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NATIONAL RESEARCH COUNCIL OF CANADA

DIVISION OF PHYSICS & ELECTRICAL ENGINEERING

RESOLVING POWER TESTS ON A BAUSCH & LOMB 40" F/8 TELESTIGMAT LENS

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S E C R E T

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National Research Council of Canada

Division of Physics and Electrical Engineering

RESOLVING POWER TESTS ON A BAUSCH & LOMB 40" F/8 TELESTIGMAT LENS

BY

K. M. Baird

For Joint R.C.A.F.-N.R.C. Photographic Research Committee, Ottawa

Submitted by L. E. Howlett
Section Head, Optics.

Ref S4-P.10-2 L.O.3084 Minutes of the 12th Meeting

Approved by
Director of Division

Ottawa, 14 November 1944.

RESOLVING POWER TESTS ON A BAUSCH & LOMB 40" F/8 TELESTIGMAT LENS

This report includes results of lens-film resolving power tests on a Bausch & Lomb 40" F/8 Telestigmat lens (Serial No. U.F.3463). The lens was tested at various separations of the elements using the methods described in PO-350 (See also Appendix A). An additional set of curves has been obtained using the new annulus type target (See PO-348). It is intended to follow this procedure in future lens tests in order to compare the usefulness of the annulus type target with the Cobb target.

In figure 10 the arrows indicate the separation of the elements when the lens is in its mount. It will be seen that this is not the best separation when it is remembered that the lower of the tangential and radial resolving powers is the more important in determining definition (See PO-348). At separation 8.200" the tangential resolving power has increased to 7.3 lines per millimeter. Because of its long focal length the lens in this position has an average ground resolving power at F/8 comparable with that of the Booth 36" telephoto at F/6.3.

TABLE I

AVERAGE RESOLVING POWER FOR 9" x 9" SUPER XX AERO FILM (LINES/MM.)

	Radial	Tangential
Booth Telephoto F/8	10.4	8.8
Booth Telephoto F/6.3	8.5	7.5
Bausch & Lomb Telephoto F/8 (in its mount)	10.5	6.5
Bausch & Lomb Telephoto F/8 (with separation 8.2)	9.8	7.3

The results indicate that it would be worth while to change the separation of Bausch & Lomb lenses now in use.

It is interesting that the curve obtained using the annulus type target indicates immediately that 8.200 is the best separation.

KMB:MPM
12 Oct.1944

APPENDIX A

SUMMARY OF LENS-FILM RESOLVING POWER TEST PROCEDURE FOR TESTING AERIAL PHOTOGRAPHIC LENSES AT THE NATIONAL RESEARCH COUNCIL

Illumination of Target
Mean noon sunlight with minus blue filter (Wratten II).

Target
Low contrast (Density difference = 0.20)
Cobb type and annulus type photographed on Eastman HR plates (type 548G), and mounted in the focal plane of an 85" collimator with clear aperture of 6". Equality of lines and spaces maintained to a few microns on the smallest targets.

Film
Super XX Aero positioned by either a register glass or suction back according to the requirement of the lens.

Exposure
Constant for all positions in the field and chosen so that the density is approximately 0.9 over the greatest possible proportion of the negative area.

Density Measurements
All density measurements are made with an Eastman Transmission Densitometer (Capstaff-Purdy).

Development
D19b to gamma 1.35.

Reading Resolving Power
Performed by a non-technical person experienced in reading. A low power microscope, a magnifying glass or the naked eye is used depending on which leads to the highest value for the resolving power.

Results
Given in lines per millimeter and in log. $\frac{1}{\theta}$ where $\theta = \frac{1}{R \times F}$

