B. R. Shoemaker
Nov. 12 1919.

What Lens Shall I Buy

BAUSCH & LOMB OPTICAL CO.
613 15th Street, N. W.
WASHINGTON, - D. C.

What Lens Shall I Buy?

We have for some time felt the need of definite printed information which will assist the purchaser in the proper selection of a photographic lens. Our complete photographic catalog gives the specific descriptions and prices and shutter fittings on our various series of lenses, but in this booklet we attack the problem from another angle. Look up your requirements in the pages which follow and you will note what lens or lenses are best for the specific purposes named.

While our anastigmats are truly universal, there are special applications which require special recommendations. We are always ready to take up in detail your various photographic needs and will gladly assist in selecting a lens.

As we are always ready to send lenses on approval through the local photographic dealer, the decision of the purchaser can be made without undue haste.

The work of our Scientific Bureau is of particular significance in our photographic production. The formulae for our different lenses are computed by our own staff of scientists—the same scientists who compute the formulae for practically every type of lens, from that the size of a pinhead for use in our

high power microscope objectives to large searchlight mirrors five feet or more in diameter. Furthermore, they have supervision of the testing room, to make sure that the finished product measures up to the standard set by their computations.

Owing to our unique position in the optical world, we gather a fund of experieoce on photographic matters. If you have any photographic problems call on us freely for advice. The camera is used for a multitude of purposes, and we will gladly give you the benefit of our experience in photographic matters.

We also manufacture lenses for photo-engraving, prisms and other accessories, lenses for motion picture cameras and motion picture projectors, lenses and cameras for photo-micrography, projection apparatus for lantern slides and opaque objects, lenses for color photograpy, stereoscopic work, etc., focusing and reading glasses, field glasses, magnifiers of all kinds, microscopes, engineering instruments and many other optical lines. Catalogs and information gladly furhished on request.

BAUSCH & LOMB OPTICAL CO.

ROCHESTER, N. Y.

MADE WITH IC TESSAR BY C. E. KELSEY

Selecting a Lens

Architectural Work.

Protar Series VIIa is the first choice on account of its superb corrections and reserve covering power. For details of architecture at some distance from the observer, where the Series VIIa images would be too small, the Series VII elements of the VIIa are useful as the image increases in size as the focal length of lens is increased. In restricted spaces, Protar Series IV or Series V Wide Angle lenses are almost necessities. For the inaccessible details, such as cornices, gargoyles, etc., the Bausch & Lomb telephoto attachment will be found to be invaluable.

Athletic Sports.

The Ic Tessar, F:4.5, should be selected on account of its great speed. The motion of the object must be arrested by the shutter in order to obtain sharp images, no matter what the light conditions may be at time of exposure. By working at a greater distance, smaller images are produced with greater depth, which images therefore can be enlarged successfully.

The IIb Tessar, F:6.3, and Compound Shutter will also do very satisfactory work along these lines, if the pictures are made at moderate distances. The Ic Tessar should always be selected in preference to the IIb Tessar if a reflecting type of camera is available, as the Ic Tessar stopped down will duplicate the IIb Tessar; but the Ic Tessar can-

not be recommended for compact hand cameras as it is necessarily more bulky than the IIb Tessar and some cameras do not have room enough to permit its use.

Button and Stamp Pictures.

For this work the required image is so small that the lens works practically at a universal focus. A short focus lens will probably be demanded on account of the restricted operating space. The Ic Tessar, F:4.5, such as No. 13, 14 or 15, is the proper selection.

Children's Photographs.

For this fascinating branch of photography, we need speed—therefore the Ic Tessar, F:4.5, is the best lens. With reflecting type of camera and the Ic Tessar, one can catch the fleeting expression of the child, make pictures of him at play, or a snap-shot in the house. The Ic Tessar is of necessity more bulky than the IIb, which is generally fitted to the folding type of hand camera. There are some types of cameras with ground glasses for focusing which also have front board room enough to take Ic Tessars, but in general these cameras will take only the IIb Tessars, F:6.3. The latter lens will do excellent work, for it has about twice the speed of the ordinary camera lens.

Construction Work.

A IIb Tessar, F:6.3, on a light hand camera should be used for reconnoitering and preliminary surveys. For all-round work by a

resident photographer for large engineering projects a VIIa Protar, supplemented by Series V Wide Angle Protar, is the best equipment on account of the convertible features.

Copying.

All of our lenses can be used with good success for this work. The IIb Tessar is excellent in this line and for an inexpensive copying lens the Series IV or V Wide Angle Protars are recommended. Specially corrected copying lenses are made for photo-engravers. (See Photo-Mechanical Work.)

Enlarging.

The Tessar IIb, F:6.3, should be selected on account of its excellent optical corrections. In enlarging a flat object (the negative) is projected onto another flat surface (the bromide paper) and the necessity of a perfectly flat field lens is of course obvious. If the Tessar is intended primarily for enlarging, we recommend a specially adjusted lens for the purpose. When such an adjustment is made, the lens can be used at much larger openings, thus gaining speed.

Flashlight Photography.

For flashlight work, banquets, interiors, etc., the most useful lens is one which has a large available image circle. Series VIIa or IIb Tessar allow focusing at large apertures, and save flashlight powder, expense and

MADE WITH IIB TESSAR BY F. I. MONSEN

smoke. Series IV is an excellent lens for flashlight groups. Series V may also be used if greater angle is desired.

Flower Photography.

In this work there is no great necessity for speed, so that a Convertible Protar Series VIIa, F:6.3, with several focal lengths can be selected, gaining the advantage of better proportions of parts, resulting from the use of long focus lenses. Our New Ray Filter is a necessity if the photograph is to show the differences in color values.

Groups.

In no line of photographic work is the anastigmat more essential for good results. The best investment is the VIIa Protar. The reserve covering power of this type makes it possible to use a shorter focus lens and have definition from corner to corner—an obvious advantage where work must be done in a limited space. The speed is ample and the single lenses are useful as longer focus lenses for distant objects.

The VIIa Protar may also be used for commercial work, such as photography of landscape gardening, buildings in construction, machinery and automobile photographs, as well as groups.

If conditions do not justify expense, the IIb Tessar may be employed or the Ic Tessar. These lenses may be worked at moderate apertures for groups and when used at full openings are, on account of their speed, useful lenses for studio or for home portrait

7-inch doublet, No. 8, Series VIIa, F:22. $\frac{1}{2}$ second

$11\frac{3}{16}$-inch single lens, No. 3, Series VII, F:32. 1 second

MADE WITH

BAUSCH & LOMB

CONVERTIBLE PROTAR VIIA

Position of Camera not changed. Would be impossible to secure this result by getting closer with the doublet.

$13\frac{3}{4}$-inch single lens, No. 4, Series VII, F:32. 1 second

The longer focus lenses are preferable, as the front rows will be more in proportion to the back rows, but the focus of a lens, for a group, is governed by restrictions of operating space—an important fact.

