Early symmetrical lenses

Lens Design OPTI 517

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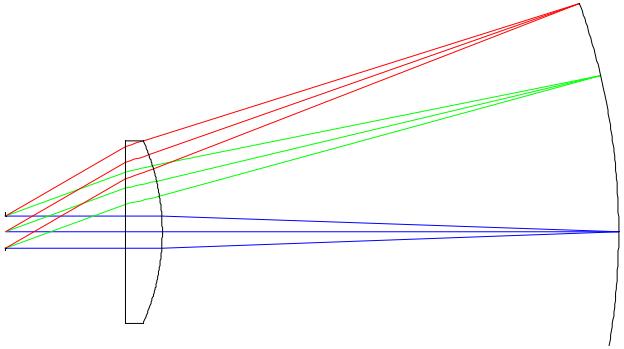
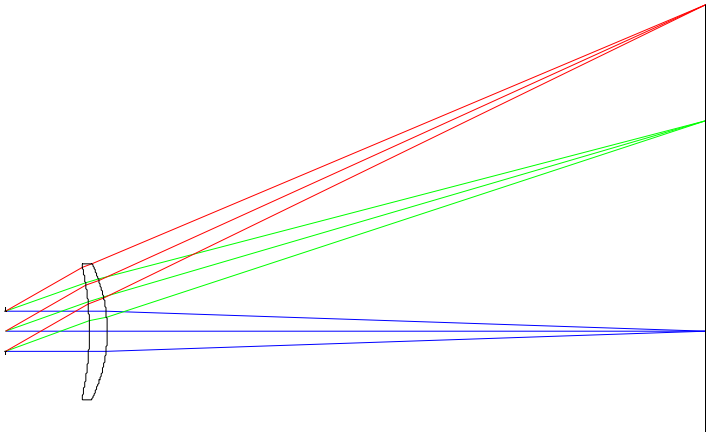
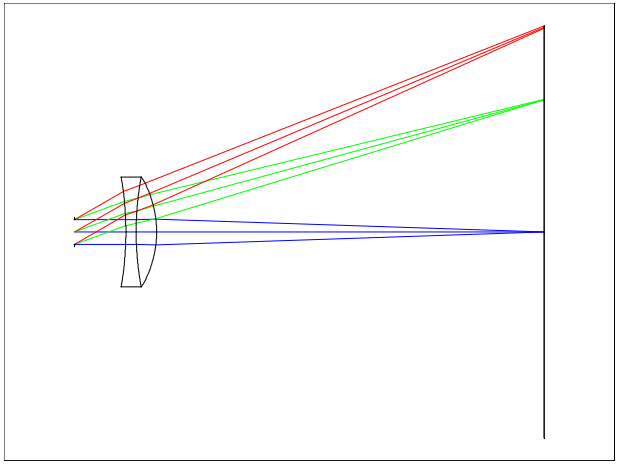
Singlet/doublet lens solutions



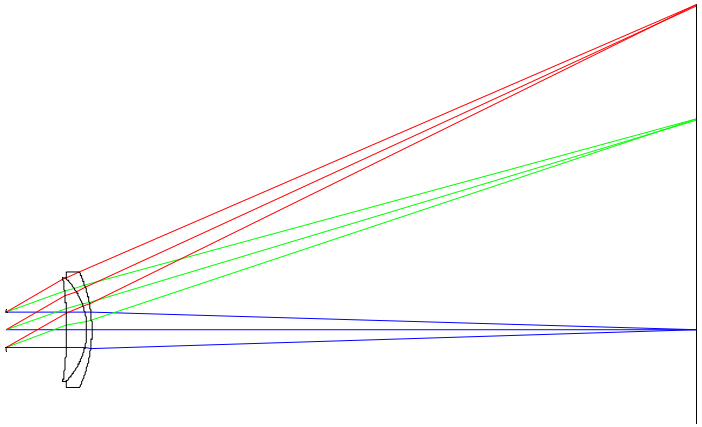
Plano-convex (Studied by Airy)



