BAUSCH & LOMB OPTICAL Co

OTOGRAPHIC OBJECTIVES SHUTTERS AND ACCESSORIES

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ROCHESTER·N·Y
NEW YORK — CHICAGO

PHOTOGRAPHIC LENSES

SHUTTERS AND ACCESSORIES

"THE BEST OF EVERYTHING OPTICAL"



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BAUSCH & LOMB OPTICAL CO.

ROCHESTER, N. Y.

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Bausch & Lomb Optical Company
Rochester, N. Y.

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Reduced from an 8 x 10 Photograph, made with a No. 1 Series V Lens.

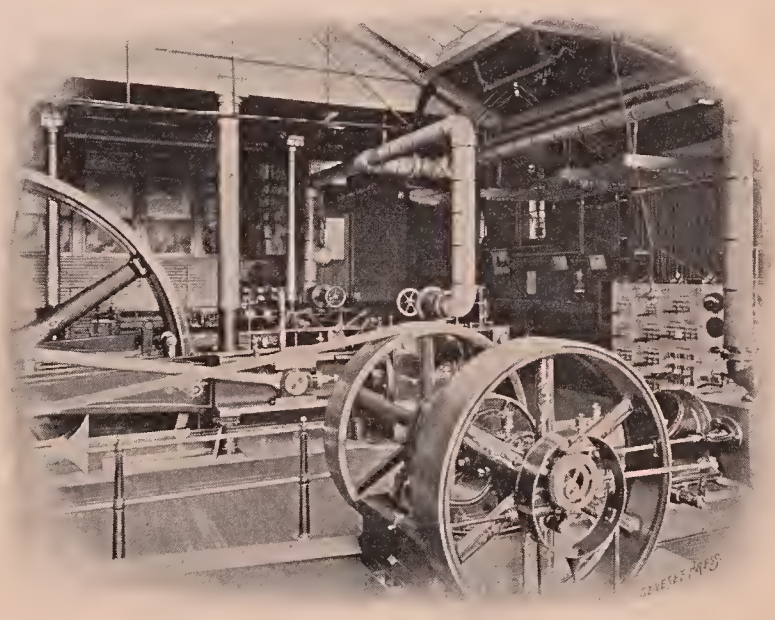
FRONT VIEW OF FACTORY, ROCHESTER, N. Y.

A FEW WORDS ON LENS MAKING

LENS making has been our specialty for nearly half a century, and embraces every conceivable form of lens, from that marvel of accuracy, the object lens of a high-power microscope objective, scarcely half the size of a pin's head, to the huge 36-inch lenses which serve as reflectors for the searchlights of modern men-o'-war.

The development of our business, from its most insignificant beginning until we are, at the present moment, the largest manufacturers of lenses in the world, has been due solely to the painstaking, accurate, and conscientious work which has been bestowed upon each individual one of our products, coupled with a never-tiring vigilance in securing for our works the most improved mechanical equipment, the best raw materials, and every advance which science has made in constructive formulæ.

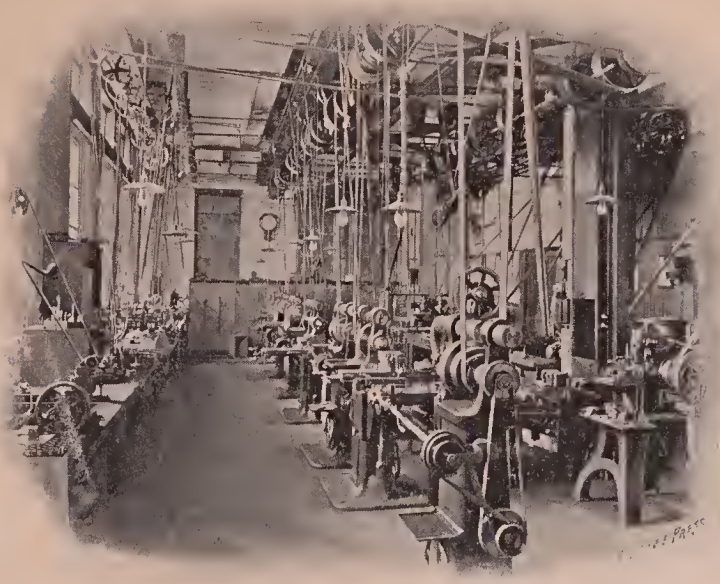
How many users of a lens realize the number of skilled hands and the number of operations through which the various parts have passed on the way from the rough material to the perfected objective?



A Village of Complicated Devices.

So exacting are the requirements of modern construction, that the processes involved are multiplied until a good sized village is employed. In our manufactory nearly one thousand operatives are actually employed in

optical work, using a mechanical equipment, consuming the energy of a seven hundred horse-power double engine. Steam, gas, compressed air, drinking and wash water are distributed in the departments through more than seven miles of piping. Over five thousand gallons of chilled water are required per day for washing lenses, and over seven hundred gallons of ice-water for drinking purposes in the same time, to cool which an eighteen-ton ice machine is in constant operation.



The Milling Machine has made it Possible to Duplicate Parts with Absolute Accuracy.

Optical work requires constant and careful inspection. To provide against dark days, early twilight, and for night labor, a complete electric lighting plant has been installed, with engine and dynamos, for two thousand incandescent and one hundred arc lights, which are fed through ten miles of insulated wire.



A piece of optical glass thirteen inches thick, and having the two surfaces polished, was placed over the calendar and the whole photographed to show the light transmitting power of the Jena glass.

Every department is in perfect communication with every other department by means of the Bell internal telephone system, requiring thirty miles of wire and forty telephone stations. From the central station one may not only communicate with every part of the works, but with every portion of the civilized world reached by telegraph, cable, or long-distance telephone. These are the nerves and arteries of our manufactory, and serve simply to outline the extensive equipment of delicate and accurate machinery, absolutely necessary in order to produce a grade of work which will test up to the high optical and mechanical standards which we have established.



Slab of optical glass partly sawed into strips from which lenses are cut.

In making the selection of a lens

or any other piece of apparatus, the construction and working value of which cannot be competently judged except by an expert in the manufacture of that particular article, the purchaser is almost wholly at the mercy of circumstances unless he can, by a knowledge of the methods employed in their production, form an estimate of the probabilities in favor of obtaining a perfect article. The purpose of this note is to give, in the briefest space, a plan of the methods employed in our works in making photographic lenses and accessories, but especially lenses, since it is regarding the optical qualities of lenses that the most extravagant claims are made, and the public has the least chance of determining the facts from a superficial examination or test such as is usually given before purchase.

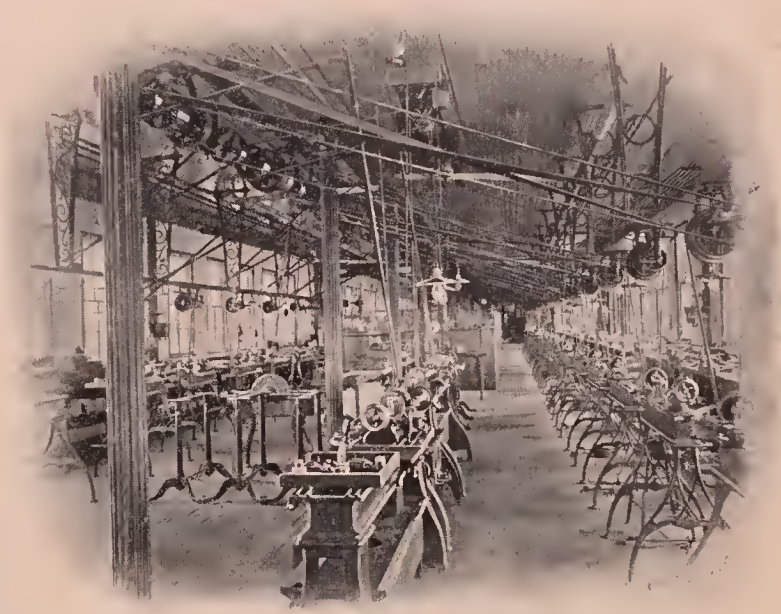


Piece of optical glass from which the lens is ground.

The glass stock vaults contain the choicest glass obtainable from all the best glass makers of the world, German, French, English — the justly famous Jena glass preponderating. Optical glass comes from the makers in square or oblong blocks, each having two small surfaces polished on opposite sides, so that each block may be examined and tested before any work is done upon it, in order that the foundation of the lens may be perfect to begin with. The first step in the manufacture of a lens is cutting the glass into pieces of suitable size by means of a diamond saw. The pieces are then carefully cemented upon a tool and ground roughly to the form the lens is to have. These partly formed lenses are then passed to the skillful grinder, who grinds the surfaces to the exact curvature required by the optical formula which he has constantly before him, testing the work at each step with a steel gauge to insure its accuracy. This continual testing is rigidly adhered to notwith-



Lens roughly ground to form.



The making of Lens Mountings and Iris Diaphragms is an industry in itself.

standing the high degree of manipulative and tactile skill acquired by the operatives. The lens now has the correct form and thickness, and is ready for that final process in which the highest skill and care are required, the polishing. The polish given the surfaces of a lens determines whether the finished objective shall give brilliant pictures or flat ones, whether it shall be slower than its ratio of focus to aperture indicates it should be, or have its normal speed, and whether it will retain its speed and brilliancy, or gradually lose them. Realizing the importance of perfect polishing, we have introduced the most thorough and exacting system of tests in our polishing department which has ever been devised. The foundation of the lens testing system is the test-glass, which consists of a block of hard glass having the curvature required for the finished lens polished in it absolutely true in every respect. To this curve the lens to be tested is fitted. If the lens surface is perfectly true, a series of rainbow colored rings (Newton's rings) will appear from the center to the circumference.



In grinding, as in all other processes, the skill and patience of individual labor enters into the excellence of our lenses.

A variation of $\frac{1}{500000}$ of an inch is instantly detectable by this test, and when the extreme delicacy of the test is considered, the reader will begin to appreciate the high standards which we have set for ourselves, and what it means to have the guarantee words

Bausch & Lomb Optical Company

engraved on a piece of optical work. The tests for thickness, freedom from scratches, striæ, etc., are equally severe, and the testing is not omitted when the lens leaves the polishing department. All the way through the various processes, centering, cementing, mounting, assembling, and the



Pit marks in defectively polished lens. Not visible to unaided eye.



Circular striation from defective polishing. Not visible to unaided eye.

finished objective itself, test after test is applied. As the lenses come from the final polishing they are perfect as to curvature and thickness, but the edges are still rough and the optical center does not coincide with the geometrical center. Each lens, large or small, must, therefore, be cemented on the spindle of a lathe and centered. The first operation in centering is to make the optical center of the lens coincide with the center of the lathe spindle. To do this the workman warms the cement and, with a forked wooden tool, presses the rapidly revolving lens into the proper position. The correct position is determined by watching the reflection of a bright object in the lens. When the image appears perfectly steady the lens is known to be centered. This centering test is an extremely delicate one and requires great dexterity and long practice on the part of the operative. The lens having been centered, it is turned down to the correct diameter with a diamond.



Cross striation, from defective polishing. Not visible to the unaided eye.



Stria in glass. Would not be noticed except by an expert glass tester.

The centered lenses are then thoroughly cleaned and passed to the cementers. Here the crown and flint lenses which are to form a lens system are carefully warmed to a uniform temperature and joined together with a special transparent balsamic cement. The utmost care is required in this step, as the slightest variation in the film of cement or the least decentering of any lens in the system would be fatal to its optical perfection. Even so apparently slight a thing as a little too much pressure on one side of the lens during the cementing may introduce a strain which will produce the most disastrous results.



Effect of strain in cement. Undetectable except by special test.

The cemented combinations have their edges carefully sealed with a black impermeable cement, and are then ready for mounting. The mounting of a lens does not seem at a glance to be so very important, but in reality the mount plays just as important a part in the make-up of a good photographic objective as the lenses themselves. First, the cells in which the lenses are placed must be perfectly true and centered to the smallest fraction of a millimeter, and the lenses must be fastened in them in such a manner as to be held perfectly rigid and true to the axis of the

mount, but at the same time not too tightly, lest the undue tension cause a false refraction. The interior of the mount must be so constructed that the full aperture of the lenses shall be utilized and all opportunity for reflections destroyed. The distances between the lens systems must be calculated with absolute accuracy, as the covering and defining power of the objective depends largely upon it. Finally, lightness combined with rigidity, and these with a pleasing and compact form, are required.



The final testing — the proof of skillful, patient labor.

The necessity for critical testing at every stage is apparent when it is remembered that a variation of $\frac{1}{1000}$ of an inch in the thickness of some lenses impairs the definition of the objectives, that the slightest variation of the thickness of the film of cement between the lenses, the slightest decentering or too tight mounting in the cell, will have the same result, and yet such an objective might pass the purchaser's test. It is always wiser to rely upon the products of an institution whose *methods* and *principles* are known to be the best.



Effect of minute crack in cement, such as would escape ordinary examination.

We are pleased to be able to state that our products have been our best and almost our sole advertisements in the past, and the fact that there are now over 102,000 of our photographic lenses in use, is sufficient evidence that the years of trial have demonstrated their superior quality to the entire satisfaction of the photographic world.

This enormous number represents only the double combination lenses, and does not include the several millions of single achromatic and other single lenses which we have made for photographic use. When our initial efforts in the production of photographic lenses were made, at which time only foreign lenses were in use, it was seriously questioned whether lenses could be made in this country.

As to the production of photographic shutters, of which tens of thousands are made annually, the same systematic and careful methods are employed; special tools and machinery, comparing in delicacy with those used in watch-making, are employed throughout.

IMPROVEMENTS IN LENS MOUNTINGS.

The mountings for our various lenses have been reconstructed to secure the greatest compactness, neatness, and interchangeability.

We have discarded the unsightly brass hoods formerly employed on the front of the lens, except in the very rapid lenses used in portraiture, as large hoods are found to be of no real benefit if the lenses and interior of mount are properly constructed. Large hoods will, however, be supplied if desired.

We have applied the iris diaphragm between the combinations of lenses whenever it is possible to do so, the smaller sizes of the wide-angle lenses only being supplied with revolving diaphragms.

Although steel is often used for the leaves of the iris diaphragm, they are liable to rust or become glossy and thereby create reflections; we prefer vulcanite, as it remains permanent. We use a large number of leaves, forming a practically round opening, which cannot be obtained otherwise.

After considerable experience in the use of aluminum we have entirely discarded it as unsuitable for the lens cells, and, while we recommend brass for the remainder of the mount, will employ aluminum for parts other than lens cells if it is desired, at an extra cost.

All lens mounts are engraved with our name, designation, number of lens, and size of plate. This is our guarantee, and every lens so engraved is warranted free from optical and mechanical defects.

ANGLES OF LENSES.

To avoid any misconception on the part of the purchaser, we give, in addition to the angle of the image circle, the exact angle of view of each lens, using the *long side of the plate for which the lens is rated* as the base. It has heretofore been customary to use the angle of the whole image circle of a lens, or at least that formed with the diagonal of the largest plate the lens would cover in designating the angle of a lens. Neither of these gives a correct idea of the *working angle* of the lens.

NEW APPARATUS.

The entire series of Bausch & Lomb-Zeiss Anastigmats is retained except Series I, and a new one is added under the name of the Bausch & Lomb-Zeiss Planar, giving advantages not possessed by any other lenses.

The popularity of our Iris Diaphragm Shutter is undiminished. We also list for the first time our Unicum Shutter, to meet the demand for a more simple form.

The Iconoscope, a perfect finder for all kinds of cameras, is also listed for the first time.

Although our Bichromate of Potash Ray Filters have found their way around the world, they have come into existence since our last catalogue was issued.

FOREIGN ORDERS.

It is gratifying to note that our products are finding favor abroad, where there are so many long established manufacturers of optical apparatus.

Accordingly we have established foreign agencies where our products may be obtained. Orders from foreign purchasers not convenient to an agency can be filled from our Rochester office.

DOMESTIC ORDERS.

The apparatus listed in this catalogue can be obtained from any dealer in photographic goods, either in the United States or Canada. Where there is any difficulty in obtaining our products through the dealer, we shall be pleased to supply them direct at prices as per catalogue.

LENSES ON APPROVAL.

We send lenses on ten days' approval to responsible parties sending satisfactory references, or will forward lenses for examination and trial in care of the express companies. The purchaser may, if he desires, forward the price of the desired apparatus with his order. The goods will then be sent on ten days' trial, and if not wanted, the amount in full will be returned on receipt of goods uninjured and charges paid.

Lenses may be ordered on approval through dealers in photographic goods.

TERMS.

Parties unknown to us will please send cash with order; or, if desirous to open credit account, will please give information and references that will enable us to pass upon the matter.

Checks drawn on banks other than New York, Boston, or Philadelphia are subject to collection charges of fifteen cents for amounts less than one hundred dollars, or one-eighth of one per cent. for amounts more than one hundred dollars, and this sum should be added to remittance.

When cash accompanies order, and goods are to be sent by mail, *add amount of postage to remittance*, otherwise goods will be sent by express, charges collect. Goods sent by mail are at purchaser's risk.

Goods will be sent by express C. O. D. only when amounting to more than five dollars, express and return charges to be borne by purchaser. One-fourth of total amount should accompany order.

CATALOGUES ISSUED

BY THE

BAUSCH & LOMB OPTICAL COMPANY:

MICROSCOPES, ACCESSORIES, AND LABORATORY SUPPLIES.

EYEGLASSES AND LENSES.

BAUSCH & LOMB-ZEISS STEREO FIELD GLASSES.

PHOTOGRAPHIC LENSES, SHUTTERS, AND ACCESSORIES.



NEGATIVE BY H.E. MURDOCK

GENESEE ART PRESS ROCHESTER N.Y.

