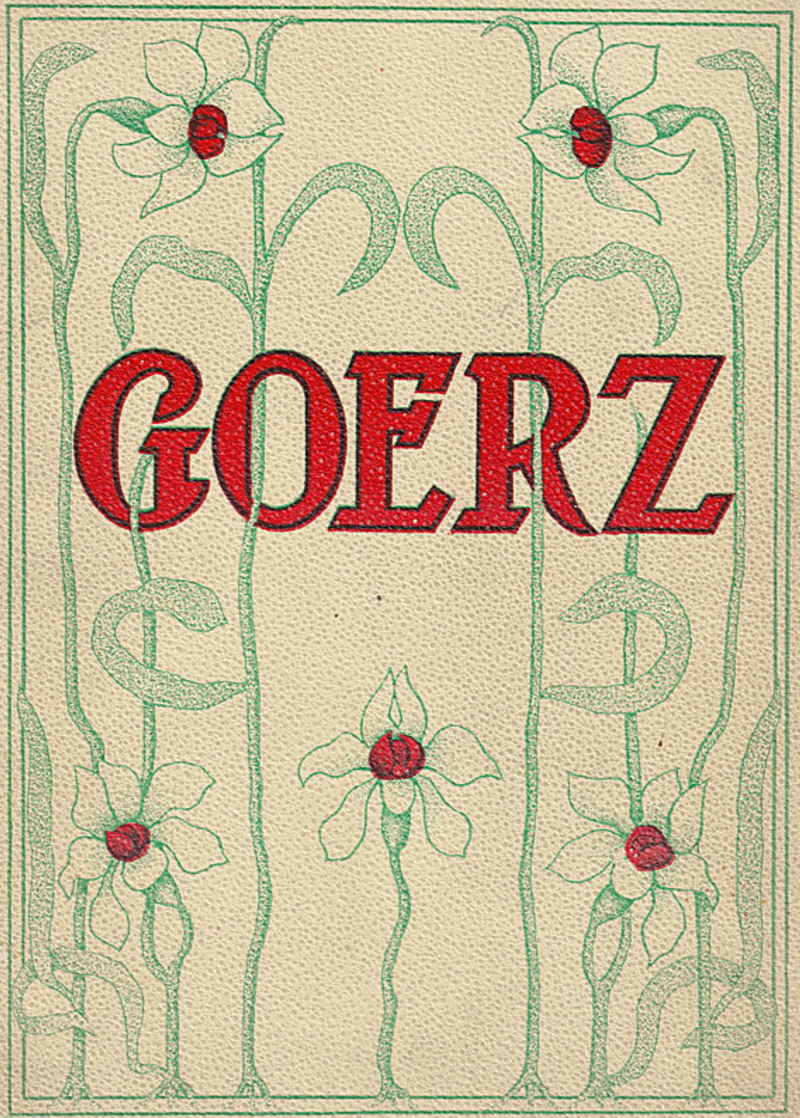

GOERZ

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MAIDEN LANE, NEW YORK

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Boston.

PRICE LIST

OF

Double=Anastigmat Lenses Goerz' Anschutz Cameras Shutters, Etc., Etc. And Trieder Binoculars

MANUFACTURED BY THE

C. P. GOERZ OPTICAL WORKS

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1903

TERMS

All prices are quoted in the currency of the United States. **Goods delivered f. o. b. New York.**

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Lenses which are not approved of will be exchanged or their value refunded if returned in an intact condition within 10 days after arrival.

All goods are packed with the utmost care. We cannot therefore be held responsible for any damage during transport.

All goods contained in this catalogue can be obtained **from any good dealer in photographic supplies** in the United States and in Canada; or in all cases where this should not be possible, from our New York office.

When ordering by wire, please use the code word specified.

Telegraphic Address:—Goerz, New York.

Made with No. 9, Series III., on 14 x 17 plate. By W. F. Schreiber.

Goerz Double Anastigmats

German Patent No. 74437. — Brit. Patent, 1892, No. 23378. — Austria-Hungarian Priv. No. 65495/18760.
French Patent N.. 226500. — Italian Patent, Vol. LXV. No. 144. — Swiss Patent No. 6167.
United States Patent No. 528155.

THE ever advancing claims made upon the means employed in photography and in its development have prompted me in directing particular attention to the improvement of photographic lenses with respect to the astigmatic curvature of the image.

My scientific assistant, Mr. Emil von Höegh, carried out a series of exhaustive mathematical calculations which have led to most surprising and equally happy results. He found that a doublet, each member of which consists of three lenses of different refractive power, afforded the means of compensating the astigmatism in a theoretically perfect manner, and, at the same time, of obtaining within wide limits a perfectly flat field, without detriment to any of those other qualities which a good photographic lens should possess.

The constructive type comprising these new lenses has been patented in Europe and America.

Although only a few years have passed since these new lenses first entered into public competition, they have attained in all parts of the globe the foremost position, and have been declared to be **the most perfect of modern lenses** by authorities on the subject of photographic optics, who had an opportunity of exhaustively testing their properties.

The **astigmatism** is completely corrected, the result being that, even with full aperture, the image is as sharp at the edge as it is in the centre.

The **curvature of the field** is, within an angle of 72°, eliminated—*i. e.*, that part of the image which is comprised within this angle is absolutely flat. The **definition** and **depth** are the same in all parts of the field.

The co-existence of these two essential qualities, viz., absence of astigmatism and of curvature of the field, places these lenses in a foremost position and **secures for them the supremacy over all other existing types.**

By reason of the symmetrical arrangement of the two combinations of the Double Anastigmats, the image is perfectly **orthoscopic,** and all traces of **distortion** are, *a priori*, obviated.

The Double Anastigmats are free from internal reflections, and the image produced by them is accordingly **brilliant** and **free from flare.**

The two combinations are placed in close proximity, with the result that there is no perceptible falling off of the luminosity towards the edge. The entire surface of the image is, therefore, uniformly illuminated, and, besides, the compactness of the Double Anastigmats renders them extremely rigid and portable.

The glasses employed in the construction of the three elements are so chosen as to minimize the irrationality of their spectra, and thus to reduce the secondary chromatic aberration to an inappreciable quantity. The approach to **apochromatic** correction is, therefore, much more perfect than with the older types of photographic lenses.

The **chromatic difference of the spherical aberration** is almost entirely compensated.

The Double Anastigmats are spherically and chromatically corrected for the **axial** and **oblique** pencils even with the largest stop.

The symmetrical arrangement of the two members of the Double Anastigmat has the advantage over the dissymmetrical types of admitting of either half (which has approximately double the focal length of the entire system) being used as a single **landscape lens.**

The following glasses are employed in the construction of the Double Anastigmats, viz., a Barium-Silicate Crown, a light Baryta Flint and a Silicate Crown. All three glasses are absolutely permanent and are **highly transparent** and **perfectly homogeneous.**

They are the products of the well-known glass works at Jena. Owing to difficulties in the manufacture of these optical glasses it has hitherto been impossible to obtain Baryta crown glass entirely free from **small bubbles.** This slight imperfection has, as is well understood, no detrimental influence on the optical properties of the lens, its only effect being a reduction of the light transmitted, but the amount of this reduction is so inappreciably small that it stands for nothing as compared with the immense advantages resulting from the use of the new glasses. Until it becomes possible to eliminate this imperfection complaints made in this respect cannot be considered.

The system of stops regularly used in these lenses is the Universal System (U. S.), but if preferred we will engrave the barrel or shutter in the F system or the Dr. Stolze system, as used in our German made lenses.

The stops used and their corresponding F values are as follows :

U. S. System,	$1.^{25}$	$1.^{44}$	$1.^{56}$	$1.^{90}$	$2.^{50}$	$2.^{90}$	4.	8.	16.	32.	64.	128.	256.
F "	$4.^{5}$	$4.^{8}$	5.	$5.^{5}$	$6.^{3}$	$6.^{8}$	8.	$11.^{3}$	16.	$22.^{6}$	32.	$45.^{2}$	64.

For further information relative to stop denominations, see pages 10, 11.

The optical and photographic qualities of each lens sent out are carefully tested in a laboratory fully equipped with the instruments required for this purpose. Thus only faultless instruments are sent out from the works.

NOTICE.—We withdraw the guarantee on our lenses when the shutters are fitted by others than ourselves.

COMMUNICATION

From the firm of

SCHOTT & GEN, JENA (Germany)

Glass-Manufactory for Optical and Other Scientific Purposes.

THE efforts of the opticians in the improvement of objectives in the higher characteristics of optical results have in later years, particularly in photographic objectives, resulted in an increasing demand for such kinds of glasses, which, in their optical properties and chemical composition, differ very considerably from the crown and flint formerly used, and the production of which presents far greater technical difficulties for the producer than the former current optical glass. Particularly does the majority of the kinds of glasses required in the construction of the improved photographic objectives, which have been recently introduced, offer unusual difficulties in the accomplishment of complete purity, that is, freedom from small air bubbles. For the different demands, which are made from these special glasses, varying from the ordinary materials in their conditions between refractive index and dispersive power, subject the chemical composition of the glass flux to such narrow limits, that the technique of melting leaves no choice to bring about favorable conditions for the greatest possible purity. The result is that in such kinds of glass it becomes practically impossible regularly to produce pieces which are free from **small air bubbles.**

> We must point out that the existence of such small air bubbles, even in the most unfavorable case, hardly reaches a loss of light amounting to 1/50th per cent., and therefore is entirely without influence on the optical result of a lens system.

It is, therefore, obviously **unreasonable** to demand of the producer of optical glass that, to meet the increased demand of the optician in reference to all the **really** important properties necessary for the function of the objectives, he should reject 9/10ths of the produced glass, merely because it shows a defect, which in application is entirely insignificant.

If the purchaser, especially of photographic objectives, should, as has hitherto been customary, declare lenses with a few small air bubbles as "faulty," the optician will be constrained to explain that objectives of improved quality in **optical** results cannot be produced out of any crown and flint which may be selected at will, but only from such kinds of glass, in the selection of which higher considerations than the presence of a few small air bubbles must be decisive.

SCHOTT & GEN.

The Universality of the Goerz Double Anastigmat Demonstrated

THREE LENSES IN ONE.

Using Complete Lens.

Reproduced from 4x5 Negative made with No. 1 **Double Anastigmat—focus 6 inches.**

Using Rear Combination Alone without Changing Position of Camera.

Reproduced from 4x5 Negative made with the rear combination of the **same lens—focus 11½ inches.**

Reproduced from 6½x8½ negative, using the No. 1 **Double Anastigmat** lens of **6 inches focus** as a **wide-angle lens.** For similar purposes the **Double Anastigmats** are superior in all respects to any other wide-angle lens. They cannot be equalled for **depth of focus, sharpness of definition, freedom from distortion, and correctness of perspective.**

COMPARATIVE "STOP" (DIAPHRAGM) DENOMINATIONS

Stolze System as used on Goerz Lenses	$1.^{5}$	$1.^{52}$	2	$2.^{3}$	$2.^{5}$	3	$3.^{1}$	4	$4.^{6}$	$4.^{9}$	$5.^{62}$	6	$6.^{4}$	8
Corresponding F Values . . .	$3.^{9}$	4	$4.^{5}$	$4.^{8}$	5	$5.^{5}$	$5.^{6}$	$6.^{3}$	$6.^{8}$	7	$7.^{5}$	$7.^{7}$	8	9
English System of F Values .	. .	4	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	8	. .
Corresponding Values according Universal System (U. S.)	$0.^{95}$	1	$1.^{25}$	$1.^{44}$	$1.^{56}$	$1.^{90}$	$1.^{96}$	$2.^{50}$	$2.^{90}$	$3.^{07}$	$3.^{54}$	$3.^{75}$	4	$5.^{06}$

Stolze System as used on Goerz Lenses	9	10	12	$12.^{7}$	$14.^{4}$	$18.^{2}$	24	$25.^{6}$	48	$48.^{4}$	51	96	$102.^{4}$	192	$202.^{5}$	$204\frac{3}{4}$	384	$409.^{6}$	768
Corresponding F Values	$9.^{5}$	10	11	$11.^{3}$	12	$13.^{5}$	$15.^{5}$	16	$21.^{9}$	22	$22.^{6}$	31	32	$43.^{8}$	45	$45\frac{1}{4}$	62	64	$87.^{6}$
English System of F Values	. .	. .	11	. .	. .	. .	. .	16	. .	22	. .	. .	32	. .	45	. .	. .	64	. .
Corresponding Values according Universal System (U. S.)	$5.^{64}$	$6.^{25}$	$7.^{56}$	8	9	$11.^{37}$	$14.^{5}$	16	30	$30.^{25}$	32	60	64	120	$126.^{5}$	128	240	256	478

The speed of a lens is determined by the amount of light it passes, and consequently varies in direct proportion of the **areas** of the different stops or diaphragms used. It is, however, usual to name the different stops by their diameters, as the $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$ of the focus, commonly written F : **8**, F : **16**, F : **32**, etc. These denominations do not express the relative quantities of light they permit to pass through, as the areas they represent are not proportionate to these diameters, but to their squares. For instance, the area corresponding to F : **16** is **four** times smaller than that represented by F : **8**, and four times larger than that corresponding to F : **32**. As this circumstance has often led to mistakes in exposures, lens manufactures have adopted systems of stop-denomination whereby the relative times of exposures are made directly proportionate to the various numbers with which the different stops are marked. The above table gives the comparison of the Stolze system with the Universal system and the F system.

