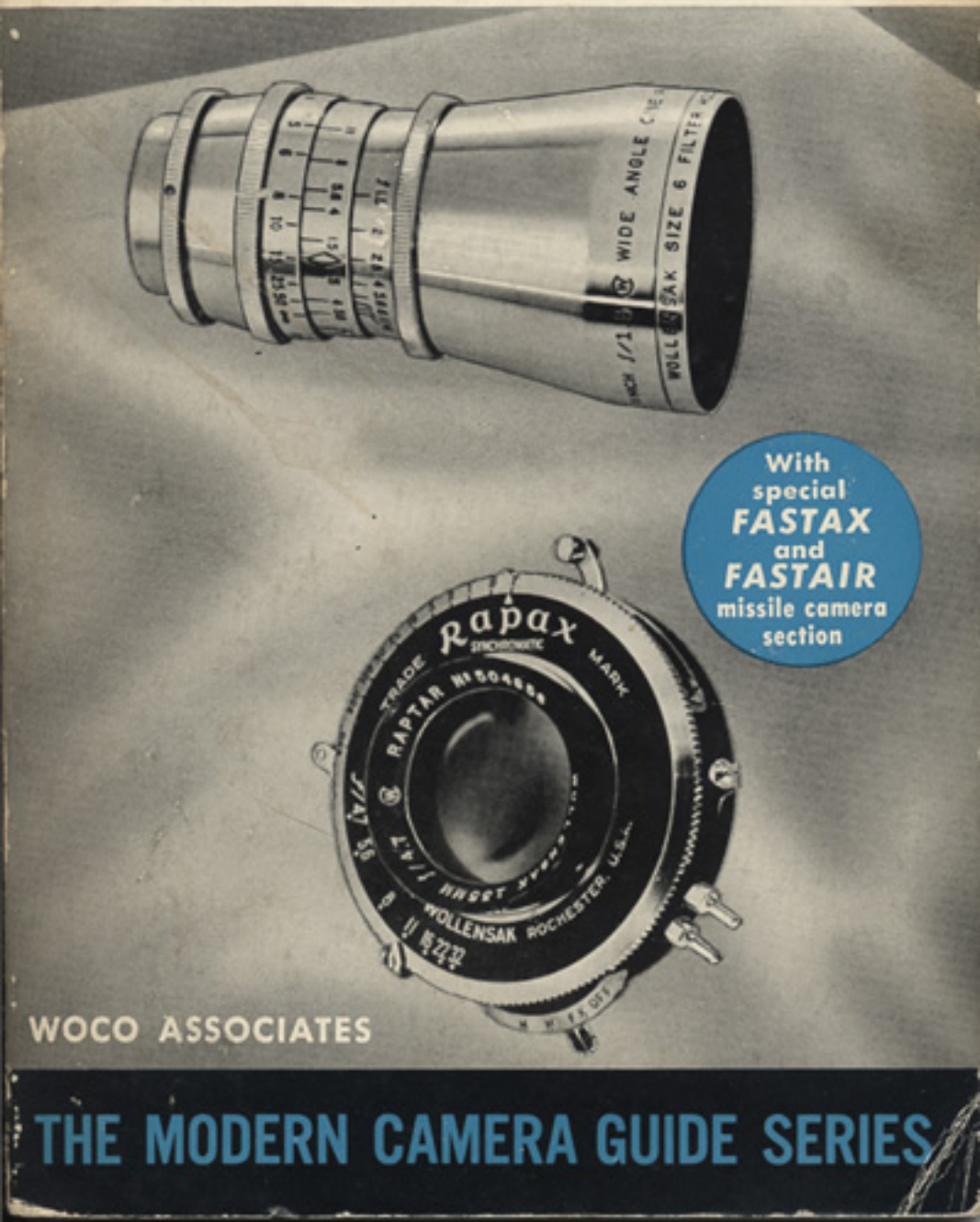
WOLLENSAK

LENS and SHUTTER

GUIDE



With special **FASTAX** and **FASTAIR** missile camera section

WOCO ASSOCIATES

THE MODERN CAMERA GUIDE SERIES

3. Still Camera Lenses

by A. EUGENE TURULA

Wollensak Optical Company offers a complete variety of lenses for every conceivable type of still camera application, whether it be for pictorial, press, commercial, industrial, copying, or portraiture photography. The lenses discussed in this chapter are those which find widest universal usage. Wollensak has many other lenses available for innumerable specialized industrial and military applications.