Wollanston's meniscus 1812

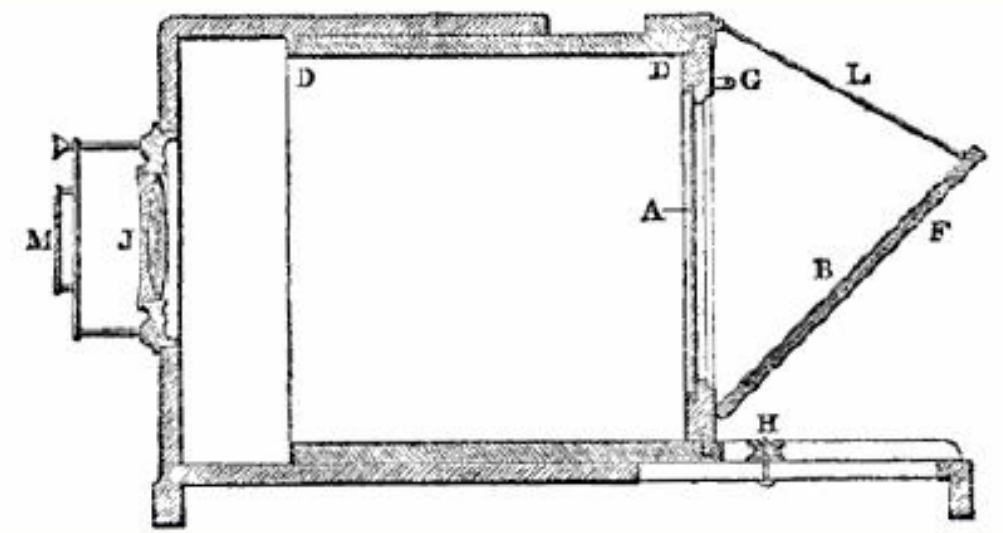


Chevalier's or French Landscape lens early 1800's



Grubb's "aplanat" 1857

French landscape lens

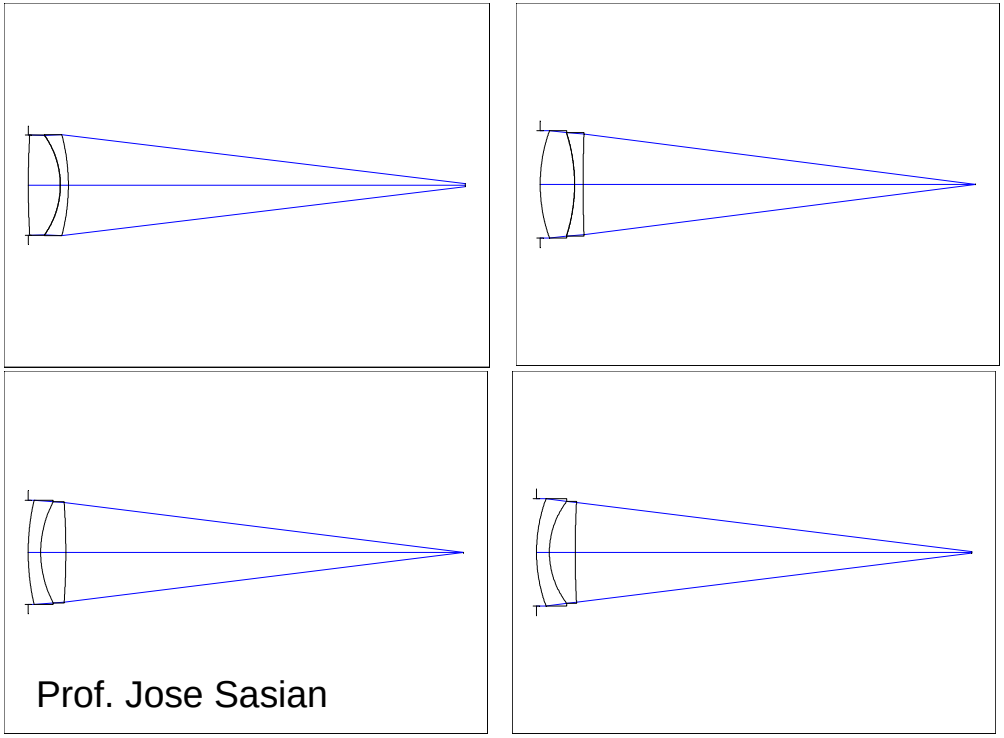


Daguerre's camera using a Chevalier lens.