EXAMPLE.—A lens working at F : **$7.^{7}$** calls for an exposure of **$1.^{5}$** second. What will be the correct exposure when stopping down to F : **31 ?**

The table shows in the Stolze system that F : **$7.^{7}$** corresponds to **6** and F: **31** to **96**. The should thus be as $\frac{96}{6} \times 1.^{5}$ seconds, or **24** seconds.

The U. S. system gives **$3.^{75}$** and **60** respectively as corresponding to F : **$7.^{7}$** and F : **31**, and thus gives $\frac{60}{3.^{75}} \times 1.^{5}$ seconds=**24** seconds.

By examining the above Comparative Stop Denominations, the percentage of speed of one lens over the other will be seen. For example, a lens listed at F : **$4.^{8}$** is equal to **$1.^{44}$** U. S., and a lens listed at F : **$5.^{6}$** is equal to **$1.^{96}$**, therefore F : **$5.^{6}$** is **over 36% SLOWER** than F : **$4.^{8}$** . In like manner, F : **$4.^{8}$** equals U. S. **$1.^{44}$**, and F : **$6.^{8}$** equals U. S. **$2.^{90}$**, thus F : **$6.^{8}$** is **102%** slower than F : **4^{8}** .

In the Dr. Stolze system each stop indicates the time of exposure in accordance with the following formula :

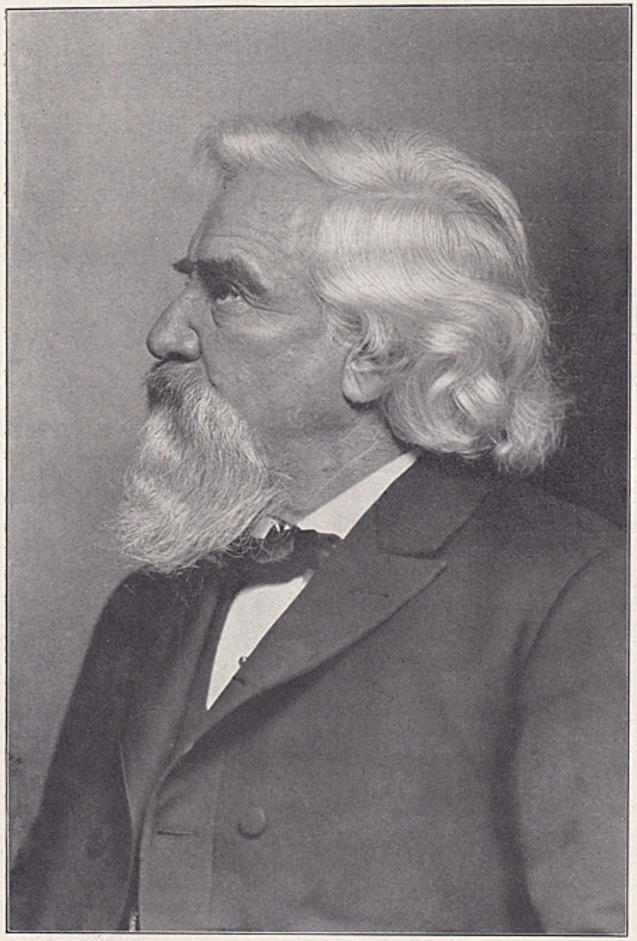
$t = \frac{1}{10}\left(\frac{F}{d}\right)^2$, "F" being the equivalent focus, and "d" the effective aperture of the lens.

According to this system, "I" denotes the rapidity of a lens working at aperture $\frac{F}{\sqrt{10}} = \frac{F}{3.16}$; "6" is that of a lens working at the effective aperture $\frac{F}{\sqrt{60}} = \frac{F}{7.7}$, etc. For the Universal System (U. S.) the formula is as follows:

$t = \frac{1}{16}\left(\frac{F}{d}\right)^2$, and in this instance "I" denotes the rapidity of a lens working at aperture $\left\{\frac{F}{\sqrt{16}} = \frac{F}{4}\right.$.

In accordance with these formulæ the comparative table has been computed, giving at a glance the corresponding figure in the various systems.

Made with Series III. "McMillan" By E. F. Keller.



Made with No. 9, Series III. By W. F. Schreiber.

On the Choice of Lenses

THE following tables, in which the properties of each objective are specified, are intended to facilitate the proper selection of a lens which best answers certain requirements.

The choice of a **lens** is governed by the **focal length,** which determines the size of the picture with respect to a given distance of the object, and more particularly by **rapidity, angle** and **depth.** The tables will be found to contain full particulars respecting the rapidity, which depends upon the ratio of the effective aperture to the focal length of the objective and the angular extension of the image, which, in conjunction with the focal length, determines the covering power of the lens. It will, however, be well to say a few words on **Depth of Definition.** Regarding this point incorrect notions have extensively been promulgated in the price lists of even eminent makers, as well as in text-books on photography. According to these notions, certain types have been claimed to be, *cæteris paribus,* possessed of great depth, whereas, in truth, depth of definition is entirely independent of any particular constructive type, and depends solely upon the ratio between effective aperture and focal length, and upon the absolute value of the focal length itself*, inasmuch as the depth increases in proportion as the ratio between the aperture and focal length becomes less and as the focal length itself diminishes. Only inasmuch as the passage of light is, in a variable degree, affected by reflection at the lens surfaces and by absorption through the glass and balsam, lenses having similar effective apertures and equal focal lengths may be said to vary in point of rapidity, and, therefore, also of depth. Hence lenses possessing few and feebly reflecting surfaces, and made of the most transparent substances, are naturally placed at an advantage in this respect. In the construction of my Double Anastigmats these factors have received the most careful attention.

Bearing in mind the true relation of depth to other properties of a lens, it will at once be understood that in the following tables the smallest lenses of each series possess the greatest depth, and *vice versa.* It goes without saying that the depth of any objective increases in proportion as the stop is reduced. (For further particulars, see table on pages 16-17.

* Apparent differences in the depth, which practical photographers profess to notice in lenses having the same relative aperture and the same focal length, are due to unequal distribution, in different cases, of the depth towards the front or back, which will happen when a lens is imperfectly free from focal difference or when the image is curved. In all lenses which are free from these defects the definition varies in accordance with a fixed law with a greater or less distance of the objects as compared with the distance of those objects which are strictly in focus.

GOERZ DOUBLE ANASTIGMAT LENSES

The four characteristical qualities of the Goerz Double Anastigmat Lenses, viz., extreme rapidity, minute definition, great covering powers, and utmost depth of focus, give them the leading position of all anastigmats throughout the world.

They are the ideal lenses for the professional and amateur ; they are, in fact, "The Universal Lenses."

Goerz Double Anastigmats, Series III., are adapted for every conceivable photographic purpose,—portraiture, groups, landscapes, animal life, architecture, interiors, and for copying.

The **speed** of the Goerz Double Anastigmat, Series III., F:6.8 is **actual** and combined with their **even illumination** insures the taking of instantaneous views at late hours and on dull days.

The **definition** of pictures obtained by using the Goerz Double Anastigmat, Series III., is **microscopically sharp,** even to the very corners of the plate. The disturbing defects of **chromatic aberration** and **distortion** are **entirely eliminated,** and the **astigmatism** and **curvature of field** are **absolutely corrected up to an angle of 72° when using the full aperture.**

Sharp corners are secured **at full aperture** on a plate considerably greater than the focal length of these lenses. This immense advantage requires a few words of explanation. Suppose we were to take a certain landscape on a 5 x 7 plate with the following lenses of equal focal length (say 4¾ inches), always using the same stop (say F: 11):

No. 1.—A Landscape Lens.
No. 2.—An Aplanatic Double.
No. 3.—A Goerz Double Anastigmat.

The first lens would give a sharp image in the centre of the plate only, every other part being out of focus. The second lens would barely cover 3¼ x 4¼ inches, while the Goerz Double Anastigmat would cover the whole plate, and even more, sharp to the very corners.

All other conditions being equal, the Goerz Double Anastigmat is **vastly superior** in **definition** and **evenness of illumination,** which are the most important factors for instantaneous exposures.

The perfection of the **chromatic correction** of these lenses and the entire elimination of the **curvature of field** make them **the most perfect lenses for reproduction** and half-tone work.

The single combinations may be used as long focus objectives, suitable for all classes of work where extreme rapidity is not required. The focal length is about double that of the complete lens, and the size of the image is, therefore, about twice that given by the complete lens.

The circle of illumination of the Goerz Double Anastigmats is equal to twice the focal length, and they are **thus most perfect and fast wide angle lenses,** as it is possible to cover the corners sharply up to the circle of light.

For example, a No. 1, Series III., of 6-inch focus listed for a 4 x 5 plate, will cover a plate 7 x 9, and a No. 3, Series III., of 8¼ inch focus listed for a 5 x 8 plate, will cover a plate 10 x 12 with the utmost perfection.

Few "wide angle" lenses possess larger openings than F:16, and whereas the Goerz Double Anastigmat has an aperture of F:6.8, the advantage of this latter lens for focusing in dark interiors is thus very apparent, as **the corrections** are so very **perfect** that **the plane of greatest sharpness** remains the **same at all apertures,** and no refocusing is necessary.

For portraiture, the Goerz Double Anastigmat is an ideal lens. It possesses every qualification of the old portrait lenses, and surpasses them. It is possible to have all the softness and diffusion of the old type, and yet, if necessary, the depth of focus can be made use of. This latter quality is very essential for groups.

To sum up, the Goerz Double Anastigmat combines the special advantages of all other lenses, which, combined with our methods of manufacture, make them **the Universal lens**—the best lens for all work.

"A Rainy Day in Berlin" W. Titzenthaler.
Made with No. 8, Series III., on plate 12 x 15 inches, 1/25 second.

Increase of the Focal Distance of the Lens due to Different Distances of the Object

A CERTAIN distance exists for each lens, at and beyond which the parallaxes of the luminous points are so small that the incident rays may be considered to be parallel to each other. In this case the distinct image is situated in the principal focal plane of the lens — *i. e.,* in the plane which is conjugate to infinitely distant objects.

The subjoined table shows how far, in the case of my lenses, the distinct object lies behind the principal focal plane when the object is situated at a finite (and partly rather short distance) from the lens.

