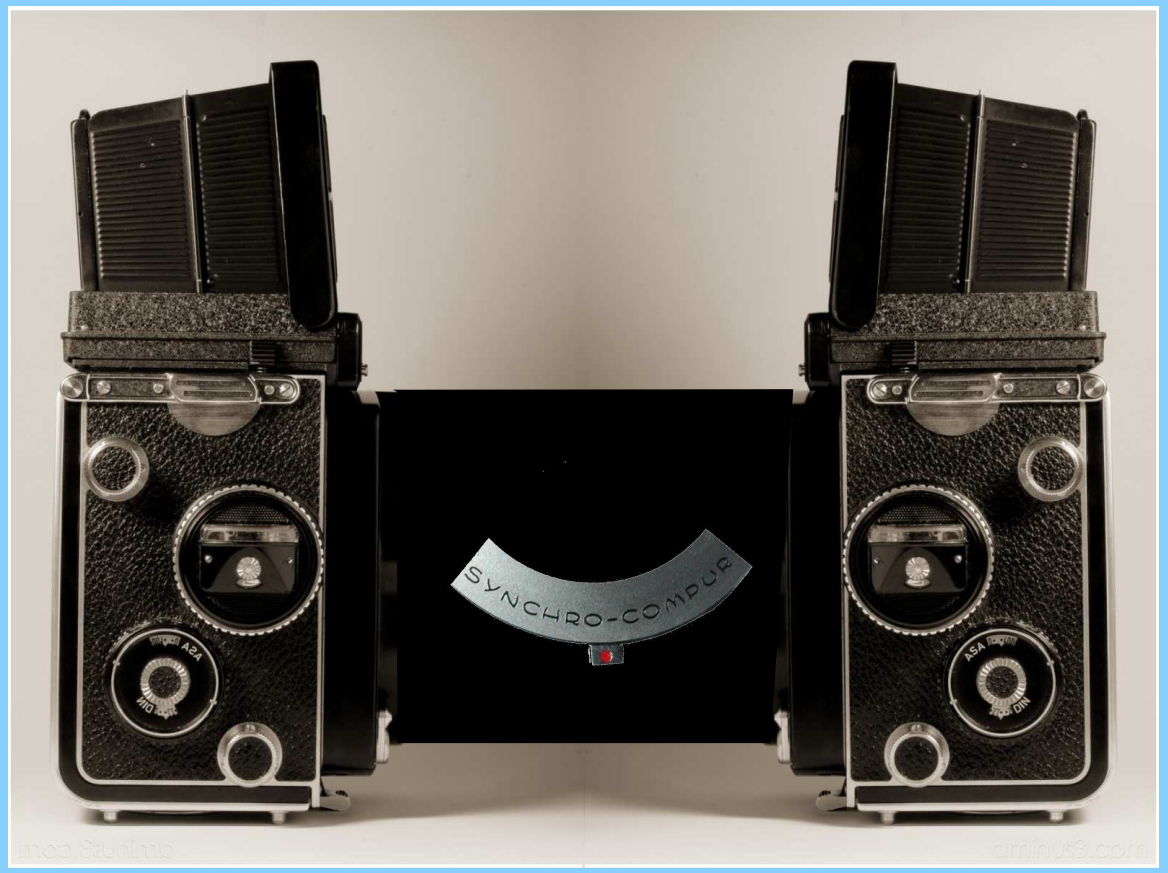
To date, the bugbear is reduced to one percent,
but the fight is still going on, mercyless.

Conclusions − 2 −

A sentence to think about, however :

" If the Invisible Man (or Woman) could exist, he (or she) could not see the surrounding World. "

Toward a camera totally immune against diffuse parasitic light?



- 0% of parasitic light guaranteed inside the taking−lens chamber.
- A bright viewinder 100% available any time.

A respectful tribute to Denis Bigler's very special twin−bicycle...
http://www.st−denis.ch/sculpture/zDosSculpture/tourDeVis/niv2tourDeVis.html