IN MINNESOTA.

Bausch and Lomb-Zeiss Anastigmat Lens Series IIa

BAUSCH & LOMB-ZEISS ANASTIGMAT LENSES.

Invention of Dr. P. Rudolph. These lenses, invented by Dr. P. Rudolph of the firm of Carl Zeiss, Jena, from whom we have secured the exclusive right to manufacture them in America, under American patents, have marked an epoch in the construction of photographic lenses. Their optical advantages are so pronounced that they were immediately recognized, and are to-day generally accepted as the standard photographic lenses.

Like all meritorious articles, they were followed by imitations, but it is self-evident that the knowledge and ability which *originated* this type of lens must forge ahead of all imitators, no matter how strenuous their efforts. This truth is exemplified in the fact that "Zeiss Anastigmat" is the synonym for the "*Best photographic lenses in existence.*"

Imitations.

Material and Specifications Direct from Zeiss. The patentees have supplied us with the exact specifications for their construction, and keep us fully informed as to all improvements and the construction of new types. The high quality of these lenses exacts the most critical methods of workmanship in the various processes of manufacture and in the final tests. However, our long experience in the production of precise optical work, the painstaking care which is used, and the systematic control of work at each step of manufacture enable us to produce lenses possessing in the highest degree the superior optical properties appertaining to this improved construction.

Points of Superiority. The advantages of the Zeiss Anastigmat Lenses are: *The perfect correction of astigmatism*, astigmatism being a defect inherent in all the older types of lenses and even in some "anastigmat" lenses of other makers.

The proper correction of axial and marginal rays, and the *exact coincidence and equal magnitude of the visual and chemical images* giving sharply defined pictures over the entire plate, *reproducing straight lines* as such and *retaining the definition* with all stops, whichever may have been used to obtain the focus.

There is *no flare spot or ghost* to impair the brilliancy of the image, even when used under dazzling light.

The definition being perfect even with large apertures, as a result of the elimination of astigmatism and of curvature of the image, lenses of shorter focus for a given sized plate may be used, giving greater depth of focus, wide angle, and making the lens itself more compact.

Not Symmetrical. The Zeiss Anastigmats, except Series VIIa, are not symmetrical lenses in the sense that either of the combinations composing them may be used separately for photographic purposes, as it is impossible without the use of an additional set of elements to produce a single combination which will give satisfactory results.

If one will but give the claims made for lenses of symmetrical construction a moment's consideration, their fallacy will be recognized. Almost all lenses, except for studio and technical purposes, are at present used on folding hand cameras where compactness is the first consideration. In such cameras there is not sufficient bellows extension to permit the use of the rear combination of these lenses, as the focus is much longer than in the anastigmats covering the same plate. Furthermore, the results obtainable are far from satisfactory, as such single combinations not only require microscopic stops to secure definition, but are even then not at all rectilinear.

The Zeiss Anastigmat Lenses are the nearest approach to the ideal universal lens.

BAUSCH & LOMB-ZEISS PLANAR LENS, SERIES Ia.

SPEED f–3.6

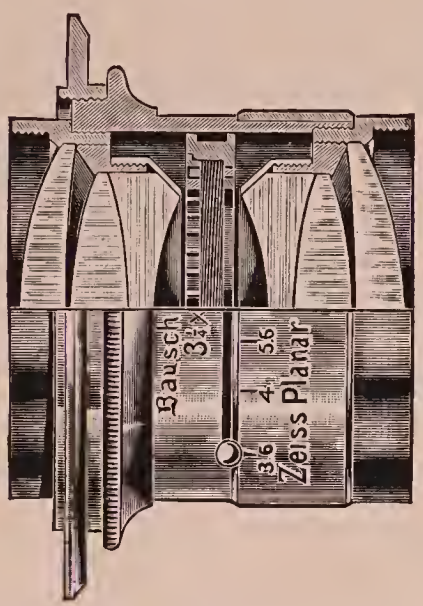


Figure shows the 3¼ x 4¼ Series Ia Lens actual size.

Description. These objectives are composed of two systems, the outer element of each being a single collective lens, and the inner composed of two dispersive lenses, having approximately the same refractive, but different dispersive power. On account of their extreme rapidity and the consequent large size of the lenses, the planars are somewhat heavier than the other anastigmats.

Optical Properties. These lenses reach the extreme limit of rapidity, the speed varying from f–3.6 in the smaller and medium sizes to f–5 in the larger sizes. The angle of the image circle is 72 degrees, of which 50 degrees are utilized on the small plates for which the lenses are rated. The Planars are superior in precision of defining power to any of the other anastigmats. In fact, the results obtainable are such as to leave nothing further to be desired.

Application. In this lens the photo-engraver will find that which he has looked in vain for in other lenses, viz., a lens which will give a reproduction equal to the copy, from same size down to the smallest reduction. They possess in addition great speed, making them time savers, not only in giving the best work, but with very short exposure.

Photo-Engraving.

Ultra Rapid Instantaneous Photography. For those difficult and peculiar classes of instantaneous photography where speed is the imperative quality, the Planar will be found a great improvement over the extra rapid lenses of other types heretofore used, as they have speed equal to that of the fastest portrait lenses, and at the same time a covering power which the others have not. For making kinemetograph and other negatives for the projection of animated pictures, these lenses are particularly well adapted, the smaller sizes having the requisite depth of focus and speed.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Planar Lenses.

SERIES Ia.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Largest Stop.* Inches.	Equivalent Focus. Inches.	Diameter of Lens. Inches.	Speed.	Angle. Deg.	Price. Lens Only.†
Plagium	9	2½ x 3¼	4½	1¼	f–3.6	70	$ 53 00
Plakoid	10	3¼ x 3¼	5	1½	f–3.8	70	63 00
Planeta	11	3¼ x 4¼	6¼	1¾	f–3.8	70	77 00
Planum	12	4¼ x 6½	8	2	f–4.	65	109 00
Plasma	13	5 x 8	10	2½	f–4.	65	150 00
Plastic	14	6½ x 8½	12	2¾	f–4.2	62	192 00
Plastron	15	7 x 9	14½	3¼	f–4.5	72	241 00
Plata	16	8 x 10	16¾	3¾	f–4.5	72	300 00
Platanno	17	10 x 12	18½	3¾	f–5.	68	349 00
Platinid	18	12 x 16	24	4¾	f–5.	68	698 00

* The next larger plate is well covered with intermediate stop.

† Nos. 9, 10, 11, and 12 only can be fitted with Iris Diaphragm Shutter.

Sizes larger or smaller than listed above will be made to order if desired.

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

BAUSCH & LOMB-ZEISS ANASTIGMAT LENS, SERIES II.

SPEED f–6.3

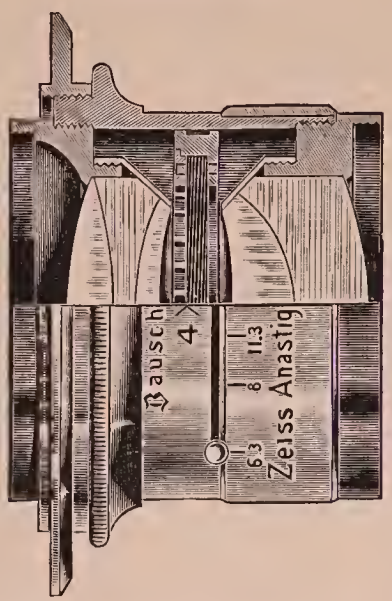


Figure shows 4 x 5 Series II Lens actual size.

Description. The front system of these objectives is composed of two and the back system of three lenses. As the systems are necessarily quite large, on account of the large aperture, the lens as a whole is somewhat heavy; the mounts, however, are reduced in weight in every practical way. The Iris Diaphragm shutter may be fitted to all sizes up to and including the 6½ x 8½. The sizes larger than 6½ x 8½ have an aperture greater than the largest opening of the shutter, hence, if fitted with a shutter, the speed would be reduced. Special shutters must therefore be used on these larger sizes.

Optical Properties. The speed of this series is f–6.3. Being one of the most rapid of the anastigmats, they are particularly adapted for the fastest instantaneous exposures, ordinarily rapid instantaneous work on cloudy days, in shaded situations, and in the studio.

The full angle of the field is 85 degrees, of which 46 degrees are utilized on the plates for which the respective sizes are rated. The anastigmatic and spherical corrections are of a very high order, especially considering the speed and angle.

Application. Where a lens is to be selected solely on account of great speed, and where the VIIa is too expensive, this lens will be found the best of all anastigmats.

Instantaneous Photography.

They possess a further advantage, that they may be used for all ordinary purposes by reducing the speed (aperture), thus giving the same covering power and depth of focus which other lenses working under the same conditions have.

General Work.

The Series II lenses are especially desirable for the studio on account of their great speed combined with optical qualities which enable the photographer to place sitters for groups in any desired position, and does not confine them to the usual semi-circular arrangement in order to secure equal definition and size of figures.

Studio.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Anastigmat Lenses.

SERIES II.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f-9.* Inches.	Equivalent Focus. Inches.	Free Diameter of Largest Lens. Inches.	Price.	
					Lens Only.	When Fitted with Diaphragm Shutter.
Zaffer	1	$2\frac{3}{4}$ x $3\frac{1}{4}$	$3\frac{3}{8}$	$\frac{5}{8}$	$ 30 00	$ 45 00
Zany	2	$3\frac{1}{4}$ x $4\frac{1}{4}$	$4\frac{1}{8}$	$\frac{3}{4}$	33 50	48 50
Zealous	3	4 x 5	$5\frac{1}{2}$	1	40 50	55 50
Zedoary	4	$4\frac{1}{4}$ x $6\frac{1}{2}$	$6\frac{11}{16}$	$1\frac{1}{4}$	51 00	66 00
Zephyr	5	5 x 7	$8\frac{1}{4}$	$1\frac{7}{16}$	64 50	80 50
Zigzag	6	5 x 8	$9\frac{13}{16}$	$1\frac{5}{8}$	78 50	96 00
Zinc	7	$6\frac{1}{2}$ x $8\frac{1}{2}$	$11\frac{13}{16}$	2	108 50	126 00
Zincky	8	8 x 10	$14\frac{3}{16}$	$2\frac{3}{8}$	150 00	
Zodiac	9	10 x 12	$16\frac{15}{16}$	$2\frac{13}{16}$	192 00	
Zone	10	11 x 14	$20\frac{1}{16}$	$3\frac{1}{4}$	240 50	
Zoology	11	12 x 15	$23\frac{1}{4}$	$3\frac{11}{16}$	300 00	

* The next larger plate is well covered with small stop.

Price for matching two lenses for stereoscopic work, $3.00.

For sizes of flanges, see page 66.

Special sizes of Series II lenses, either larger or smaller than listed above, are made to order only. Prices on application.

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

BAUSCH & LOMB-ZEISS ANASTIGMAT LENS, SERIES IIa.

SPEED f–8

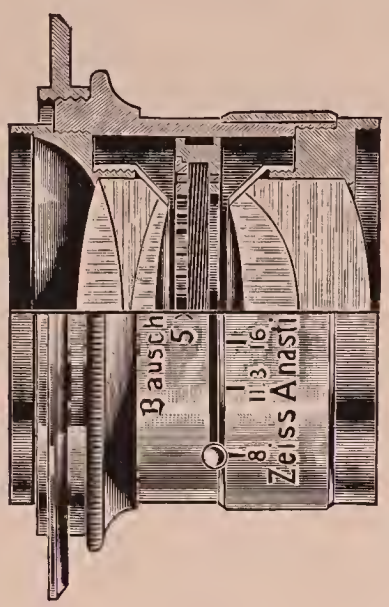


Figure shows the 5 x 7 Series IIa Lens actual size.

Description. The front system of these objectives is composed of two and the back system of three lenses, special Jena glass being used. The two systems have a greater separation than in the other anastigmat lenses, and therefore admit the application of the Iris Diaphragm shutter, as well as the Unicum and other shutters which operate between the lenses, to the smaller sizes. The mountings are extremely neat and compact.

Optical Properties. These lenses have a speed of f–8 and give ample illumination under unfavorable circumstances. The anastigmatic and spherical corrections are not equaled in any other lens, except the Series VIIa. They have therefore unequaled covering power, reproducing the minutest detail without the necessity of reducing the aperture, and rendering straight lines at all angles and in all parts of the field as such. They have an angular field of 75 degrees, 60 degrees of which are utilized on the plates for which the various sizes are rated. The focus of each lens of the series is shorter for the plate for which it is rated, than can be employed with other lenses, thus giving greater depth of focus and angle.

Application. On account of their superior optical qualities, short focus, the compactness of the mounting, and the applicability of shutters to them, the smaller numbers are better suited for use with hand cameras than any other lenses, excepting only the Series VIIa. This is also true regarding all the sizes when used for tripod cameras. In fact, they are the best of all the Zeiss Anastigmats where one lens only is to serve for all kinds of work.

Hand Cameras.

General Photography.

Studio. In a well lighted studio they are suited for portraits of heads and full figures on account of their depth of focus and for groups, as they do not require the proverbial semi-circular arrangement in order to secure definition and equal size of all figures.

Reproductions. Severe and practical tests have shown the Series IIa lenses to be well suited for copying, on account of faultless reproduction of detail, flatness of the field, and the capacity to copy straight lines at all angles. They are in everyday use by a large number of photo-engravers.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Anastigmat Lenses.

SERIES IIa.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f-8.* Inches.	Equivalent Focus. Inches.	Free Diameter of Largest Lens. Inches.	Price.	
					Lens Only.	When Fitted with Diaphragm Shutter.
Zaba	1	4 x 5	$4\frac{3}{8}$	$\frac{5}{8}$	$ 30 00	$ 45 00
Zaccho	2	$4\frac{1}{4}$ x $6\frac{1}{2}$	$5\frac{3}{8}$	$\frac{3}{4}$	33 50	48 50
Zapha	3	5 x 8	$6\frac{1}{2}$	1	44 00	59 00
Zamia	4	$6\frac{1}{2}$ x $8\frac{1}{2}$	8	$1\frac{3}{16}$	54 50	69 50
Zapote	5	8 x 10	$9\frac{5}{8}$	$1\frac{7}{16}$	64 50	80 50
Zarmich	6	10 x 12	$11\frac{5}{8}$	$1\frac{5}{8}$	85 50	103 00
Zax	7	11 x 14	$13\frac{3}{4}$	2	125 50	143 00
Zayah	8	14 x 17	17	$2\frac{3}{8}$	160 50	

* The next larger plate is well covered with small stop.

Price for matching two lenses for stereoscopic work, $3.00.

See page 66 for sizes of flanges.

Special sizes of the Series IIa lenses, either larger or smaller than listed above, will be made to order only. Prices on application.

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

BAUSCH & LOMB-ZEISS ANASTIGMAT LENS, SERIES III.

SPEED f–7.2

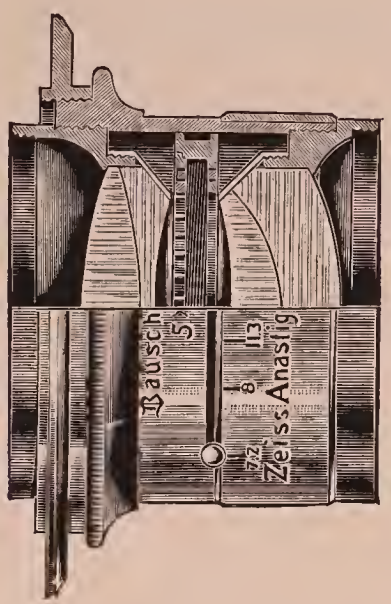


Figure represents the 5 x 7 Series III Lens actual size.

Description. The front system of these objectives is composed of two and the back system of two lenses, not, however, of symmetrical construction. This is the original type of the anastigmat lenses, and embodies the principles of correction on which the anastigmats are founded. They are of simpler construction than the Series II and IIa.

Optical Properties. The speed of this series is f–7.2. The anastigmatic corrections are not quite equal to the Series IIa and IIIa, but the speed being greater, it meets the requirements for a lens between the Series II and the IIa and IIIa.

The field embraces an angle of 85 degrees, about 50 degrees of which are intercepted by the plate for which the special sizes are rated.

Application. The Series III lenses being less in price than the Series II and IIa, and still spherically and anastigmatically well corrected, are often preferred to the latter, as they are sufficiently rapid for nearly all instantaneous work.

General Photography.

They are particularly adapted for portraiture and for photographing groups, as they do not require the proverbial semi-circular arrangement, and for single figures give roundness with excellent definition.

Studio.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Anastigmat Lenses.

SERIES III.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f-7.2.* Inches.	Equivalent Focus. Inches.	Free Diameter of Largest Lens. Inches.	Price.	
					Lens Only.	When Fitted with Diaphragm Shutter.
Zumic	1	$3\frac{1}{4}$ x $4\frac{1}{4}$	$3\frac{13}{16}$	$\frac{5}{8}$	$ 24 50	$ 39 50
Zurbite	2	4 x 5	$4\frac{3}{4}$	$\frac{3}{4}$	28 00	43 00
Zoonic	3	$4\frac{1}{4}$ x $6\frac{1}{2}$	$5\frac{13}{16}$	1	31 50	46 50
Zoolite	4	5 x 7	$7\frac{11}{16}$	$1\frac{1}{4}$	42 00	57 00
Zomar	5	5 x 8	$8\frac{11}{16}$	$1\frac{7}{16}$	52 50	68 50
Zode	6	$6\frac{1}{2}$ x $8\frac{1}{2}$	$9\frac{13}{16}$	$1\frac{5}{8}$	63 00	80 50
Zizel	7	8 x 10	$12\frac{5}{16}$	2	84 00	101 50
Zorcon	8	10 x 12	$17\frac{3}{8}$	$2\frac{13}{16}$	132 50	
Zincode	9	12 x 15	$23\frac{1}{16}$	$3\frac{11}{16}$	188 50	

* The next larger plate is well covered with small stop.