No. of LENS	000	00	0	1	2	3	4
FOCUS in inches.	2⅜	3½	4¾	6	7	8½	9½
DISTANCE OF OBJECT in feet.	DISTANCE OF THE CONJUGATE FOCUS BEYOND THE PRINCIPAL FOCUS in inches.						
1666	.0004	.0008	.0012	.0020	.0028	.0036	.0048
333	.0016	.0028	.0056	.0092	.0128	.0174	.0232
166	.0028	.0064	.0116	.0180	.0260	.0352	.0464
100	.0052	.0108	.0192	.0300	.0436	.0592	.0776
66	.0072	.0164	.0288	.0452	.0652	.0892	.1164
50	.0096	.0216	.0388	.0604	.0872	.1192	.1560
40	.0120	.0272	.0484	.0760	.1096	.1496	.1960
33	.0144	.0328	.0584	.0912	.1320	.1800	.2360
30	.0160	.0364	.0648	.1016	.1468	.2008	.2628
27	.0180	.0408	.0732	.1144	.1656	.2264	.2968
23	.0208	.0468	.0836	.1312	.1900	.2600	.3408
20	.0244	.0548	.0976	.1540	.2228	.3048	.4000
17	.0292	.0660	.1180	.1856	.2688	.3684	.4840
13	.0364	.0828	.1484	.2336	.3392	.4640	.6120
10	.0492	.1112	.2000	.3160	.4600	.6220	.8360
7	.0740	.1694	.3064	.488	.7120	.9840	1.3080
3	.1532	.3560	.656	1.060	1.5800	2.2320	3.0320

This table is very instructive. It shows, *e. g.*, that lens No. **000**, in the case of an object situated at a distance of **33** feet requires only a displacement of **.0144** in. of the focusing screen (with respect to its position in the plane of the principal focus), whereas lens No. **3** requires this displacement already when the object is at a distance of **333** feet. Since, with the rapidities ordinarily employed, a difference of **.016** inches in the position of the focusing screen does not produce any sensible diffusion, we see from the table that lens No. **000** is capable of simultaneously sharply depicting objects situated at a distance beyond **33** ft., No. **3** those beyond **333** ft., No. **9**, however, only those beyond **3,333** ft., etc.

In general the table shows that, *cæteris paribus*, *i. e.*, with the same relative apertures or with the same rapidities, the depth of focus rapidly diminishes as the focal length increases.

When the objects are very near to the lens the focusing screen, or the sensitive plate, must necessarily be moved away from the principal focal plane, which causes the more distant objects to move out of focus and to become indistinct.

This table may be employed to sharply focus an object without the aid of the focusing screen, when the distance of the former is approximately ascertained by pacing off or otherwise known.

No. of LENS.	5	6	7	7a	8	9	10	11
FOCUS in inches.	10¾	12	14	16½	19	24	30	35
DISTANCE OF OBJECT in feet.	DISTANCE OF THE CONJUGATE FOCUS BEYOND THE PRINCIPAL FOCUS in inches.							
1666	.0060	.0072	.0104	.0144	.0184	.0288	.0452	.064
333	.0292	.0360	.0520	.0708	.0928	.1448	.2268	.326
166	.0584	.0724	.1044	.1420	.1860	.2916	.456	.660
100	.0980	.1212	.1748	.2384	.3120	.488	.768	1.112
66	.1476	.1838	.2640	.3212	.468	.740	1.148	1.696
50	.1980	.2448	.3540	.484	.636	1.000	1.576	2.296
40	.2484	.3080	.444	.608	.800	1.264	2.000	2.920
33	.2996	.3716	.536	.736	.968	1.532	2.432	3.560
30	.3340	.412	.600	.824	1.080	1.712	2.728	4.00
27	.3772	.468	.680	.932	1.224	1.948	3.104	4.56
23	.432	.536	.780	1.072	1.412	2.252	3.600	5.32
20	.508	.632	.920	1.264	1.668	2.668	4.28	6.36
17	.616	.764	1.116	1.540	2.040	3.272	5.28	7.92
13	.784	.972	1.424	1.972	2.620	4.24	6.82	10.44
10	1.068	1.332	1.964	2.736	3.656	6.00	10.00	15.44
7	1.684	2.116	3.160	4.48	6.08	10.28	18.00	29.44
3	3.996	5.16	8.12	12.16	17.72	36.00	90.00	324.00

REDUCING TABLE

No. of LENS.		000	00	0	1	2	3	4
FOCUS.		2⅜	3½	4¾	6	7	8¼	9½
RATIO a : b.		a—DISTANCE OF OBJECT, b—DISTANCE OF IMAGE } from the lens in inches.						
1 : 1 …………	a	4.¾	7.	9.½	12.	14.	16.½	19.
	b	4.¾	7.	9.½	12.	14.	16.½	19.
1 : 1.½ …………	a	6.	8.^{9}	12.	14.¾	17.¾	20.⅝	24.
	b	4.	6.	8.	9.⅘	12.	13.⅘	16.
1 : 2 …………	a	7.	10.⅔	14.	17.¾	21.¼	25.	28.
	b	3.½	5.⅓	7.	8.^{9}	10.⅝	12.½	14.
1 : 2.½ …………	a	8.¼	12.⅗	16.½	20.⅝	25.	29.	33.
	b	3.⅓	5.	6.⅔	8.¼	10.	11.⅝	13.⅕
1 : 3 …………	a	9.½	14.	19.	24.	28.	33.	38.
	b	3.⅙	7.	6.⅓	8.	9.⅓	11.	12.⅝
1 : 4 …………	a	12.	17.¾	24.	29.½	35.⅗	41.⅛	47.¼
	b	3.	4.⅖	6.	7.⅖	8.^{9}	10.⅛	11.^{9}
1 : 5 …………	a	14.	21.¼	28.	35.½	42.	50.	56.¾
	b	2.^{8}	4.¼	5.⅔	7.	8.⅖	10.	11.⅓
1 : 6 …………	a	16.½	25.	33.	41.⅛	50.	58.	66.
	b	2.¾	4.⅕	5.½	6.^{9}	8.⅓	9.⅔	11.
1 : 7 …………	a	19.	28.	38.	47.¼	56.¾	66.	75.⅝
	b	2.^{7}	4.	5.⅗	6.¾	8.	9.½	10.¾
1 : 8 …………	a	21.¼	32.	42.	53.	63.¾	74.⅗	85.
	b	2.⅔	4.	5.¼	6.⅝	8.	9.⅓	10.⅝
1 : 9 …………	a	24.	35.⅗	47.	60.	70.^{9}	82.⅝	94.½
	b	2.⅔	4.	5.¼	6.½	7.^{9}	9.⅙	10.½
1 : 10 …………	a	26.	39.	52.	65.	78.	91.	104.
	b	2.^{6}	3.^{9}	5.¼	6.½	7.^{8}	9.^{1}	10.⅖
1 : 12 …………	a	30.^{7}	46.	61.⅖	76.¾	92.	107.½	122.⅘
	b	2.^{5}	3.^{8}	5.⅕	6.⅖	7.⅝	9.	10.⅛
1 : 15 …………	a	37.^{8}	56.^{7}	75.⅔	94.¾	113.½	132.⅛	151.
	b	2.^{5}	3.^{8}	5.	6.⅓	7.^{5}	8.⅘	10.
1 : 20 …………	a	49.^{6}	74.⅖	99.⅕	124.	149.	173.⅕	198.⅖
	b	2.^{4}	3.^{7}	5.	6.⅕	7.⅖	8.⅝	9.^{9}
1 : 25 …………	a	61.^{4}	92.	122.⅖	153.½	184.½	215.	245.¾
	b	2.^{4}	3.^{6}	4.^{9}	6.⅕	7.⅓	8.½	9.⅘
1 : 30 …………	a	73.	110.	146.⅝	183.	220.	256.⅛	293.
	b	2.⅖	3.⅔	4.^{9}	6.^{1}	7.⅓	8.½	9.¾
1 : 40 …………	a	96.^{8}	145.	193.	242.	290.	339.	387.⅖
	b	2.⅖	3.⅔	4.⅘	6.	7.¼	8.⅖	9.⅝
1 : 50 …………	a	120.⅖	180.^{7}	241.	300.	361.	421.	482.
	b	2.⅖	3.⅔	4.⅘	6.	7.⅕	8.⅖	9.⅝
1 : 75 …………	a	179.½	269.¼	360.	449.	538.	628.	718.
	b	2.⅓	3.½	4.⅘	6.	7.⅕	8.⅓	9.½
1 : 100 …………	a	238.½	358.	477.	596.	715.	835.	954.⅛
	b	2.⅓	3.½	4.¾	5.^{9}	7.⅙	8.½	9.½

No. of LENS.		5	6	7	7a	8	9	10	11
FOCUS.		10⅝	12	14	16½	19	24	30	35
RATIO a : b.		a—DISTANCE OF OBJECT, b—DISTANCE OF IMAGE } from the lens in inches.							
1 : 1 …	a	21.¼	24.	28.^{3}	33.	37.^{8}	47.¼	59.	70.^{9}
	b	21.¼	24.	28.^{3}	33.	37.^{8}	47.¼	59.	70.^{9}
1 : 1.½ …	a	26.½	29.½	35.½	41.⅓	47.¼	59.	73.^{8}	88.½
	b	17.¾	19.¾	23.⅝	27.½	31.½	39.⅛	49.⅕	59.
1 : 2 …	a	32.	35.⅖	42.^{5}	49.⅝	56.¾	70.^{9}	88.½	106.⅓
	b	16.	17.¾	21.¼	24.^{8}	28.⅓	35.½	44.¼	53.
1 : 2.½ …	a	37.¼	41.⅛	49.⅝	57.^{9}	66.	82.⅝	103.⅓	124.
	b	14.^{9}	16.½	19.^{8}	23.^{2}	26.⅖	33.	41.⅓	49.⅝
1 : 3 …	a	42.½	47.¼	56.¾	66.	75.⅝	94.½	118.	141.¾
	b	14.⅕	15.¾	18.^{9}	22.	25.⅕	31.½	39.⅓	47.¼
1 : 4 …	a	53.	59.	70.^{9}	82.¾	94.½	118.	147.⅝	177.
	b	13.⅛	14.¾	17.¾	20.¾	23.⅝	29.½	39.	44.¼
1 : 5 …	a	63.¾	70.^{9}	85.	99.¼	113.⅓	141.¾	177.	212.⅝
	b	12.¾	14.⅕	17.	19.^{9}	22.⅝	28.⅓	35.⅖	42.½
1 : 6 …	a	74.⅗	82.¾	99.¼	115.	132.⅓	165.⅓	206.¾	248.
	b	12.⅖	13.¾	16.½	19.⅕	22.	27.½	34.½	41.⅓
1 : 7 …	a	85.	94.½	113.⅓	132.¼	151.⅛	190.	236.¼	283.½
	b	12.⅕	13.½	16.¼	18.^{9}	21.⅝	27.	33.¾	40.½
1 : 8 …	a	95.⅝	106.⅓	127.½	148.^{8}	170.	212.⅝	265.¾	319.
	b	11.^{7}	13.⅓	16.	18.^{6}	21.¼	26.½	33.¼	39.^{9}
1 : 9 …	a	106.⅓	118.	141.⅝	165.⅓	189.	236.⅕	295.⅓	354.⅓
	b	11.⅘	13.	15.¾	18.⅓	21.	26.⅕	32.⅘	39.⅖
1 : 10 …	a	117.	130.	155.½	182.	208.	260.	325.	390.
	b	11.¾	13.	15.½	18.¼	20.⅘	26.	32.½	39.
1 : 12 …	a	138.	153.½	183.½	215.	245.¾	307.	383.⅘	460.⅝
	b	11.½	12.⅘	15.⅓	18.	20.½	25.⅝	32.	38.⅖
1 : 15 …	a	170.	188.⅘	226.¾	264.½	302.⅓	378.	472.⅖	567.
	b	11.⅓	12.½	15.⅛	17.⅔	20.⅕	25.	31.½	37.^{8}
1 : 20 …	a	223.⅕	248.	297.⅝	347.⅕	393.¾	496.	620.	744.⅕
	b	11.	12.⅖	14.^{9}	17.⅓	19.⅝	24.⅝	31.	37.⅕
1 : 25 …	a	276.⅓	307.	368.½	430.	491.⅓	614.	767.¾	921.⅕
	b	11.	12.⅕	14.¾	17.⅕	19.⅝	24.½	30.¾	36.⅘
1 : 30 …	a	329.½	366.	439.⅓	512.⅝	585.⅖	732.⅛	915.⅛	1098.⅖
	b	10.^{9}	12.⅕	14.⅝	17.	19.½	24.⅕	30.½	36.⅝
1 : 40 …	a	435.⅘	484.⅕	581.	678.	775.	968.½	1210.	1453.
	b	10.⅘	12.	14.½	17.	19.⅖	24.⅕	30.⅓	36.⅓
1 : 50 …	a	542.	602.⅓	722.⅘	843.⅓	963.⅘	1204.¾	1506.	1807.
	b	10.⅘	12.	14.⅖	17.	19.¼	24.	30.⅛	36.⅐
1 : 75 …	a	808.	897.⅝	1077.	1256.¾	1433.	1795.⅕	2244.	2693.
	b	10.¾	11.^{9}	14.⅓	16.¾	19.⅛	23.^{9}	29.^{9}	35.^{9}
1 : 100 …	a	1073.⅝	1193.	1429.	1670.	1909.	2385.⅝	2982.⅓	3579.
	b	10.¾	11.^{9}	14.¼	16.¾	19.	23.^{8}	29.^{8}	35.¾