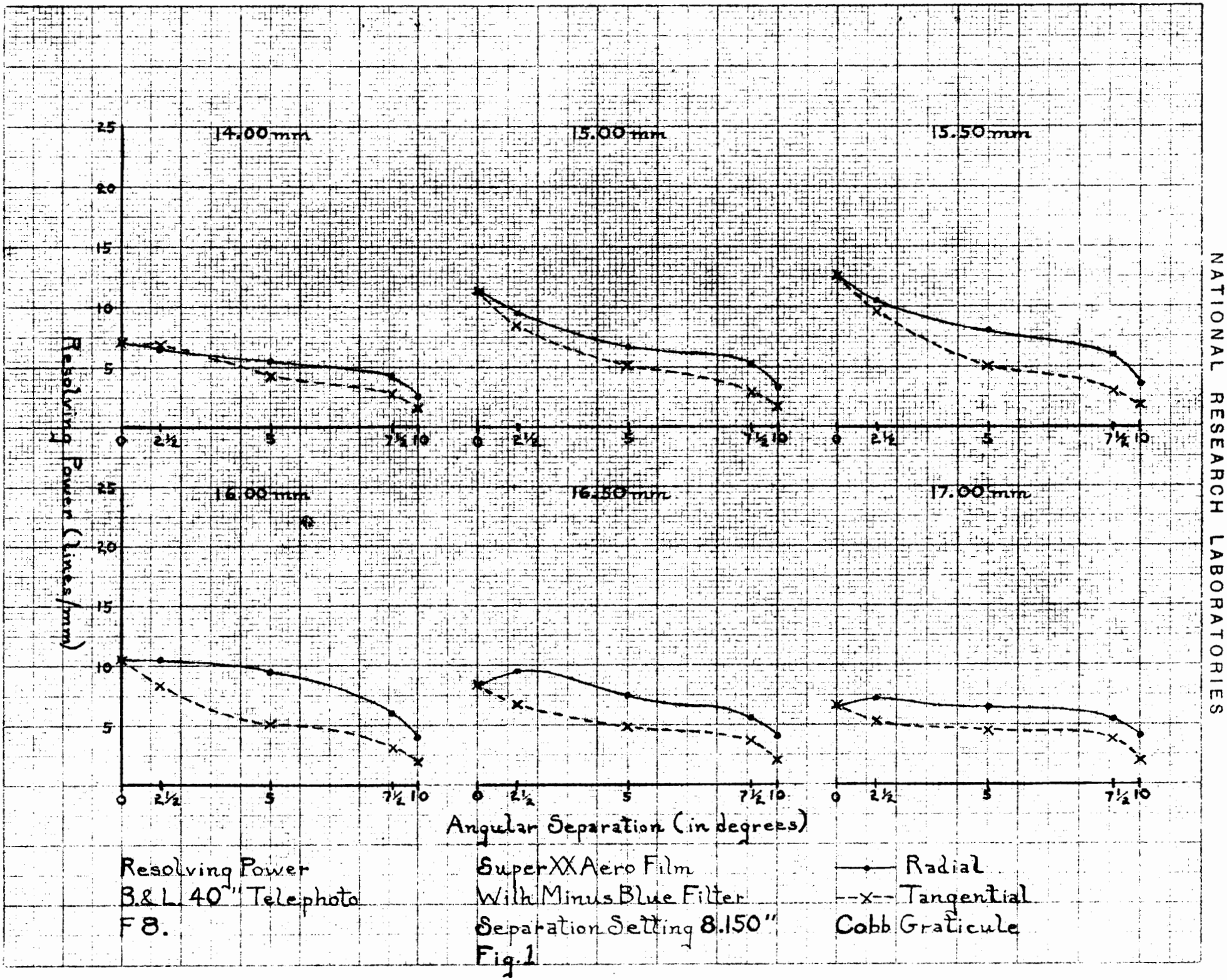
R = resolving power in lines per millimeter
F = focal length of the lens under test
Provisionally for the annulus type target $R = \frac{1}{d}$ where $d = \frac{2}{3}$ diameter of the bounding circle.

Graphs
Broken lines indicate resolving power on tangential lines and solid lines resolving power on radial lines.

METHOD OF AVERAGING RESOLVING POWER

The average resolving power is found for 9" x 9" or 5" x 5" film area, depending on the lens. The resolving power is determined at a number of positions in the field. Each resolving power is multiplied by the fraction of the total film area for which that resolving power is representative. The sum of these products is considered the average resolving power. For example, in the case of wide angle lenses the resolving power is found at 0°, 5°, 10°, 15° etc. The resolving power at 0° is multiplied by the fraction of the total film area included by a circle at $2\frac{1}{2}^{\circ}$ in the field, the resolving power at 5° by the fraction of area between $2\frac{1}{2}^{\circ}$ and $7\frac{1}{2}^{\circ}$; that at 10° by the fraction of area between $7\frac{1}{2}^{\circ}$ and $12\frac{1}{2}^{\circ}$, and so on. The sum of these products is the average resolving power. This approximation to the actual average $\frac{1}{A}\int_{A} R\, dA$ has been found consistent with the precision of the experimental observations.

LEH:MPM



Resolving Power
B.& L. 40" Telephoto
F 8.

Super XX Aero Film
With Minus Blue Filter
Separation Setting 8.150"