Price for matching two lenses for stereoscopic work, $3.00.

See page 66 for sizes of flanges.

Special sizes of Series III lenses, either larger or smaller than listed above, are made only to order. Prices on application.

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

BAUSCH & LOMB-ZEISS ANASTIGMAT LENS, SERIES IIIa.

SPEED f–9

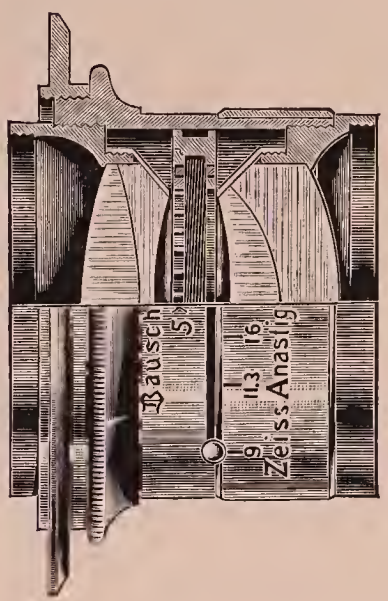


Figure represents the 5 x 7 Series IIIa Lens actual size.

Description. The objectives of this series are composed of four lenses, somewhat less in diameter than the preceding series, therefore lighter and more compact.

Optical Properties. Having a speed of f–9, they are suitable for all ordinary instantaneous work. The anastigmatic corrections are perfect beyond the size of plate for which they are rated. The field embraces an angle of 97 degrees, and about 55 degrees are included by the plates for which the various numbers are scheduled. It is therefore practical to use them as medium wide-angle lenses on larger plates than those for which they are rated, giving perfect definition to the margin, an advantage not possessed by any lens of any other make.

Application.

Hand Cameras. Where a cheaper though somewhat slower lens than series IIa is desired for hand camera work, the IIIa is recommended.

General Photography. For general photography, they are good outdoor lenses and cheaper than Series IIa, and may be used as medium wide angle objectives on larger sized plates than those for which they are rated.

Stereoscopic Work. The small sizes have the proper angle for stereoscopic work with great depth of focus.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Anastigmat Lenses.

SERIES IIIa.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f–9.* Inches.	Equivalent Focus. Inches.	Free Diameter of Largest Lens. Inches.	Price.	
					Lens Only.	When Fitted with Diaphragm Shutter.
Zas	0	2¾ x 3¼	3	7/16	$ 21 00	$ 36 00
Zif	00	3¼ x 4¼	3¾	½	21 00	36 00
Zinn	1	4 x 5	4¾	⅝	23 00	38 00
Zihn	2	4½ x 6½	5⅞	¾	26 50	41 50
Zeguel	3	5 x 7	6¾	⅞	31 50	46 50
Zaddow	4	5 x 8	7 11/16	1	35 00	50 00
Zerial	5	6½ x 8½	9 1/16	1¼	45 50	60 50
Zerious	6	7 x 9	10¾	1 7/16	56 00	72 00
Zerf	7	8 x 10	12½	1⅝	70 00	86 00
Zerge	8	10 x 12	16	2	105 00	122 50
Zet	9	11 x 14	19⅞	2 7/16	139 50	
Zeton	10	12 x 15	23⅝	2 13/16	174 50	
Zetto	11	14 x 17	27 3/16	3¼	227 00	
Zeven	12	16 x 20	32¼	3 11/16	279 00	

* Next larger plate is well covered with smaller stop.

Price for matching two lenses for stereoscopic work, $3.00.

For size of flanges see page 66.

Special sizes of Series IIIa lenses, either larger or smaller than listed above, are made to order only. Prices on application.

In using the telegraphic code specify *Diaphragm* if diaphragm shutter is desired, in addition to the code word for the size of lens.

BAUSCH & LOMB-ZEISS ANASTIGMAT LENS, SERIES IV.

SPEED f–12.5

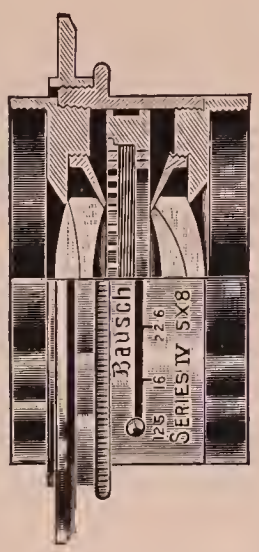


Figure shows 5 x 8 Series IV Lens actual size.

Description. These are very compact objectives, each system being composed of two lenses. The two systems are not, however, of the same focus, hence not usable as single lenses. The improved Jena glass is used in this as in the other anastigmats.

The mountings are all fitted with Iris Diaphragm, except the two smaller sizes, in which the systems are so close together that the revolving diaphragm only can be used.

Optical Properties. The speed is f–12.5, which is fast enough for outdoor instantaneous work under favorable circumstances. The field of the first six numbers embraces an angle of over 100 degrees. They give an angle of 68 degrees on the long side of the plates for which they are rated. The full angle of the larger numbers is 85 degrees, of which 44 degrees are utilized on the plates for which they are listed.

Application.

Instantaneous Wide-angle Photography. *For rapid wide-angle work* or where architectural or other subjects are to be photographed instantly, and where the distance from the camera is such as to require a wide-angle lens, the first six numbers are recommended.

Flash-light Interiors. Interior photography, where a rapid lens is desired, as for flash-light work, and still a wide angle required.

Reproductions. Either enlarging or reducing. The five larger sizes are designed especially for copying, and are of less aperture than the smaller numbers of the series.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Anastigmat Lenses.

SERIES IV.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f-1.5.* Inches.	Equivalent Focus. Inches.	Free Diameter of Largest Lens. Inches.	Price. Lens Only.
Zibet	1	$3\frac{1}{4}$ x $4\frac{1}{4}$	$2\frac{7}{16}$	$\frac{1}{4}$	$ 17 50
Zeud	2	4 x 5	$3\frac{7}{8}$	$\frac{3}{8}$	17 50
Zoffer	3	$4\frac{1}{4}$ x $6\frac{1}{2}$	$4\frac{11}{16}$	$\frac{1}{2}$	21 00
Zein	4	5 x 8	$6\frac{1}{16}$	$\frac{5}{8}$	24 50
Zircon	5	8 x 10	$7\frac{11}{16}$	$\frac{13}{16}$	31 50
Zoril	6	10 x 12	$10\frac{1}{4}$	1	47 00
Zennir	7	12 x 15	$15\frac{3}{16}$	$1\frac{5}{16}$	71 50
Zofil	8	16 x 20	$23\frac{13}{16}$	2	125 50
Zodic	9	20 x 24	$35\frac{11}{16}$	$2\frac{15}{16}$	282 50
Zunn	10	24 x 30	$48\frac{3}{8}$	$3\frac{7}{8}$	631 00

* The next larger plate is well covered with smaller stop.

For sizes of flanges, see page 66.

In using the telegraphic code specify *Diaphragm* if the Iris Diaphragm shutter is desired fitted to the lens, in addition to the code word for the size of lens.

BAUSCH & LOMB-ZEISS ANASTIGMAT LENS, SERIES V.

SPEED f–18

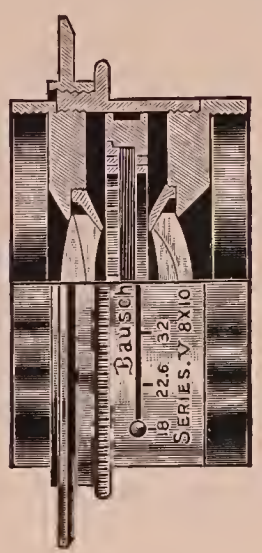


Figure shows 8 x 10 Series V Lens actual size.

Description. The two dissymmetrical systems are composed of two lenses each. Being small and very close together, the objectives are the most compact possible to construct. The mountings are fitted with the Iris Diaphragm, except in the two smaller sizes, where the systems are so close together that the revolving diaphragm only can be used.

Optical Properties. The speed of the lenses of this series is f–18. The field embraces an angle of 110 degrees in the sizes up to and including No. 7a. The full angle of the lenses above No. 7a is 90 degrees. On the plate for which the smaller numbers are rated, the angle is 75 degrees, but the full angle may be obtained by using them on larger plates with smaller stops. The larger sizes have an angle of about 40 degrees on the plates for which they are listed. The anastigmatic and spherical corrections are the most perfect yet obtained in a wide-angle lens, and the images are entirely free from distortion to the margin of the plate even with the most extreme angle.

Application. The lenses of this series are without question the most desirable wide-angle lenses made, and should be selected wherever an extreme wide angle is required. They have greater speed and covering power and greater effective angle than any other extreme wide-angle lens, and are at the same time much more compact.

Extreme Wide-angle Work.

Copying. The larger sizes were designed especially for copying, and for that purpose cannot be equaled in the quality of work which they will do. They are, however, not quite rapid enough for some kinds of photo-engraving.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Anastigmat Lenses.

SERIES V.

All Lenses are supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f-18.* Inches.	Equivalent Focus. Inches.	Free Diameter of Largest Lens. Inches.	Price. Lens Only.	Price. When Fitted with Diaphragm Shutter.
Zambo	1	$4\frac{1}{4}$ x $6\frac{1}{2}$	$3\frac{3}{8}$	$\frac{9}{32}$	$ 22 50	
Zanite	2	5 x 7	$4\frac{3}{8}$	$\frac{3}{8}$	22 50	
Zeal	3	$6\frac{1}{2}$ x $8\frac{1}{2}$	$5\frac{9}{16}$	$\frac{1}{2}$	28 00	$ 43 00
Zebra	4	8 x 10	$7\frac{3}{16}$	$\frac{9}{16}$	35 00	50 00
Zebu	5	10 x 12	$8\frac{3}{8}$	$\frac{11}{16}$	44 00	59 00
Zealot	6	11 x 14	$10\frac{7}{16}$	$\frac{13}{16}$	54 50	69 50
Zenith	7	12 x 15	$12\frac{5}{16}$	$\frac{15}{16}$	64 50	79 50
Zet	7 a	16 x 18	$15\frac{3}{8}$	1	75 00	90 00
Zulo	8	12 x 15	$18\frac{1}{8}$	1	85 50	100 50
Zero	9	16 x 18	$24\frac{7}{8}$	$1\frac{3}{8}$	125 50	141 50
Zest	10	20 x 25	$37\frac{5}{16}$	$2\frac{1}{8}$	247 50	

* The next larger plate is covered with small stop.

Special sizes of Series V lenses, either larger or smaller than listed above, will be made to order only. Prices on application.

See page 66 for sizes of flanges.

When ordering shutter fitted to lenses, by telegraph, specify *Diaphragm* if the Iris Diaphragm shutter is desired, in addition to the code word for the size of lens.

BAUSCH & LOMB-ZEISS ANASTIGMAT LENS, SERIES VII.

SINGLE ANASTIGMATS.

SPEED f–12.5

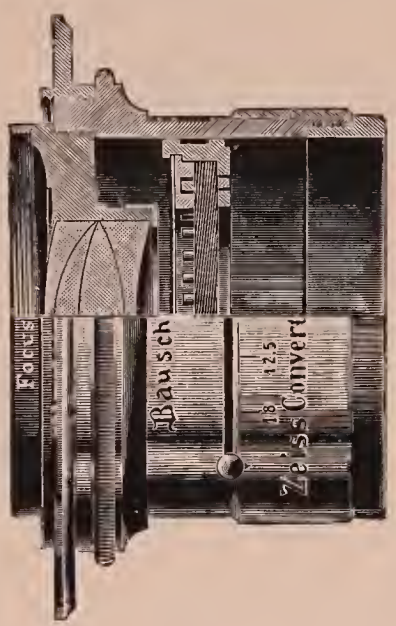


Figure shows No. 1, Series VII Lens actual size.

Description. The single anastigmatic system is composed of four elementary lenses (two pairs) cemented together. The lens system is mounted in a separate adapter of standard size, which fits either end of the tube of the mount. This construction has been adopted to carry out the original design of the inventor of this remarkable lens, viz.: the combination of two systems of the same or different foci, each of which is in itself a perfect anastigmat, to form a doublet of extreme speed and angle. A Series VII single anastigmat consists of one lens system in an adapter as described above, and a mounting into which the lens system fits (see figure). The mounting is provided with Iris Diaphragm. The diaphragm apertures (stop numbers) are engraved in U. S. numbers on a movable ring, which may bear numbers for two or more single anastigmats of different foci, and also for their combined focus. Each system has a serial number and the focal length engraved upon it for reference.

Optical Properties. The history of lenses shows the invention, trial, and decadence of a large number of "all purpose" lenses, i. e., doublets in which it was sought to produce single systems of sufficient covering power to be usable separately, and which, when combined, would produce a good doublet

of greater speed and angle. Some of these lenses are still offered, but they will be found unsatisfactory for the reason that the astigmatism and spherical distortion inherent in all single systems of the symmetrical type of lens, are impossible of elimination except by the method devised by



FIG. 1.
Made with a 7-in. Focus Convertible Anastigmat Lens.

Correction. Dr. Rudolph for the single anastigmats, viz., the anastigmatic correction of the single systems according to the same principles employed in the correction of the preceding systems of doublets. The increase in the number of lenses and the development of suitable glass has made it possible to apply these principles in the single anastigmats with much more satisfactory results than is possible where a less number is employed.

Speed. The speed of the single anastigmats is f–12.5.

Angle. The field has an angle of 85 degrees, of which from 35 to 48 degrees are utilized on the plates for which each size is listed.

The images given are anastigmatic, very flat, and with almost no distortion, the little which does exist being detectable only in that portion of the image circle outside of the area included by the plate for which each size is listed.



FIG. 2.
Made with Back Combination of 7-in. Convertible Anastigmat Lens, from same position as Fig. 1.

Application. While it is not intended that the single anastigmats shall take the place of the more rapid and wider angle doublets, they form the basis for the Series VIIa Convertible Anastigmats, and have in addition a distinct field of their own, in that, when used singly, they give the most excellent results as landscape lenses, the ratio of focus to diagonal of plate for each number being considerably greater than that of the doublet lenses commonly used for all around work.

Landscape Photography.



FIG. 3.
Made with Front Combination of 7-in Convertible Anastigmat Lens, from same position as Fig. 1.

The speed is sufficient for instantaneous exposures under favorable circumstances.

Group Work. For outside group work they are also excellent, giving negatives of great brilliancy and beautiful definition, with agreeable perspective.

PRICE-LIST

OF

Bausch & Lomb-Zeiss Single Anastigmat Lenses.

SERIES VII.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f-12.5.* Inches.	Equivalent Focus. Inches.	Back Focus. Inches.	Diameter of Front Lens. Inches.	Diam. of Image. Inches.	Price.	
							Lens Only.	When Fitted with Diaphragm Shutter.
Acacia	1	$4\frac{3}{4}$ x $6\frac{1}{2}$	$7\frac{1}{4}$	8	$\frac{5}{8}$	11	$ 26 50	$41 50
Acarina	2	5 x 7	9	$9\frac{3}{4}$	$\frac{3}{4}$	$13\frac{1}{2}$	30 00	45 00
Aceton	3	$6\frac{1}{2}$ x $8\frac{1}{2}$	$11\frac{1}{2}$	$12\frac{3}{4}$	1	$17\frac{1}{4}$	35 00	50 00
Achilles	4	8 x 10	14	$15\frac{1}{2}$	$1\frac{1}{4}$	$21\frac{1}{4}$	42 00	57 00
Acidalia	5	10 x 12	$16\frac{1}{2}$	$18\frac{1}{2}$	$1\frac{1}{2}$	25	54 50	70 50
Aconitum	6	11 x 14	$19\frac{1}{4}$	$21\frac{1}{4}$	$1\frac{5}{8}$	29	75 00	92 50
Adinol	7	12 x 16	$23\frac{1}{2}$	$26\frac{1}{4}$	2	$35\frac{1}{2}$	96 00	
Aeneas	8	13 x 16	$27\frac{1}{2}$	$30\frac{1}{2}$	$2\frac{3}{8}$	$41\frac{3}{4}$	125 50	
Aeolus	9	16 x 18	$30\frac{3}{4}$	34	$2\frac{3}{4}$	$47\frac{1}{4}$	174 50	
Aequator	10	16 x 20	34	$37\frac{1}{2}$	$3\frac{1}{4}$	52	227 00	
Aether	11	18 x 22	$39\frac{1}{2}$	$43\frac{1}{2}$	$3\frac{3}{4}$	60	296 50	

*The next larger plate is well covered with small stop.

When ordering by telegraph it is sufficient to use the code word placed opposite the number.

When ordering shutters fitted to lenses, by telegraph, specify *Diaphragm* when the Iris Diaphragm shutter is desired, in addition to the code word for the size of lens.

For sizes of flanges, see page 66.

The mountings of these lenses are provided with a revolvable ring, engraved with the F value of each of the Single and of the Doublet combinations.

If an additional combination is purchased, the graduated ring is exchanged for another engraved with scales for all of the combinations. A stop fixes the scale in the proper position.

When ordering an additional Single combination, give the serial number of the lens with which it is to be used.