The utility of the preceding table may be exemplified by the following two cases:

1. It is required to photograph a person of a height of **5** ft. **7** in., so as to reduce his size **20** times — *i. e.,* to make the picture **3**$^{5}/_{16}$ in. high. Then the person should, with lens No. **0**, be placed at a distance of **8**¼ ft. (99 in.); with No. **3**, at a distance of **14**½ ft. (174 in.).

2. When photographing a house **65**½ ft. wide, on a scale of **100** : **1**, so as to obtain a picture **8** in. wide, the camera with lens No. **4** should be placed at a distance of **79**½ ft. (954 in.), or with lens No. **9** at a distance of **199** ft. (2,388 in.) from the house.

GOERZ DOUBLE ANASTIGMATS FOR PORTRAITURE

THE question is so often asked: "How far from the sitter must the camera be placed to make a Cabinet standing figure, a Paris Panel full-length figure, or a Cabinet Bust, with the Goerz Double Anastigmat Lens?"

A Cabinet standing figure 4½ inches high is equal to a reduction from the original of 1 to 15, therefore the required distances are:

No. of Lens . . .	5	6	7	7*a*	8	9	10
Feet distant . . .	14	15¾	19	22	25	31½	39⅓

A Paris Panel full-length figure 6 inches high is equal to a reduction of 1 to 11, hence the distances required are:

No. of Lens . . .	5	6	7	7*a*	8	9	10
Feet distant . . .	10¾	12	14	16½	19	24	30

A Cabinet Bust 3½ inches in size is equal to a reduction of 1 to 5. In this case the required distances are:

No. of Lens . . .	5	6	7	7*a*	8	9	10
Feet distant . . .	5⅓	6	7	8	9½	11¾	14¾

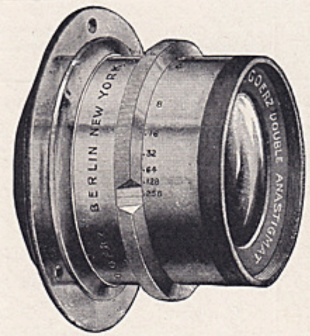
Made with No. 3, Series III. on 8x10 plate. By HENRY FUERMANN.

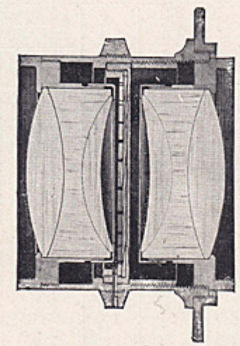
Series III.

Goerz Double Anastigmat F:6.8

UNIVERSAL EXTRA-RAPID LENS

For Portraits, Groups, Instantaneous Photography, Landscapes, Architecture, Interiors and Enlargements.





THE lenses of this series are **universal** instruments in the full sense of the word. At full aperture they admit of instantaneous photographs embracing an angle of **70°** being taken, even on dull days. By the use of small stops the photograph may be made to include an angle of **90°**. The Double Anastigmats of Series III. satisfy, therefore, the highest requirements, and are eminently adapted for all-round purposes, in and out of doors.

As the image is perfectly sharp, even with large apertures, the definition, brilliancy and depth of every point of the field is absolutely uniform. Hence perfectly sharp wide-angle instantaneous photographs may be taken.

The **back lens**, the focus of which is about double that of the entire objective, may by itself be used as a landscape lens.

NOTE.

The plate sizes specified in the subjoined table are with all the series given in round figures, in conformity with the customary sizes, and do not represent the extreme covering power ; considerable margin, in fact, is left for displacing the lens.

Series III. Goerz Double Anastigmat F: 6.8
(U. S. 2.90)

	No.	Equivalent Focus.	Free Aperture	Size of Plate Sharply Covered at F:6.8	F:15.5	F:62	Code Word.	Price with Iris Diaphragm.
F:6.8	0000	1⅝″	¼″	1⅝x1⅝″	2x2″	2x2¾″	Capo	$34 00
F:6.8	000	2⅜	⅜	2⅜x2⅜	2½x3	2¾x3½	Cardiff	34 00
F:6.8	00	3½	½	3x3	3¼x4¼	4x5	Cadiz	35 50
F:6.8	0	4¾	⅝	3¼x4¼	4x5	5x7	Cæsar	37 50
F:6.8	1	6	⅞	4x5	5x7	5x8	Calderon	45 00
F:6.8	2	7	1	5x7	5x8	7x9	Calla	51 50
F:6.8	3	8¼	1¼	5x8	6½x8½	8x10	Calvin	62 50
F:6.8	4	9½	1 5/16	6½x8½	7x9	10x12	Camerun	75 50
F:6.8	5	10¾	1½	7x9	8x10	12x15	Camillus	91 00
F:6.8	6	12	1⅝	8x10	10x12	16x18	Canada	107 00
F:7.7	7	14	2	10x12	12x15	18x22	Capet	140 00
F:7.7	7*a*	16½	2⅜	11x14	13x17	21x25	Caviar	182 00
F:7.7	8	19	2⅝	12x15	16x18	22x25	Carlos	219 00
F:7.7	9	24	3 5/16	16x18	18x22	24x30	Census	325 00
F:7.7	10	30	4¼	18x22	22x25	28x36	City	539 00
F:7.7	11	35	5	22x25	24x30	34x44	Columbia	1070 00

NOS. oo to 5 are particularly adapted for hand and field cameras. The higher numbers will be found of great service for large portraits and group photography and similar work.

For stereoscopic views the lenses are "paired" at an extra charge of $2.50.

Series III. Goerz Double Anastigmat F: 6.8

(U. S. 2.90)

Fitted with Iris diaphragm and a very convenient worm-focusing screw.

This lens is fitted on the Goerz-Anschutz Cameras It is intended for cameras that have no other method of focusing.

Number.	Equivalent Focus in.	Free Aperture. in.	Size of Plate Sharply Covered at F : 6.8 in.	F : 15.5 in.	F : 62 in.	Code Word	Price with Iris Diaphragm.
00	3½	½	3 x 3	3¼ x 4¼	4 x 5	Circe	$41.00
0	4¾	⅝	3¼ x 4¼	4 x 5	5 x 7	Corso	43.00
1	6	⅞	4 x 5	5 x 7	5 x 8	Courant	51.50
2	7	1	5 x 7	5 x 8	7 x 9	Cuba	59.00
3	8¼	1¼	5 x 8	6½ x 8½	8 x 10	Cuno	70.50
4	9½	1 5/16	6½ x 8½	7 x 9	10 x 12	Cyrano	84.50

C. P. Goerz Esq'r.,

52 Union Square,

New York, N. Y.

Dear Sir:-

Since the burning of our old works we have purchased several Series IV Goerz lenses. Our choice in this matter was made only after careful trial of many well known lenses, with a prejudice in favor of a maker who had hitherto been pre-eminent, in our judgment, in the matter of objectives for reproduction.

The result of the trials on these lines leaves no room for doubt as to the superiority of the "Goerz". Our operators say that it is a pleasure to work with the lenses and, even on dull autumn days, it is possible to make good work and satisfactory progress without the use of artificial light. In short, we get good definition with large apertures.

We feel that we can congratulate both you as maker and ourselves as possessors of such optically perfect instruments.

Very truly,

A. Hoen & Co.

Sent to
Messrs. Halgl-Cummins Co.

Series IV.

Goerz Double Anastigmat F:11

(U. S. 7.56)

RAPID COPYING LENS

For Full Size Reproductions, Enlargements, Large Groups, Landscapes, Instantaneous Photography and Interiors.

SERIES IV. of the Double Anastigmatic Lenses has been specially computed for **copying** in full size. It is, for this purpose, made to cover a plate of a diameter which is double the focal length of the lens without any distortion and without astigmatic aberrations, and with perfectly uniform sharpness up to the extreme edge.

This excellent lens may also be used for photographing distant objects; for in this case the curvature of the image is barely appreciable, and is counterbalanced by the **depth** of the focus and the sharpness of the image, which is free from astigmatic aberrations. The sharp image subtends an angle of 75° with the largest stop; hence **instantaneous wide-angle photographs, groups, landscapes and architectures** may be taken with these lenses. By means of small stops the image may be made to embrace an angle of 90°.

The back lens, the focus of which is about double that of the whole objective, may, in like manner as the lenses of Series III., be used by itself as a landscape lens.

Series IV. Goerz Double Anastigmat F: 11

(U. S. 7.[56])

Number.	Equivalent Focus. in.	Free Aperture. in.	Normal Size of Plate for Copying at F : 22 to F : 31. In Life Size. in.	Normal Size of Plate for Copying at F : 22 to F : 31. In Reduced Size. in.	Size of Plate Covered at F : 11. For Groups. in.	Size of Plate Covered at With Smaller Stops for Landscapes, Interiors, etc. in.	Code Word.	Price with Waterhouse Stops.
6	12	$1\frac{1}{16}$	16 x 20	10 x 12	10 x 12	16 x 20	Damara	$ 110.00
7	14	$1\frac{5}{16}$	20 x 24	12 x 16	12 x 16	20 x 24	Darius	141.50
7*a*	16½	1½	24 x 28	14 x 18	14 x 18	24 x 28	Davina	192.00
8	19	1¾	28 x 32	16 x 20	16 x 20	28 x 32	Dekan	230.00
9	24	2⅛	36 x 40	20 x 24	20 x 24	36 x 40	Dictator	345.00
10	30	2¾	40 x 48	24 x 28	24 x 28	40 x 48	Dolomit	565.00
11	35	3¼	48 x 60	28 x 32	28 x 32	48 x 60	Doria	1096.00
12	47	$4\frac{5}{16}$	60 x 80	36 x 40	36 x 40	60 x 80	Drusus	1980.00

THE normal plate sizes tabulated above for copying in full size are covered with great uniformity, and with a degree of sharpness which is equal to that of a fine engraving. Where this degree of sharpness is not insisted upon, *e. g.*, for reproductions in mezzo-tint, the same area may be covered with full aperture.

In order to obviate any misunderstanding, I beg to remark that the Double Anastigmatic Lenses F : **11** cover a considerably larger plate than those usually required by photographers. Nearly all cameras now in use are designed for long focus lenses, owing to the inferior capabilities of the older types of copying lenses. For this reason it is often advisable not to choose a lens of inconveniently short focus.