—•— Radial
--x-- Tangential
Cobb Graticule

Fig. 1

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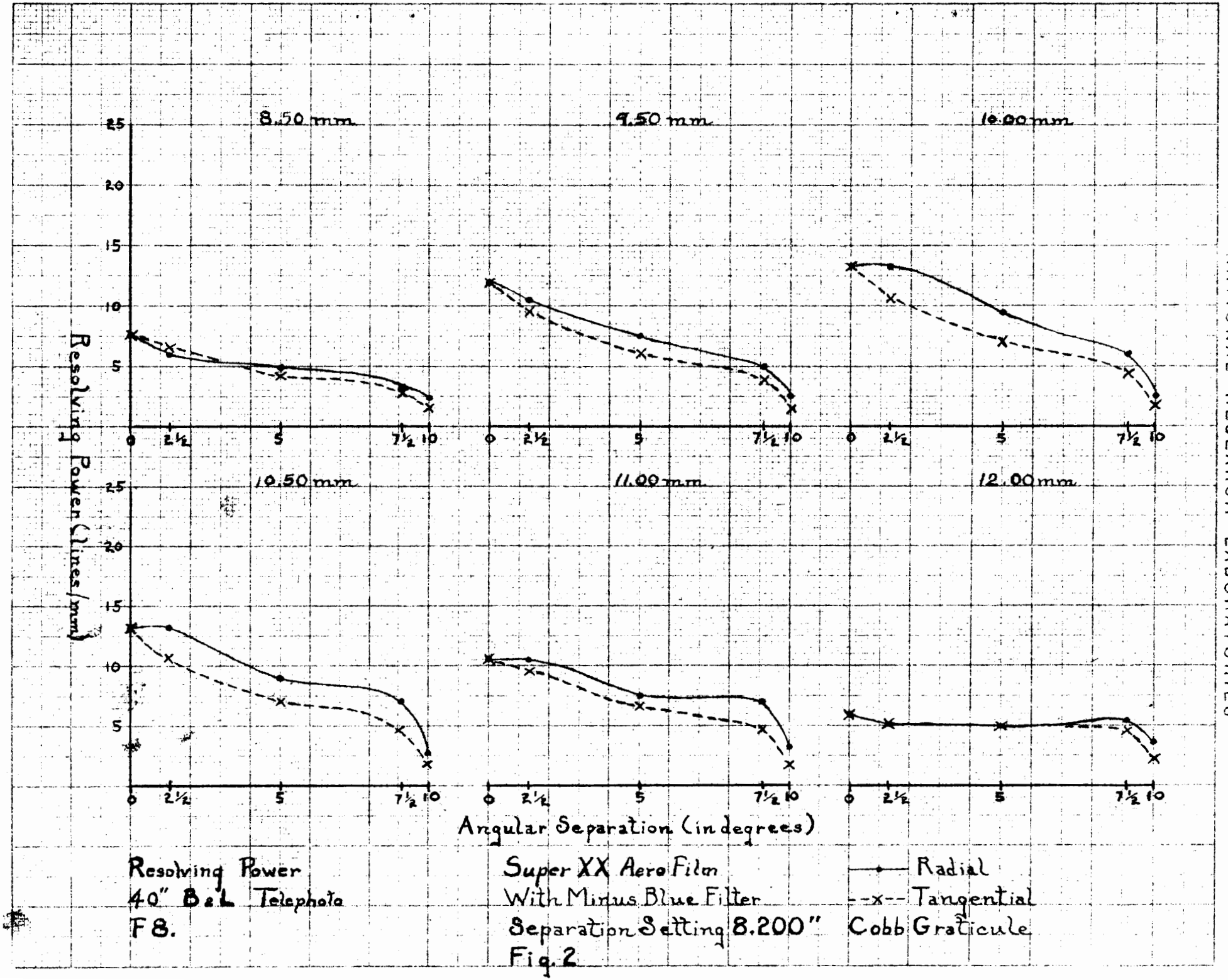

Fig. 2

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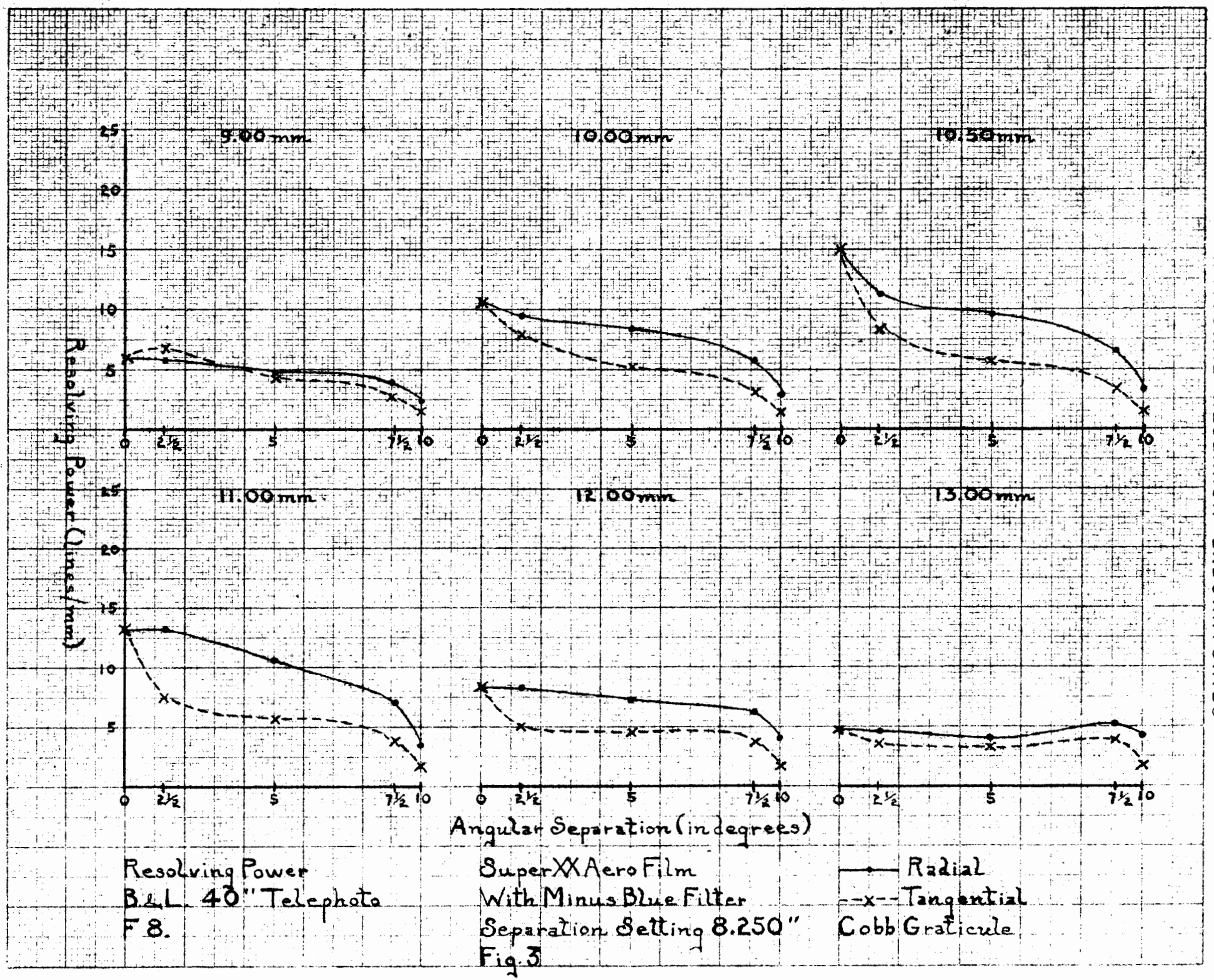