The lens included in this chapter are all of anastigmatic quality except the Portrait Veritar which will be described more fully later. Anastigmatic quality is descriptive of a lens highly corrected for astigmatism and all the other aberrations including field curvature, distortion, spherical aberration, coma, longitudinal and lateral color, and thus it will take a picture that is reasonably sharp over the whole format. Good results do not come automatically by virtue of the use of a particular lens construction. Other lenses may appear to be similar in construction, design type, and coverage, but still will not necessarily produce equally satisfactory pictures. The finest optical designs are the result of thorough, costly, and lengthy analyses and computations by experienced optical design engineers. A lens has many variables—glass type (of which there are over one hundred), curvature of the lens surface, lens thickness, and spacing between elements. Each individual variable affects every aberration to a different degree. The designer's problem is to determine the best combination of all variables which will simultaneously reduce all aberrations to an insignificant amount. Once this has been established, we are dependent upon the manufacturing techniques, test methods, and standards to ensure that the performance of the final product is fully equal to the design. Thus, the Wollensak Optical Company has decided that the name Raptar assigned to lenses should designate a standard of highest quality and workmanship rather than a specific type of design.

Field Coverage

A normal lens for still cameras is one which has a focal length about the same as the diagonal of the negative, or an angular field of

ANGULAR FIELD OF VIEW — CORNER TO CORNER

FILM SIZE	PICTURE SIZE INCHES	PICTURE SIZE MILLIMETERS	DIAGONAL MILLIMETERS	FOCAL LENGTH OF LENS																
				1	1 3/8	1 1/2	2	2 2/16	3	3 11/32	3 1/2	4	5	5 5/16	6	6 3/8	7 1/2	8	10	INCHES
				25.4	35.0	38.1	50.8	65.0	76.2	85.0	90.0	101.6	127	135	52.4	162	190	203.2	254	MILLIMETERS
DOUBLE 35MM	945×418	24×36	43.2	80.6	63.4	59.2	46.0	36.8	31.6	28.6	27.0	24.0	19.4							DEGREES
BANTAM	1.1×1.6	28×40	48.8	87.8	69.8	65.2	51.4	41.2	35.6	32.0	30.4	27.0	21.8	20.4	18.2	17.2	14.6	13.6	11.0	
127	1 5/8×2 1/2	41×63	75			89.0	72.8	60.0	52.4	47.6	45.2	40.6	33.0	31.0	27.6	26.0	22.9	21.0	16.8	
12EXPON 120	2 1/8×2 1/4	57×57	80			92.8	76.4	63.2	55.4	50.4	48.0	43.0	35.0	33.0	29.4	27.8	23.8	22.2	17.8	
120	2 1/4×3 1/4	57×83	101				89.6	75.6	67.0	61.4	58.6	52.8	43.4	41.0	36.6	34.6	29.8	28.0	22.6	
116	2 1/2×4 1/16	635×108	125					87.8	78.8	72.6	69.6	63.2	52.4	49.6	44.6	42.2	36.4	34.2	27.6	
118	3 1/16×4 1/16	83×108	136					92.6	83.4	77.4	74.2	67.6	56.4	53.4	48.0	45.6	39.4	37.0	30.0	
130	2 3/8×4 1/8	73×124	144						86.8	80.6	77.4	70.6	59.2	56.2	50.6	48.0	41.6	39.0	31.6	
122	3 1/4×5 1/2	83×140	162						93.4	87.2	84.0	77.2	65.0	62.0	56.0	53.2	46.2	43.4	35.4	
	4×5	101×127	162						93.4	87.2	84.0	77.2	65.0	62.0	56.0	53.2	46.2	43.4	35.4	