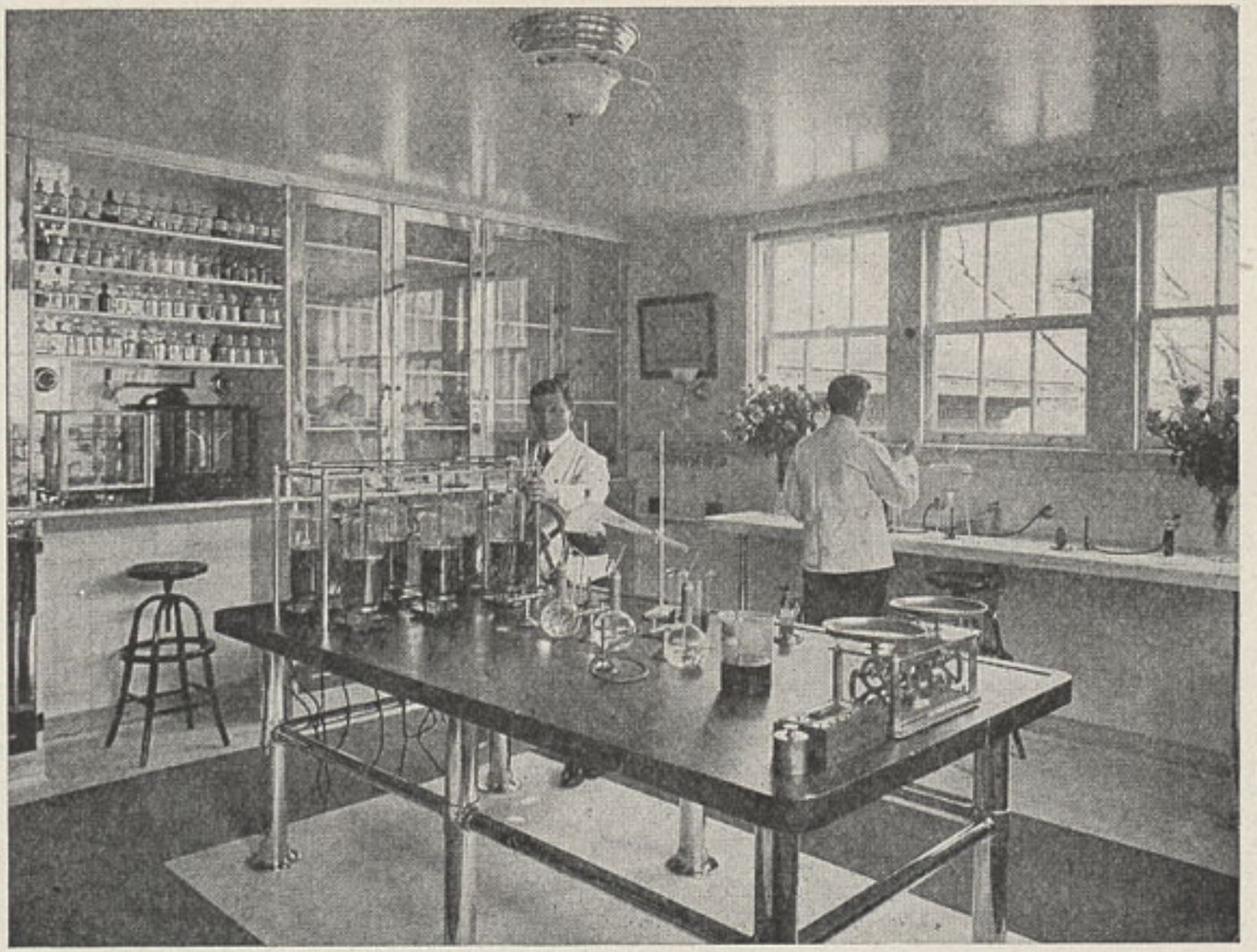
Landscapes.

For this work the Convertible Protar Series VIIa, F:6.3, should be chosen. The speed is ample and the convertible features of the lens, containing in one lens barrel or shutter fitting, the possibility of using two or three focal lengths according to the lens purchased, makes the selection an ideal one. If the Series VII lenses which make up the VIIa lens are equal in focus, a speed of F:6.3, equal to the IIb Tessar, is obtained; if the combinations are unequal, an extra focal length is gained, with a slight loss of speed. By adding one or more Series VII elements, a set of Protars is built up, for full details of which see page 27.

Convertibility means convenience in photography. If the image size is too small with the VIIa, a single element can be used at the same tripod location and larger image secured. You simply find the proper viewpoint and select some combination from the set to give you the scale and perspective which you desire.

Lantern-Slide Making.

For the reduction method, a IIb Tessar, F:6.3, should be employed with the cap end of lens facing negative and flange end of lens



MADE WITH V PROTAR BY W. B. STARR

facing lantern-slide plate. Ic Tessar or VIIa Protar of suitable foci may also be used.

Naturalist Photography.

For work from "blinds" with shutter operated from a distance, the Tessar Ic should be selected.

At a distance from the animal, the apparent motion of image on camera is not so great as when near the animal, for in this case he may be startled and away before exposure is made. The Convertible Protar Series VIIa is therefore useful and combines in one lens a speed lens and a long focus lens.

Newspaper Photography.

The Ic Tessar appeals to newspaper photographers on account of its speed, F:4.5, which satisfies requirements for exposures under difficult conditions. The reserve covering power of Ic, F:4.5, is of wonderful value for portraiture where the swing-back comes into play, or for exposures on larger size plates in emergencies. Tessar Ic has largest covering power, focus for focus of any ultra rapid anastigmat.

Every newspaper man has use also for a Series V Wide Angle lens, when forced to work in restricted spaces.

Photomechanical Work.

In this work the very highest precision is required. For the exacting demands of the three-color process, the Apochromatic Tessar Series VIII must be used since it is absolutely necessary to bring the images produced through the red, green and violet filters to the same focus so that the images will be of exactly the same size.

For black and white work the VIII Apochromatic Tessar is equally valuable, on account of its accurate precision. (Our special literature sent on request, covering photo engraver's lenses, prisms and ray filters for three-color work, magnifiers, etc.)

Photomicrography.

The Micro Tessars are useful for direct enlarged photographs from small objects such as insects or seeds and plant life where the magnification does not exceed 25 times. (Special literature sent on request covering Photomicrography, Microscopes, etc.)

Portraiture.

As the reduction of exposure is of the greatest importance, speed such as is possessed by our Tessar Ic, F:4.5, is essential. This lens has a flat field which makes it adaptable for standing figures and groups. For home portraiture the shorter focus members of the series are unequalled as they can be fitted to portable cameras.

No. 18 is particularly adapted (in connection with 5 Compound Shutter), for compact home portrait outfits.

No. 18a is the standard lens for the ordinary studio. No. 19 is intended for large heads and 11 x 14 work.

Tessar Ic is the ideal lens for the professional who wishes one truly universal lens.

Projection Work.

The Tessar IIb, on account of its flat field, is the finest projection lens made, and the Micro Tessar has special properties which fit it for the projection of microscope slides. IIb Tessars for projection are furnished in special rack and pinion mounts with steel iris diaphragm leaves.

(Special catalogs on projection lenses and projection apparatus sent on request.)

Reflecting Camera Work.

The Ic Tessar, F:4.5, is here supreme. The speed, F:4.5, is maintained in all sizes of the Ic Tessar, and the angle of sharp field in proportion to focal length is much greater in this lens than in competing lenses. As the Tessar Ic does not shift focus when stopped down, the lens can be used at smaller apertures when full opening is not needed.

Science Work.

Teachers will be interested to correspond with us regarding their special requirements, and for all round work on science outfits we recommend the VIIa Protar or a set of Protars on account of the several focal lengths. IIb Tessar also makes an excellent selection, if a somewhat lower price lens is desired.

Standing Figures.

Any of our Tessar series or Protar VIIa members may be selected for standing figures in the studio. They excel the old portrait types of lenses because of their ability to make a large standing figure without stopping down. This is of great importance as the standing position is the hardest for a person to maintain, and when slow lenses are used many plates are spoiled by the movement of the subjects. Ic Tessar No. 18 or 18a is a good selection for an all around studio lens, on account of its speed, F:4.5, combined with perfectly flat field. IIb Tessar No. 7, 8, 9 or 9a can also be used with good success, up to the limits of speed, F:6.3.

Stereoscopic Photography.