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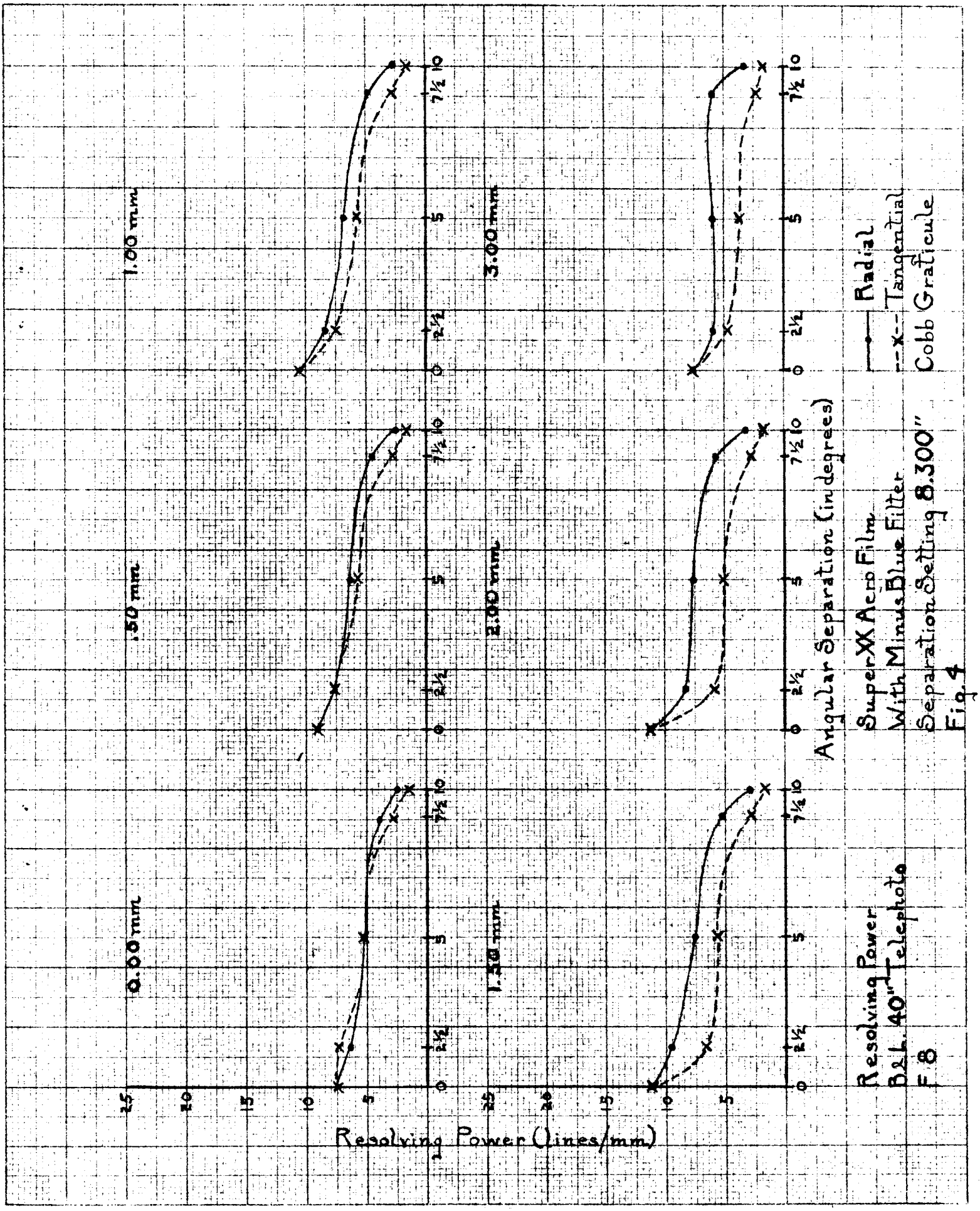