Photography, R. Hunt, 1853.

The doublet solutions

- Four cemented
- More un-cemented
- How do you find them?



Crown in front

Flint in front

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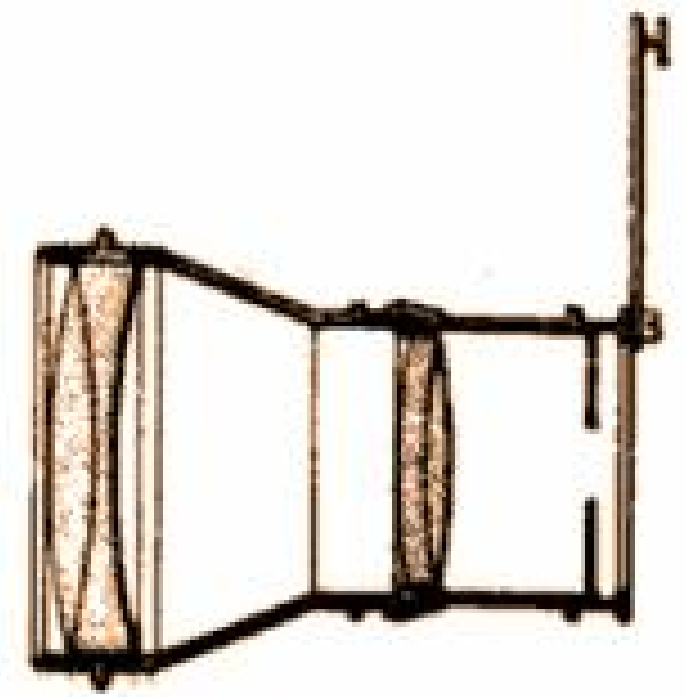
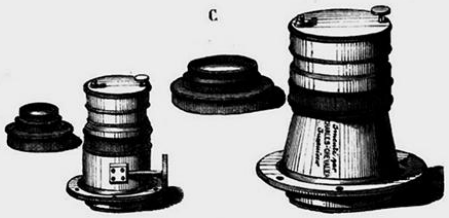
Chevalier double lens 1840



C.



C

OBJECTIFS DOUBLES A VERRES COMBINÉS

Demi-rapides pour portraits et rapides pour paysages.

(Inventés par CHARLES CHEVALIER en 1840.)

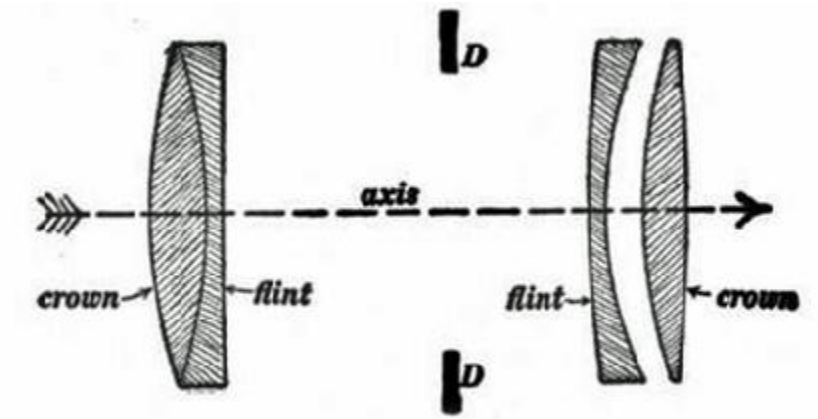
Ces objectifs, d'un foyer moyen, opèrent moins vite que les objectifs A, mais ils donnent plus de netteté générale et couvrent une surface plus grande. Ils sont composés de deux verres, mais on peut acquérir un troisième verre, afin de pouvoir modifier leur foyer. Ce troisième verre se substitue au verre antérieur. Lorsqu'on nous demande ces objectifs sans désignation spéciale, nous les livrons avec le verre antérieur à foyer court; de la sorte, on peut faire le portrait et le paysage en employant un petit diaphragme. On peut aussi, afin d'avoir le système complet, demander l'objectif à 3 verres, ou encore l'acquérir seulement avec un verre antérieur long foyer, on a ainsi l'objectif le plus parfait pour le paysage, bien préférable à l'objectif simple, car l'objectif double donne plus de perspective, d'harmonie, de profondeur et de finesse.—Nous ferons aussi remarquer qu'à partir du format 30 sur 40, les objectifs ne servent plus pour portraits, mais seulement pour paysages; dans ce cas, le troisième verre s'applique pour modifier le foyer, ce qui peut être utile dans certains cas.