The IIb Tessar, F:6.3, with Stereo Compound shutter is recommended. The lenses must be accurately matched in focus. For stereoscopic work on reflecting cameras, the Tessars are used in barrels.

Telephotography.

Since the telephoto magnifies the image produced by the regular photo lens, it is necessary to have as perfect a lens as possible for the basis of the telephoto outfit. The Tessars and the VIIa Protar are suitable selections, but they must be very carefully adjusted to the telephoto attachment. We cannot fit satisfactorily without having the regular photo lenses at hand. **Telephoto attach-**

ments cannot be sent on approval. Statistics regarding magnifications possible with various camera extensions are given on page 31.

Wide Angle Work.

Series IV gives a medium angle and a moderate speed, F:12.5. Series V covers the demand for extreme angle and can be used for snap shots in good lights. Its speed is F:18. Series IV and V are also good for flashlight work. Those who own Convertible Protar VIIa lenses can also use them as wide-angle lenses when stopped down on account of their reserve covering power. When stopped down the circle of sharp definition is increased. **It should be noted that Series IV or Series V lenses cannot be fitted with shutters like Compound or Automat,** but demand a shutter such as **Volute** in which diaphragm blades and shutter blades are identical.

Water Pictures.

On account of the light which is reflected from the water and sky, the lenses can almost always be stopped down. For yachting pictures the Convertible Protar VIIa, F:6.3, is useful, as for a long distance exposure the single lenses can be used. For motor-boat racing, diving pictures, etc., a Tessar Ic, F:4.5, is of advantage as the exposures must be short on account of rapid movement of object.

General Notes

The word Anastigmat means without "astigmatism," that curious defect in the older type of lens in consequence of which they could not render sharply a horizontal line and a vertical line at the same time. Photographs of a subject like a window would show this defect in the window sashes, while in ordinary photography the effect of uncorrected astigmatism is shown in the lack of quality of definition. Anastigmat negatives, on the other hand, have remarkable precision and can be enlarged to an unusual degree on account of this excellence.

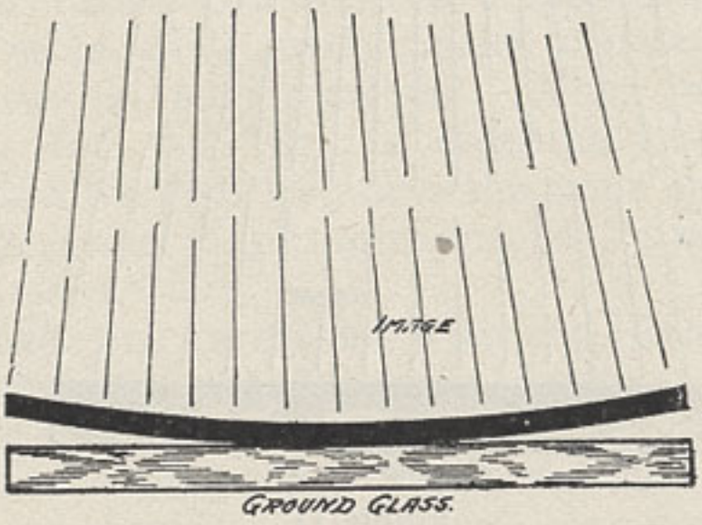


Figure I

The Bausch & Lomb Tessars and Protars represent the highest perfection in anastigmat quality, and the diagram below will show strikingly the speed advantages of these lenses. Figure 1 represents the image of a non-anastigmatic type, an ordinary rapid rectilinear lens, somewhat exaggerated

to show the point. The curved line indicates the saucer shape curved field of the image. As the plate or film is flat, the corners are obviously out of focus. While a gain in sharpness may be realized by stopping down the lens, it represents a loss in speed.

In Figure 2, the image is that of a Tessar or any of our anastigmats. The exceptionally flat field coincides with the plate at even the fullest aperture, and there is no need for stopping down except for depth of focus, which means that the lens may be used for very difficult light conditions.

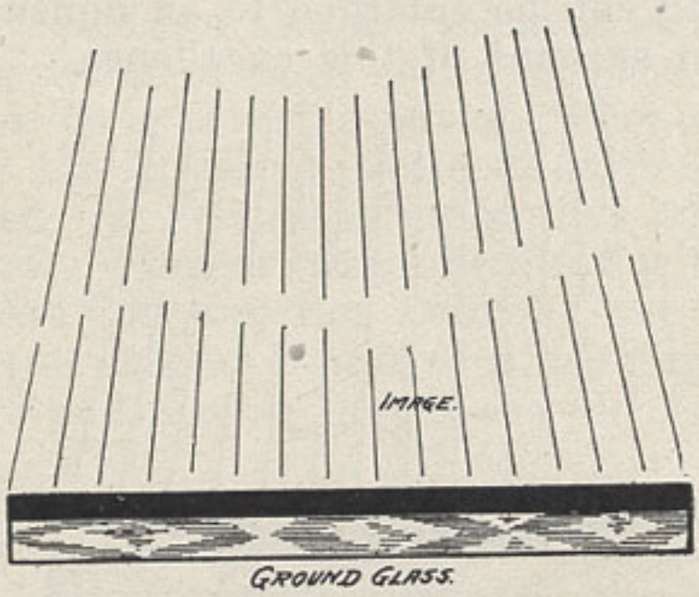


Figure II

It is therefore necessary to see that register of plate holders is perfect in testing our high grade lenses and, if swing back adjustments are used, to see that they are normal in testing. On cameras with focusing scales, reasonable care must be used to see that the focusing pointer is set correctly before making the exposure.

It is absolutely necessary that lenses be mounted correctly on the camera front. If the lens is improperly set in place, the image will not register all over the surface of negative.