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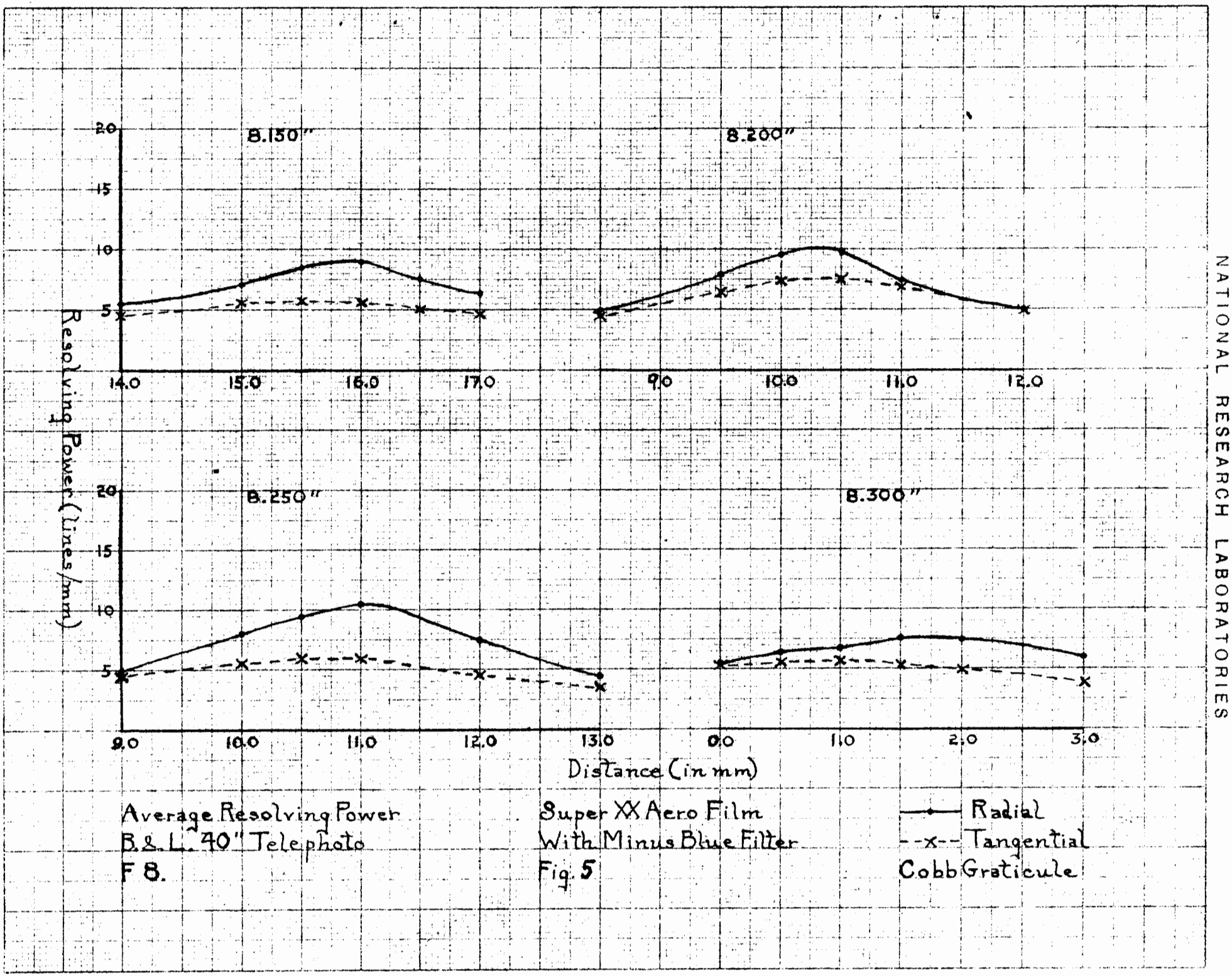
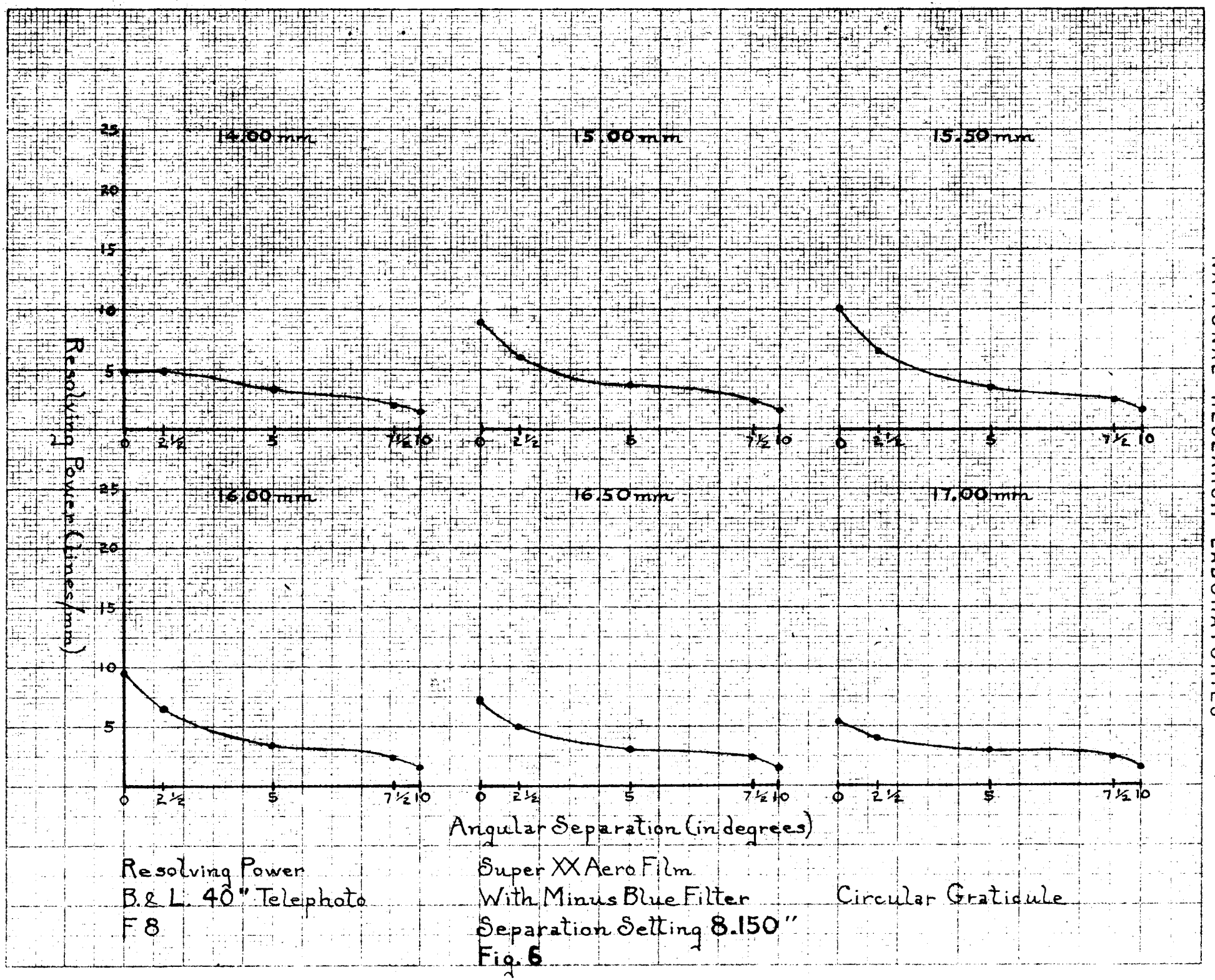