49.	**Pour** 1/6 de plaque	(35 millim.	de diam.)	avec engrenage.	35	»
50.	— 1/4 —	(48	—)	—	45	»
51.	— 1/2 —	(61	—)	—	75	»
52.	— plaque entière	(80	—)	sans engrenage.	160	»
53.	— — 27—21	(80	—)	—	160	»
54.	— — 30—24	(95	—)	—	180	»
55.	— — 37—28	(108	—)	—	350	»
56.	— — 30—40	(108	—)	—	350	»
57.	— — 40—50	(108	—)	—	350	»
58.	— — 50—60	(135	—)	—	500	»
59.	— — 60—70	(135	—)	—	500	»
60.	— — 120—100	(165	—)	—	1000	»

PRIX DU TROISIÈME VERRE.

61.	**Pour** 1/6.	10	»
62.	— 1/4.	15	»
63.	— 1/2.	25	»
64.	— plaque entière.	25	»

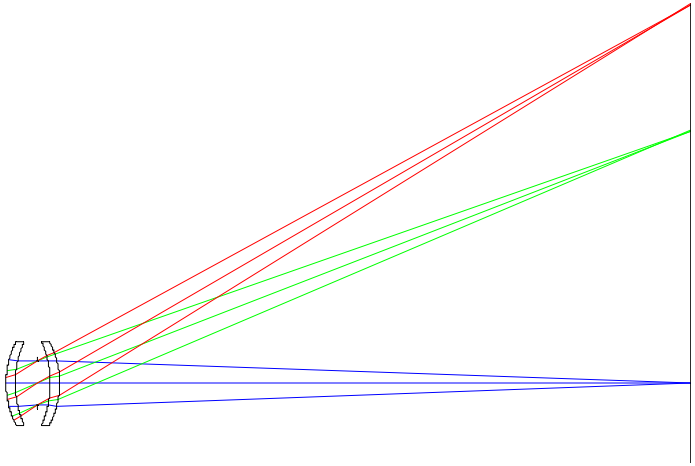
Petzval lens use of doublets



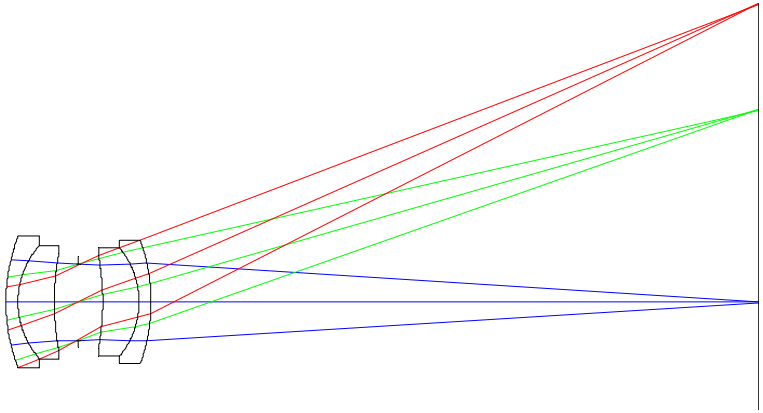
Petzval's portrait lens.