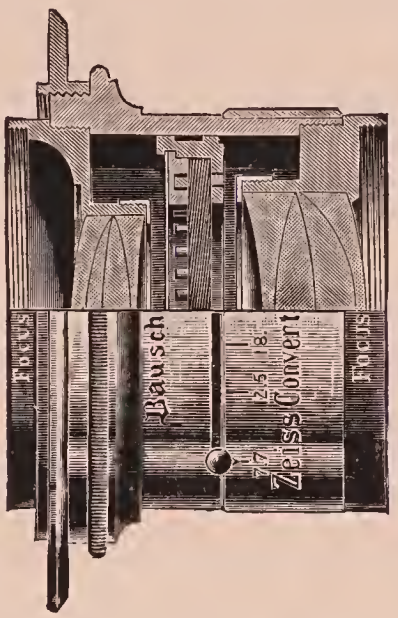
When the Single combination is desired without mounting, an allowance of $1.50 will be made on numbers 1–5, and $3.00 for numbers 6–10.

Nos. 1, 2, and 3 fit the same mount, and each larger size requires a succeedingly larger mount; all sizes below any given size can, however, be fitted for that mount if desired.

BAUSCH & LOMB-ZEISS CONVERTIBLE ANASTIGMAT LENS SERIES VIIa.

QUADRUPLE ANASTIGMATS.

SPEED f–6.3



Description. The Convertible Anastigmats are doublet lenses composed of two of the single anastigmats, Series VII. They contain eight elementary lenses arranged in pairs, two pairs in each system. They may therefore be properly termed quadruple anastigmats. Such a lens is convertible into three lenses of different foci and angle where the two single anastigmats are of different foci, or into two where they are of the same foci.

The most practical combinations of single anastigmats are indicated in the appended table of Series VIIa lenses.

Optical Properties. The speed when composed of two single anastigmats of the same foci is f–6.3. When the single anastigmats are of different foci, the speed is f–7 or f–7.7, according to the relative foci employed.

The full angle of the image circle is 80 degrees. The average angle utilized on the size plate for which the numbers are commonly used is about 55 degrees.

As might be expected from the excellence of the single anastigmats, the Convertible Anastigmats formed by combining two of them are simply perfection in all the qualities which are desired in a photographic lens. The covering and defining power is faultless. All parts of the image circle are equally well corrected. It is possible, therefore, to use, and still retain the large aperture, lenses of much shorter foci than where the optical properties are of a lower order, hence the great depth of focus and angle which the members of this series possess.

Astigmatism is entirely eliminated, and as an example of the mathematical perfection of the image, we cite the fact that the Series VIIa lenses are now used in the delicate work of copying bank check, certificate, and bond engravings, the lines of which are very fine and run at every conceivable angle. Such perfection not only yields excellent results in ordinary photography under adverse circumstances, but adds that much desired brilliancy to all the work of the lens.

Application. The photographer who essays all classes of subjects with one lens only, whatever the focus of that lens may be, will surely be disappointed in many ways.

The long-focus lens which gives the most pleasing landscapes will fail utterly for photographing a moving object. Examples of this kind might be cited indefinitely. On the other hand, the multiplicity of lenses, front boards, flanges, shutters, cases, caps, etc., which the photographer is forced to carry about with him in order to have a "complete equipment" in the ordinary sense of the word, is almost equally unfortunate. The problem is solved by the Convertible Anastigmat, as each of its systems may be used singly for work requiring a long or medium long focus, low or medium angle and medium speed, while the combined systems give an extra rapid lens of wide angle suitable for the fastest instantaneous exposures, the most difficult architectural subjects, and for any situation where speed, angle, covering power, depth of focus, and brilliancy are required. By the addition of one single anastigmat to a Series VIIa lens, six lenses, three single and three doublets, each having different angle, focus, and covering power, may be obtained.

Typical Universal Lens.

The addition of two single anastigmats to a Series VIIa lens, gives ten different lenses, four single and six doublets.

The advantages of the convertible features of the Series VIIa lenses may be summed up as follows:

Every doublet is in reality three lenses, each perfectly adapted for a separate kind of work.

The addition of one system adds three lenses, making six in all.

The addition of two systems adds seven lenses, making ten in all.

The greatest possible compactness is secured.

The least weight.

The fewest parts to lose or wear out.

For hand cameras these lenses stand at the head of the list both in optical qualities and in their adaptability to the limited space allowed for the lens. In selecting the lens see that the *back focus* of no combination selected is longer than the greatest extension of which the bellows is capable.

Hand Cameras.

The Series VIIa Anastigmats in which the two systems are of the same foci, and especially the larger sizes, are well adapted for process work and copying of all kinds. The fact that they are now in use by many prominent photo-engravers, and give universal satisfaction, is the best evidence of their excellence.

Photo-Engraving.

PRICE-LIST

OF

Convertible Anastigmat Lenses.

SERIES VIIa.

Telegraphic Code.	No.	Size in Inches of Plate Covered with Full Aperture.*	Combinations of Single Anastigmats. Focus. Front Lens.	Combinations of Single Anastigmats. Focus. Back Lens.	Combined Equivalent Focus. Inches.	Speed.	Diameter of Image Inches.	Price. Lens Only.	Price. When Fitted with Diaphragm Shutter.
Agonie	1	3¼ x 3¼	7¼	7¼	4⅛	f–6. 3	6¾	$ 51 00	$ 66 00
Alabaster	2	3¼ x 4¼	9	7¼	4½	f–7	7½	54 50	69 50
Alauda	3	4 x 5	11½	7¼	5	f–7. 7	8½	59 50	74 50
Albatros	4	4 x 5	9	9	5	f–6. 3	8½	58 00	73 00
Alizarin	5	4¼ x 6½	11½	9	5¾	f–7	9½	63 00	78 00
Alkaloid	6	4¼ x 6½	14	9	6¼	f–7. 7	10½	70 00	85 00
Alkohol	7	4½ x 7¼	11½	11½	6½	f–6. 3	10¾	68 00	83 00
Amidon	8	5 x 7½	14	11½	7	f–7	12	75 00	90 00
Ananas	9	5 x 8½	16½	11½	7½	f–7. 7	12¾	87 50	103 50
Anchovis	10	5 x 8½	14	14	8	f–6. 3	13¼	82 00	97 00
Anilin	11	6½ x 8½	16½	14	8½	f–7	14¼	94 50	110 50
Anthracit	12	6½ x 8½	19¼	14	9¼	f–7. 7	15¼	115 50	133 00
Antimon	13	6½ x 8½	16½	16½	9¼	f–6. 3	15½	106 50	122 50
Antipyrin	14	7 x 9	19¼	16½	10	f–7	16¾	127 50	145 00
Apostat	15	7 x 9	23½	16½	11	f–7. 7	18¼	148 50	166 00
Aristos	16	7 x 9	19¼	19¼	11	f–6. 3	18¼	146 50	164 00
Asbest	17	8 x 10	23½	19¼	12	f–7	20	167 50	185 00
Athene	18	8 x 10	27½	19¼	12¾	f–7. 7	21½	197 00	214 50
Atlas	19	8 x 10	23½	23½	13¼	f–6. 3	22¼	188 50	206 00
Atropin	20	10 x 12	27½	23½	14½	f–7	24	218 00	
Aurora	22	10 x 12	27½	27½	15½	f–6. 3	26	247 50	
Autor	25	10 x 12	30¾	30¾	18¼	f–6. 3	26	345 50	
Azoflavin	28	11 x 14	34	34	20¼	f–6. 3	28¼	450 00	
Azurin	30	12 x 16	39½	39½	23½	f–6. 3	31½	589 50	

* The next larger plate is covered with smaller stop.

The mountings of these lenses are provided with a revolvable ring, engraved with the F value of each of the Single and of the Doublet Combinations.

The correct stop for each of the lenses is thus always read from the scale, exactly as in the case of a simple lens.

If an additional combination is purchased, the graduated ring is exchanged for another, engraved with scales for all the combinations.

When ordering an additional Single Combination, give the number of the lens with which it is to be used.

Nos. 1, 2, 3, 4, 5, and 7, when desired for hand cameras, are mounted in special compact mountings, and the 4 x 5 Iris Diaphragm Shutter can then be fitted to them, in which case a reduction of $1.00 is made from the listed price of the respective sizes fitted with Iris Diaphragm Shutter.

SETS OF BAUSCH & LOMB-ZEISS CONVERTIBLE ANASTIGMATS.

While a large number of doublet combinations are listed, having their uses for the same purposes as other doublet lenses, there are two sets of the Single Anastigmats which practically cover the entire field.

These sets are offered complete with the lenses mounted interchangeably, each set consisting of:

One lens mount with iris diaphragm, cap, and flange, as described under Series VII.

The Single Anastigmat Lenses (three or four as the case may be).

A neat and compact morocco case containing all the parts of the set.

C SET OF ANASTIGMATS.

Complete in case, $103.00. Code word, *Alpha.*

C set of anastigmats fitted with Iris Diaphragm Shutter, $118.00.

The six lenses which may be formed with the C set of anastigmats are shown in the accompanying table, together with their angles, covering power, and speeds.

SERIES.	No.	Size of Plate Covered with Largest Stop.* Inches.	Equivalent Focus of Lenses in Inches.			Speed.	Angle on 5 x 8 Plate. Degrees.
			Front Lens.	Back Lens.	Combined Focus.		
VII.	2	5 x 8		9		f–12.5	48
	3	6½ x 8½		11½		f–12.5	38
	4	8 x 10		14		f–12.5	32
VIIa.	5	4¼ x 6½	11½	9	5¾	f– 7.0	70
	6	5 x 7	14	9	6¼	f– 7.7	65
	8	5 x 8	14	11½	7	f– 7.0	59

* The next larger plate is well covered with smaller stop.

D SET OF ANASTIGMATS.

Complete in case, $200.00. Code word, *Alphabet.*

D set of anastigmats fitted with Iris Diaphragm Shutter, $217.50.

The lenses of this set are the numbers 3, 4, 5, and 6 of Series VII.

The following table shows the ten lenses which may be formed with this set, together with their angles, covering power, and speed.

SERIES.	No.	Size of Plate Covered with Largest Stop.* Inches.	Equivalent Focus of Lenses in Inches.			Largest Stop.	Angle on 8 x 10 Plate. Degrees.
			Front Lens.	Back Lens.	Combined Focus.		
VII.	3	6½ x 8½		11½		f–12.5	47
	4	8 x 10		14		f–12.5	39
	5	10 x 12		16½		f–12.5	34
	6	11 x 14		19¼		f–12.5	29
VIIa.	8	5 x 8	14	11½	7	f– 7.0	71
	9	5 x 8	16½	11½	7½	f– 7.7	67
	9a	5 x 8	19¼	11½	8	f– 7.7	64
	11	6½ x 8½	16½	14	8½	f– 7.0	61
	12	6½ x 8½	19¼	14	9¼	f– 7.7	57
	14	8 x 10	19¼	16½	10	f– 7.0	53

* The next larger plate is well covered with small stop.



Made with Iris Diaphragm Shutter.

UNIVERSAL PORTRAIT LENS, SERIES A.

SPEED f–4

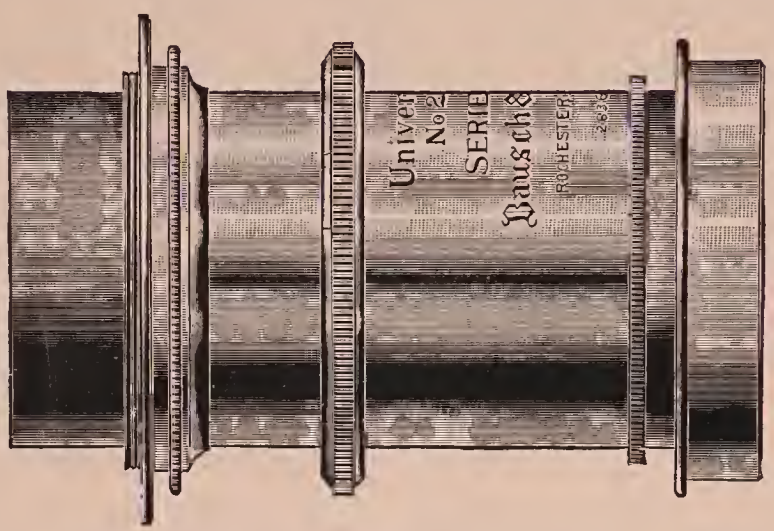


Figure shows the No. 2 Universal Portrait Lens one-fourth actual size.

Description. These lenses are composed of two systems, the elementary lenses of the front system being cemented together, while those of the back system are separated. The rear lens is mounted in an adjustable mounting, permitting correction of the lens by the operator.

All sizes are provided with improved iris diaphragm.

Optical Properties. The speed of these lenses being f–4, they are suited for the most rapid studio work. Optically they possess those special requisites which make a portrait lens, and which exist only to a very indifferent degree in lenses constructed for other work.

The lenses as sent from our factory are corrected to give the greatest sharpness, as required for small portraits. For large portraits, where the sitter is near the lens, a greater depth and equality of definition is obtained by separating the back lenses by means of the adjustable mounting. In this manner any desired softness, roundness, or distribution of focus may be obtained. In addition to the above qualities, these lenses have unusual freedom from distortion, and even illumination.

Application. For portrait work only, these lenses are unequaled. They were designed solely for this purpose, and the favorable reception they have had at the hands of the most expert and well-known photographers, proves that they meet the requirements.

Portrait Photography.

The number three of this series is especially recommended for cabinet work.

Testimonials on application.

PRICE-LIST

OF

Universal Portrait Lenses.

SERIES A.

Telegraphic Code.	No.	Size. Inches.	Diameter of Lenses. Inches.	Equivalent Focus. Inches.	Price.
Uberty	1	4 x 5	$2\frac{3}{4}$	$6\frac{1}{2}$	$ 65 00
Udal	2	5 x 8	$3\frac{1}{2}$	$8\frac{1}{2}$	90 00
Udaler	3	$6\frac{1}{2}$ x $8\frac{1}{2}$	$4\frac{1}{6}$	$11\frac{1}{2}$	135 00
Udder	4	8 x 10	$4\frac{1}{2}$	$13\frac{1}{2}$	190 00

EXTRA RAPID UNIVERSAL LENS, SERIES D.

SPEED f–6

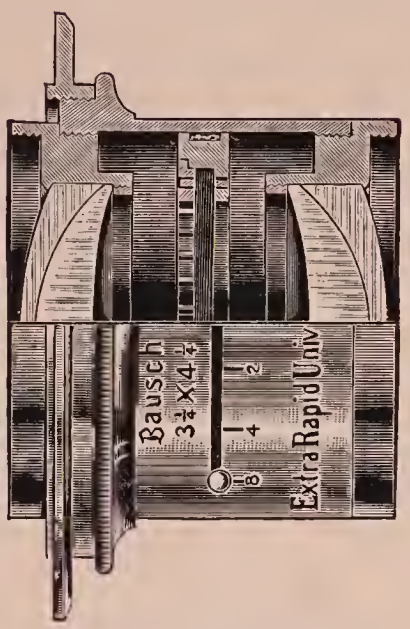


Figure shows 3¼ x 4¼ Series D Lens actual size.

Description. This is the extra rapid type of rectilinear lens, the front and back systems being each composed of two lenses cemented together.

The lenses are of large diameter, but, being quite thin, do not increase the weight of the lens appreciably. The mounting is very compact.

Optical Properties. The speed of the lens is f–6.

The image circle embraces an angle of 70 degrees.

This series represents the best of the rectilinear type of lenses, in speed, covering power, and depth of focus.

Application. Thousands of photographers in all branches are to-day using this excellent lens, and, while it does not equal the anastigmats in all respects, it is **General Work.** a good and serviceable lens for general work, has sufficient speed for the most rapid instantaneous work and a decided advantage in price.

The compactness, speed, depth of focus, and moderate price recommend **Hand Cameras.** the smaller sizes for hand cameras, while its speed is greater than necessary under ordinary conditions. Ample exposure is obtained on dark and misty days where other slower lenses would fail.

Studio. For studio work this lens will be found especially satisfactory, as the field and focus, especially in the larger sizes, are admirably suited for portraiture, and it has sufficient covering power for excellent group work.

The speed, f–6, is sufficient for all occasions, as the rapid plates now in general use do not require a more rapid lens in the studio. These lenses are now in use in many of the best known studios.

PRICE-LIST

OF

Extra Rapid Universal Lenses.

SERIES D.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate. Inches.	Diameter of Lenses. Inches.	Equivalent Focus. Inches.	Back Focus. Inches.	Price.	
						Lens Only.	Lens with Diaphragm Shutter.
Ukase	0	$3\frac{1}{4}$ x $4\frac{1}{4}$	1	$4\frac{3}{8}$	$3\frac{13}{16}$	$ 24 00	$ 39 00
Ulaus	00	4 x 5	$1\frac{1}{4}$	$6\frac{3}{8}$	$5\frac{9}{16}$	28 00	43 00
Ulcer	1	5 x 8	$1\frac{1}{2}$	8	7	36 00	51 00
Ulema	2	$6\frac{1}{2}$ x $8\frac{1}{2}$	$1\frac{3}{4}$	$9\frac{7}{16}$	$8\frac{1}{4}$	46 00	62 00
Ulnim	3	8 x 10	$2\frac{1}{8}$	$11\frac{1}{4}$	$9\frac{13}{16}$	58 00	75 50
Ulnage	4	10 x 12	$2\frac{5}{8}$	$14\frac{1}{4}$	$12\frac{7}{16}$	75 00	
Umbel	5	12 x 15	$3\frac{5}{16}$	$17\frac{1}{2}$	$15\frac{1}{4}$	100 00	
Umber	6	16 x 20	$3\frac{3}{4}$	$22\frac{3}{4}$	$19\frac{7}{8}$	130 00	

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

Testimonials from prominent photographers on application.

RAPID UNIVERSAL LENS.