Average Resolving Power
B. & L. 40" Telephoto
F 8.

Super XX Aero Film
With Minus Blue Filter
Fig. 5

—•— Radial
--x-- Tangential
Cobb Graticule



Resolving Power
B. & L. 40" Telephoto
F 8

Super XX Aero Film
With Minus Blue Filter
Separation Setting 8.150"

Circular Graticule

Fig. 6

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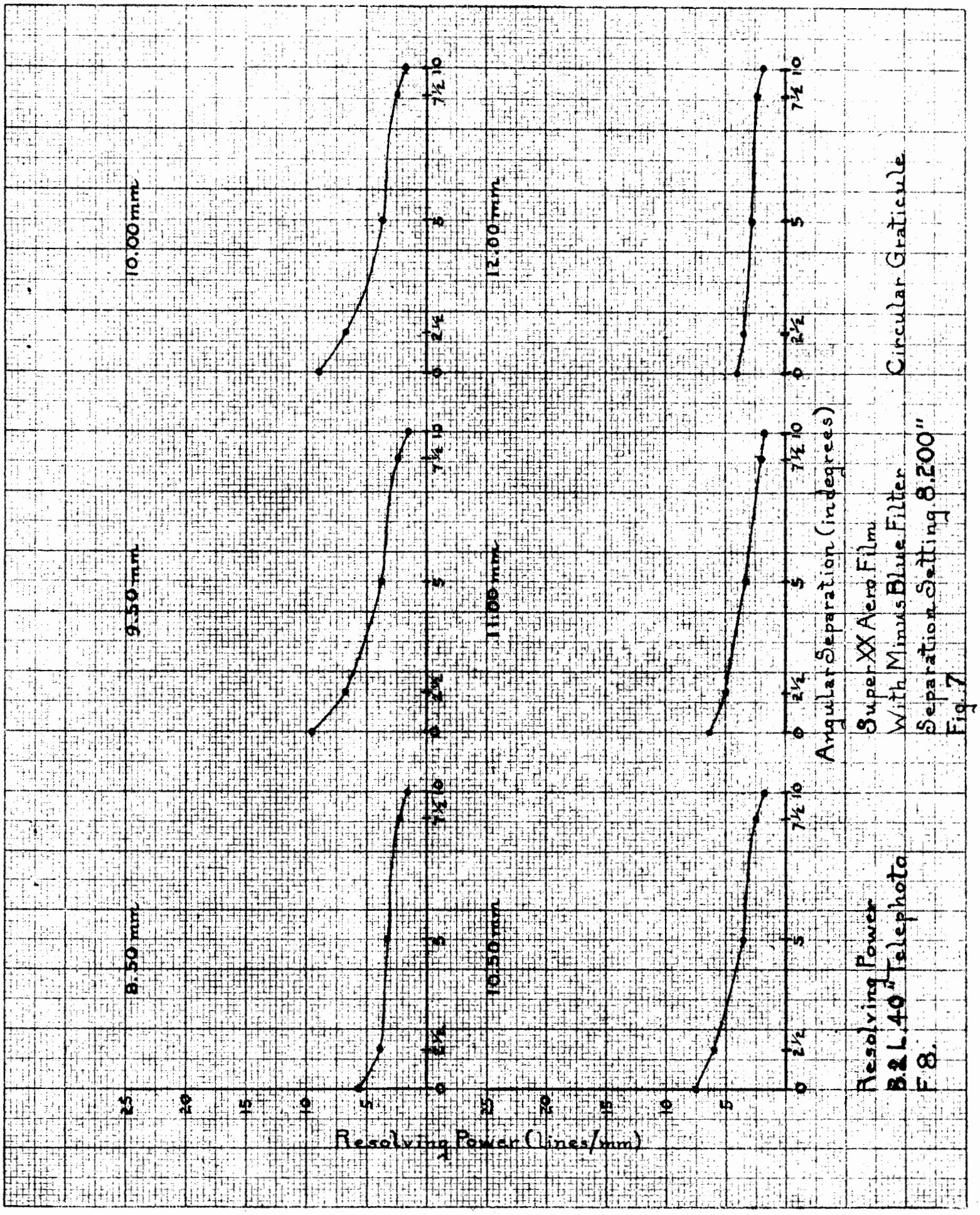