Early symmetrical lenses

(Symmetrical about the stop)



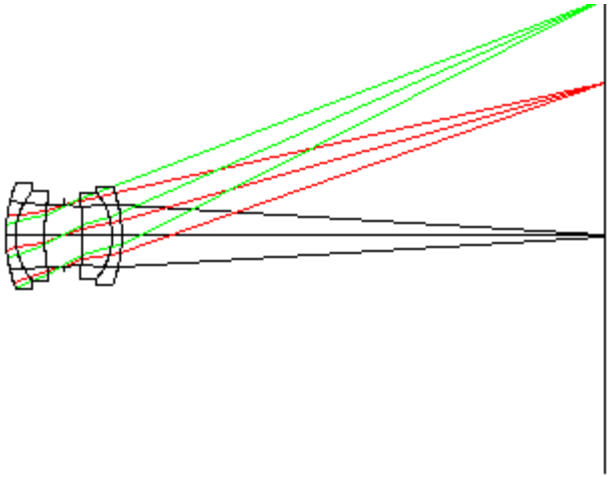
Stenheil, periskop 1865

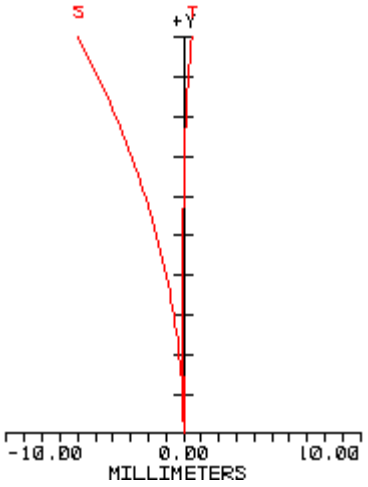


Rapid rectilinear, Dallmeyer 1866, Steinheil 1866

- Use of the symmetrical principle
- Odd aberrations cancel
- “Doubling of a lens” principle
- F/16

Rapid rectilinear lens

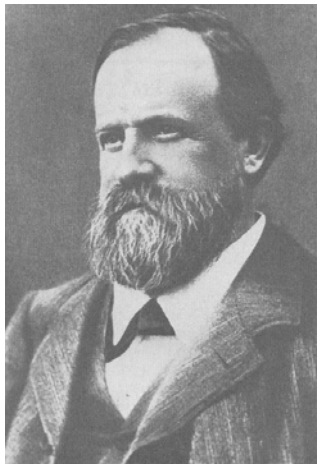




Dallmeyer

- Intermediate lens at f/8
- A great design
- ~70 years life span
- 1866
- John Dallmeyer
- Hugo Steinheil
- Glass selection is key

Steinheil



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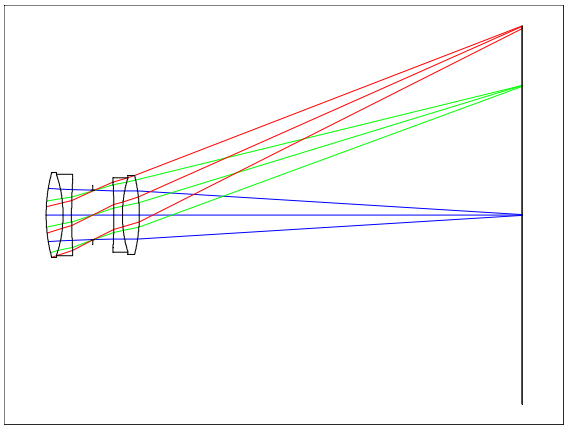
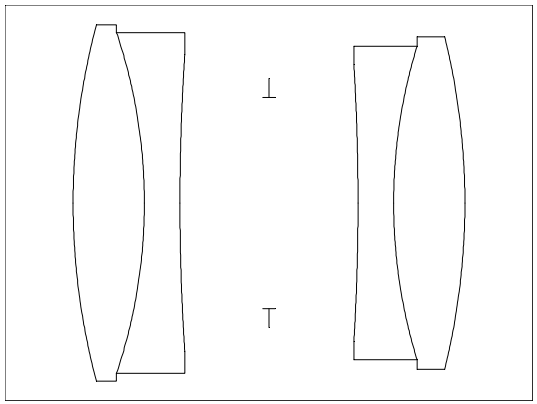
Comparison I