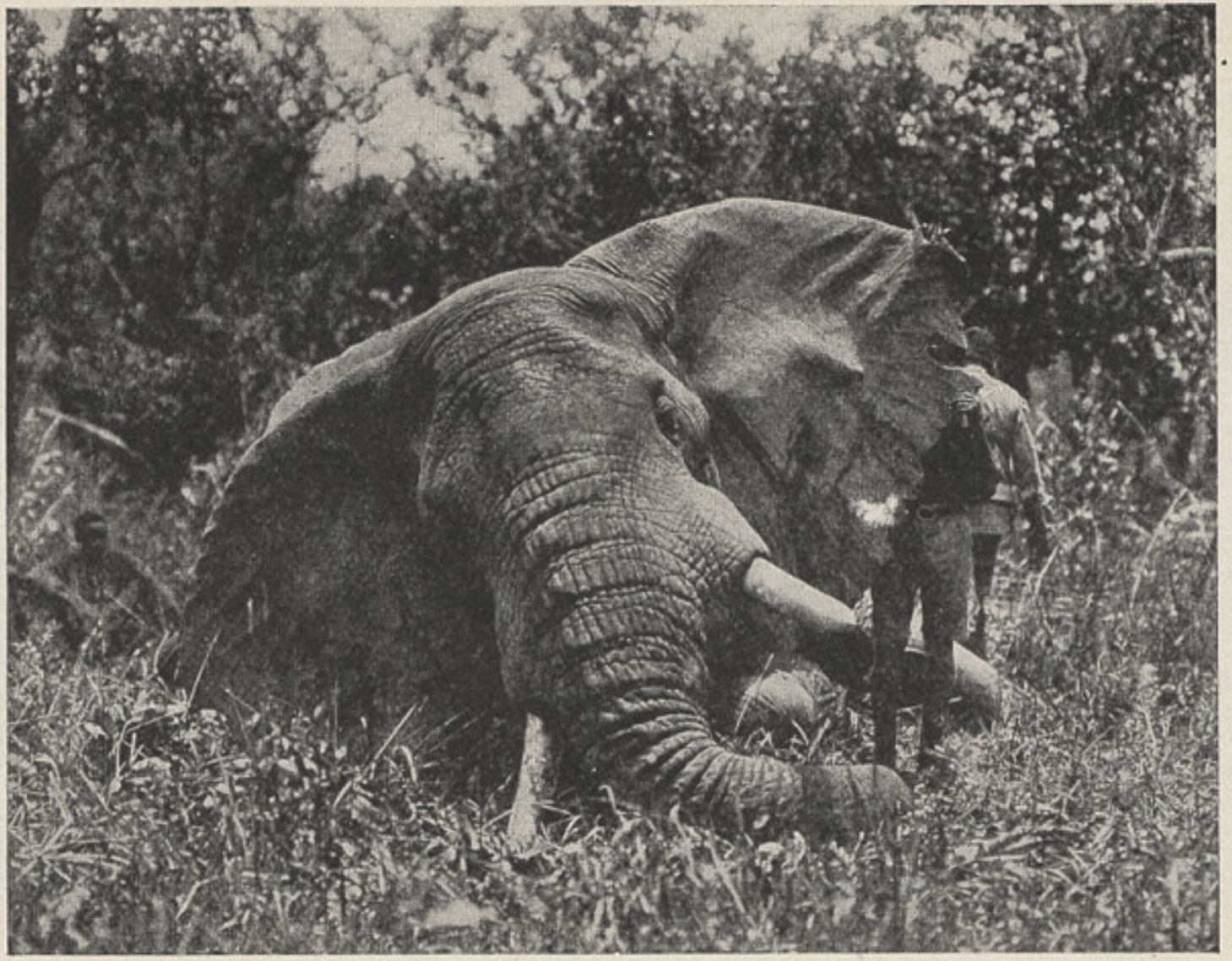
Lens Mounting

The Tessars Ic and IIb in barrels have beveled diaphragm rings, so that stop values may be read easily from above or when viewed from the front. This is a great advantage on reflecting cameras.

The VIIa Protars have a mounting with revolvable collar, which locks in position for all possible combinations. When set correctly for the various combinations, each combination then requires the same exposure for the same diaphragm number, a very obvious advantage.

Lenses are furnished with cap, flange and leatheroid case. Focusing scales are furnished when requested. For cameras of compact construction, improved flanges are used on inside of camera, clamping lens firmly in place.

Our lenses are compact in mounting and can, therefore, be adapted with greatest ease to the various cameras on the market. The table of camera fittings, given at the close of this publication indicates in detail the lenses recommended for the various types of cameras.



MADE WITH VIIA PROTAR BY C. E. AKELEY (COPYRIGHT)

Price Lists

Bausch & Lomb Tessars

Made in two series: Ic *F:4.5*, designed primarily for speed work and particularly adapted to reflecting cameras; and IIb, *F:6.3*, a fast universal anastigmat for use on compact hand cameras.

Series Ic *F:4.5*

The Tessar Series Ic is admittedly the most universal objective of the unsymmetrical type. It is constructed with four thin elements of Jena glass and the absorption of light is practically nothing. It is very compact, considering its speed, *F:4.5* in all its sizes, which is an unprecedented achievement in lens making. The lens must be used entire.

The definition of the Tessar Ic at its full aperture is remarkable. This lens will do all that it is possible to do with the Series IIb and, in addition, has twice as great speed, which becomes available when the lens is used at its full opening.

Owing to its needle point definition, flatness of field, extraordinary speed and even illumination over the entire plate, the Tessar Series Ic is recommended by its users for speed work on reflecting cameras, portraits, groups and both professional and amateur general photography, in and out of doors.

Series IIb *F:6.3*

The numerous and valuable attributes of the Tessar Series IIb together with its compact form are very largely responsible for the present popularity of the smaller hand cameras. The Series IIb is not as fast a lens as Series Ic and it is consequently smaller in diameter and can for that reason be mounted on smaller cameras. The construction is of the same type as the Ic and its definition and even illumination leave nothing to be desired. Snap shots without sunlight are easily made with this lens. The speed of the Series IIb is nearly twice that of the ordinary hand camera lens and it makes possible many photographs which, without the Tessar, would be entirely out of the question.

Bausch & Lomb Tessar

Series Ic—*F:4.5*

Code Word	No.	Size of Plate Covered with Stop F:4.5* Inches	Size of Plate Covered with Small Stops	Equiv. Focus Inches	Diam. of Lens Inches	Lens and Barrel with Iris Diaphragm	Fitted with Aluminum Volute Shutter
Habit	**12**	2¼ x 3¼	3¼ x 4¼	3½	¾	**$28.00**	**$45.00**
Haema	**13**	2½ x 3½	3¼ x 4¼	4½	1	**31.00**	**48.00**
Hafter	**14**	3¼ x 4¼	4 x 5	5½	1⅛	**35.00**	**52.00**
Hagdon	**15**	4 x 5	5 x 7	6½	1 5/16	**40.50**	**59.00**
Haggle	**15a**	5 x 7	5 x 8	7½	1⅝	**50.00**	**68.50**
Hail	**16**	5 x 8	6½ x 8½	8½	1⅞	**62.00**	**82.00**
Hairen	**17**	6½ x 8½	8 x10	9⅞	2¼	**99.00**	**119.00**
Hakim	**18**	8 x10	10 x12	11¾	2 1/16	**139.50**	
Halberd	**18a**	10 x12	11 x14	14¾	3⅜	**180.00**	
Halter	**19**	11 x14	12 x16	15⅝	3 9/16	**217.00**	
Halicore	**20**	14 x17	16 x18	19½	4⅜	**310.00**	

Series IIb—*F:6.3*

Code Word	No.	Size of Plate Covered with Stop F:6.3* Inches	Size of Plate Covered with Small Stops	Equiv. Focus Inches	Diam. of Lens Inches	Lens and Barrel with Iris Diaphragm	Fitted with Aluminum Volute Shutter
Hag	**2a**	2¼ x 3¼		3 1/32	½	**$22.00†**	
Hallux	**3**	2½ x 3½	3¼ x 4¼	4⅜	¾	**28.00**	**$45.00**
Halogen	**4**	3¼ x 4¼	4 x 5	5⅜	⅞	**29.50**	**46.50**
Halones	**5**	4 x 5	5 x 7	6⅛	1	**31.00**	**48.00**
Halser	**5k**	3¼ x 5½	5 x 7	6 1/16	1 1/16	**38.50**	**55.50**
Halyard	**5a**	5 x 7	5 x 8	7 1/16	1 3/16	**43.50**	**62.00**
Hamble	**6**	5 x 8	6½ x 8½	8¼	1⅜	**53.00**	**71.50**
Hamlet	**7**	6½ x 8½	8 x10	10	1 11/16	**71.50**	**90.00**
Hammock	**8**	8 x10	10 x12	12	2 1/16	**105.50**	**125.50**
Hamper	**9**	10 x12	12 x15	14⅜	2 7/16	**136.50**	**156.50**
Hamular	**9a**	11 x14	14 x17	16½	2¾	**166.00**	
Handbill	**10**	14 x17	16 x20	19¼	3 1/16	**217.00**	
Handsel	**11**	16 x20	20 x24	23¼	3¾	**279.00**	

*Larger plates covered with smaller stops. †Cells only.

For matching lenses for stereoscopic work, add $2.50 to the price of the lenses.

Each lens is furnished in a case which protects it from injury. Lens cap and focusing scale are included.

When ordering lenses fitted with shutter, by telegraph, specify *Volute* in addition to the code word for the size of lens.

Tessar Ic For Motion Picture Camera

Our lenses for motion picture photography are described in a special circular, which will be sent on request. Ask also for our Projection Lens Booklet if interested in projection lenses.