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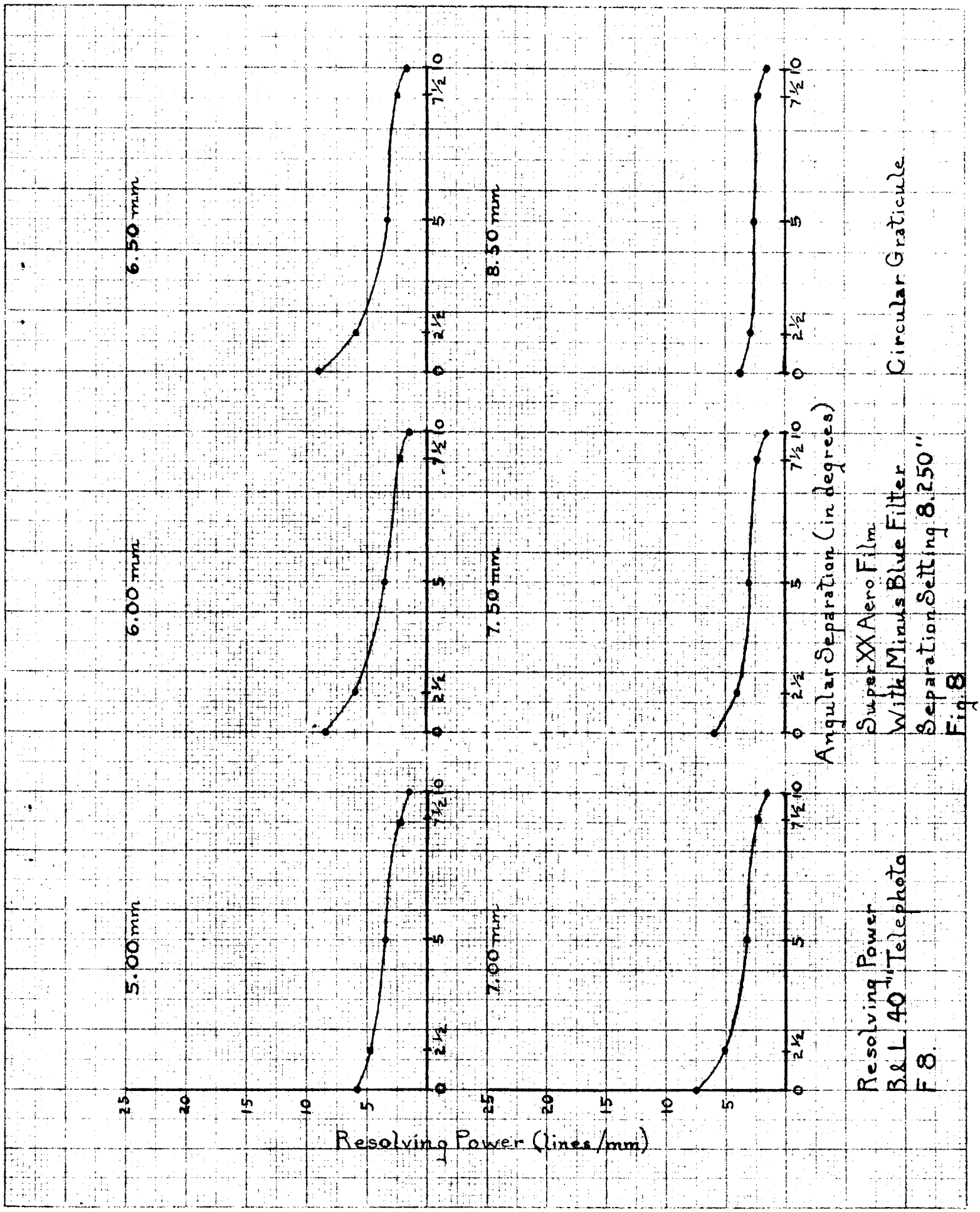