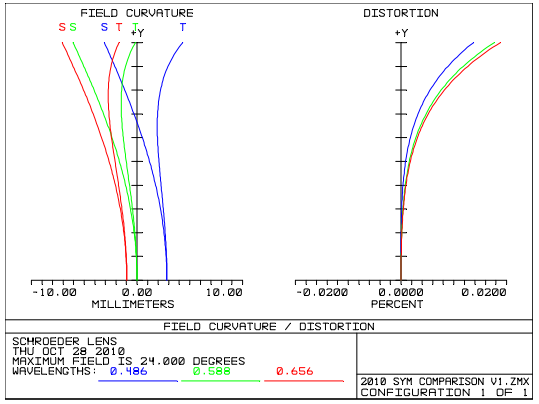
24 deg @ f/8



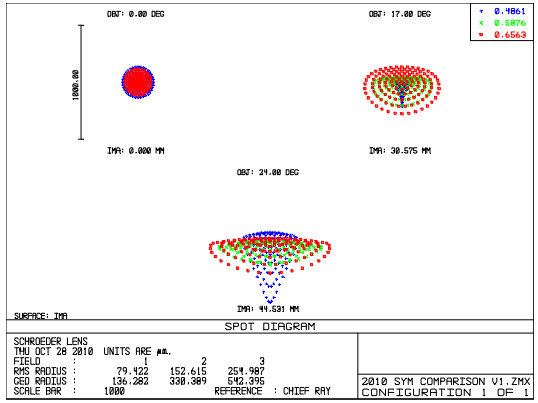


BK7-F2

F=100 mm



10 mm spacing



Weight 5 on axis

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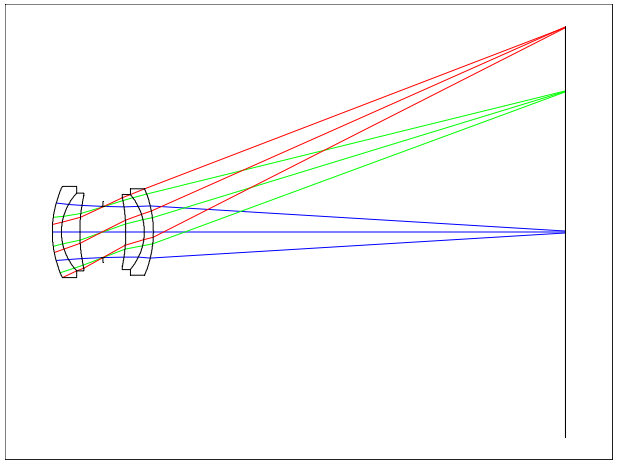
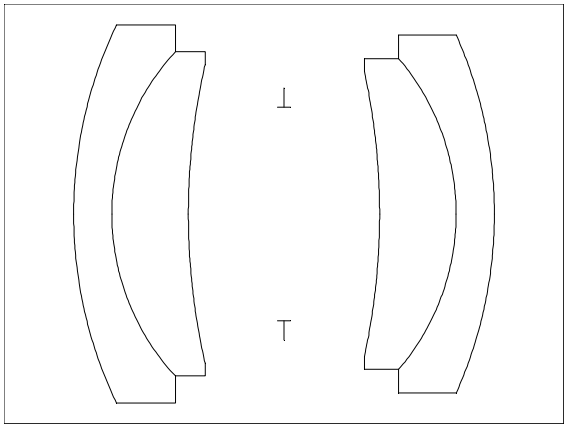
Comparison II