In Barrel with Iris Diaphragm

Code Word	Speed	Cat. No.	Covers at Full Opening	Equiv. Focus In.	Equiv. Focus Mm	Diameter	Price
Hack	F:3.5	1	¾ x 1	2	50	9/16	$25.00
Hade	F:3.5	1a	1¼ x 1¼	3	75	27/32	31.00
Hangle	F:4.5		¾ x 1	1¼	32	⅜	26.00
Hank	Lens Hood for above lenses . . .						1.00

In Spiral Focusing Mount

Code Word	Speed	Cat. No.	Covers at Full Opening	Equiv. Focus In.	Equiv. Focus Mm	Diameter	Price
Hackfocus	F:3.5	1	¾ x 1	2	50	9/16	$28.00
Hadefocus	F:3.5	1a	1¼ x 1¼	3	75	27/32	34.00
Hanglefocus	F:4.5		¾ x 1	1¼	32	⅜	29.00
Hanker	Lens Hood for above lenses . . .						1.00

In Tubes For Rack and Pinion Mount

(Rack and Pinion Mount Extra)

Code Word	Speed	Cat. No.	Covers at Full Opening	Equiv. Focus In.	Equiv. Focus Mm	Diameter	Price
Hackrack	F:3.5	1	¾ x 1	2	50	9/16	$28.00
Haderack	F:3.5	1a	1¼ x 1¼	3	75	27/32	34.00
Haikal	Rack and Pinion Mount, complete with flange, for above lenses and for Nos. 15 and 15a with adapter						7.50

For Telephoto Effects

Code Word	Speed	Cat. No.	Covers at Full Length	Equiv. Focus In.	Equiv. Focus Mm	Diameter	Price
Hagdon	F:4.5	15	4 x 5	6		1 5/16	$40.50
Haggle	F:4.5	15a	5 x 7	7¼		1⅝	50.00
Hailse	Adapter for using rack and pinion mount with the above lenses (specify for which lens						2.50
Haikal	Rack and Pinion Mount for above lenses with adapter and for Nos. 1 and 1a in tubes						7.50

Bausch & Lomb Convertible Protar

Series VII—*Speed F:12.5*

Code Word	No.	Size of Plate Covered with Stop F:12.5* Inches	Size of Plate Covered with Small Stops	Equiv. Focus Inches	Back Focus Inches	Diam. of Lens Inches	Lens and Barrel with Iris Diaphragm	Fitted with Aluminum Volute Shutter
Hector	1	4¾ x 6½	5 x 7	7 3/16	7¾	¾	$23.50	$40.50
Hederic	2	5 x 7	6½ x 8½	8¾	9 5/8	⅞	26.50	43.50
Hedonic	3	6½ x 8½	10 x12	11 3/16	12¼	1⅛	31.00	48.00
Heelless	4	8 x10	11 x14	13¾	15	1⅜	37.50	56.00
Hegge	5	10 x12	12 x16	16 3/16	17½	1 21/32	48.00	66.50
Heiress	6	11 x14	16 x18	18⅞	20½	1⅞	66.50	86.50
Helena	7	12 x16	18 x22	23¼	25¼	2	85.50	105.50
Helican	8	13 x16	22 x27	27⅛	29 1/16	2 7/16	111.50	131.50
Heliotype	9	16 x18	24 x30	30¾	34	2¾	155.00	
Helix	10	16 x20	27 x35	33⅞	37½	3¼	201.50	
Helmet	11	18 x22	30 x40	39¼	43½	3¾	263.50	

*Larger plates covered with smaller stops.

NOTE—Series VII is the name given to the single elements of the Convertible Protar. When two Series VII lenses are used together, the combined lens is known as Series VIIa. When three or more Series VII elements are fitted to interchange in a barrel or a shutter, they are technically known as a Protar set (see page 27.) The advantage of having one barrel or shutter to take all lens combinations is obvious, and multiplication of flanges and front boards is thus avoided.

Sundries

Flanges for Bausch & Lomb Lenses

Number	1	2	3	4	5	6	7	8	9	10	11
Diameter, inch	1½	1¾	2	2¼	2½	3	3½	4	5	5½	6
Price, each	$ .50	.50	.75	1.00	1.00	1.25	1.50	1.75	2.00	2.50	3.00

Grained Leather Caps for Bausch & Lomb Lenses

Number	1	2	3	4	5	7	8	9	10
Diameter, inch	1⅜	1½	2 1/16	2 11/32	2¾	3 7/32	3 9/16	4 9/16	5½
Price, each	$ .40	.45	.50	.55	.60	.70	.80	.90	1.00

Bausch & Lomb Protars

Series VII and VIIa

An anastigmat, the parts of which may be used separately, is obviously more nearly universal than the Tessar, since a variation in the focal length is obtainable by using the component parts singly. The construction of such a lens is a difficult task and amounts to producing two anastigmats corrected for use separately, which when used together produce an image conforming to the highest standard.

In the Series VII, this desirable construction has been achieved and the optical construction is unsurpassed. The Series VII, which makes up the Series VIIa, is composed of four elements cemented together, and is always used back of the diaphragm. The speed is *F:12.5* which is sufficient for instantaneous work out of doors under favorable light conditions and, while the single lens (like all lenses with a diaphragm in front) is not absolutely rectilinear, the results are entirely satisfactory.

Two lenses of the Series VII are combined to produce a member of the Series VIIa. The advantage is that three different size images of an object from the same point, or the same size image from three different points may be obtained, providing the single lenses are properly selected. Starting with No. 4, Series VII, adding No. 3, forms No. 8 of the Series VIIa, the focal lengths being 13¾ in. and 11 3/16 in. in the single lenses and 7 in. in the doublet. Later, another Series VII, say No. 2, may be acquired, thereby adding a single lens of 8¾ in. focus and two doublets of 5⅝ in. and 6⅛ in. focus, depending upon which of the single lenses are used together. Thus, with three separate lenses, six different focal lengths are possible. This is known as the "C set" and may be built up gradually if desired. The D set is similar.

The speed of the doublets depends upon the focal lengths used together, *F:6.3* resulting when the lens is symmetrical.

In considering the price of a Series VIIa it is reasonable to divide the cost by the number of focal lengths obtainable with the doublet or set, which in the C set reduces the cost to $14.58 for each lens. The possibilities of development must also be considered.