Goerz Double Anastigmat

Type B, Series 1B

German Patent No. 109,283
U. S. Patent No. 635,472

F:4.[5]—F:5.[5]

Angle of Field of Sharp Definition, 62°, 66°

EXTRA RAPID, APOCHROMATIC

Special Objective for Fastest Instantaneous Exposures (Focal Plane Shutters); Portraits in Rooms and Studios; Projection; Enlargements and Reproductions; Three-Color Process; Tele-Photography. Also, Landscapes and Architectural Views, and for all purposes not requiring a very wide angle of view.

THOUGH the Double Anastigmat lenses working at a maximum opening of F:6.[8] are fully capable of giving perfect definition over the entire surface of the plates for which they are listed, when used at their full aperture, they do not possess the speed required to produce fully exposed negatives under adverse conditions of light. The continuously increased exactions of photographers, who demand objectives which will enable them to produce fully timed plates, no matter how poor the light, or how rapid the motion of the object, has led Mr. Emil von Höegh to perfect a new type of Double Anastigmat lens which fulfills these requirements.

There are a number of anastigmat lenses in the market which possess a very great relative opening and thus theoretically leave nothing to be desired with regard to speed, but when used at their full opening do not possess a sharp field of sufficient extent to permit of making practical use of their speed. To overcome this difficulty such lenses are made with greater focal length and thereby accentuate all the more the lack of depth of focus, which is already reduced as a result of the increased relative opening. These considerations show that a fast lens, to be really useful in the everyday practice of photography, should not alone possess speed, but must at the same time be able to cut sharp at full opening an image embracing an angle of 60°, or in other words, a plate the longer side of which is about equal to the focal length of the lens. Our new Type B Double Anastigmat Lens combines these properties, and may thus be hailed as a valuable addition to the outfit of the up-to-date photographer who wishes to be ever ready to answer the call of his most exacting patrons.

We claim superiority of the Type B, Double Anastigmat Lenses over all other Anastigmats of equal maximum relative opening, because of their *larger field of sharp definition at* full *opening*. This enables the photographer to select, if desired, a *shorter* lens of the Type B to sharply cover a given size of plate than he could when using other makes of equal rapidity, and *thereby* he gains in depth of focus, and consequently in *actual* working speed.

Another great advantage of this new type of Double Anastigmat Lenses is their unusual short build. This makes them not only extremely light and rigid, but at the same time *guarantees an evenness of illumination over the entire plate* which cannot be obtained with constructions in which the lenses are placed farther apart. The faster the exposure the more noticeable the "vignetting" effect of long-built lenses—*ergo,* fast lenses should be built as short as possible. The Type B Lenses fulfill this condition completely.

Though Mr. Emil von Höegh has attained advantages in the computation of this new type which are not found in any other objective of equal rapidity, he could not gain them without offering up some of the properties which have secured for the Goerz Series III. Double Anastigmats the front rank among the Universal Anastigmatic Lenses, and this new type is therefore neither *intended nor* **capable** of replacing the Series III. Lenses, but should be selected in all cases where extreme rapidity is the principal consideration, and where an angle of view not exceeding 66° is sufficient. In short, the Lenses of the Type B are "Special" Lenses, whereas those of the Series III. remain without peer, "**The Universal Lenses.**"

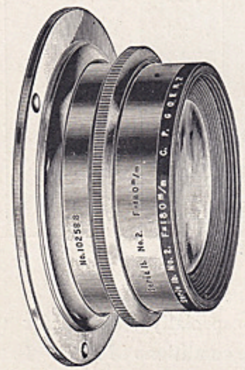
The new Goerz Double Anastigmat Lenses, Type B, are made in two series, known as Series 1B, F:4.⁵, 5.⁵, and Series 1C, F:6.³, both of which are more fully described in the following pages.

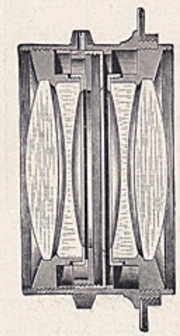
Made with Series 1B, No. 1 — Negative by A K Boursault.

GOERZ DOUBLE ANASTIGMAT

Type B. Series 1^B

This is a symmetrical objective. Each combination is composed of two thin glasses, separated by a small air space. The loss of light through absorption is therefore very small.





The illustration shows the unusual short build of these lenses. They are very light and compact and therefore specially useful for folding cameras. Their shortness also insures great evenness of illumination.

The *rear lens*, which has about twice the focal length of the complete system can only be used with small stops; it will then cut a plate double the size of that for which the complete lens is listed.

Series 1B. Goerz Double Anastigmat. Type B

$F{:}4.^{5}$ $F{:}5.^{5}$ (U. S. $1.^{25}$-$1.^{90}$)

No.	Focus.	Relative Opening.	Diameter of Lenses.	Size of Plate. Full Open.	Size of Plate. F:15.5	Code Word.	Price with Iris Diaphragm.
000..........	$2\frac{3}{8}''$	F $4.^{5}$	$\frac{9}{16}''$	$1\frac{1}{2}$ x $2\frac{1}{2}''$	2 x $2\frac{1}{2}''$	Baal	$ 34.50
00..........	$3\frac{1}{2}$	F $4.^{8}$	$\frac{25}{32}$	$2\frac{1}{2}$ x $3\frac{1}{2}$	3 x 4	Babel	38.00
0..........	$4\frac{3}{4}$	F $4.^{8}$	$1\frac{1}{32}$	$3\frac{1}{4}$ x $4\frac{1}{4}$	4 x 5	Bacca	40.00
1..........	6	F $4.^{8}$	$1\frac{1}{4}$	4 x 5	5 x 7	Babuin	47.00
2..........	7	F $4.^{8}$	$1\frac{1}{2}$	5 x 7	5 x 8	Bacchus	54.50
3..........	$8\frac{1}{4}$	F 5.	$1\frac{3}{4}$	5 x 8	$6\frac{1}{2}$ x $8\frac{1}{2}$	Baco	67.00
4..........	$9\frac{1}{2}$	F 5.	$1\frac{31}{32}$	$6\frac{1}{2}$ x $8\frac{1}{2}$	7 x 9	Bairam	90.50
5..........	$10\frac{3}{4}$	F 5.	$2\frac{3}{16}$	7 x 9	8 x 10	Bagdad	108.50
6..........	12	F $5.^{5}$	$2\frac{1}{4}$	8 x 10	10 x 12	Bagger	126.50
7..........	14	F $5.^{5}$	$2\frac{21}{32}$	10 x 12	12 x 15	Bagno	163.00
7*a*	$16\frac{1}{2}$	F $5.^{5}$	$3\frac{3}{32}$	11 x 14	13 x 17	Bacillus	208.50
8..........	19	F $5.^{5}$	$3\frac{19}{32}$	12 x 15	16 x 18	Bakul	245.00

The lenses of Type B, Series 1B, are especially suitable for the **fastest instantaneous** exposures, under unfavorable conditions of light. In midsummer they enable the operator to expose his plates correctly during the early forenoon and late afternoon, when lenses with lesser relative openings would be insufficient, owing to the weaker actinic action of the light during these hours. They actually lengthen the photographic workday by two hours. And in the winter season, when even at noonday the light is frequently too weak to permit of rapid exposures with other lenses, the Series 1B will satisfactorily produce the desired results.

For the very same reasons this type of Double Anastigmat lense is excellently adapted for all kinds of photography with *artificial light.*

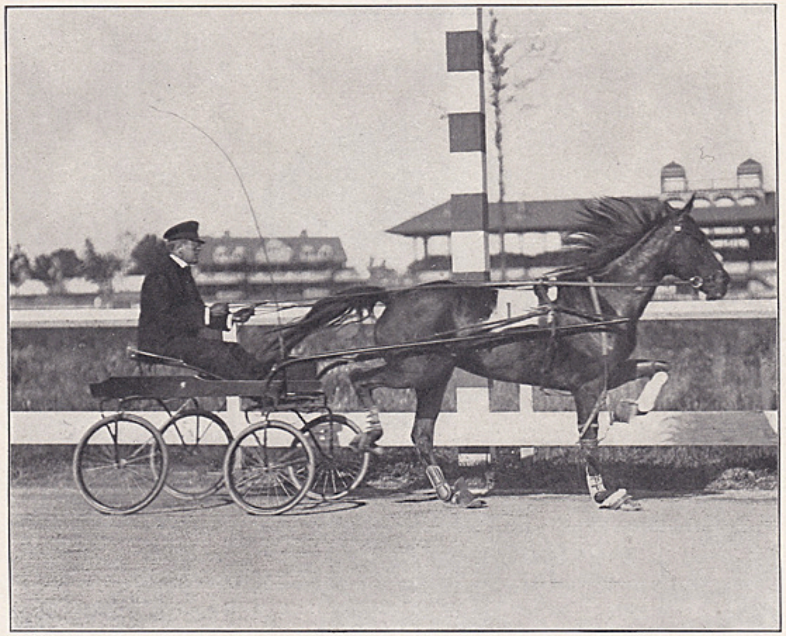
The smaller numbers of the Series 1B, render perfect results with kinematographic apparatus.

Type B. Goerz Double Anastigmat. Series 1 B

$F: 4.^{5}$ to 5

This is our regular Type B, Series 1B, lens, listed on previous page, but is mounted in our worm screw focusing mount, for use on Anschutz cameras, or cameras that have no other method of focusing.

No.	Focus.	Relative Opening	Diameter of Lenses	Size of Plate. Full Open	Size of Plate. F:15.	Code Word.	Price with Iris Diaphragm.
000..........	$2\frac{3}{8}''$	F $4.^{5}$	$\frac{9}{16}''$	$1\frac{1}{2}$ x $2\frac{1}{2}''$	2 x $2\frac{1}{2}''$	Baspec	$40 00
00..........	$3\frac{1}{2}$	F $4.^{8}$	$\frac{25}{32}$	$2\frac{1}{2}$ x $3\frac{1}{2}$	$3\frac{1}{4}$ x $4\frac{1}{4}$	Babulo	43 50
0..........	$3\frac{3}{4}$	F $4.^{8}$	$1\frac{1}{32}$	$3\frac{1}{4}$ x $4\frac{1}{4}$	4 x 5	Bacciri	45 50
1..........	6	F $4.^{8}$	$1\frac{1}{4}$	4 x 5	5 x 7	Babusa	52 50
2..........	7	F $4.^{8}$	$1\frac{1}{2}$	5 x 7	5 x 8	Badcotu	59 50
3..........	$8\frac{1}{4}$	F 5.	$1\frac{3}{4}$	5 x 8	$6\frac{1}{2}$ x $8\frac{1}{2}$	Bacosep	74 50
4..........	$9\frac{1}{2}$	F 5.	$1\frac{31}{32}$	$6\frac{1}{2}$ x $8\frac{1}{2}$	7 x 9	Bairaku	98 00



Made with Series 1C. No. 3 on 5x7 Plate. By C. S. Gottheil.

GOERZ DOUBLE ANASTIGMAT

Type B. Series 1C. F:6.3 (U. S. 2.50)

This series, which is with the exception of its smaller relative opening similar to the Series 1B, has been computed in order to satisfy the demand for a high-class modern Anastigmat Lens at a moderate price. They are particularly suitable for hand cameras, and their design permits of fitting them to all shutters.

Type B. Series 1C. F:6.3

Number.	Equivalent Focus.	Diameter.	Size of Plate Sharply Covered.		Code Word.	Price with Iris Diaphragm.
			Full Open.	F:15.		
00	$3\frac{1}{2}''$	$\frac{21}{32}''$	$2\frac{3}{8}$ x $3\frac{1}{2}$	$3\frac{1}{4}$ x $4\frac{1}{4}$	Braga	$25.50
0	$4\frac{3}{4}$	$\frac{13}{16}$	$3\frac{1}{4}$ x $4\frac{1}{4}$	4 x 5	Brom	29.00
1	6	1	4 x 5	5 x 7	Break	32.50
2	7	$1\frac{3}{16}$	5 x 7	$6\frac{1}{2}$ x $8\frac{1}{2}$	Blak	40.00
3	$8\frac{1}{4}$	$1\frac{13}{32}$	5 x 8	7 x 9	Buffo	51.00
4	$9\frac{1}{2}$	$1\frac{9}{16}$	$6\frac{1}{2}$ x $8\frac{1}{2}$	8 x 10	Bull	61.50
5	$10\frac{1}{4}$	$1\frac{3}{4}$	7 x 9	10 x 12	Burgi	72.50

Original made with No. 1 Hypergon on 11"x14" plate.