24 deg @ f/8

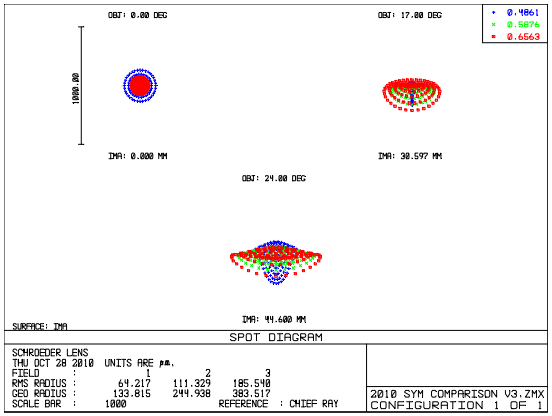




F2-BK7

F=100 mm

10 mm spacing



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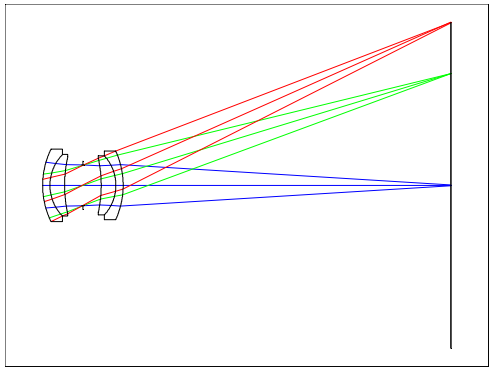
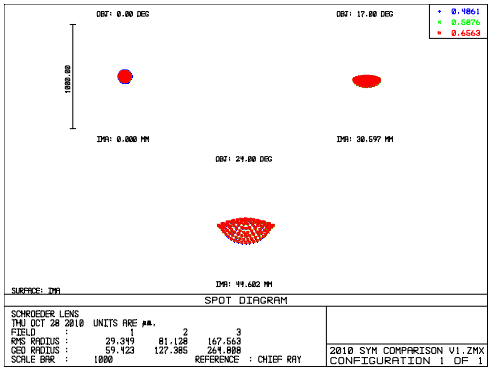
Comparison III

24 deg @ f/8

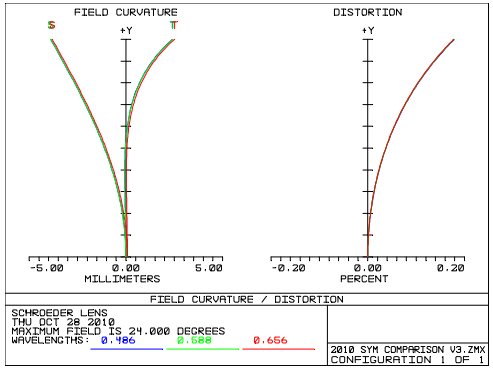


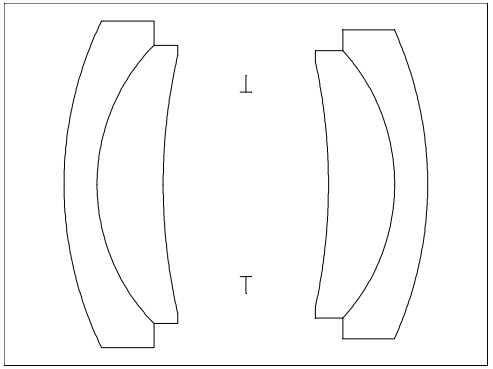


F2-BK7
F2 to v=51

F=100 mm

10 mm spacing





Weight 5 on axis
V1=51
V2=64

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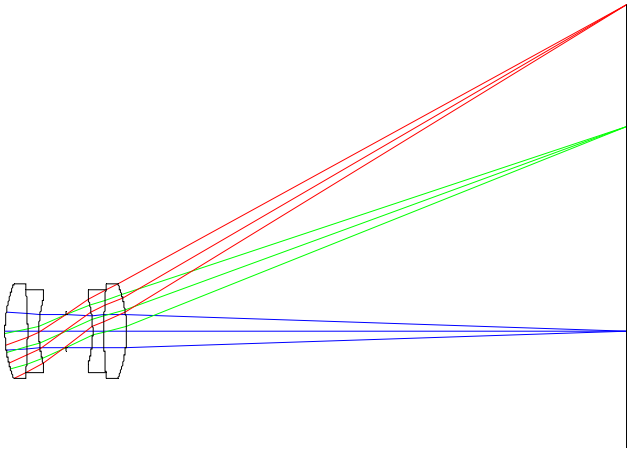
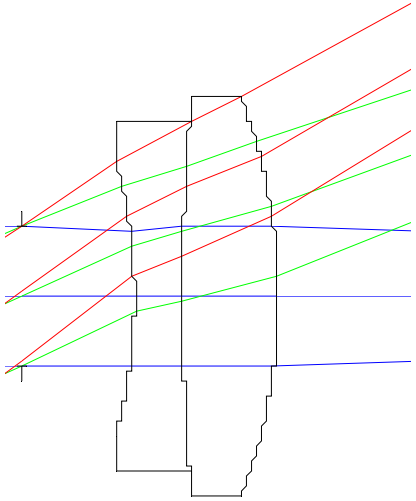
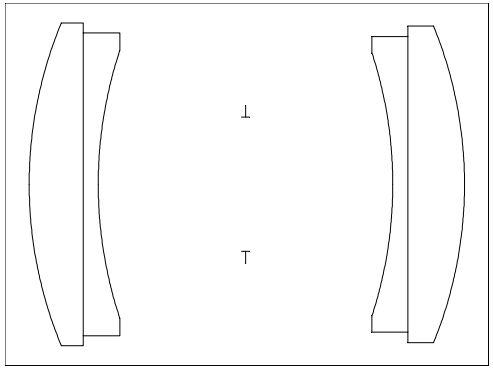
Ross concentric lens