Bausch & Lomb Convertible Protar

Series VIIa—*Speed F:6.3—F:7.7*

Code Word	No.	Size of Plate Covered with Full Aperture Inches	Size of Plate Covered with Small Stops	Combin. of Single Protars Focus Inches		Combined Equiv. Focus Inches	Speed F	Lens and Barrel with Iris Diaphragm	Fitted with Aluminum Volute Shutter
				Front Lens	Back Lens				
Hem	1†	3¼ x 3¼	3¼ x 4¼	7 3/16	7 3/16	4⅛	6.3	$42.50	$59.50
Hematin	2	3¼ x 4¼	4 x 5	8¾	7 3/16	4½	7.0	45.50	62.50
Hematite	3	4 x 5	4¾ x 6½	11 3/16	7 3/16	5	7.7	50.00	67.00
Hemin	4	4 x 5	4¾ x 6½	8¾	8¾	5 1/16	6.3	48.50	65.50
Hemipter	5	4¼ x 6½	5 x 7	11 3/16	8¾	5⅝	7.0	53.00	70.00
Hemisect	6	4¼ x 6½	5 x 7	13¾	8¾	6⅛	7.7	59.50	78.00
Hemitone	7	4½ x 7¼	5 x 8	11 3/16	11 3/16	6⅜	6.3	57.00	74.00
Hemlock	8*	5 x 7	6½ x 8½	13¾	11 3/16	7	7.0	63.50	82.00*
Hempen	9	5 x 8	6½ x 8½	16 3/16	11 3/16	7½	7.7	74.00	92.50
Henbane	10	5 x 8	7 x 9	13¾	13¾	7⅞	6.3	69.50	88.00
Henotic	11	6½ x 8½	8 x10	16 3/16	13¾	8½	7.0	80.00	98.50
Hepar	12	6½ x 8½	8 x10	18⅞	13¾	9⅛	7.7	98.50	118.50
Hepatica	13	6½ x 8½	8 x10	16 3/16	16 3/16	9¼	6.3	90.50	109.00
Heptad	14	7 x 9	10 x12	18⅞	16 3/16	10	7.0	109.00	129.00
Heptane	15	7 x 9	10 x12	23¼	16 3/16	10⅞	7.7	128.00	148.00
Heptoic	16	7 x 9	10 x12	18⅞	18⅞	10 3/16	6.3	126.50	146.50
Heraldic	17	8 x10	11 x14	23¼	18⅞	11⅞	7.0	145.50	165.50
Herand	18	8 x10	11 x14	27⅛	18⅞	12¾	7.7	171.50	191.50
Herbage	19	8 x10	12 x16	23⅛	23¼	13¼	6.3	160.50	180.50
Herbar	20	10 x12	14 x17	27⅛	23¼	14 5/16	7.0	186.50	206.50
Herd	22	10 x12	16 x18	27⅛	27⅛	15½	6.3	209.00	229.00
Herdic	25	10 x12	17 x20	30¾	30¾	18¼	6.3	294.00	
Hereon	28	11 x14	18 x22	33⅞	33⅞	20¼	6.3	383.00	
Heresy	30	12 x16	22 x27	39¼	39¼	23⅜	6.3	504.00	

Larger plates are covered with smaller stops.

*No. 2 Volute is here regularly supplied. If it is desired to use the lens on a hand camera and No. 2 Volute is not wanted, we can adapt the Volute No. 1 by reducing the diameter of the lens. This in no way affects the speed of the combination. In ordering, kindly specify whether No. 1 or No. 2 Volute is to be furnished.

For matching lenses for stereoscopic work, $2.50 additional.

When ordering lenses fitted with shutter, by telegraph, specify *Volute*, in addition to the code word for the size of lens.

Each lens is furnished in a case which protects it from injury. Lens cap and focusing scale are included.

The shutter diaphragm scale is graduated for each focal length.

Bausch & Lomb Convertible Protar

In Sets

We list a large number of doublet combinations, and the purchase of additional Series VII combinations will furnish new focal lengths thus increasing proportionately the usefulness of the lens.

We offer two sets complete with the lenses mounted interchangeably, each set consisting of one lens mount with iris diaphragm, cap and flange, focusing scale and the single Protar lenses (three or four, as the case may be), all in a neat and compact moroco case.

C Set—Bausch & Lomb Convertible Protars

Complete in case, **$87.50.** Code word, *Hermes.*
Fitted with aluminum Volute Shutter, **$106.00.**
Case for complete set including shutter, **$1.00** extra.

Series	No.	Size of Plate Covered with Largest Stop* Inches	Equivalent Focus of Lenses in Inches			Speed
			Front Lens	Back Lens	Combined Focus	
VII	2	5 x 8		8¾		F:12.5
	3	6½ x 8½		11 3/16		F:12.5
	4	8 x 10		13¾		F.12.5
VIIa	5	4¼ x 6½	11 3/16	8¾	5⅝	F:7.0
	6	5 x 7	13¾	8¾	6⅛	F:7.7
	8	5 x 8	13¾	11 3/16	7	F:7.0

*Larger plates covered with smaller stops.

D Set—Bausch & Lomb Convertible Protars

Complete in case, **$170.00.** Code word, *Heriot.*
Fitted with aluminum Volute Shutter, **$190.00.**
Case for complete set including shutter, **$1.50** extra.

Series	No.	Size of Plate Covered with Largest Stop* Inches	Equivalent Focus of Lenses in Inches			Speed
			Front Lens	Back Lens	Combined Focus	
VII	3	6½ x 8½		11 3/16		F:12.5
	4	8 x 10		13 ¾		F:12.5
	5	10 x 12		16 3/16		F:12.5
	6	11 x 14		18 7/8		F:12.5
VIIa	8	5 x 8	13¾	11 3/16	7	F:7.0
	9	5 x 8	16⅛	11 3/16	7½	F:7.7
	9a	5 x 8	18⅞	11 3/16	8	F:7.7
	11	6½ x 8½	16⅛	13¾	8½	F:7.0
	12	6½ x 8½	18⅞	13¾	9⅛	F:7.7
	14	8 x 10	18⅞	16 3/16	10	F:7.0

*Larger plates covered with smaller stops.

Bausch & Lomb Wide Angle Lenses

Series IV *F:12.5*, Medium Wide Angle

This wide angle lens is remarkable for its covering power and speed which is sufficient for instantaneous exposures under favorable light condition out of doors. It is an ideal lens for interior flash light and group work, because its aperture admits ample light for focusing interiors and sufficient illumination is obtainable with less flashlight than when using lenses of less speed.

The first six numbers embrace an angle of field of more than 100°, the others an angle of 85° of which 70° and 45° respectively are utilized on the plates for which the various focal lengths are listed.

The Series IV is unsymmetrical in construction, and the combinations cannot be used singly.

Series V *F:18*, Extreme Wide Angle

This lens should be chosen for the most exacting wide angle photography, because the corrections for flatness of field and astigmatism have been carried to a greater degree of perfection than in other lenses of a similar type. Its effective angle and covering capacity especially recommend the Series V for architectural and interior reproductions.

The angle of view of the image circle is about 110° in the sizes from 1 to 7a; in the other sizes the angle is approximately 90°, of which 75° and 40° respectively are utilized. Larger plates are well covered at smaller apertures with increased angle of view. The Series V is unsymmetrical, and the combinations cannot be used singly.

Bausch & Lomb Medium Wide Angle
Series IV — *F:12.5*

Code Word	No.	Size of Plate Covered with Stop F:12.5 * Inches	Size of Plate Covered with Small Stops	Equiv. Focus Inches	Diameter of Large Lens Inches	Lens and Barrel with Iris Diaphragm
Harden	**1**	3¼ x 4¼	4 x 5	2 7/16	1/32	**$15.00**
Hardock	**2**	4 x 5	4¼ x 6½	3⅞	⅜	**15.00**
Harem	**3**	4¼ x 6½	5 x 7	4 11/16	15/32	**18.00**
Hark	**4**	5 x 8	6½ x 8½	6 1/16	⅝	**21.00**
Harmel	**5**	8 x10	10 x12	7 11/16	25/32	**27.00**
Harmonic	**6**	10 x12	12 x15	10¼	1 1/16	**40.50**
Harness	**7**	12 x15	16 x20	15 3/16	1 9/16	**61.50**
Harpoon	**8**	16 x20	18 x22	23 13/16	2½	**108.00**
Harrow	**9**	20 x24	24 x30	35 11/16	2 15/16	**243.50**
Hart	**10**	24 x30	28 x36	48⅜	3⅞	**543.50**

No. 2 to 6 inclusive, take No. 1 Volute, **$17.00** additional
" 7 " " " " " 2 " **19.50** "
" 8 " " " " " 3 " **20.00** "