SPEED f–8

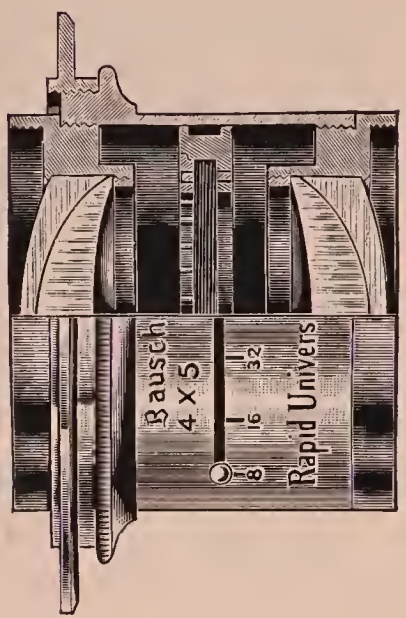


Figure shows the Rapid Universal Lens 4 x 5 actual size.

Description. This is our original rapid rectilinear type lens, the front and back systems being similar and composed of two lenses each. The mountings are now reduced in size and made as compact as possible in accordance with modern requirements.

Optical Properties. The speed of these lenses is f–8. The angle of the image circle is 70 degrees.

Application. This is the lens which a large majority of all amateur photographers have used up to 1896, and which a very large number are still buying and using. It has excellent covering power, and sufficient speed for all ordinary uses. The focus is such as to give a most agreeable perspective. The moderate price places a really good lens in the hands of those who cannot afford an anastigmat.

General Photography.

PRICE-LIST

OF

Rapid Universal Lenses.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Large Stop Covers.	Equivalent Focus. Inches.	Diameter of Image Circle. Inches.	Diameter of Lenses. Inches.	Back Focus. Inches.	Price.	
							Lens Only.	When Fitted with Diaphragm Shutter.
Ucubis	4¼	3¼ x 4¼	5¼	8	⅞	4¾	$ 18 00	$33 00
Umbria	5	4 x 5	6¾	9¼	1 1/16	5¾	22 00	37 00
Unca	8	5 x 8	8⅞	11	1⅜	7¾	26 00	41 00
Unelli	8½	6½ x 8½	11¾	13¼	1⅝	10⅜	35 00	51 00
Upis	10	8 x 10	13⅞	15⅝	1⅞	12¼	48 00	65 50
Uraca	12	10 x 12	17	20	2⅛	15	60 00	
Uxantis	15	12 x 15	20¼	21½	2⅝	18	75 00	
Utica	18	16 x 18	24¾	27½	3⅛	22¼	95 00	
Uzita	22	20 x 22	31⅝	36	4⅛	28	125 00	

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

ALVAN G. CLARK LENS.

SPEED f–8

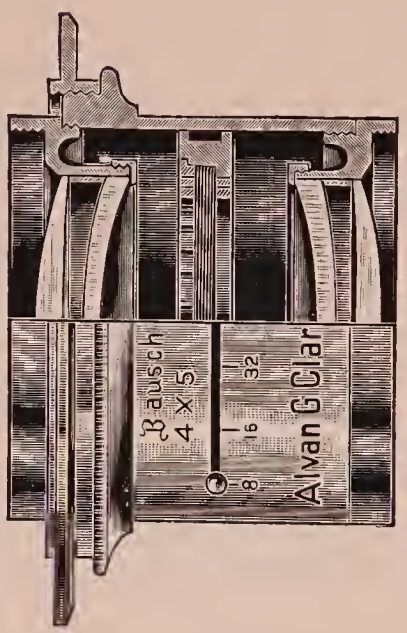


Figure shows the 4 x 5 Alvan G. Clark Lens actual size.

Description. These lenses are the invention of the late Alvan G. Clark, maker of the famous Clark telescopes, and differ from the rapid rectilinear type of lens, in that none of the lenses are cemented, and that the hardest glass is placed outermost; hence the lenses will never degenerate, or become slower, and are less liable to become scratched. The mountings are more compact than in the rectilinear lenses, as the systems are closer together.

Optical Properties. The speed is f–8.

The angle of the image circle is 100 degrees.

They are well corrected objectives, and have given satisfaction to a large number of photographers.

Application. They are applicable to all work for which the rectilinear type of lens is adapted, and possess the advantage over many in that they may be used for medium wide-angle work also.

PRICE-LIST

OF

Alvan G. Clark Lenses.

All Lenses are Supplied with Improved Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Largest Stop. Inches.	Equivalent Focus. Inches.	Diameter of Image Circle. Inches.	Diameter of Lenses. Inches.	Back Focus. Inches.	Price.	
							Lens Only.	When Fitted with Diaphragm Shutter.
Abel	4¼	3¼ x 4¼	5⅛	8½	¾	4¾	$ 20 00	$ 35 00
Abner	5	4 x 5	6⅛	13	⅞	5¾	24 00	39 00
Achan	8	5 x 8	8¼	16	1⅛	7¾	30 00	45 00
Adam	8½	6½ x 8½	11⅛	21½	1½	10¼	38 00	54 00
Agate	10	8 x 10	13⅛	24¾	1¾	12 3/16	50 00	67 50
Alema	12	10 x 12	16	33	2⅛	15	64 00	
Amasa	15	12 x 15	19¼	38	2⅝	18	82 00	
Arab	18	16 x 18	23 7/16	47	3	22	105 00	
Arbah	22	20 x 22	30	64	4⅛	28	145 00	

When ordering lens fitted with Iris Diaphragm Shutter, by telegraph, specify *Diaphragm* in addition to the code word for size of lens.

UNIVERSAL WIDE-ANGLE LENS.

SPEED f–16

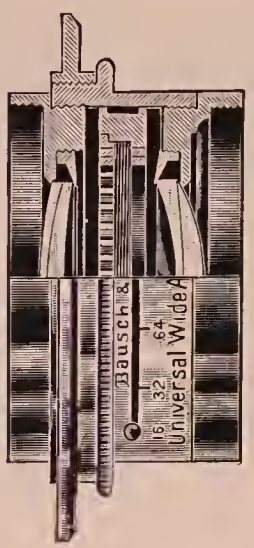


Figure shows the 6½ x 8½ Universal Wide-Angle Lens, actual size.

Description. These lenses represent the best of the symmetrical wide-angle lenses, the front and back systems each composed of two elementary lenses. They are extremely compact and portable. The substitution of the iris for the rotary diaphragm in this lens not only adds to the compactness of the mount, but gives a much greater variety of openings.

Optical Properties. The speed is f–16.

The image circle embraces an angle of over 100 degrees, of which 80 degrees are utilized on the plate for which the various sizes are rated. With smaller stops the full angle is obtained on smaller plates.

Application. The covering power and definition are excellent, and there is very little distortion of the image, even with the highest angles.

The speed of these lenses is sufficient to permit their use for interior flash-light and outdoor instantaneous photography. Their great aperture fits them for general wide-angle work, and while the images are not as perfect with extreme angles as in the anastigmats, they are most satisfactory lenses when anastigmat correction is not essential.

PRICE-LIST

OF

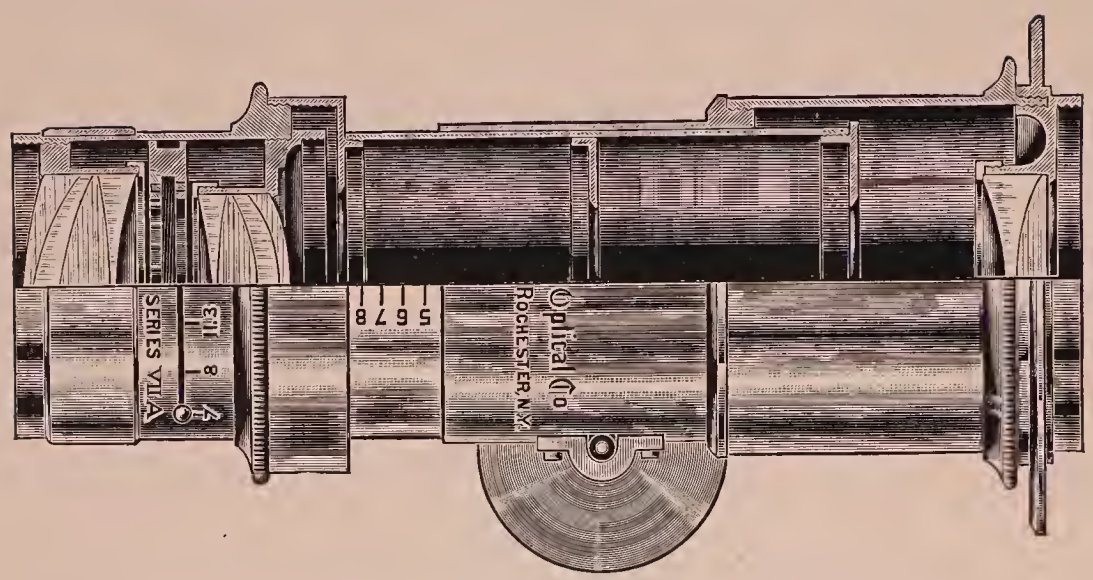
Universal Wide-Angle Lenses.

All Lenses are Furnished with Iris Diaphragm and Morocco Cap.

Telegraphic Code.	No.	Size of Plate Covered with Stop f-16.* Inches.	Equivalent Focus. Inches.	Back Focus. Inches.	Diameter of Lenses. Inches.	Diameter of Image Circle. Inches.	Price.
Wade	5	4 x 5	$3\frac{1}{2}$	$3\frac{1}{4}$	$\frac{3}{4}$	$8\frac{3}{4}$	$16 00
Wait	8	5 x 8	$5\frac{1}{4}$	$4\frac{7}{8}$	$\frac{3}{4}$	13	20 00
Walk	$8\frac{1}{2}$	$6\frac{1}{2}$ x $8\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{16}$	$\frac{7}{8}$	15	24 00
Walrus	10	8 x 10	8	$7\frac{1}{2}$	$1\frac{1}{8}$	18	28 00
Water	14	11 x 14	$10\frac{1}{2}$	$9\frac{7}{8}$	$1\frac{1}{2}$	$25\frac{1}{2}$	36 00
Weaver	17	14 x 17	14	$13\frac{1}{8}$	2	32	48 00
Wale	22	18 x 22	17	16	$2\frac{1}{4}$	37	60 00
Whistle	30	25 x 30	22	$20\frac{3}{4}$	$2\frac{1}{2}$	49	90 00

* The next size plate is well covered when using small stop, giving 95 degrees angle.

BAUSCH & LOMB
TELE-PHOTO ATTACHMENT.



The Figure shows the Tele-Photo Attachment as applied to a Photographic Lens.

Description. The purpose of the Tele-Photo attachment is to produce larger pictures in connection with a photographic lens than can be obtained with the lens alone.

The Tele-Photo attachment is so designed that any ordinary photographic lens may be used with it. It possesses the advantage over a single long-focus lens that it does not require nearly as long a camera or extension of bellows to obtain the same magnification, and over the fixed tele-photo lens that it is easily applicable to lenses already in use, thus greatly reducing the cost and permitting a considerable variation in focus.

The attachment consists of an achromatic negative system mounted in a barrel with sliding tube, which is adjustable by rack and pinion.

The front of the barrel is threaded to receive the photographic lens, and the rear end is provided with a flange for attachment to the front board of the camera. The sliding-tube has scale indicating the exact amount of magnification.

Optical Properties. In the construction of this negative system, the greatest latitude has been allowed for variation in the lenses with which it is to be used, but it must always be borne in mind that any lack of sharpness in the image formed by the photographic lens will be exaggerated by the Tele-Photo attachment in direct proportion to the amount of enlargement, hence only lenses of the highest grade are suitable for tele-photo work.

Our Tele-Photo attachment permits a variation of magnifying power from three to eight diameters by simply adjusting the distance between the negative and positive lenses with the rack and pinion.

Application.

Photographing Distant Objects. There are many objects so situated that they cannot be satisfactorily photographed with an ordinary lens, but may be, readily, from a distance. In such cases a magnified (tele-photo) picture is required.

PRICE-LIST

OF

Bausch & Lomb Tele-Photo Attachment.

DISTANCE FROM THE FRONT BOARD TO THE GROUND GLASS.

Size.	Equivalent Focus of Photo Lens.	Magnification. Resulting Focus when used with Tele-Photo Attachment.						Price.
		3	4	5	6	7	8	
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	
4 x 5	6½	6⅜	9⅝	12⅞	16⅛	19⅜	22⅝	$16 00
5 x 8	8¾	8½	13	17½	22	26½	31	18 00
6½ x 8½	11½	10½	16½	22½	28½	34½	40½	20 00
8 x 10	13½	13½	20½	27½	34½	41½	48½	24 00
Telegraphic Code.	Size. Inches.	Diameters of Image Circle. When used with Tele-Photo Attachment.						
Tab	4 x 5	5¼	7½	9½	12	15	17½	
Tabby	5 x 8	6½	9¾	12½	16¼	19⅜	22½	
Tabid	6½ x 8½	8	11	14¼	18	22	26	
Table	8 x 10	9	12¾	16½	20¾	26	30	

N. B.—We do not advise the fitting of Tele-Photo Attachment to *any* except the *very best quality* lenses, as results will not be satisfactory.

Lenses should in all cases be sent us in order to secure correct adjustment and fitting.

The scale indicating magnification is computed for prevailing foci of photographic lenses, but special standardized scale will be made at an extra cost of 75 cents.

PROJECTION LENSES.

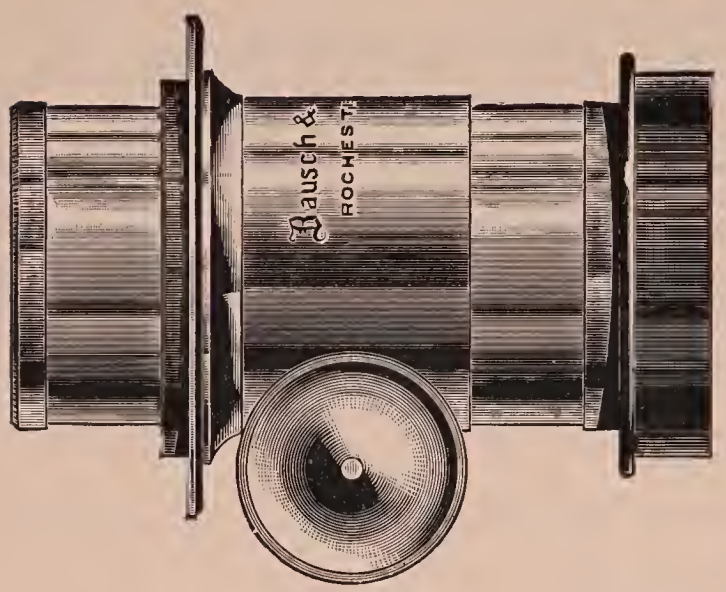


Figure shows the 1/4 Plate Objective two-thirds actual size.

Description. These lenses are designed for projecting magnified images of positive pictures on the screen, and are used in the stereopticon, magic lantern, etc. The lenses are mounted in a nickeled tube, which is adjustable by rack and pinion for rapid and accurate focusing. Each lens also has a flange for attaching to camera board. The working parts are all constructed with great accuracy, and will be found to work much smoother than those of other lenses now on the market.

Optical Properties. These lenses are especially designed for projection purposes and utilize an exceptionally large amount of the light of the lantern, giving beautifully illuminated, sharp, clear pictures. Their extremely flat field gives a clear picture of equal sharpness over the entire screen. Optically, these lenses are greatly superior to the imported lenses which have been sold for projection work.

Application. For stereopticon, magic lantern, and all kinds of projection work, these lenses should be selected. Where a small picture is to be made to cover a large screen at a short distance, the special wide-angle objective No. 6 is recommended.

PRICE-LIST

OF

Projection Lenses.

All Lenses are Furnished with Leather Cap.

No.	Size.	Back Focus. Inches.	Equivalent Focus. Inches.	Diameter of Lenses. Inches.	Price.
1	4/4 Plate	10½	15	3	$32 00
2	2/3 "	8½	12	2½	21 00
3	1/2 "	7	10	2¼	14 50
4	1/3 "	5½	7½	1⅞	12 00
5	1/4 "	4½	6	1⅝	7 00
6*	1/4 "	3	5	1⅝	8 00

* Wide Angle.

TABLE SHOWING DISTANCE FROM OBJECT TO SCREEN, DIAMETER IN FEET OF PICTURE, AND FOCUS OF LENS WHICH MUST BE USED WHEN OBJECT IS THREE INCHES DIAMETER.

Equivalent Focus of Lens.	Distance from Object to Screen, in Feet.									
	Diameter of Image on Screen. 10	20	30	40	50	60	70	80	90	100
15 in.			6	8	10	12	14	16	18	20
12 "			7½	10	12½	15	17½	20	22½	25
10 "		6	9	12	15	18	21	24		
7½ "	4	8	12	16	20	24				
6 "	5	10	15	20						
5 "	6	12	18	24						

PHOTOGRAPHIC PRISMS.

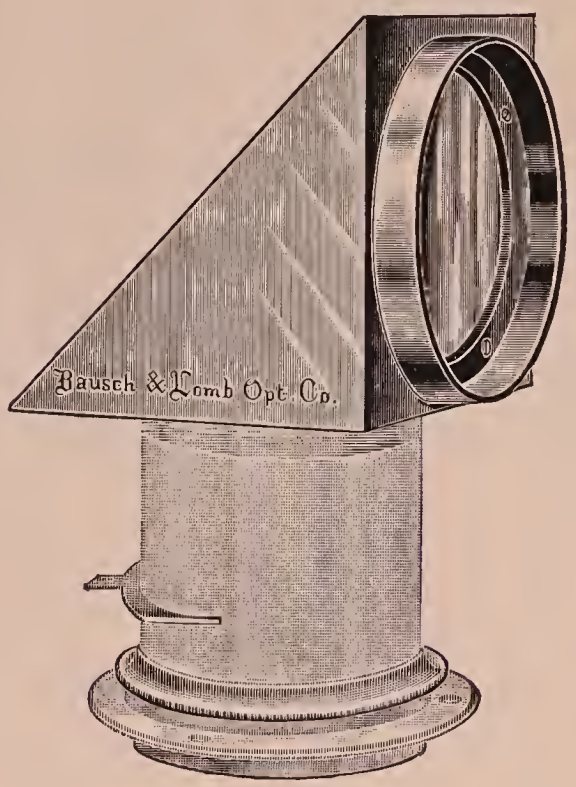


Figure shows the Prism and method of applying it to the lens.