FILM SIZE	PICTURE SIZE INCHES	PICTURE SIZE MILLIMETERS	DIAGONAL MILLIMETERS	FOCAL LENGTH OF LENS												
				4 1/4	6 1/4	7 1/2	8 1/4	9 1/2	10	12	13	14	15	16	20	25
				108	159	190	210	241	254	305	330	355.6	381	406	508	635
	5×7	127×178	219	91.0	69.4	60.7	55.2	49.0	46.8	39.6	36.8	34.4	32.2	30.4	24.4	
	8×10	203×254	325		91.0	81.0	75.2	67.8	65.0	56.0	52.4	49.0	46.0	43.6	35.4	
	11×14	279×356	452				94.2	86.4	83.4	73.0	68.8	64.8	61.4	58.2	48.0	39.2

HORIZONTAL AND VERTICAL ANGULAR FIELD OF VIEW

FILM SIZE	PICTURE SIZE		DIAGONAL		FOCAL LENGTH OF LENS																
	INCHES	MILLIMETERS	MILLIMETERS		1	1 3/8	1 1/2	2	2 9/16	3	3 11/32	3 1/2	4	5	5 5/16	6	6 3/8	7 1/2	8	10	INCHES
					25.4	35.0	38.1	50.8	65.0	76.2	85.0	90.0	101.6	127	135	152.4	162	190	203.2	254	MILLIMETERS
DOUBLE 35MM	.945×.418	24×36	43.2	HORIZONTAL	70.6	54.4	50.6	39.0	31.0	26.6	24.0	22.6	20.8	16.2	15.2	13.5	12.7	10.8	10.1	8.1	DEGREES
				VERTICAL	50.6	37.8	35.0	26.6	21.0	17.8	16.0	15.2	13.4	10.8	10.2	9.0	8.5	7.2	6.8	5.4	
BANTAM	1.1×1.6	28×40	48.8		76.4	59.4	55.4	43.0	34.2	29.4	26.4	25.0	22.2	17.8	16.8	15.0	14.0	12.0	11.2	9.0	
					57.8	43.6	40.4	30.8	24.3	20.8	18.5	17.7	15.7	12.6	11.8	10.5	9.9	8.4	7.9	6.3	
127	1 5/8×2 1/2	41×63	75				58.9	45.9	36.6	31.5	28.4	26.9	23.9	19.2	18.1	16.0	15.1	12.9	12.1	9.7	
							56.6	44.0	35.0	30.1	27.1	25.6	22.8	18.3	17.3	15.4	14.4	12.3	11.5	9.2	
127 EXP. ON 120	2 1/4×2 1/4	57×57	80				73.6	58.6	47.4	40.9	37.1	35.2	31.4	25.3	23.8	21.2	20.0	17.0	16.0	12.7	
							73.6	58.6	47.4	40.9	37.1	35.2	31.4	25.3	23.8	21.2	20.0	17.0	16.0	12.7	
120	2 1/4×3 1/4	57×83	101					78.1	65.2	57.2	52.0	49.5	44.4	36.2	34.2	30.5	28.8	24.6	23.1	18.6	
								58.6	47.4	40.9	37.1	35.2	31.4	25.3	23.8	21.2	20.0	17.0	16.0	12.7	
116	2 1/2×4 1/4	63.5×108	125						79.4	70.0	64.8	61.9	56.0	46.0	43.6	39.0	36.8	31.7	29.8	24.0	
									52.0	45.2	40.9	38.8	34.6	28.0	26.4	23.5	22.1	19.0	17.7	14.2	
118	3 1/4×4 1/4	83×108	136						79.4	70.0	64.8	61.9	56.0	46.0	43.8	39.0	36.8	31.7	29.8	24.0	
									65.2	57.2	52.0	49.5	44.4	36.2	34.2	30.5	28.8	24.6	23.1	18.6	
130	2 7/8×4 1/4	73×124	144							78.2	72.2	69.2	62.8	52.0	49.3	44.3	41.9	36.2	33.9	27.4	
										51.2	46.5	44.2	39.5	32.1	30.3	26.9	25.4	21.8	20.4	16.4	
122	3 1/4×5 1/2	83×140	162							85.2	79.0	75.8	69.1	57.7	54.8	49.4	46.8	40.5	38.0	30.8	
										57.2	52.0	49.5	44.4	36.2	34.2	30.5	28.8	24.6	23.1	18.6	
	4×5	101×127	162							79.6	73.5	70.4	64.0	53.1	50.4	45.2	42.8	37.0	34.7	28.1	
										67.0	61.4	58.6	52.8	43.4	41.0	36.6	34.6	29.8	28.0	22.6	