Fig. 8

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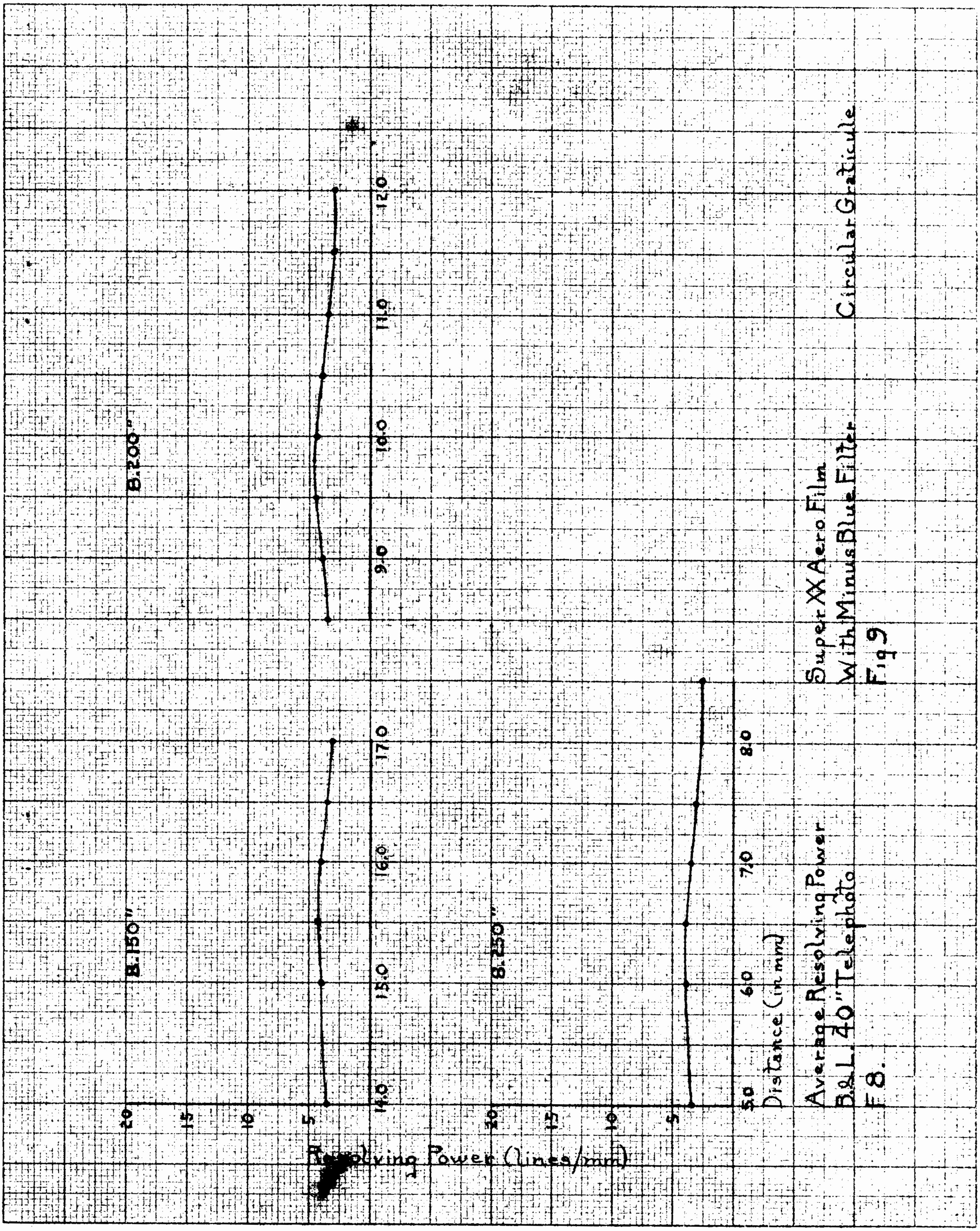

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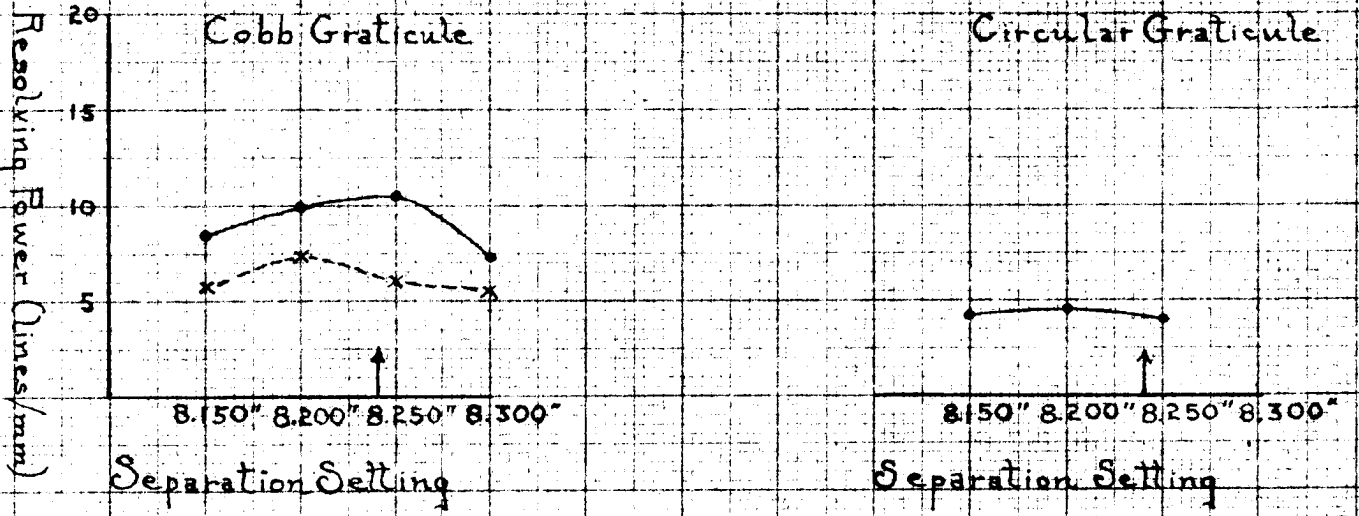

Average Resolving Power
B. & L. 40" Telephoto
F 8.
Fig. 10

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