[Copyright.] By C. C. LANGILL.

Goerz Hypergon Double Anastigmat

Series X. F:22 (U. S. 30.25)

Patents Pending.

Special Objective for Wide-Angle Interiors, Landscapes, Architectural and Panoramic Pictures

THE HYPERGON (copyright, extreme wide angle) Double Anastigmat is a symmetrical doublet, consisting of two very thin semi-spherical single lenses. The maximum relative opening is F:22.

The image circle of this new lens embraces an angle of 135°, which constitutes an enormous increase over the angle taken in by any other wide-angle lens thus far on the market. The diameter of the image circle, or in other words, the diagonal of the plates worked out by the Hypergon Double Anastigmat, is equal to five times its focal length; this means that a Hypergon Double Anastigmat of 6" focus will work out a plate of 20x24 inches, whereas the best 6" wide-angle lens of older construction could only produce a picture of 10x12 inches.

Stigmatism, spherical aberration and curvature of field are completely corrected over the entire surface of the field of view; consequently the definition is sharp to the very edges of the image.

The chromatic aberration is *not* corrected, but is eliminated after the image is focused by the use of a smaller diaphragm opening.

The symmetrical design of the "Hypergon" insures complete orthoscopic results. Distortion is thus entirely obviated.

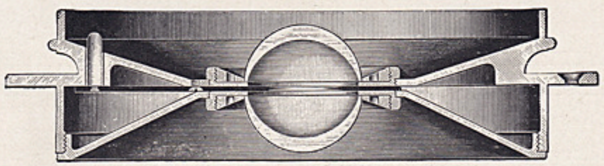
To overcome the unavoidable effects of vignetting (uneven illumination), a rotating star-diaphragm is applied to the outside of the lens.

The plates indicated in the table on the next page are not the largest plates each lens will work out. It is, therefore, possible to move the lens a considerable distance out of the center of the plate, in whatever direction may be desired.

SERIES X

GOERZ HYPERGON DOUBLE ANASTIGMATS

F:22. ANGLE 135°



Series X No.	Equivalent Focus in Inches.	Plate covered sharp at F: 31	Maximum Plate	Code Word	Price including Star-diaphragm
000	$2\frac{3}{8}$	5 x 7	(8 x 10)	Hydrat	$43.50
000 *a*	3	8 x 10	(10 x 12)	Hyla	49.00
00	$3\frac{1}{2}$	10 x 12	(11 x 14)	Hymne	52.50
0	$4\frac{3}{4}$	12 x 16	(15 x 18)	Hyperbel	62.00
1	6	16 x 20	(20 x 24)	Hyperion	72.50
2 *a*	$7\frac{7}{8}$	24 x 28	(25 x 30)	Hyrta	91.00

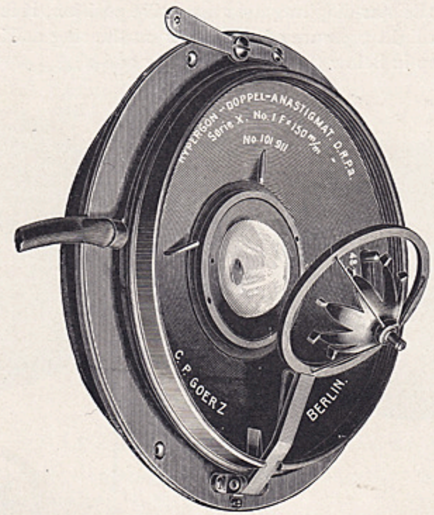
The above listed lenses are fitted with rotary diaphragms, giving openings corresponding to F:22 and F:31 (U. S. $30.^{25}$—60). This diaphragm is adjusted by means of a little pin projecting through the front part of the mounting.

They are besides provided with a hinged star-diaphragm and pneumatic movement for the same.

DESCRIPTION

The extreme wide angle embraced by the Hypergon Double Anastigmat necessitates a peculiar design for the mounting.

It should be so formed that the rim projects above the top of the front lens to protect it and at the same time leave free passage to the oblique rays. These conditions combined, give rise to an unusually large diameter of the mount.



The openings in the lens board required for the different lenses are as follows:

000	**000*a***	**00**	**0**	**1**	**2*a***
$2\frac{3}{8}$	**3**	**$3\frac{1}{2}$**	**$4\frac{3}{4}$**	**6**	**$7\frac{7}{8}$ inch focus.**
$2\frac{7}{16}$	**$2\frac{7}{16}$**	**$3\frac{9}{16}$**	**$3\frac{9}{16}$**	**$4\frac{3}{16}$**	**7 " diameter of hole in lens board.**
3	**3**	**$4\frac{1}{4}$**	**$4\frac{1}{4}$**	**5**	**$7\frac{3}{4}$ " diameter of flange.**

The diminution of the light toward the margin of the image, which is unavoidable in all wide angle lenses and becomes more noticeable with the increased angle of the image, is corrected by the application of the star-diaphragm, the construction of which is clearly visible in the accompanying illustration.

The arm, *m* (figs. 1 and 2), is hinged on the pin, *a*, on the lower part of the rim and carries a ring, K_1, K_2, which in its turn supports the *star* by means of a light wire frame. The star is curved to lay very close to the surface of the lens and shields the centre of the plate from light, whereas more and more light is passed towards its margin. If this star should remain at rest during the exposure, it would produce its blurred image on the plate; it is therefore necessary that it should turn, and as the centre of the plate must also be exposed, it must be removed altogether during the latter part of the exposure. For this purpose a spring has been placed under the arm, *m*, whereby on releasing the catch arm, *h*, the star-diaphragm is suddenly swung downward (see fig. 2). To place the star-diaphragm in operative position, it is carefully turned upward and with a light pressure of the finger on the ring at K (and at no other place) made to snap in below the catch, *t* (figs. 1 and 2).

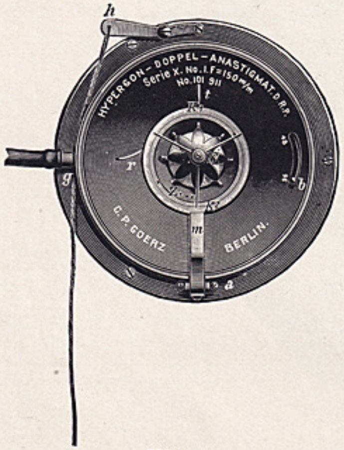


FIG. 1.

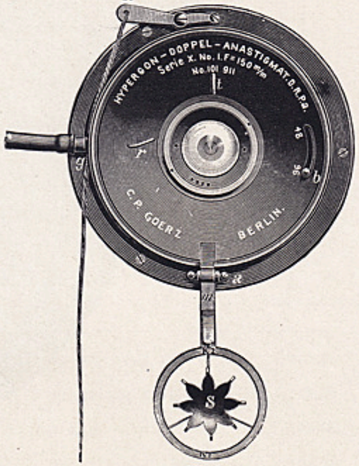


FIG. 2.

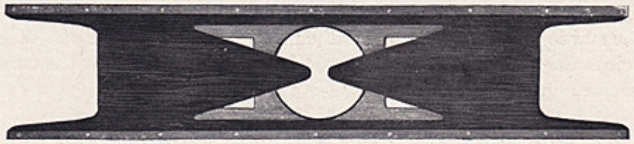
By means of the pin, *b*, the rotary diaphragm is adjusted.

As the Hypergon Lens has been proven capable of taking pictures at a speed of about 1/25th of a second, we have made a special shutter which eliminates the necessity of using the rotating star-diaphragm, as it is so constructed that it gives the proper relative exposure to both the edges and the centre of the plate.

For comparatively short exposures, the star-diaphragm is rotated by means of a rubber ball and tube, which, on being compressed by the hand, blows air against the extremities of the star points, which for that purpose are spoon-shaped.

The mechanism of the star-diaphragm is of necessity very sensitive and light and should thus be handled with great care, to prevent bending it out of shape.

HYPERGON SHUTTER



This is the most ingenious shutter ever devised and is simplicity itself. It is so constructed that the relative proportion of timing between the edges and the center of the lens results from the one movement of the slide across the lens. Before the plate-holder slide is withdrawn the shutter slide is placed at the end of its course. The lens is thereby closed. To make an exposure the shutter slide is either pushed or pulled, as the case may be, until it reaches the opposite limit of its course. The speed is simply regulated by the degree of swiftness with which the slide is moved. A maximum speed of 1/35 second is practicable.

PRICES.

000	$10.00
000*a*	10.00
00	12.00
0	12.00
1	15.00
2*a*	18.00

DIRECTIONS FOR USE

Focus with the star-diaphragm turned down and with the rotary diaphragm at F:22. (Stolze system 48; U. S. $30.^{25}$.)

It is recommended to make the exposure with the opening, F:31, in which case the focusing remains final, but if an exposure at F:22 is desired, the ground glass should be moved 1/50 of the focal length nearer to the lens.

In order to easily see the image on the edges of the ground glass, it is recommended to rub the latter with a little oil or vaseline. When the proper focus has been found, the star-diaphragm is placed in position and the lens cap put on.

When exposing on a fairly evenly illuminated object, the proportion of exposure with star-diaphragm to that with the free lens is as six or eight to one. For instance, after exposing six to eight seconds with the star, a final exposure of one second is required with the free lens.

The easiest manner to remove the star is by attaching a string to the lever, *h*. A light pull will produce the desired result without risk of shaking the camera.

In case of prolonged interior exposures, it is neither feasible nor necessary to maintain the star in permanent rotation, but it should be moved a little at regular intervals. For this purpose four bright points have been marked on the mounting at *z*, and one of the star points is similarly marked. The time during which the star is to be used should be divided in five, and at the end of each of these periods the marked star point should be carefully shifted to the next point of the mounting.

It is evident that if desired these intervals and the divisions can be halved.

The lens should be so attached to the camera that the lever, *h*, is just on top.

In some instances, especially when there are strong contrasts of light and shade in the centre of the image, the negative will show some *halo* in the centre. This is a peculiarity of all extreme wide angle lenses and cannot be obviated, but is easily cured by local reduction of the negative.

N. B.—The Hypergon Double Anastigmat should be used only in connection with back-focusing cameras, as otherwise the baseboard would intercept the foreground part of the image, owing to the extreme wide angle.