Description. These prisms are mounted so as to be entirely protected by the metal case. They are attached to the hood of any photographic lens by a threaded adapter. The mountings are so arranged as to bring the surface of the prism as close as possible to the front of the lens, thus securing the greatest effective angle of the lens and the maximum illumination and speed. The glass is of the purest quality and greatest possible light transmitting properties.

Optical Properties. The three surfaces are optically plane and have the highest possible polish, thus giving the least loss of light. There is no interference whatever with the sharpness of the image produced by the lens.

Application. The prism is used to reverse the image formed by the lens, from left to right, thus making it unnecessary to strip and turn the films in process work.

It effects a great saving in time and labor, and obviates the danger of stretching or damaging the film during manipulation.

PRICE-LIST

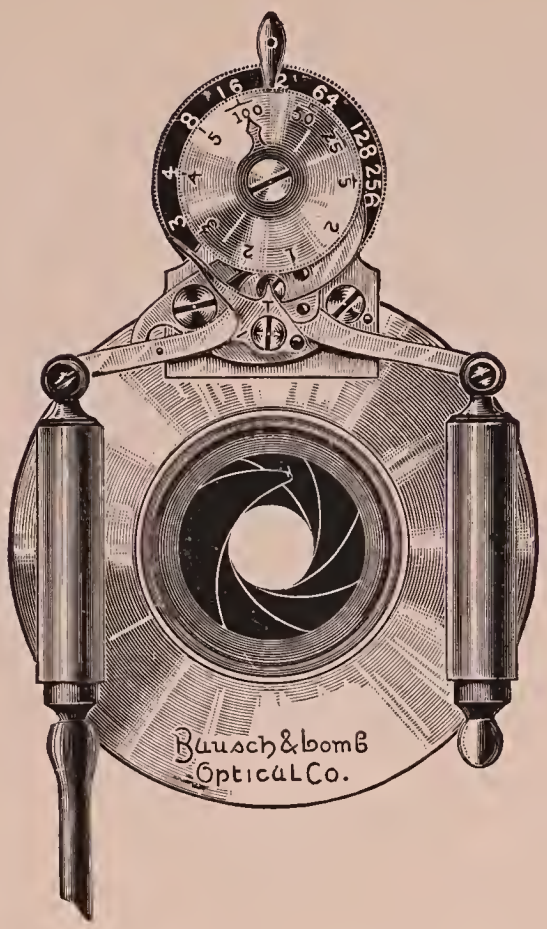
OF

Photographic Prisms.

Full Aperture of Prism. Inches.	Figures in the margin show correct size Prism for Lenses as below.					Price.	
	Bausch & Lomb Zeiss Planar. Series Ia.	Bausch & Lomb Zeiss Anastigmat. Series IIa.	Bausch & Lomb Zeiss Anastigmat. Series IV.	Bausch & Lomb Zeiss Anastigmat. Series V.	Bausch & Lomb Zeiss Convertible Anastigmat. Series VIIa.	When fitted to B & L-Zeiss Lens.	When fitted to Lenses of other make.
$2\frac{1}{2}$	No. 12	No. 6	No. 7	No. 9	No. 16	$ 45 00	$ 47 00
$2\frac{3}{4}$	No. 13	....	....	....	....	53 00	55 00
3	No. 14	No. 7	No. 8	No. 10	No. 19	65 00	67 00
$3\frac{1}{2}$	No. 15	No. 8	....	....	No. 22	78 00	80 00
4	No. 16	....	....	....	No. 25	90 00	93 00
$4\frac{1}{2}$	No. 17	....	No. 9	....	No. 28	140 00	145 00
$5\frac{1}{2}$	No. 18	....	No. 10	....	No. 30	180 00	185 00

In estimating the size of prism which is required for a particular lens, a size should be selected which is at least equal to the diameter of the hood. A size which is larger than this is preferable, but under no circumstances should a smaller one be selected, as, in the work in which these prisms are required, it is of great importance to utilize all the light which the lens can transmit.

THE IRIS DIAPHRAGM SHUTTER.



The construction of the Iris Diaphragm Shutter is based on a careful consideration of the optical principles involved, and it is without question the most scientifically correct shutter yet produced.

The following are some of its advantages:

It is placed between the systems of the lens, at the diaphragm point, thus acting as stop and shutter at once. No extra stops or iris diaphragm are needed.

It gives absolutely uniform illumination over the entire plate.

It gives brilliant high lights, and at the same time definition in the shadows.

It gives automatically any exposure from one one-hundredth of a second to three seconds. It gives time exposures of any duration.

It has setting device to give any size opening from pin-hole to the largest stop.

It is operated either by pneumatic bulb or finger release.

A simple turn of the setting lever makes it ready for exposure.

It cannot open, or expose the plate, while being set.

It does not jar the camera, even when working at the highest speed.

It can be applied to any lens, and always improves its covering power and depth of focus.

It can be arranged for use with two or more lenses.

It is especially adapted for hand camera lenses.

In devising the Iris Diaphragm Shutter we have succeeded in equalizing the distribution of light over the entire plate more perfectly than is possible with any other construction.

It can be easily proven, both theoretically and by actual experience, that as the size of stop is decreased, the lens has not only greater covering power, but the illumination (exposure) becomes more uniform. Furthermore, it is well known that exposures with large openings give greater contrast between the high lights and shadows, while with small stops and long exposures, greater detail is obtained in the shadows. For this reason a shutter constructed on the iris diaphragm principle, opening in the center with a minute aperture, and gradually enlarging to the full opening desired, then gradually reducing its opening to the closing point, gives the high lights full value and sharpness, depth of focus, and detail in the shadows approaching the results obtained with small stops, so that in actual use the diaphragm shutter gives greater covering power, more equal illumination, and greater depth of focus than is possible with any other form of shutter. This principle having been brought before the public by the introduction of our shutter, a number of prominent optical firms in Europe have recognized its advantages, and have endeavored to construct shutters embodying the same principle, but they are prevented by our patents from following our construction, and hence cannot obtain the advantages which our shutter alone possesses.

The popularity of the Iris Diaphragm Shutter is greater to-day than ever before, both in America and abroad. It is used in every quarter of the globe in which photography is practiced, and from the hot, moist atmosphere of the Indian jungles to the Peary-traversed wilds of Greenland, has proven its adaptability to every climate and every condition.

While the Iris Diaphragm Shutter meets all requirements for instantaneous work, we disclaim its suitability for ultra rapid photography, although surprising results, such as trains running sixty miles per hour, and trotting horses, show its capacity under suitable management.

For all except the ultra-rapid, it has no competitor.

Price-List of Iris Diaphragm Shutter.

SIZE.	When Fitted to Rapid Universal, Extra-rapid Universal, with Regular Barrel and Diaphragm.	When Fitted to Lenses of Other Manufacture, Leaving Barrel Intact.	Alvin G. Clark.		Bausch & Lomb-Zeiss Anastigmat Series II, IIa, and III.	
4 x 5	$14 00	$14 50				
5 x 8	15 00	15 50	4¼, 5, 8	$15 00	1, 2, 3, 4	$15 00
6½ x 8½	16 00	16 50	8½	16 00	5, 6	16 00
8 x 10	17 50	18 00	10	17 50	7	17 50

BRANCHES: NEW YORK CITY AND CHICAGO.

Price-List of Iris Diaphragm Shutter.—Continued.

SIZE.	Bausch & Lomb-Zeiss Anastigmat Series II and IIa. Special for Hand Cameras.	Bausch & Lomb-Zeiss Anastigmat Series IIIa.	Bausch & Lomb-Zeiss Anastigmat Series IV.	Bausch & Lomb-Zeiss Anastigmat Series V.
4 x 5	1†, 2†, 3† — $14 00			
5 x 8	4, 5 — 15 00	0, 00, 1, 2, 3, 4, 5 — $15 00	3, 4, 5, 6 — $15 00	3, 4, 5, 6, 7, 8 — $15 50
6½ x 8½		6, 7 — 16 00	7 — 16 00	9 — 16 00
8 x 10		8 — 17 50	8 — 17 50	

SIZE.	Bausch & Lomb-Zeiss Anastigmat Series VII.	Bausch & Lomb-Zeiss Anastigmat Series VIIa.	Bausch & Lomb-Zeiss Anastigmat Series VIIa. Special for Hand Cameras.	Telegraphic Code.
4 x 5			1†, 2†, 3†, 4†, 5†, 7† — $14 00	*Dalphon*
5 x 8	1, 2, 3, 4 — $15 00	1, 2, 3, 4, 5, 6, 7, 8, 10 — $15 00		*Danites*
6½ x 8½	5 — 16 00	9, 11, 13 — 16 00		*Dara*
8 x 10	6 — 17 50	12, 14, 16, 15*, 17*, 18* — 17 50		*Darius*

*Gives effective aperture when lens is used as a doublet, but reduces speed of the single combination of longest focus.

† Owing to additional work involved when so adapted, no extra barrel is supplied.

To graduate disk to correspond with stops accompanying lens, extra, 50c.

Finger release attachment to shutters, 5 x 8 to 8 x 10 size, extra, $1.00. (4 x 5 is regularly supplied with finger release at no additional cost.)

Telegraphic code refers to shutters in brass mounting; if desired in aluminum it should be so stated.

Size of Opening, in inches,	⅞	1⅛	1⅜	1¾
Size of Shutter { Over all, in height and width. }	2⅝ x 4	3⅛ x 4½	3¾ x 5⅛	4¼ x 5¾

THE UNICUM SHUTTER.

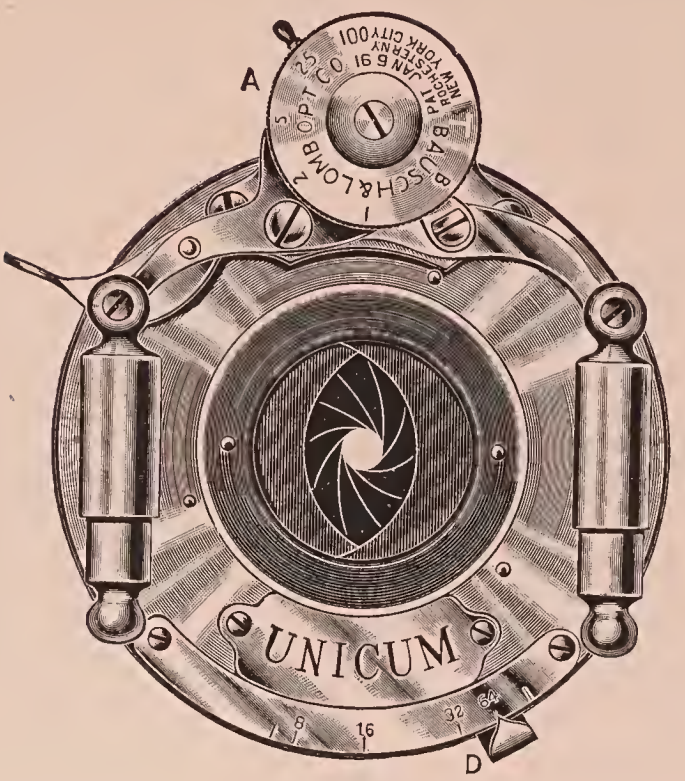


Figure shows the 4 x 5 Unicum Shutter actual size.

The Unicum Shutter is of the same general form as the Iris Diaphragm Shutter, and is intended to meet the demand for a cheaper, yet well made and durable shutter.

The case of the Unicum Shutter is of highly finished bronze metal, and the actuating mechanism is well protected from dust and injury.

The shutter blades are of thin rubber, so shaped as to give the most even illumination possible with two blades only, the aperture formed by them being at first elliptical, becoming circular.

Back of the shutter blades there is an iris diaphragm, operated by the index lever at the lower margin of the shutter, by which any desired size of stop can be obtained.

This shutter gives automatic exposures from one one-hundredth of a second to one second, and has, in addition, a "bulb exposure" so arranged that compression of the pneumatic bulb opens the shutter, and the blades remain open as long as the bulb is compressed, closing instantly when it is released. This is a very useful feature, as short exposures over one second can be made with sufficient accuracy, and in photographing children, animals, and other objects where their movements are uncertain, it is also possible to obtain a much longer exposure with the bulb than it would be safe to hazard with the automatic exposure.

The shutter also has regular time exposure, the blades being opened by pressure of the bulb, and remaining open until closed by again pressing the bulb.

Accuracy of exposure and freedom from jar are secured by our pneumatic retarding device.

The Unicum Shutter can be fitted between the combinations of all lenses except where they are extremely close together.

The tens of thousands of these shutters, which are now in daily use in all parts of the world, vouch for their correctness of construction and superior workmanship.



Price-List of Unicum Shutter

When fitted to lenses as specified.

SIZE.	Size of Opening. Inches.	Rapid Universal, A. G. Clark, and Extra-rapid Universal Lenses.	Bausch & Lomb-Zeiss Anastigmat Series II, IIa, and III.	Bausch & Lomb-Zeiss Anastigmat Series IIIa.	Bausch & Lomb-Zeiss Anastigmat Series VII.	Bausch & Lomb-Zeiss Anastigmat Series VIIa.
4 x 5	$\frac{7}{8}$	. . . . .	. . . . .	. . .	. . .	. . .
5 x 8	$1\frac{1}{8}$	$3\frac{1}{4}$ x $4\frac{1}{4}$ 4 x 5	1 2 3	2 3 4	1 2 3	1 2 3 4 5 6 7 8 10
$6\frac{1}{2}$ x $8\frac{1}{2}$	$1\frac{3}{8}$	5 x 8 $6\frac{1}{2}$ x $8\frac{1}{2}$	4 5	5 6	4 5	9 11 13

SIZE.	Price.		Price when Fitted to Other Lenses.	
	With Retarding Device.	Without Retarding Device.	With Retarding Device.	Without Retarding Device.
4 x 5	$ 8 00	$6 50	$ 9 00	$7 50
5 x 8	9 00	7 50	10 00	8 50
$6\frac{1}{2}$ x $8\frac{1}{2}$	10 00	8 50	10 00	9 50

THE BAUSCH & LOMB STEREOSCOPIC SHUTTER.

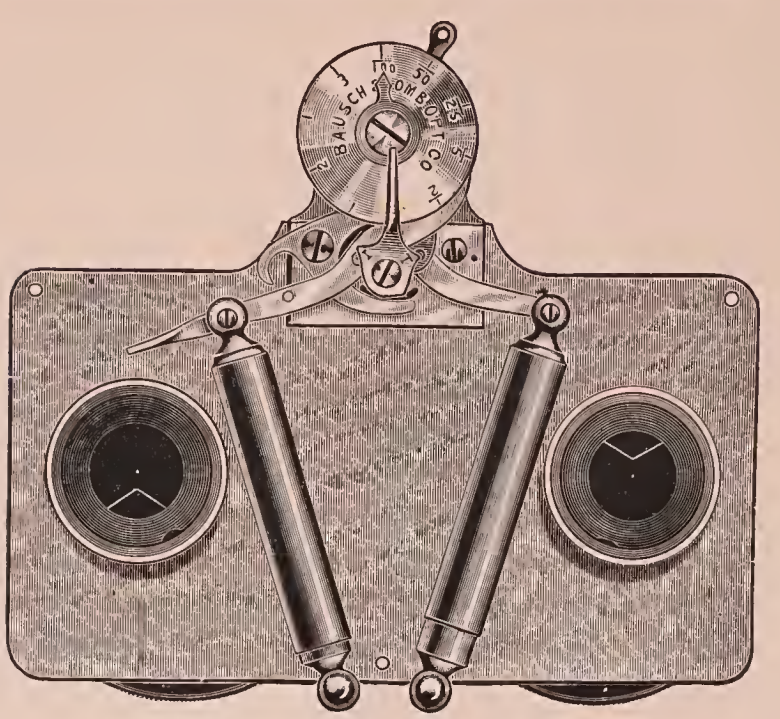


Figure shows Stereoscopic Shutter two-thirds actual size.

In designing this shutter we have applied the desirable features of the Iris Diaphragm Shutter, the actuating mechanism and pneumatic retarding device being the same. The exposure is made by two thin rubber blades opening vertically, the openings being diamond shaped. The opening and closing of the leaves is absolutely synchronous, thus making both pictures exactly alike.

The centers of the openings are 3 1/8 inches apart. The speed regulator gives all speeds from one one-hundredth of a second to three seconds. Time exposures of any desired duration over three seconds may be made with the pneumatic release or finger release, as desired.

Where extremely rapid exposures are required, the shutter blades will be made to open horizontally, with a rectangular opening across the entire aperture, becoming slightly wedge-shaped at full opening. This form is supplied only on special order.

The Stereoscopic Shutter is screwed directly to the front board of the camera.

We can assume no responsibility as to satisfactory fitting unless the lenses to be used with the shutter are sent here to be fitted.

Price $18.00, fitted to lenses.

The Stereoscopic Shutter may be fitted to the following sizes of our lenses.

Extra-rapid Universal.	Rapid Universal.	A. G. Clark.	Zeiss Anastigmat.			
			Series II.	Series IIa.	Series III.	Series IIIa.
No. 00	No. 5	No. 5	No. 2	Nos. 2 & 3	Nos. 2 & 3	Nos. 2 & 3

THE BICHROMATE OF POTASH RAY FILTER.