					FOCAL LENGTH OF LENS																
					4 1/4	6 1/4	7 1/2	8 1/4	9 1/2	10	12	13	14	15	16	20	25				INCHES
					108	159	190	210	241	254	305	330	355.6	381	406	508	635				MILLIMETERS
	5×7	127×178	219	HORIZONTAL	78.4	58.5	50.2	45.9	40.6	38.6	32.5	30.2	28.1	26.3	24.7	19.9	16.0				DEGREES
				VERTICAL	60.9	43.6	37.0	33.7	29.5	28.1	23.5	21.8	20.3	18.9	17.8	14.3	11.4				
	8×10	203×254	325			77.2	67.5	62.3	55.6	53.1	45.2	42.1	39.3	36.9	34.8	28.1	22.6				
						65.1	56.2	51.6	45.6	43.2	36.8	34.2	31.9	29.8	28.1	22.6	18.2				
	11×14	279×356	452				86.3	80.6	72.9	70.0	60.5	56.7	53.2	50.1	47.4	38.6	31.3				
							72.6	67.2	60.1	57.6	49.2	45.8	42.9	40.2	37.9	30.7	24.8				

view of 53°. The focal lengths of wide angle lenses used for greater coverage are considerably shorter and may amount to only half the picture diagonal. The telephoto lenses have longer focal lengths and thus cover a comparatively narrow angular field. It is well to remember that these effects are a function of the focal length and film size rather than the optical design itself, although often the maximum effects are attainable only with lenses of true wide angle and telephoto designs.

Figure 26 gives the picture diagonal dimensions of the most popular film sizes and the angular field of view included therein for most focal lengths. Figure 27 gives the same information except the angular field of view is given for the horizontal and vertical fields. For example, 2¼" x 3¼" film has a 101mm diagonal. Using a 4-inch (101.6mm) lens, the corner to corner angular field of view is 52.8°. The horizontal field of view across the 3¼" dimension is 44.4° and the corresponding vertical field of view for the 2¼" dimension is 31.4°.

Depth of Field Tables

It is impractical to include a depth of field table in this book for each lens. However, these tables are readily available from Wollensak upon request.

162mm f/4.5
Raptar Series II
in Rapax X-Sync. Shutter

Raptar, Series II, f/4.5

This series of lenses represents one of the most versatile types for general and normal lens usage. The design is of the basic Tessar type construction as indicated in Figure 28 and is the most popular of all four element lens types. It has been optimized greatly throughout the

years, resulting in an especially good correction of all lens aberrations. It is similar to a triplet except that the rear element has been replaced with a cemented doublet which has furnished the designer with additional variables to improve definition and coverage still further.

The Raptar Series II lenses are ideal for press and feature photography, sports, industrial and other unposed action shots. The speed and excellent covering power are important favorable factors. These lenses can be fitted to all the popular press type cameras with interchangeable lens boards and are available in Wollensak high-speed full synchromatic Rapax shutter mountings for synchronized flash.

In pictorial photography the crisp, brilliant images, edge-to-edge sharpness, and fine shadow detail obtained with the Raptar Series II lenses are of primary importance to the discriminating photographer. For full color work the fine lens aberration corrections and anti-reflection hard coating result in well-defined true colors.

The longer focal lengths of the Raptar Series II lenses provide the true perspective so essential in commercial photography. Satisfactory depth of field for more exacting requirements can be obtained at the smaller apertures.

In portraiture the Raptar Series II is recommended to those who prefer crisp, sharp negatives. The Portrait Veritar—to be described later—is recommended for soft, muted effects. The 9½" focal length should be used on split 5 x 7 film and 11⅞" focal length on full 5 x 7 or 8 x 10 film for full figure work.