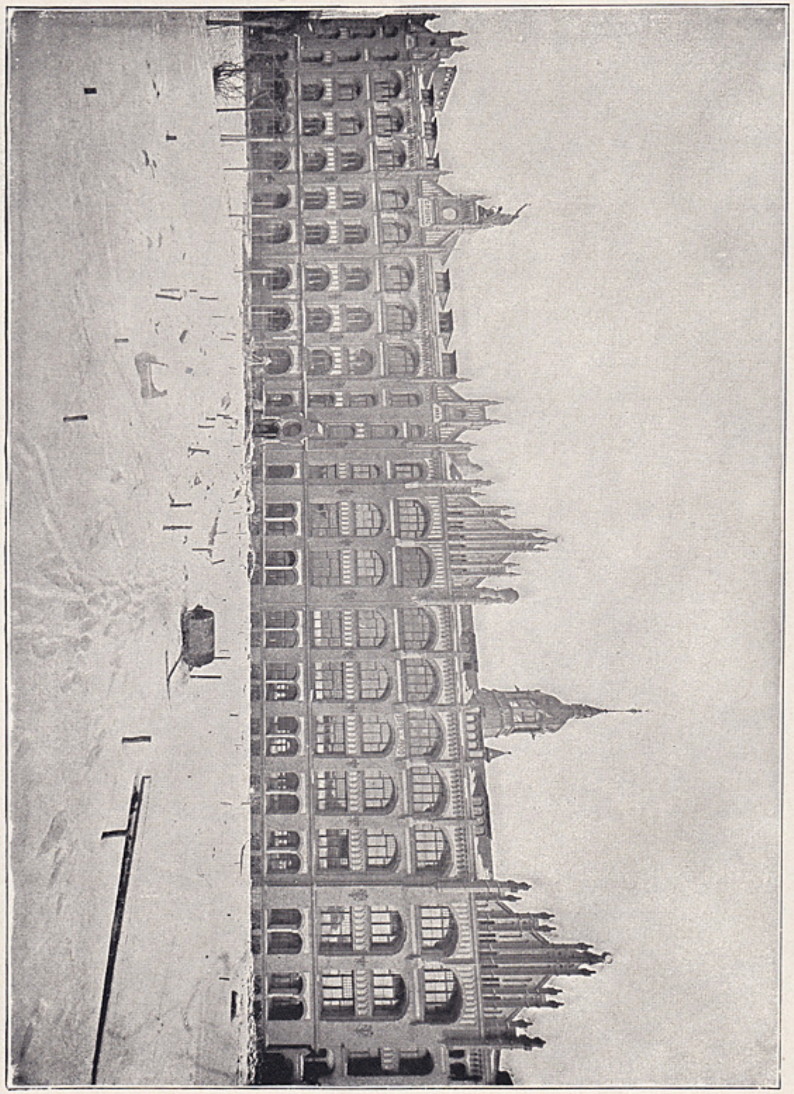
RAY FILTERS

OF OPTICALLY PLANE COLORED GLASS.

These filters are made in three different densities, which call respectively for exposures 5, 10 and 20 times as long as with the free lens when using ordinary plates. They are made to fit the various sizes of the Series III., up to the 7*a*; Series 1*b*, up to the No. 5; Series 1*c*, all numbers.

PRICES

Series III	0, 1, 2, 3	4, 5, 6	7, 7*a*
" 1*b*	0, 1	2, 3	4, 5
" 1*c*	0, 1, 2, 3	4, 5	—
	$1.00	$1.50	$2 00 each.
Sets of 3 colors, in cardboard box,	3.00	4.50	6.00 "



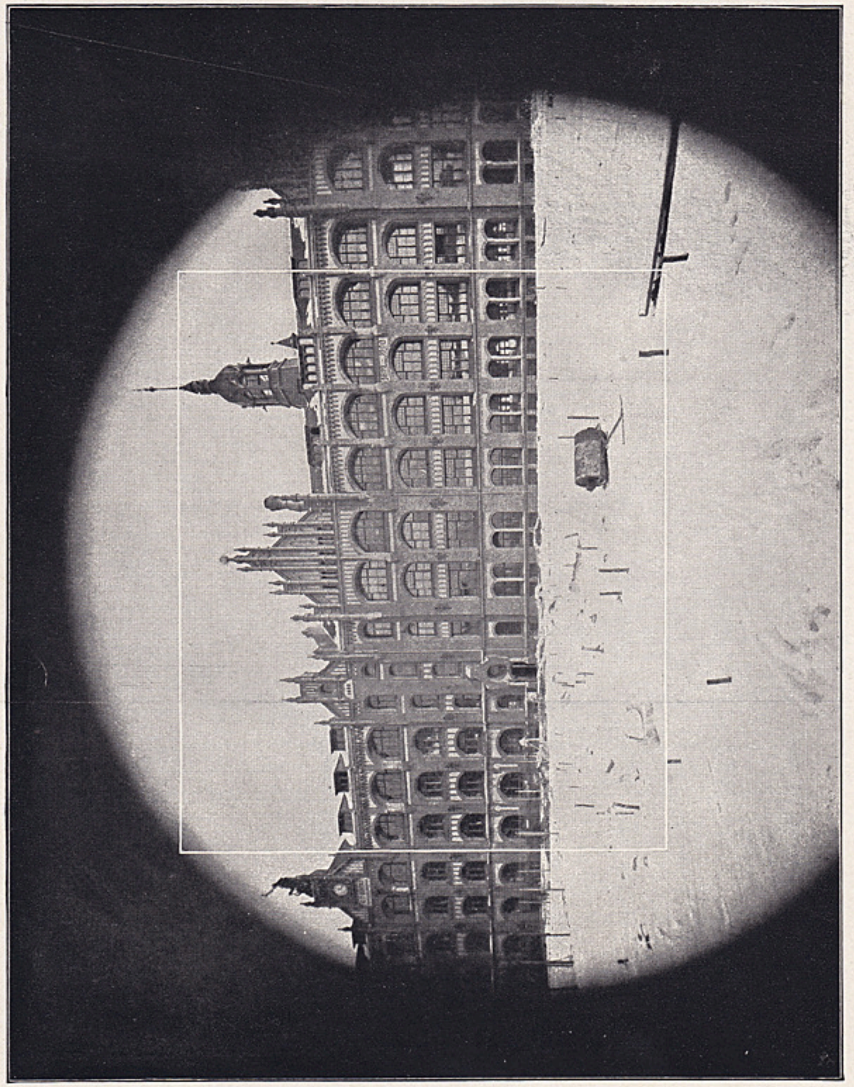
TAKEN WITH

GOERZ HYPERGON DOUBLE ANASTIGMAT.

Series X, No. 000, 2⅜" focus on 6½x8½ Plate, Stop F:31. Angle 132°. Length of Factory, 346 feet. Distance from Camera, 117 feet. See Comparative Picture on other side.

HOLD UP AGAINST THE LIGHT AND COMPARE WITH VIEW ON BACK.

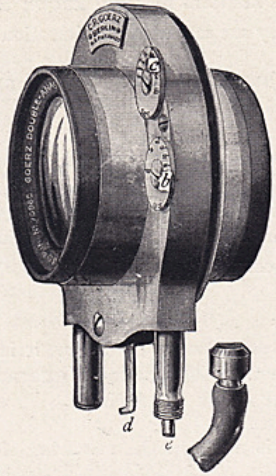
COMPARATIVE PICTURE.



Exposed under entirely equal conditions, same focus, same distance, same stop with the best of heretofore existing Wide Angle Anastigmat. The square shows the plate on which this lens can be satisfactorily used (4x5) reduced scale.

Sector Shutter

(GOERZ PATENT)



THIS new shutter is formed by segments situated in the plane of the diaphragm, and opening from and closing toward the centre.

This shutter not only combines the good qualities of the best system of shutters hitherto known, but actually surpasses them in many respects.

Its advantages are as follows :

1. **Simplicity of mechanism,** hence permanently uniform and reliable action.

2. All moving parts are **completely covered** in, hence they are not susceptible to disturbing external influences, such as concussions, dust, moisture, etc.

3. It can be fitted **between lens systems which have very little separation from each other** (*e. g.*, double anastigmats with short focus), as the segments are one-tenth of a millimeter only in thickness.

4. After opening with the greatest velocity it will remain for a certain period in this fully opened position, thereupon closing with the same rapidity. Hence the lens will work during the greater part of the time of the exposure **with the full size of opening for which it is set.** (The duration of full opening is equal to 5/6 of indicated speed.

5. It will work without any shock or jerk, and permits, with certainty, great variations of speed, ranging from $\frac{1}{150}$ to ½ second. The speeds marked on the shutter are absolutely reliable, and will apply equally for any adjustment or size of stop. In most shutters hitherto known the speed will vary with the size of stop for which they are set, without alteration of the speed adjustment.

6. It serves at **the same time as a "stop,"** and can be adjusted for any desired "size of aperture."

7. It is set for action **without opening** it in doing so.

8. It is perfectly light-proof, its manipulation is most simple, and it is very light, being made of aluminium (Nos. 0 to 3 weigh 3 ounces only, Nos. 4 to 6 weigh only 6 oz.); it occupies very little space. The workmanship is most perfect.

The shutter being fitted between the lenses, it is necessary that it should be well centered with them. **We cannot guarantee faultless mounting unless the lens is sent to us for fitting.**

The **Sector** shutter is made in the following sizes only, suitable for lenses as stated below :

Size of Shutter.	For GOERZ LENSES. Series III.			Price.	
0	Double-Anastigmat 111/0 F 6.8	....	....	$22 00	17.00
1	Double-Anastigmat 111/1 F 6.8	....	I C/0 F:6.3	22 00	
2	Double-Anastigmat 111/2 F 6.8	....	I C/1 F:6.3	22 00	
3	Double-Anastigmat 111/3 F 6.8	I B/0 F:4.8	I C/2 F:6.3	22 00	
4	Double-Anastigmat 111/4 F 6.8	I B/1 F:4.8	I C/3 F:6.3	30 00	20.00
5	Double-Anastigmat 111/5 F 6.8	I B/2 F:4.8	I C/4 F:6.3	30 00	
6	Double-Anastigmat 111/6 F 7.2	I B/3 F:5.5	I C/5 F:7.2	30 00	

Cost of fitting, $1.50 to $3.50 each, according to size.

The original lens tube is not altered, and will be returned.

No charge will be made for fitting if the shutter is ordered *simultaneously with* one of our lenses ; in this case no intermediate barrel can be delivered.

DIRECTIONS FOR USE.

(SEE ILLUSTRATIONS.)

The method of operating this shutter is so very simple that much need not be said.

For Instantaneous Exposures set index, found on left side of shutter, on *I*, push the bar *d* completely back into the casing, whereby the shutter is set, and in order to release it squeeze the rubber bulb, or depress the trigger *e* with the finger.

For Time Exposures place the time wheel *c* at 1/150 ; set index on *T*, push bar *d* completely back into the casing, and press the bulb once for opening and a second time for closing.

The size of the Stop which is to be employed can be set by means of the little wheel *b*. The openings are expressed in accordance with the Universal System (U. S.), found on pages 10 and 11.

The Speed is set by means of the wheel *c*. (The figures 1/2, 1/3, 1/5, 1/10, 1/25, 1/75, 1/100, 1/150, mean parts of seconds.)

By E. F. Keller.

Made with Series III, No. 4, on 6½x8½ Plate.

The Goerz-Anschutz FOLDING CAMERA

PHOTOGRAPHY is doubtless one of the most important discoveries of the nineteenth century. From its first humble application to the art of portraiture, it has within the last 50 years developed into a power the influence of which can be traced in almost every branch of art, industry, and science. One of its most wonderful advances is in the direction of the so-called instantaneous photography. The instantaneous camera enables us to arrest and truthfully depict the various positions of rapidly moving objects, such as the eye is absolutely incompetent to analyze. How valuable and manifold is the information which we may thus obtain with regard to the nature of movements, is shown by the superb animal photographs taken by Ottomar Anschutz, which have supplied artists and savants, as well as the general public, with rich material for study and pleasure. Anschutz was the first who succeeded in reproducing rapidly moving objects with all their details and in all their changes of light and shade. He was likewise the first to synthetically unite the photographic phases of a movement by means of an invention from which the wonderful instruments for the production of animated pictures may be said to have developed. His photo-

Neg. by HENRY WENZEL.

graphs of jumping horses, birds on the wing, flying projectiles, are feats in instantaneous photography which have not as yet been surpassed. Anschutz achieved these remarkable results primarily through the original and ingenious construction of the instantaneous shutter employed by him, the so-called focal-plane shutter, which to this day is regarded as the most perfect shutter for photographing rapid movements. We have adopted this shutter as the principal feature of our *Goerz-Anschutz Folding Camera.*

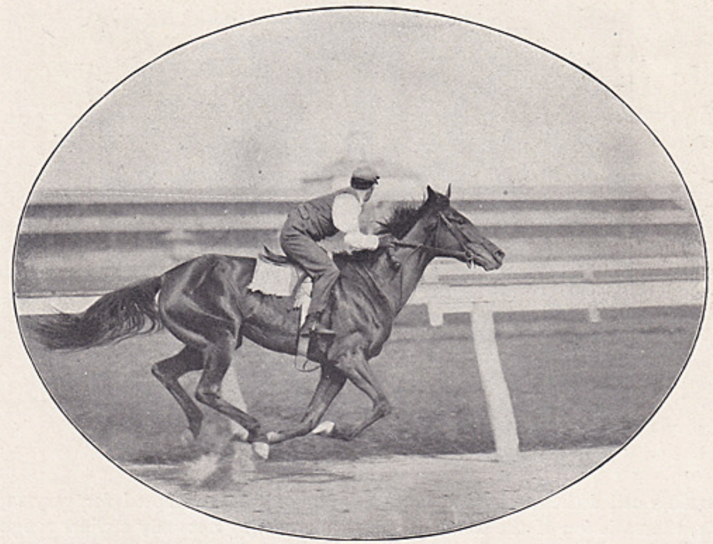
A modern camera should, however, not merely satisfy one single requirement but should be constructed for more extended use.