The Ray Filter is, as its name implies, a light filter for the purpose of absorbing, from the light which reaches the lens, certain rays the presence of which would render the making of a natural picture with true color values, clouds, and perspective impossible.

The Ray Filter prevents over-exposure of the sky, and gives not only the correct gradation of shading from zenith to horizon, but reproduces clouds and the detail in the clouds as well.

The Ray Filter gives the true color value of all objects in the picture. The artist, in drawing or painting, depends entirely on color values to individualize objects and develop their proper relative position. The photographer, in order to overcome the tendency to flatness in his monochrome picture, must reproduce color values with the greatest possible accuracy.



A Rayfiltergraph.



A Photograph.

The two views of the same scene, one made with the Ray Filter and the other an ordinary photograph, are introduced to demonstrate practically the value of the Bichromate of Potash Ray Filter in landscape work.

The Ray Filter prevents halation by absorbing the rays which cause the halation, hence non-halation plates may be dispensed with when it is employed.

The Ray Filter improves the defining power of the lens by absorbing those rays for which the average lens is not well corrected.

The Ray Filter gives distinct pictures of distant objects, such as mountain peaks, which cannot be photographed at all without it, by absorbing the highly refractive rays which cause the blurry mist that fills up the distance in ordinary photographs of mountainous country.

In short, the Ray Filter is the equalizer which compensates for the super-sensitiveness of the photographic plate to ultra-violet, violet, and blue light, and its lack of sensitiveness to the red.

In Europe the Ray Filter has been known and used in a crude form for many years, and European as well as American photographers have not been slow to take advantage of the improved Bichromate of Potash Ray Filter.

Bausch & Lomb Optical Co., Rochester, N. Y.

Our Ray Filter consists of two thin pieces of optical glass, the surfaces of which have been ground perfectly plane and parallel. Between these plates is cemented a glass ring of uniform thickness throughout, thus forming a cell in which the Bichromate of Potash solution is contained. The glass part is mounted in a neat metal ring, which protects it.

The glass cell and mounting forms the basis for the most practical ray filter which can be made for the three-color photo-engraving process, as the cells may be filled with fluids of any desired color, and the shade can be varied easily and indefinitely by diluting or strengthening the solutions. Furthermore, the liquid color screen does not degenerate as film screens do. We have furnished a considerable number of cells for this purpose, and they give excellent satisfaction.



A Rayfiltergraph.



A Photograph.

Both pictures are of the same bouquet; one made with the Ray Filter, the other without, and demonstrate the effectiveness of reproducing color values correctly.

The Ray Filter fits on the front of the lens exactly as a cap does. It is therefore in the most convenient position in case it is desired to remove it for any purpose.

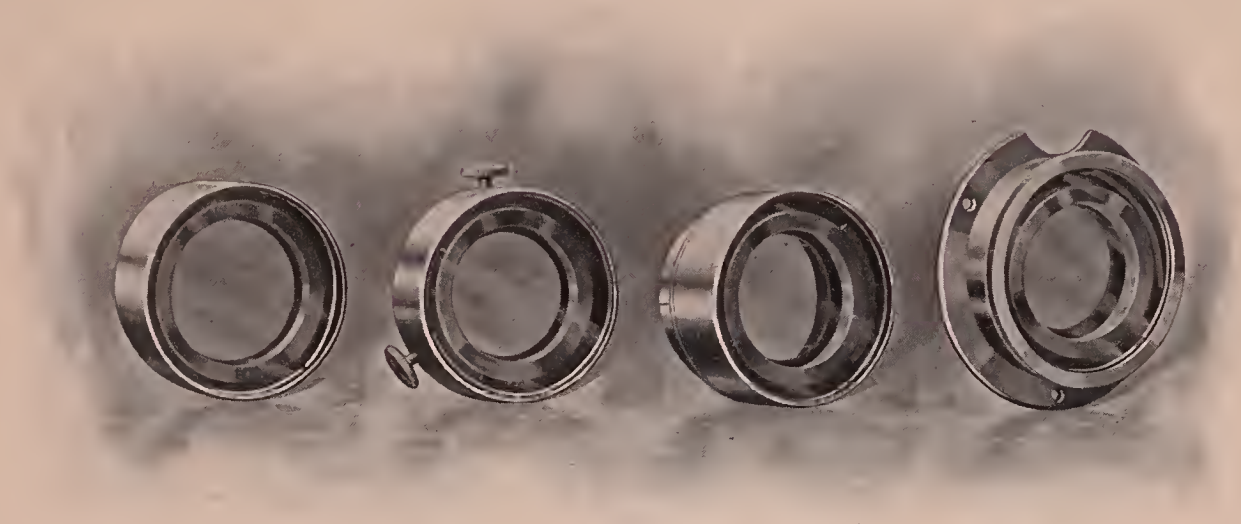
The Ray Filters are made in four forms: style "A," in which the portion of the mounting which fits upon the hood of the lens is lined with cork. This form must be fitted to the lens for which it is intended, and it is therefore necessary when ordering style "A" to send the exact measure of the circumference of the lens hood.

Style "B" is similar to style "A," except that, instead of a cork lining for holding the filter upon the lens hood, it has three binding screws so that it may be fitted to lenses varying in size from the diameter given in table to one-half inch smaller.

The No. "1 P" Ray Filter is like style "A," except that it is the proper size to fit the 4 x 5 or 5 x 8 Folding Kodak, Premo, Poco, Montauk, Sunart, and other camera lenses, '98 model, and is not lined with cork, and it is only necessary to specify the lens for which it is intended.

The No. "1 FF" is intended for box cameras with fixed focus lenses, in which the lens does not have a mounting projecting beyond the front of the

camera. The Ray Filter is mounted in a metal ring which slips into an extra flange. The flange has three screws by which it is fastened to the front of the camera. The Ray Filter may thus be used on the camera, and quickly removed when desired.



Style A. Style B. Style 1P. Style 1FF.

Price-List of Bichromate of Potash Ray Filters.

Each filter is packed in a neat box, with a bottle of fluid, and pipette for refilling.

Number.	Inside Diameter in Inches.	Price.	Price of Morocco Cap.
1P	$1\frac{3}{8}$	$ 3 25	$ 70
1FF	$1\frac{3}{8}$	3 25	75
1	$1\frac{3}{8}$	3 25	70
2	$1\frac{3}{4}$	3 50	70
3	$2\frac{3}{16}$	3 50	75
4	$2\frac{9}{16}$	4 00	80
5	$2\frac{15}{16}$	4 50	90
6	$3\frac{3}{8}$	5 00	1 00
7	$3\frac{3}{4}$	5 50	1 10
8	$4\frac{1}{8}$	6 00	1 20
9	$4\frac{3}{4}$	8 00	1 35
10	$5\frac{1}{2}$	10 00	1 50

When ordering style "A" Ray Filter, send strip of good paper just reaching around the hood of the lens.

THE ICONOSCOPE.

Description. The purpose of a finder is to give a reduced image of that portion of the view of which a photograph is desired. It should, therefore, give an exact reproduction of that view in miniature.

A perfect finder should meet the following requirements:

What a Finder Should Be. The image should have the same proportions as the plate in the camera. The angle of view of the finder should be the same as that of the lens in the camera.

The image should be so bright as to be easily seen under all conditions, sharply defined to the extreme edges, and free from reflections. Objects should appear in their natural position —not upside down, or the left where the right should be.



Photographic Enlargement of the Image in the Iconoscope Shows Definition to Margin of Field and Rectilinear Image.

What Other Finders Are. All finders heretofore constructed have been lacking in several or all of the above respects, giving a very dim, poorly defined, reversed or inverted image, reflections interfering with the distinctness of the image, image projected vertically or horizontally so that the operator is forced to assume an unnatural and unsteady position in order to watch the image, a fatal defect for hand camera work.

Importance of a Finder. Since for the majority of work, and for all hand camera work, one is absolutely dependent upon what he sees in the finder, the existence of any of these defects should be sufficient to bar it out of the list of efficient photographic accessories.

Iconoscope, the Ideal Finder. The Iconoscope is an instrument of precision, constructed on correct optical principles, and possesses none of the defects mentioned above, even in the smallest degree. It is, therefore, the ideal finder.

Particular care has been given to the mechanical construction. Accuracy, convenience, stability, and pleasing appearance have been so combined that the Iconoscope is a decided addition to the appearance as well as the effectiveness of any camera.

Elegant Appearance.

Brilliant Image. The image is even more brilliant than the actual objects appear to the eye, being formed by a concave lens which projects the picture through a solid glass prism direct to the eye. One sees with the Iconoscope all that is visible to the eye alone.

Sharply Defined and Rectilinear. The image is as sharp and clear as that formed by a good photographic lens, and is perfectly rectilinear, so that not only the objects as a whole may be clearly seen, but every detail, position, or expression as well.

Not Reversed or Inverted. The image is not reversed or inverted, hence objects appear in their natural position.

The adjustable hood prevents all reflections and permits the image to be viewed without shading the instrument. It is held in the proper position by a spring click. The image is projected at a convenient angle, so that the photographer stands in a natural position and easily glances from the image to the object without moving the head.

Convenience in Use.

Perfect Mounting. The mounting of the Iconoscope is extremely ingenious, and, being of metal throughout, forms a perfect protection for the glass parts without undue weight.

The mounting proper is attached to a small metal slide piece ("S" Fig. 3) by a spring hinge, so that, whether the camera is used for vertical or horizontal pictures, the Iconoscope is always vertical.

The slide works in a metal bed-plate which is attached by screws to the bed of the camera.

One Iconoscope for Several Cameras. The Iconoscope may thus be instantly detached if desired, or by having several bed-plates may be used on any number of cameras with equal facility.

The Iconoscope is made in three sizes, in each of which the proportions of the image are exactly the same, although varying in size. The larger sizes, therefore, give larger images, and permit a more precise judgment of a view. The smallest Iconoscope is applicable to and may be conveniently enclosed in the smallest folding hand cameras to which ordinary finders are fitted.

Fig. 1.

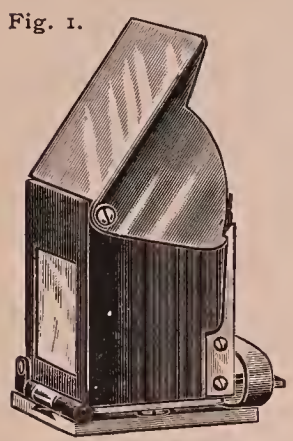


Fig. 2.

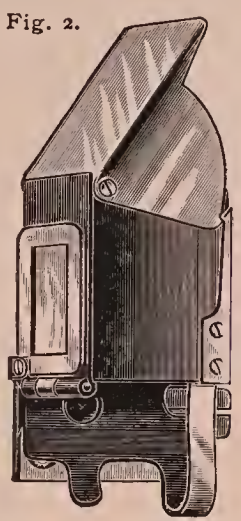


Fig. 3.

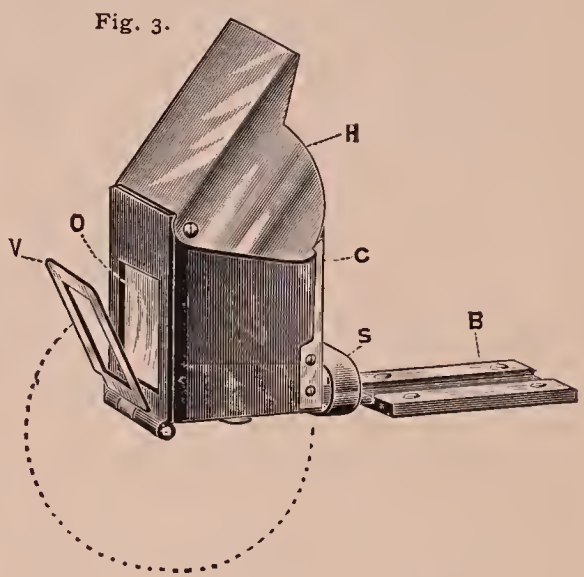


Fig. 1. Iconoscope as ordinarily used.

Fig. 2. Iconoscope in position for vertical view.

Fig. 3. Diagram showing the use of parts of the Iconoscope.

- H. Hood. The hood may be folded down flat when the camera is closed.
- B. Bed-plate attached to the camera bed by screws.
- S. Slide piece attached to the Iconoscope and sliding in the groove of B, so that the Iconoscope can be instantly removed from the camera if desired.
- V. Vertical attachment consisting of a metal plate with oblong opening, and hinged to the base of the Iconoscope. The vertical attachment when swung up in front of the opening O gives vertical pictures (Fig. 2), and is folded under the Iconoscope out of the way when the full aperture of the instrument is desired as for horizontal pictures (Fig. 1).
- C. Spring Click which holds the hood in position.

Fig. 4.

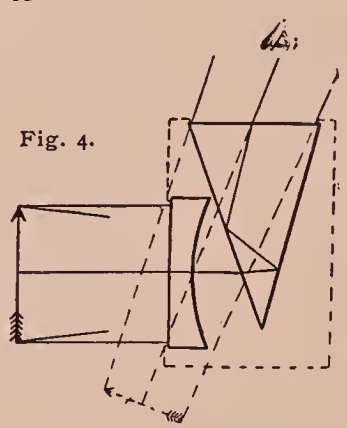


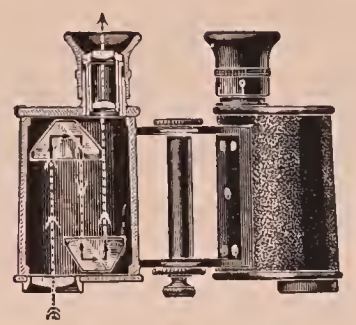
Fig. 4. Diagram showing path of a ray of light through the Iconoscope, and the angle and apparent position of the projected image.

PRICE-LIST OF ICONOSCOPES.

Each Iconoscope is furnished in a neat box.

Size A . .	Height, $1\frac{1}{8}$ in. . .	Width, $\frac{7}{8}$ in. . .	Depth, $\frac{7}{8}$ in. . .	Each, $5 00
Size B . .	" $1\frac{1}{2}$ " . .	" $1\frac{1}{8}$ " . .	" $1\frac{1}{8}$ " . .	" 5 50
Size C . .	" 2 " . .	" $1\frac{1}{4}$ " . .	" $1\frac{1}{4}$ " . .	" 6 00
Extra Bed-plates				" 75

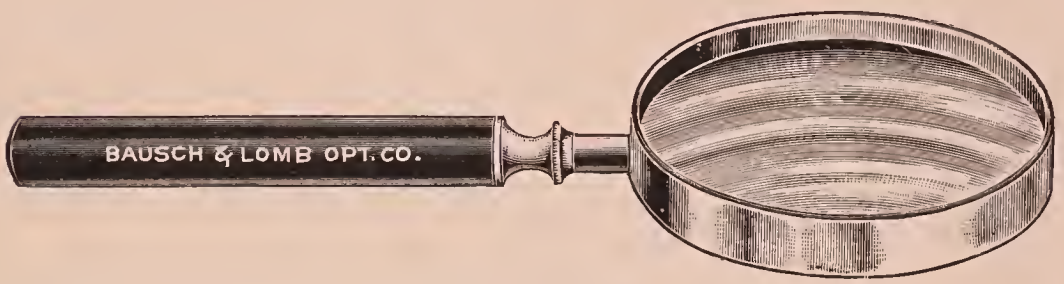
BAUSCH & LOMB-ZEISS STEREO FIELD GLASS.



The photographer will find a good field glass a very agreeable companion. It will save him many a hard climb and time-consuming journey, besides adding greatly to the pleasure of every trip.

Our new Stereo Field Glass is superior to all others in power, field, range, stereoscopic effect, compactness, lightness, and elegance of appearance. Indispensable when touring, yachting, cycling, racing, at the games, and for military observations. Booklet postpaid.

FOCUSING AND RETOUCHING GLASSES.



Number, . . .	252	253	254	255	256	257	258	259	260	261
Diameter, inches,	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	4	$4\frac{1}{2}$
Price, each, . .	$ .80	.90	1.00	1.25	1.50	1.75	2.00	2.25	2.50	3.25

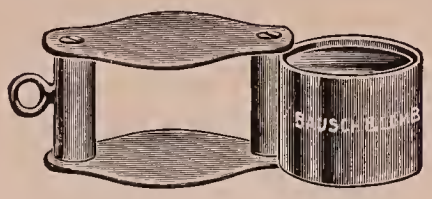
REDUCING GLASSES.



Number, . . .	252cc	254cc	256cc	258cc	260cc	262cc
Diameter, inches,	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	5
Price, each, . .	$1.50	2.00	2.50	3.00	4.00	6.00

BRANCHES: NEW YORK CITY AND CHICAGO.

HASTINGS' APLANATIC TRIPLET MAGNIFIER.

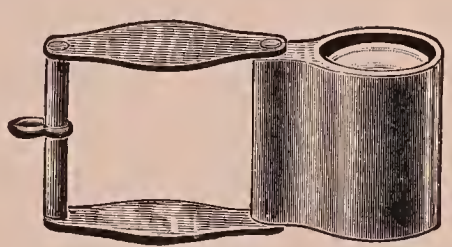


No. 35–39.

As a fine focusing glass and for examining all small objects, minerals, chemical crystals, etc., this lens will be found the best, as it is constructed after a formula by Professor Charles S. Hastings of Yale University.

Number.	Magnification.	Focal Length.		Real Field. Mm.	Price.
		Inches.	Mm.		
35	5.0	2	51.0	40.0	$7 00
36	6.7	1½	38.0	30.0	7 00
37	10.0	1	25.0	20.0	7 00
38	15.0	¾	19.0	14.0	7 00
39	20.0	½	13.0	7.5	7 00

APLANATIC TRIPLET LENS.