The recommended film size coverages, as well as the available iris diaphragm barrel and shutter mountings for each focal length, are listed in the following table.

Film Size Inch	Equivalent Inch	Focus mm	Barrel Size	Rapax Size	Alphax Size
2¼ x 3¼	3½	90	1	1	
2¼ x 3¼	4	101	1	1	
2¼ x 3¼	4½	114	2	2	2
3¼ x 4¼	5	127	2	2	2
4 x 5	5⅜	135	3	2	2
4 x 5	6⅜	162	4	3	3
5 x 7	7½	190	5		3
5 x 8	8¼	210	6		4
6½ x 8½	9½	241	6		4
8 x 10	11⅞	302	7		5

8" f/5.6 Raptar Telephoto
in Rapax Full-Sync. Shutter

Raptar Telephoto f/5.6

The Raptar Telephoto f/5.6 is available in focal lengths of 8", 10", and 15". The magnification produced by a telephoto is equal to the ratio of its focal length to that of the normal lens. For example, the image obtained with an 8" f/5.6 Raptar Telephoto will be two times larger than that rendered by a 4" lens.

Close-ups that look like impossible feats of photography are the results of using a telephoto lens. Like a powerful telescope, a Wollensak Raptar Telephoto brings distant images up close, enlarged in sharpest detail.

Use a Raptar Telephoto for sports events, nature study, travel, architecture, and news shots. Because of its long focus, the Raptar Telephoto is an ideal lens for portrait photography.

The Telephoto Raptar, as indicated in Figure 28, is of the true telephoto design which has the advantage that the distance from the front of the lens to the film is considerably shorter than for other designs. This enables the use of long focal length lenses on cameras having limited bellows draw.

The following table lists the specifications for this lens:

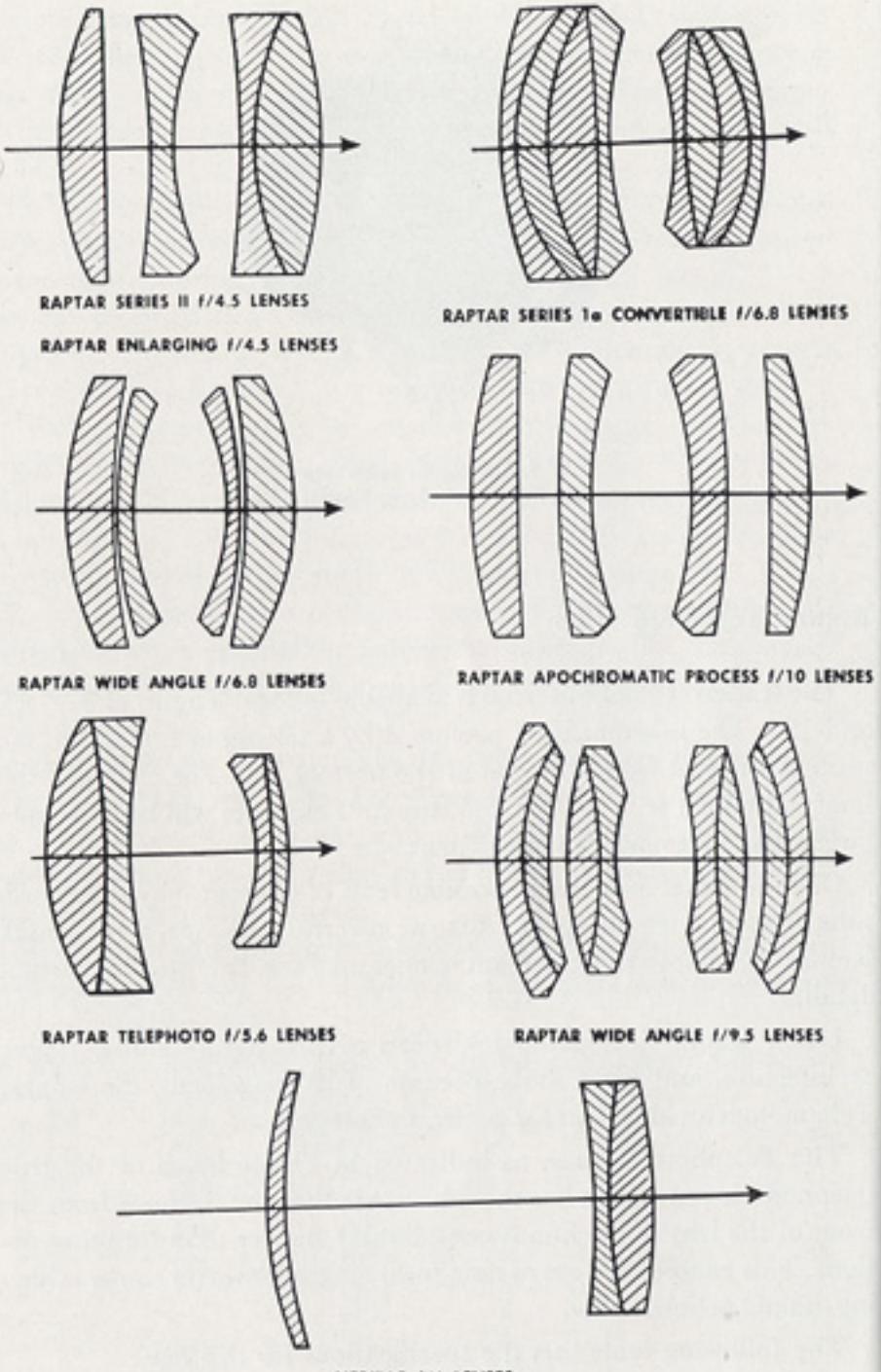


Fig. 28. Wollensak Lens Constructions

RAPTAR TELEPHOTO f/5.6 (WOCOTED)						
Film Size	*Equiv. Focus*		*Bellows Draw (flange focus) Required at Infinity*	*Barrel Size*	*Rapax Size*	*Alphax Size*
	Inch	*mm*				
2¼ x 3¼ 3¼ x 4¼	8	202	5	3	2	2
3¼ x 4¼ 4 x 5	10	254	6⅛	4	3	3
4 x 5 5 x 7	15	380	9⅞	6		4

Raptar Wide Angle Lenses f/6.8-f/9.5

Raptar Wide Angle lenses are recommended for group pictures; industrial photography; architectural shots, indoors and out; or wherever we need a wider range to include a greater breadth of view and the distances are relatively short. With these lenses, up to 69% more subject matter can be covered. Fully corrected, these lenses will produce sharp, undistorted, black and white or color pictures. The focusing aperture is unusually large and ideal for use under poor lighting conditions. As with all wide angle lenses, exposures should be made at smaller stops from f/11 downward.

3½" (90mm)
f/6.8 Wide Angle
Raptar in Rapax
Non-Sync. Shutter

RAPTAR WIDE ANGLE f/6.8 (WOCOTED)						
Film Size	*Equiv. Focus*		*Angle of View*	*Barrel Size*	*Rapax Size*	*Alphax Size*
	Inch	*mm*				
3¼ x 4¼	2⅞	65	92.6°	1	1	
4 x 5	3½	90	84°	1	1	
5 x 7	4¼	108	90.6°	2	2	2
SERIES III RAPTAR WIDE ANGLE f/9.5 (WOCOTED)						
8 x 10	6¼	159	91.2°	4	3	3

8¼" f/6.8 Raptar Series 1a Convertible in Rapax Non-Sync. Shutter

Raptar Series 1a Triple Convertible f/6.8

These lenses are noted for exceptionally large coverage, extreme adaptability, and the versatility of three focal lengths in one. They are of the basic double Protar type design which has found universal acceptance throughout the years. The front and rear components are individually corrected lenses and therefore can be used separately as well as in combination. The shortest and normal focal length is obtained when both halves (components) are used together. The focal lengths of the individual halves are each different and much longer than the normal focal length. For example, the 6½" f/6.8 Raptar Triple Convertible has a rear component equivalent focus of 10" and a front component equivalent focus of 12¾".