Ross concentric (Schroeder) lens 1889
(two new achromats)

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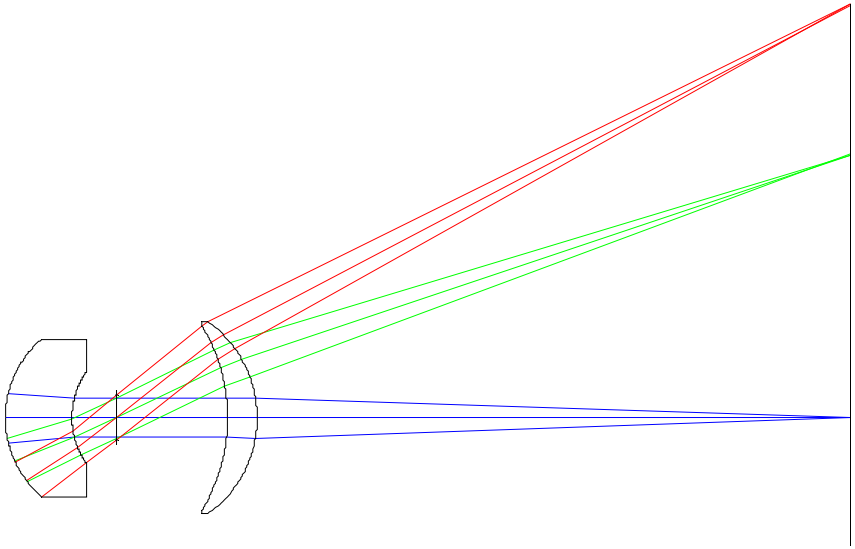
Thick and thin meniscus



- Thick meniscus lens corrects field curvature of the thin meniscus
- Thick meniscus is afocal
- Thick lens likely unconventional prior to 1890

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Time table

1812 Wollaston landscape lens; 30 deg @ f/15
1839 Photography was disclosed by Daguerre
1839 Chevalier lens
1840 Petzval (Hungarian) portrait lens; 15 deg @ f/3.7
1841 Gauss, cardinal points
1856 Seidel theory
1865 Periskop, Steinheil
1866 Normal glasses: soda-lime-silica and lead oxide
1866 Rapid rectilinear, Dallmeyer (England) and Steinheil (Germany),
40-year span; 20 deg @ f/8
1873 Piazzi Smyth field-flattener
1885 before this year the field was artificially flattened by astigmatism
1885 E. Abbe and O. Schott new glasses; barium in place of lead;
'Jena' glass; new achromat;
1889 Ross concentric lens

Fabrication issues

- Easy to make
- Same radius of curvature or flat
- Glass to air interfaces
- Ghost images
- Lens volume
- Back focal length (Packaging)
- Negative thickness. Razor blade edge.
- Lenses too thick, too thin
- Concentric meniscus centering vs. alignment

Conclusions

- Symmetrical lenses
- Doublet lens combinations
- Fabrication issues