Bausch & Lomb Extreme Wide Angle
Series V — *F:18*

Code Word	No.	Size of Plate Covered with Stop F:18* Inches	Size of Plate Covered with Small Stops	Equiv. Focus Inches	Diameter of Largest Lens Inches	Lens and Barrel with Iris Diaphragm
Hauteur	**1**	4¼ x 6½	5 x 8	3⅜	9/32	**$20.00**
Havildar	**2**	5 x 7	8 x 10	4⅞	⅜	**20.00**
Hawk	**3**	6½ x 8½	10 x 12	5 9/16	½	**25.00**
Haybote	**4**	8 x10	12 x 15	7 3/16	11/16	**31.00**
Haytian	**5**	10 x12	16 x 18	8⅜	13/16	**39.00**
Hazle	**6**	11 x14	18 x 22	10 7/16	1	**48.00**
Health	**7**	12 x15	20 x 24	12⅜	1 3/16	**57.50**
Heard	**7a**	16 x18	22 x 27	15⅜	1 1/16	**76.00**
Heathen	**8**	14 x17	17 x 20	18⅛	1 1/16	**76.00**
Heave	**9**	16 x18	22 x 27	24⅞	1 7/16	**111.50**
Heben	**10**	20 x25	24 x 30	37 5/16	2 1/16	**220.00**

No 1 to 8 inclusive, take No. 1 Volute, **$17.00** additional
" 9 " " " " " 2 " **18.50** "
" 10 " " " " " 3 " **20.00** "

For matching lenses for stereo work, add $2.50 to price of lenses.

When ordering lenses fitted with shutter, by telegraph, specify *Volute* in addition to code word for the size of lens. Each lens is furnished in a case which protects it from injury. Lens cap and focusing scale included.

Ray Filter

The new filter is made from spectroscopic Jena glass, colored throughout. It has two optically parallel plane surfaces, and is free from the ordinary filter troubles such as change of color, distortion of image, etc. The exposure on orthochromatic plates is about five times normal.

Style A has cork lining and fits like a cap. Style B has adjusting screws and fits lenses of different diameters. A1p is a special compact mounting for shutters with pumps close to cell.

Always send strip of paper just encircling lens cell when ordering.

Code Word	Catalog No.	Inside Diameter Inches	Price
Hilt	**A1**	1¼	**$4.00**
Himpne	**A1p**	1¼	**4.00**
Hindoo	**A2**	2	**6.00**
Hinge	**A3**	2¾	**9.00**
Hippa	**B1**	1¼	**4.00**
Hircic	**B2**	2	**6.00**
Hirudo	**B3**	2¾	**9.00**

Telephoto Attachment

The telephoto lens is a concave or negative element, used in a suitable mounting in connection with an anastigmat lens. As it magnifies every detail, the lens with which it is used must be of high excellence. The light being distributed over a larger area is necessarily less intense and therefore only rapid lenses can be used. The higher the magnification, the larger the image circle, but, of course, if the plate size remains constant, there will be less angle embraced at the higher magnifications.

The telephoto is mounted so that it fits the flange of the regular lens which in turn fits on the outer end of the adjustable telephoto mounting. The tables opposite give full details and specifications.

Bausch & Lomb Telephoto Attachment

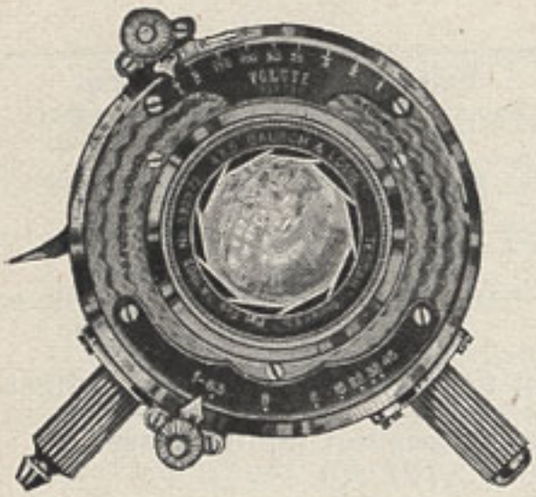
Code Word	Cat. No.	Focus Inches	Fitted to Bausch & Lomb Lenses	Fitted to Lenses of other Manufacture
Hidden	**2**	2⅜	**$22.00**	**$26.00**
Hieron	**3**	3	**28.00**	**32.00**
Highly	**4**	4	**37.00**	**42.00**

In every instance lenses should be sent to us to secure correct adjustment in fitting telephoto attachments. Price does not include case.

Bausch & Lomb Telephoto Magnifications and Extensions

POSITIVE LENS		TELE-PHOTO	AT THREE MAGNIFICATIONS		AT EIGHT MAGNIFICATIONS	
Number	Equiv. Focus Inches	Negative Element	Image Circle Inches	Bellows Draw Inches	Image Circle Inches	Bellows Draw Inches
15 Ic	6	2	5¼	4⅝	16	16
15a Ic	7 1/16	2	5	4⅜	14¼	16
5 IIb	6⅛	2	5	4¾	15½	16¼
5a IIb	7 1/16	2	4½	4⅜	13	16
5k IIb	6⅞	2	5	4⅞	13½	16
6 VIIa	6⅛	2	4¼	4⅝	15	16¾
7 VIIa	6⅜	2	4¾	4⅜	16	17¼
8 VIIa	7	2	4¼	4½	13¼	16⅛
9 VIIa	7½	2	5	4½	14	16¼
16 Ic	8¼	3	6	5¾	18	19¼
17 Ic	9⅞	3	6	5½	20	19¾
6 IIb	8¼	3	5⅞	5½	16¾	19⅞
7 IIb	10	3	5½	5⅝	17	20⅛
10 VIIa	7⅞	3	5½	5⅝	17½	19⅞
11 VIIa	8½	3	5½	5½	16	20¼
12 VIIa	9⅛	3	5¼	5 7/16	15½	19¾
13 VIIa	9¼	3	5½	5 9/16	17¾	19¾
14 VIIa	10	3	5¼	5⅜	16	19⅝
18 Ic	11⅞	4	9	7¼	24	26⅛
8 IIb	12	4	8¼	7½	21½	26¼
15 VIIa	10⅞	4	8½	7¼	22½	27⅝
16 VIIa	10 3/8	4	8	7 5/16	21½	26¾
17 VIIa	11⅞	4	7¾	7⅜	21	26½
18 VIIa	12¾	4	8	7½	23	27
19 VIIa	13¼	4	8½	7⅞	22½	28

Bausch & Lomb Volute Shutter



In the Volute shutter the diaphragm blades are the same as the shutter blades which means maximum illumination with minimum motion. There are more blades in the Volute shutter than in any other shutter on the market. This means absolutely uniform exposure and an increase in depth of focus, covering power and definition.

The Volute shutter is a setting shutter and its maximum exposure is one second. The minimum exposure varies in the different sizes as per table below but the shutter is fast enough for moving objects at such ranges as are within the limits of the cameras of the non-reflecting types. The pointer on the top sets for the various exposures, also for time and bulb exposures. The lever on the side sets the shutter and also serves as a finger release. The scale below is graduated for the various diaphragm readings and if several lenses are to be fitted, a wider scale can be provided. Where the combinations are numerous as in sets of Protars, additional scales may be put on, giving a scale for each focal length available.

The shutter cannot open and expose a plate while being set. The moving parts are enclosed, the mechanism is simple and durable, and the workmanship and finish are of the finest throughout. Volute shutters can be fitted to lenses of very slight separation such as our series IV and series V. This is because there is but one set of blades to go between the combinations.

No.	Inches Opening	Automatic Exposures	PRICE		
			Volute Shutter only	When Lenses Are Sent Us	
				Fitted to Bausch & Lomb Lenses	Fitted to Lenses of Other Manufacture
1	1	1 sec. to $\frac{1}{150}$ sec.	$17.00	$19.50	$20.50
2	$1\frac{7}{16}$	1 sec. to $\frac{1}{100}$ sec.	18.50	21.50	23.00
3	2	1 sec. to $\frac{1}{75}$ sec.	20.00	24.00	26.00

Price includes bulb and hose.