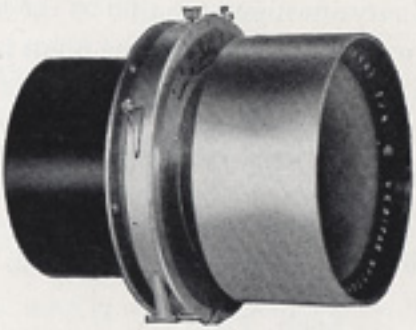
The speed of the individual halves are f/12.5—except the 20" and 25½" halves, which are f/16. The combination of two halves used together has an f/6.8 speed. Three aperture scales—one for each focal length—are provided on each barrel or shutter mounting.

Triple Convertible lenses are recommended for taking landscapes, industrial shots, architectural studies, illustrative and commercial photography. For better perspective, larger images, or telephoto effects, remove the front component and then use either the front or rear component alone in the rear behind the diaphragm.

Specification data for this lens follows:

RAPTAR SERIES 1a CONVERTIBLE f/6.8 (WOCOTED)

Equiv. Focus Inch	Equiv. Focus mm	Front Focus Inch	Rear Focus Inch	f Speed	Film Size	Barrel Size	Rapax Size	Alphax Size	For Banquet Cameras—Plates covered with smaller stop
6½	165	12¾	10	6.8	4 x 5	2	2	2	X
8¼	210	15½	12¾	6.8	5 x 8	4	3	3	X
10	254	20	15½	6.8	6½ x 8½	4	3	3	5 x 12
13	330	25½	20	6.8	8 x 10	6		4	7 x 15



14" f/6 Veritar in Alphax Sync. Shutter

Portrait Veritar Lenses f/6

The Portrait Veritar lens is ideal for portraiture photography, especially when a soft, muted type of picture is preferred. The Veritar is of an unusual 3 element design—free from distortion, corrected for color, and Wocoted for added brilliance.

The Veritar differs from many soft focus lenses in that the blending of tones or the soft focus effect is obtained by controling spherical aberration. Some soft focus lenses have accomplished this effect by chromatic aberration and therefore are not suitable for color. The ground glass image of such lenses is visually sharp but out of focus on the negatives in one or more of the color bands, and therefore the soft focus effect always changes with the different types of black and white or color films used. With the Veritar, however, there is no change in focus whether we shoot color or black and white film. What we see on the ground glass, we get!

In addition to the aperture engraving, an intermediate scale of 5 stops is engraved between f/6 and f/8. It gives the photographer five

additional calibrated degrees of softness and facilitates resetting the lens at the same position for successive pictures of the same blending. At these stops a picture of glamourizing softness is obtained with a third-dimensional roundness gained by subtle blending of highlights, halftones, and shadow. Unessential, wiry detail is suppressed so that retouching is minimized and in some cases eliminated. The softness is diminished gradually until at approximately f/11 the Veritar begins to take on the sharpness characteristics of an anastigmat. However, it differs from an ordinary anastigmat in that as the lens is stopped down the depth of field increases only behind the point focused on. Whereas when an anastigmat is stopped down, the depth of field increases both behind and in front of the point focused upon. For this reason, critical focus on the frontal face plane at the lens stop to be used is vitally important in portraiture.

Specification data for the Portrait Veritar f/6:

Size	Equiv. Focus		Barrel	Alphax*
Inch	Inch	mm.	Size	Size
5 x 7	10	254	6	4
8 x 10	14	356	8	5

* With or without Synchronization.

For large heads on full 5 x 7, the 14" Veritar is recommended for perspective reasons. For 4 x 5 or split 5 x 7, the 10" Veritar is recommended.

Fototel and Mirrotel Lenses

These lenses are unusual in that they employ mirror optics and are available in extremely long focal lengths of 20 to 80 inches. The optical system shown in Figure 29 is based on a concentric mirror system consisting of a concave spherical mirror and a correcting lens. The latter corrects the spherical aberration of the concave mirror and permits the light rays to be "folded back." This is achieved by aluminizing the central portion which forms a convex mirror. The technical term Catadioptric is used for lenses which use both reflective (mirror) and refractive optics simultaneously.

Mirror optical systems utilizing aspheric mirrors—and in certain restricted systems, spherical mirrors—have long been known. The spherical mirror alone has objectionable spherical aberration, even