No. 30–32.

The Aplanatic Triplets, while not having as large field as the Hastings lenses, give very good definition, and have good magnifying power.

Number.	Magnification.	Focal Length.		Price.
		Inches.	Mm.	
30	10	1	25.0	$4 00
31	14	¾	18.0	4 00
32	20	½	12.5	4 00

CONDENSING LENSES.

The Condensing Lenses listed below are accurately ground and polished, and will be found much superior to the imported lenses commonly employed for this purpose. When condensers are wanted mounted, we supply them in our improved mounts, which are so constructed that there is the least possible danger of the lenses breaking when heated. The mountings are also very neat and compact.

Diameter. Inches.	Focus. Inches.	One Lens. Unmounted.	Pair of Lenses. Mounted.
4	$5\frac{1}{2}$ or $6\frac{1}{2}$	$ 1 25	$ 4 00
$4\frac{1}{8}$	$5\frac{1}{2}$ or $6\frac{1}{2}$	1 35	5 00
$4\frac{1}{2}$	$5\frac{1}{2}$ or $6\frac{1}{2}$	1 50	6 00
5	$6\frac{1}{2}$	1 75	7 50
$5\frac{1}{2}$	8	2 25	9 00
6	8	3 00	12 00
$6\frac{1}{2}$	8	4 00	18 00
7	9	5 75	24 00
8	12	7 50	32 00
9	14	10 00	40 00
10	15	13 50	50 00
12	18	27 00	80 00
14	21	40 00	120 00

BRASS FLANGES FOR LENSES.

Number,	1	2	3	4	5	6	7	8	9	10	11
Diameter, inches,	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	5	$5\frac{1}{2}$	6
Price, each,	$ .50	.50	.75	1.00	1.00	1.25	1.50	1.75	2.00	2.50	3.00

MOROCCO CAPS FOR LENSES.

Number,	1	2	3	4	5	6	7	8	9	10	11	12
Diameter, inches,	$1\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{7}{8}$	$2\frac{1}{16}$	$2\frac{3}{16}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$3\frac{1}{16}$	$3\frac{9}{16}$	$4\frac{1}{16}$	$4\frac{9}{16}$	$5\frac{9}{16}$
Price, each,	$ .60	.60	.65	.70	.70	.75	.80	.90	1.00	1.10	1.20	1.25

GRAINED LEATHER CAPS FOR LENSES.

Number,	1	2	3	4	5	7	8	9	10
Diameter, inches,	$1\frac{3}{8}$	$1\frac{1}{2}$	$2\frac{1}{16}$	$2\frac{11}{32}$	$2\frac{3}{4}$	$3\frac{7}{32}$	$3\frac{9}{16}$	$4\frac{9}{16}$	$5\frac{1}{2}$
Price, each,	$ .40	.45	.50	.55	.60	.70	.80	.90	1.00

SIZES OF FLANGES REQUIRED FOR VARIOUS LENSES.

DIAMETER OF FLANGE.	Bausch & Lomb-Zeiss Anastigmats.								Sets of Convertible Anastigmats.
	Series II.	Series IIa.	Series III.	Series IIIa.	Series IV.	Series V.	Series VII.	Series VIIa.	
$1\frac{1}{2}$ in.	. . .	. . .	. . .	. . .	$3\frac{1}{4}$ x $4\frac{1}{4}$ 4 x 5 5 x 7 8 x 10 10 x 12 11 x 14	5 x 7 $6\frac{1}{2}$ x $8\frac{1}{2}$ 8 x 10 10 x 12 12 x 15			
$1\frac{3}{4}$ "	$3\frac{1}{4}$ x $4\frac{1}{4}$ 4 x 5	4 x 5 $4\frac{1}{4}$ x $6\frac{1}{2}$ 5 x 8	$3\frac{1}{4}$ x $4\frac{1}{4}$ 4 x 5 $4\frac{1}{4}$ x $6\frac{1}{2}$	$4\frac{1}{4}$ x $6\frac{1}{2}$ $3\frac{1}{4}$ x $4\frac{1}{4}$ 5 x 7 5 x 8 $6\frac{1}{2}$ x $8\frac{1}{2}$	. . .	. . .	1 2 3	1 2 3 4 5 7	
2 "	$4\frac{1}{4}$ x $6\frac{1}{2}$	$6\frac{1}{2}$ x $8\frac{1}{2}$	5 x 7	. . .	. . .	. . .	. . .	6 8 10	C Set
$2\frac{1}{4}$ "	5 x 7	8 x 10	$6\frac{1}{2}$ x $8\frac{1}{2}$	7 x 9	. . .	. . .	. . .	9 11 13	
$2\frac{1}{2}$ "	$6\frac{1}{2}$ x $8\frac{1}{2}$	10 x 12 11 x 14	8 x 10	8 x 10 10 x 12	. . .	. . .	. . .	12 14 16	D Set
3 "	8 x 10	. . .	. . .	11 x 14					
$3\frac{1}{2}$ "	10 x 12 11 x 14	. . .	10 x 12						



TABLE FOR DETERMINING THE MINIMUM LENGTH OF STUDIO.

Equivalent Focus of Lens.	Height of image when subject is 6 feet high.										
	3 in. High.	4 in. High.	5 in. High.	6 in. High.	8 in. High	10 in. High.	12 in. High.	16 in. High.	20 in. High.	24 in. High.	30 in. High.
4 inches	8/4	6/4	5/2	4/4							
5 "	10/5	7/11	6/5	5/5	4/2						
6 "	12/6	9/6	7/8	6/6	5/0	4/1					
8 "	16/8	12/8	10/3	8/8	6/8	5/6	4/8				
10 "	20/10	15/10	12/10	10/10	8/4	6/10	5/10	4/7			
12 "	25/0	19/0	15/5	13/0	10/0	8/2	7/0	5/6	4/7		
16 "	33/4	25/4	20/6	17/4	13/4	10/11	9/4	7/4	6/2	5/4	4/6
20 "	41/8	31/8	25/8	21/8	16/8	13/8	11/8	9/2	7/8	6/8	5/8
24 "	50/0	38/0	30/10	26/0	20/0	16/5	14/0	11/0	9/2	8/0	6/10
30 "	62/6	47/6	38/6	32/6	25/0	20/6	17/6	13/9	11/6	10/0	8/6

Distance in feet and inches from subject to lens.

TABLE FOR DETERMINING THE DISTANCE BETWEEN LENS AND GROUND-GLASS.

Equivalent Focus of Lens.	Height of image when subject is 6 feet high.										
	3 in. High.	4 in. High.	5 in. High.	6 in. High	8 in. High.	10 in. High.	12 in. High.	16 in. High.	20 in. High.	24 in. High.	30 in. High.
4 inches	4.1	4.2	4.3	4.33							
5 "	5.2	5.3	5.35	5.4	5.6						
6 "	6.2	6.3	6.4	6.5	6.6	6.8					
8 "	8.3	8.4	8.5	8.6	8.9	9.1	9.3				
10 "	10.4	10.5	10.7	10.8	11.1	11.4	11.6	12.2			
12 "	12.5	12.6	12.8	13	13.3	13.7	14	14.6	15.3		
16 "	16.6	16.9	17.1	17.3	17.8	18.2	18.6	19.5	20.4	21.3	22.6
20 "	20.8	21.1	21.4	21.6	22.2	22.8	23.3	24.4	25.5	26.6	28.3
24 "	25	25.3	25.6	26	26.6	27.3	28	29.3	30.6	32	34
30 "	31.2	31.6	32.1	32.5	33.3	34.2	35	36.6	38.3	40	42.5

Distance in inches from lens to ground-glass.

TABLE FOR COMPUTING THE ANGLE OF VIEW.

Divide the long side of the plate by the equivalent focus of the lens.

If the Quotient is	The Angle is	If the Quotient is	The Angle is	If the Quotient is	The Angle is	If the Quotient is	The Angle is
.282	16 Deg.	.631	35 Deg.	1.02	54 Deg.	1.48	73 Deg.
.3	17 "	.65	36 "	1.041	55 "	1.5	74 "
.317	18 "	.67	37 "	1.063	56 "	1.53	75 "
.335	19 "	.689	38 "	1 086	57 "	1.56	76 "
.353	20 "	.708	39 "	1.108	58 "	1.59	77 "
.37	21 "	.728	40 "	1.132	59 "	1.62	78 "
.389	22 "	.748	41 "	1.155	60 "	1.649	79 "
.407	23 "	.768	42 "	1.178	61 "	1.678	80 "
.425	24 "	.788	43 "	1.2	62 "	1.7	81 "
.443	25 "	.808	44 "	1.225	63 "	1.739	82 "
.462	26 "	.828	45 "	1.25	64 "	1.769	83 "
.48	27 "	.849	46 "	1.274	65 "	1.8	84 "
.5	28 "	.87	47 "	1.3	66 "	1.833	85 "
.517	29 "	.89	48 "	1.32	67 "	1.865	86 "
.536	30 "	.911	49 "	1.35	68 "	1.898	87 "
.555	31 "	.933	50 "	1.375	69 "	1.931	88 "
.573	32 "	.954	51 "	1.4	70 "	1.965	89 "
.592	33 "	.975	52 "	1.427	71 "	2.	90 "
.611	34 "	1.	53 "	1.45	72 "		

What kind of a lens do I want?

Will it meet my requirements?

Are the questions which face the purchaser of a photographic outfit, questions which require experience and a thorough knowledge of the optics of lenses, as well as of the purpose for which they are to be used, to answer. To aid in making a wise selection, we give below the results of our experience in supplying the wants of all kinds of photographers. The results which may be obtained with a photographic lens (objective) depend upon the care and skill with which it is made fully as much as upon its construction. The following statements therefore apply only to lenses in which the workmanship is the best.

The leading characteristics to be considered are the following:

1. *Definition.*
2. *Rapidity.*
3. *Covering Power.*
4. *Freedom from Astigmatism.*
5. *Rectilinearity.*
6. *Angle of View.*
7. *Depth of Focus.*

1. *Definition* is that quality of a lens which enables it to produce sharp and crisp images. If a lens fails in this respect it is of inferior quality. Partial correction for this fault may be made by decreasing the opening (using smaller stop), but this shuts out light and consequently requires a longer exposure.

In a perfect lens the definition should be faultless with the largest stop.

2. *Speed* should be the greatest possible, and at least sufficient for making instantaneous outdoor and gallery photographs with unfavorable light. Speed depends upon the relation of aperture to focus; that is, the relation of the opening (not diameter of lenses) to the focus, and is expressed by a fraction of the diameter of aperture, obtained by dividing the diameter of diaphragm by the focal length. For example, suppose the diameter of diaphragm to be 1 inch, and the equivalent focal length of the lens to be 8 inches, the speed would be designated by the fraction f–8.

To meet all conditions for hand camera and outdoor work, a lens should have a speed of not less than f–9.

3. Covering Power. A lens is said to have perfect "covering power" when the image is sharply defined to the margins of the plate. A lens may have definition and speed and still be unable to "cover the plate" or give a sharp image over the full size of the plate used. In general, it may be said that the sharper the definition over all parts of the plate, the better is the quality of the lens. Again, the better the quality of the lens, the shorter the focus which may be used with any given size of plate, thus increasing the angle and depth of focus, as well as adding to the compactness of the lens itself.

A good lens should give good definition to the margin of the plate, with large opening.

4. Freedom from Astigmatism. This important improvement, first accomplished in the Zeiss Anastigmat lenses, has, to a considerable extent, revolutionized the construction of photographic lenses. Astigmatism is a fault inherent in all lenses and lens systems, except those especially constructed to eliminate it, and may be defined as the inability of such a lens to bring vertical and horizontal lines to a focus at the same time, even though such lines lie in the same plane. The elimination of astigmatism from photographic lenses remained impossible until the inventor of the Zeiss Anastigmat lenses worked out the formula for a glass having the proper dispersive and refractive power to correct the ever present astigmatism. This glass is now known as Schott-Jena glass, and is used in all our Zeiss Anastigmat lenses.

Anastigmat lenses give correct delineation, hence have better definition and covering power; and, on account of better corrections, permit the use of shorter focus, giving greater angle, more equal illumination, and greater depth of focus.

5. Rectilinearity. Rectilinear lenses reproduce straight lines as straight lines. Single lenses reproduce straight lines near the margins of the plate as curves. The lack of rectilinearity shows most at the margin of the image circle, and is most pronounced in short-focus lenses. A lens may have speed, definition, covering power, and freedom from astigmatism, and still not be rectilinear.

6. Angle of View. Upon this depends the amount of view included within the size of plate. The actual angle is expressed by the extreme rays which pass through the diaphragm and reach the margin of the plate. The angle, therefore, becomes wider with the decrease in focus on the same size plate. The angle for ordinary views is calculated at about 60 degrees. When ranging at between 80 and 100 degrees it is called "wide angle." In a wide-angle lens the focus is relatively short and involves the use of smaller stops to give covering power, thus reducing speed. Under ordinary conditions the angle of a lens is invariable, so that while it may be rated to give a wider angle, this can only be gained by using it on a larger plate. If a wider angle on the same size plate is desired, a shorter focus lens must be used.

A lens should have an angle considerably exceeding that actually required for the plate on which it is to be used.

7. Depth. Upon this quality depends the capacity of the lens to give a sharp picture of objects situated at different distances from the camera. It may be obtained by the use of small stops, but at the sacrifice of speed. With any given stop it is an *invariable quality* in different lenses of the same equivalent focus, whatever may be their construction. It increases with the decrease in focus. There is no such thing as a universal focus, except with small stops, although short-focus lenses on small plates give a result nearly approximating it.

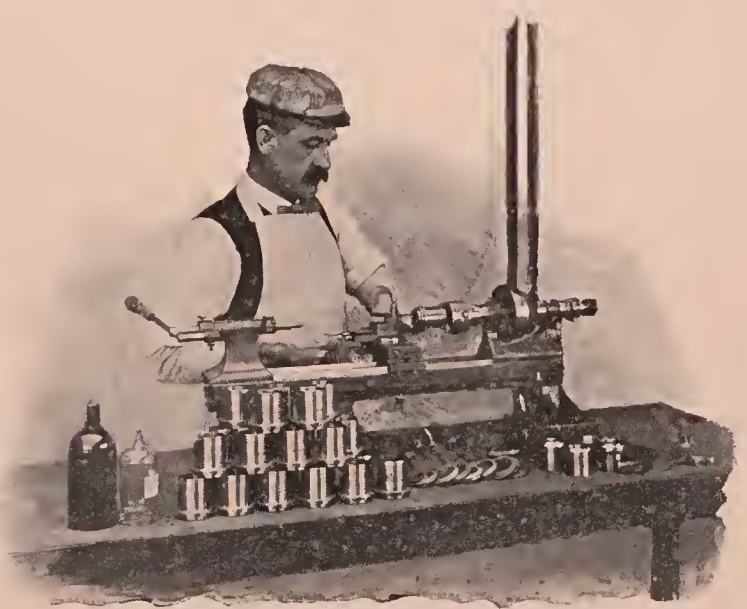
Lenses of the best quality (Anastigmat) may be used of shorter focus and give correspondingly greater depth, besides greater angle.

Resume. Assuming the same equivalent focus and rapidity, a double combination is superior to a single combination because it has:

Better definition
Greater speed
Greater covering power
Rectilinearity.

Assuming the same amount of speed, the Zeiss Anastigmat is superior to the Rectilinear lens because it has:

Freedom from astigmatism
Greater covering power
Shorter focus
Greater depth
Greater angle
Greater compactness.



CHOICE OF LENSES FOR HAND CAMERAS.

In the subjoined tables we give a resumé of lenses suitable for hand cameras, from which a selection can be readily made. For additional information on the optical properties of lenses, reference may be made to the descriptions.

Hand cameras require the mountings of lenses to be as compact as it is possible to make them in order to allow the camera to fold in a small space. We mount our lenses to meet this condition. Since hand camera work consists chiefly of instantaneous exposures, it is desirable to obtain speed, covering capacity and depth of focus with proper angular field, and the lenses recommended in the table combine these characteristics to the greatest possible extent. The equivalent focus of each is shorter than the diagonal of the plate, and longer than its short side.

In all of these lenses the angle is sufficiently large so that they can be used on the next larger plate, thus giving a greater angular range, which is an immense advantage.

It is often desirable, and, in cases of interiors and confined situations, absolutely necessary, to use lenses having considerable angle, which can be obtained only by using a shorter focus, but in which, at the same time, covering power should be retained to the utmost possible extent. We therefore give also a table of such lenses (Table II), which can be used under favorable conditions for instantaneous exposures.

An ideal outfit should comprise these two classes of lenses, which are made interchangeable in the shutter or barrel, and are optically of the greatest possible efficiency.

TABLE I—MEDIUM ANGLE LENSES.

SERIES.	3¼ x 4¼	4 x 5	5 x 7 5 x 8	6½ x 8½
Ia	No. 10	No. 11	No. 13	No. 14
II	No. 2	No. 3	No. 5 No. 6	No. 7
IIa	. . . . .	No. 1	No. 3	No. 4
III	No. 1	No. 2	No. 4 No. 5	No. 6
IIIa	No. 00	No. 1	No. 3 No. 4	No. 5
Ex. Rapid Univ.	No. 0	No. 00	No. 1	No. 2
Rapid Universal	No. 4¼	No. 5	No. 8	No. 8½
A. G. Clark . . .	No. 4¼	No. 5	No. 8	No. 8½

TABLE II—WIDE ANGLE LENSES.

IV	No. 1	No. 2	No. 4	. . . . .
V.	. . . . .	No. 1	No. 2	No. 3
Universal W.A. .	. . . . .	No. 5	No. 8	No. 8½



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