Table Showing the Sizes of Lenses and Shutters Which Can Be Adapted to Various Cameras.

No.		Size	Ic Tessar	Volute Shutter	Compound Shutter	IIb Tessar	Volute Shutter	Compound Shutter	VIIa Protar	Volute Shutter	Compound Shutter	V Protar	Volute Shutter
	KODAK												
	Vest Pocket	1⅝ x 2½				2a°							
1	Junior	2¼ x 3¼				2a		00					
1	Autog. Sp.	2¼ x 3¼	12	1*		3	1*	00					
1a	Autographic	2½ x 4¼				4		0					
1a	Special	2½ x 4¼				4		0					
1a	Autog. Sp.	2½ x 4¼				4		0					
1a	Speed	2½ x 4¼	14			4							
1a	F. P. K., R. R.	2½ x 4¼				4		0					
3	Autographic	3¼ x 4¼				4	1	0					
3	Special	3¼ x 4¼				4	1	0					
3	Autog. Sp.	3¼ x 4¼				4	1	0					
3	F. P. K.	3¼ x 4¼				4	1	0					
3a	Autographic	3¼ x 5½				5k	1‖	1					
3a	Autog. Sp.	3¼ x 5½				5k	1‖	1					
3a	Special	3¼ x 5½				5k	1‖	1					
3a	F. P. K.	3¼ x 5½				5k	1	1					
4	F. P. K.	4 x 5				5k	1	1					
4a	F. K.	4¼ x 6½				6	2	2					
4a	Speed	4¼ x 6½				6							
	GRAFLEX												
1a†	Graflex	2½ x 4¼	14										
3a†	Graflex	3¼ x 5½	15a			5a			7				
	Compact	3¼ x 5½	15a			5a			7				
	Compact	5 x 7	16										
Jr	Auto	2¼ x 3¼	13										
	R. B Junior	2¼ x 3¼	15										
	Auto	3¼ x 4¼	14			4							
	Auto	4 x 5	15			5							
	Auto	5 x 7	16			6							
	R B. Auto	3¼ x 4¼	15a			5a			10				
	R. B. Auto	4 x 5	17			7			13				
	Teles. R. B.	3¼ x 4¼	15			5							
	Teles. R B.	4 x 5	16			6			10				
	Press	5 x 7	16			6			13				
	Home Port.	5 x 7	18‡		5								
	Stereo Auto	5 x 7				Pr' 5							
	Naturalists	4 x 5							19				

°Cells to fit B. B. Shutter. †Regular or Autographic. ‡17 or 18 can be used.

*Optimo Shutter ‖ or Ia Optimo.

No.		Size	Ic Tessar	Volute Shutter	Compound Shutter	IIb Tessar	Volute Shutter	Compound Shutter	VIIa Protar	Volute Shutter	Compound Shutter	V Protar	Volute Shutter
	HAWKEYE												
1a	Model 1 or 2	2½ x 4¼				3		0					
3	Model 8 or 9	3¼ x 4¼				4	1	0					
3a	Model 3 or 4	3¼ x 5¼				5	1	1					
4	Model 3	4 x 5				5	1	1					
4	Model 4	4 x 5							7	1	1		
6	Stereo 6					P'r 4		0s					
	GRAPHIC												
	R. B. Cycle	4 x 5	15	2	2	5	2	1	7	1	2	2	1
	R. B. Cycle	5 x 7	16	3	3	6	2	2	10	2	2	3	1
	R. B. Cycle	6½ x 8½	17	3	4	7	2	3	13	2	3	3	1
	R. B. Cycle	8 x 10							17	3	4	4	1
	Stereoscopic	5 x 7				P'r 4			P'r 7			P'r 1	
		5 x 7							10				
	Speed	3¼ x 4¼	14			4							
	Speed	3¼ x 5½	15a			5a			7				
	Speed	4 x 5	15			5			4				
	Speed	5 x 7	16			6			10				
	CIRKUT												
6	Outfit	6½ film							9	2	3		
8	Outfit	8½ film							12	3	3		
	F. & S.												
	Commercial	8 x 10							17	3	4	4*	1
	Commercial	11 x 14							20	3		6‡	1
	Banquet	7 x 17				7	2	3	°16			6**	1
	Banquet	12 x 20				9a		5	°22			7**	2
	Home Portrait	8 x 10	18		5								
	CENTURY												
	Petite Grand	3½ x 5½				5	1	1	7	1	1		
	46 or Grand Sr.	4 x 5				5	1	2	7	1	2	2	1
	46 or Grand Sr.	5 x 7				6	2	3	10	2	2	3	1
	46 or Grand Sr.	6½ x 8½				7	2	3	13	2	3	3	1
	Stereo	5 x 7				4		1s	2		1s	P'r 1	

*Also IV No 8. ‡Also IV No. 9. **Series IV.

°Or any other VIIa lenses of suitable focus.

No.		Size	Ic Tessar	Volute Shutter	Compound Shutter	IIb Tessar	Volute Shutter	Compound Shutter	VIIa Protar	Volute Shutter	Compound Shutter	V Protar	Volute Shutter
—	PREMO												
12	Premo	2¼ x 3¼	12		1*	3		1*					
1a	Pr'm'ette Jr. Sp	2½ x 4¼				4		0					
	F. Plate or Spec.	2½ x 4¼				4		0					
	F. Plate or Spec.	3¼ x 4¼				4	1	0					
	F. Plate or Spec.	3 x 5¼				5	1	1					
	F. Plate or Spec.	3¼ x 5½				5k	1	1					
	F. Plate or Spec.	4 x 5				5	1	1					
	F. Plate or Spec.	5 x 7				5a	2	2	7	1	1	2	1
	Premo 4, 6 or 7	4 x 5				5	1	1	3	1	1	2	1
	Premo 4, 6 or 7	5 x 7				5a	2	2	8	§2	2	2	1
	Premo 4, 6 or 7	6½ x 8½				7	2	3	11	2	3	3	1
	Stereo	5 x 7				P'r 4		1s	P'r 2		1s		
	Premo 9	4 x 5				5	1	1	3	1	1	1	1
	Premo 9 or 10	5 x 7				5a	2	2	8	§2	2	1	1
	Premo 9	6½ x 8½				7	2	3	11	2	3	2	1
	Premo 12	2¼ x 3¼	12	1x									
	SENECA												
	Spec., Roll Film	2¼ x 3¼				2a		00					
	Spec. " "	2½ x 4¼				3		0					
	Spec. " "	3¼ x 4¼				4		0					
	Spec. " "	3¼ x 5½				5		1					
	Press	4 x 5	15a	2	3	5a	2	2	7	1	1		
	Press	5 x 7	16	3	3	6	2	3	8	1	2		
8,9	Seneca	4 x 5				5	1	1	7	1	1	1	1
8,9	Seneca	3¼ x 5½				5	1	1	7	1	1	1	1
8,9	Seneca	5 x 7				5a	2	2	8	1	2	2	1
8,9	Seneca	6½ x 8½				7	2	3	11	2	3	3	1
31	Pocket	4¼ x 5½				5	1	1					
32	Pocket	3¼ x 4¼				3	1	0					
32	Pocket	4 x 5				5	1	1					
32	Pocket	3¼ x 5½				5	1	1					
32	Pocket	5 x 7				5a	2	2					
	ANSCO												
3	V. P. Speedex		12										
1a	Fold. or Speedex					4	1	1*					
3	" " "					4	1	1*					
3a	" " "					5k	1	1a*					

§Or No. 1 Shutter. *Optimo Shutter.