It should be available for landscape photography, for instantaneous and time exposures of all kinds, for architecture, and for portraiture, in fact for any pho-

tographic problem which may present itself. By combining the Anschutz camera with our Double Anastigmat we have succeeded in producing an instrument of this kind which is adapted for every class of work.

Portability and lightness of weight must also be two of the features in a camera more particularly intended for use in the hand, and although it will in some instruments be found that too much is sacrificed for mere compactness, the small size of the Goerz-Anschutz Folding Camera has been obtained not at the expense of any movement essential to the instrument, but by the novel principles of its construction, whereby a camera of exceptional lightness and rigidity has been secured. Of the qualities of the Double Anastigmat with which the Anschutz Camera is fitted it is scarcely necessary to speak, sufficient it is to say that it is recognized all over the world as being the leading lens of its kind.

The universal adaptability of the Goerz-Anschutz Folding Camera is clearly shown by the illustrations in this list.



"BLUES." By E. MARX.

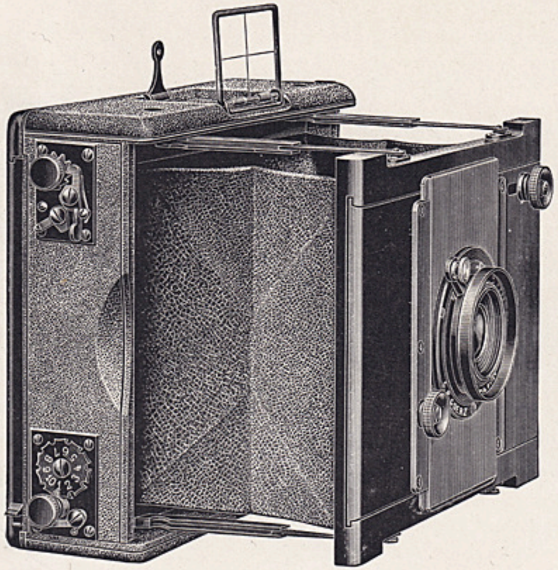
Made with No. 6, Series III., F. 6:8, at 6 a.m.

DESCRIPTION

The Goerz-Anschutz Folding Camera is a small elegant hand camera which is available both for instantaneous and time exposures. It is black throughout so as to render it inconspicuous. The wood portions, with the exception of the sliding front which is ebonized, are covered with black leather, and all metal mountings are oxidized.

The camera front has horizontal and vertical movements, and can be clamped in any position. By this arrangement it is possible to limit or extend the foreground at pleasure or to include high objects in the field.

The most important feature of the Goerz-Anschutz Folding Camera lies in the ingenious construction of the instantaneous shutter, which consists of a roller-blind with an adjustable slit or opening working immediately in front of the sensitive plate, as shown in the following illustration. This blind,

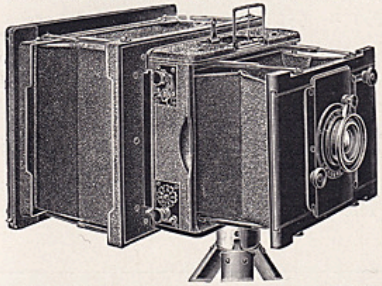


commonly called the focal-plane shutter, is the only form adapted for very rapid work, the variation of the width of the slit permitting not only a wider range of speeds, but a surer adjustment of the exposure than is obtainable with any other construction. Another great advantage of the Anschutz Shutter is that the full lighting power of the objective is available, while shutters placed close to the objective give only about half such intensity (for further details see page 53).

The camera may be opened ready for use with one motion of the hand, being held firmly fixed by patent stay pieces.

The *Lens* may be removed for use with any other camera.

When a longer focus is required, the front lens may be unscrewed and the back lens only employed. The focus of the back combination alone, is about double the focal length of the complete lens.



In order that the Goerz-Anschutz Folding Camera may be available for use with the back lens an extension can be supplied, which fits into the grooves provided for the plate-holders. This extension, as will be seen in our illustration, takes the plate-holders in precisely the same manner as the body of the camera.

The plate-holders provided are extremely light and thin, the mountings being of aluminium. The changing box is of the simplest and most reliable type and cannot get out of order.

The roll-holder is that of the Eastman Kodak Company, and can be loaded and unloaded in bright daylight.

It is difficult to say which of the three systems is the more practical. It is partly a matter of individual taste, but depends also on the conditions under which the apparatus is used. Each system has its advantages and disadvantages. In any case the choice must be left to the buyer, or he may combine the three.

Each apparatus is fitted with sights. Anschutz prefers this arrangement to the so-called "Finder," not only because it is easier to follow the real object and to get it right in the centre of the plate than with the ordinary finder, but also because by this arrangement the camera is used at the level of the eyes and a far more natural picture is secured than is the case with a camera having the ordinary finder and held against the body. When desired any other finder can be adapted in addition.

The ground glass is fitted with a light-proof cover, so that the troublesome separate black cloth is unnecessary.

The apparatus is exceedingly durable, as the mechanism is so very simple, and the manipulation is very easy. The camera will stand variations of climate, and is well adapted for use in the Tropics.

Each apparatus is thoroughly tested before delivery, and bears upon the shutter the following fac-simile :—

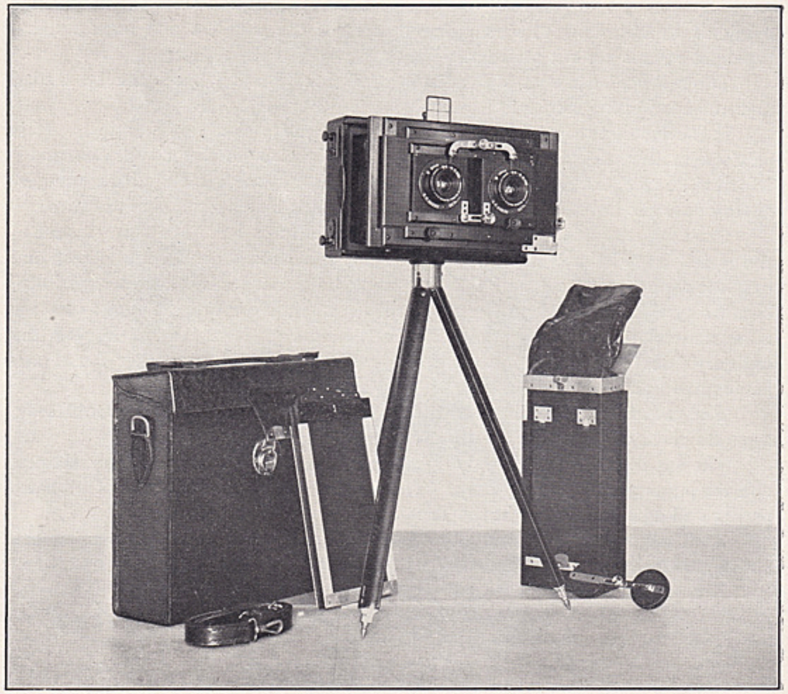
Ottomar Anschütz
Lissa (Posen)

DIMENSIONS AND WEIGHT OF THE CAMERAS

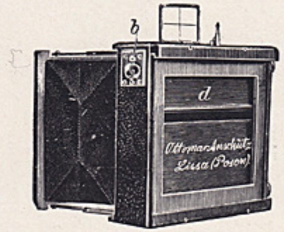
		Dimensions when closed.	Weight, including lens.
Camera,	3¼ x 4¼ ins.	2⅜ x 5¼ x 6¼ ins......	1 lb. 8 ozs.
"	4 x 5 ins.	2⅜ x 6 x 7½ ins......	1 lb. 15 ozs.
"	5 x 7 ins.	3 x 7⅜ x 9 ins......	3 lb. 3 ozs.
"	7 x 9 ins.	4 x 9⅞ x 12⅝ ins......	6 lb. 10 ozs.
"	3½ x 7 ins.	3½ x 5⅝ x 9⅝ ins......	2 lb. 11 ozs.

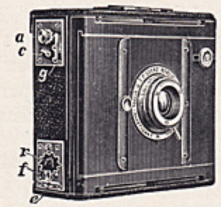
The *Stereoscopic Cameras* are so arranged that one of the lenses can be slid to the centre of the Steroscopic plate. By this means, the camera is rendered available for taking extensive panoramic views. In order that the plate may be sharply covered up to the edge, it is in this case necessary to stop the lens slightly down.

N. B.—The 7 x 9 Anschutz Cameras may also be used for 6½ x 8½ plates by inserting Kits in the plate-holders. The Kits are supplied at request; free of charge.



DIRECTIONS





Pull out the front board with the bellows until the springs of the stays catch with a click.

FOR INSTANTANEOUS EXPOSURES

Roll up the blind by means of the knob *a*, in the upper right hand corner, until the stop *h* catches; this sets the shutter ready for use. To completely roll up the blind for focusing (when required), and for time exposures, the knob *h* must be pressed in. By means of the lever *c*, the shutter, when wound up, may be locked in position, so that it cannot fall until desired.

Changing the speed can be effected in two ways:

(*a*) By adjusting the width of the slit. For this purpose the small slide above the opening must be shifted to the right or left; if it is shifted to the left the slit will widen; on shifting it to the right it becomes narrower. In order to make the two sides of the slit parallel again, pull the cord on the lower margin of the slit. The exposure is exactly proportional to the width of the opening in the blind. For instance, when adjusted to one-sixteenth of an inch, it is one-sixteenth only of what it would be if the slit was adjusted to one inch.

(*b*) By putting more tension on the spring. By turning the knob *f* to the left the tension of the spring is increased, thus increasing the speed. The little wheel *r* above *f* indicates the degree of tension. The spring may be released again as required, by depressing the lever *e*. When the camera is not in use, or the blind is wound clear of the plate, the spring tension should always be at 1. By a combination of these two modes of adjustment the speed of the exposure may be modified to any extent.

The width of slit and tension of the spring to be chosen in each case will depend upon the intensity of lighting of the object to be taken. But it is impossible to give any more definite directions on this point; personal experience will teach the operator the correct adjustment (see exposure table, page 59).

When taking very rapidly moving objects at a moderate distance, the slit should be set to a width of about a quarter of an inch, and the tension of the spring should be made as high as possible. Photos of *near* objects in rapid motion may require a briefer exposure still, but it is needless to say, such subjects should only be attempted under most favorable conditions of light.

For taking exposures of street scenes with a good light, in summer, use the slit about half an inch wide, with a medium tension of the spring, and medium aperture of the lens. If there are no rapidly moving objects in the view, the lens may be used with a smaller stop, which will improve the depth of definition.

Insert the plate-holder into the frame at the back of the camera, and pull out the slide facing the lens. (In the case of changing boxes, in order to set the plate free, push the roller slide to the right.)

If the changing box is used, this is inserted in the back frame of the camera in the same manner as the plate-holder. The metal handle attached to the end of the roller slide is grasped and thrust to the other end of the box, drawing the slide with it. The plate is now ready for exposure. After taking the photograph the handle is returned to its original position and in so doing the plate is pushed into the bag, whence it is guided by the fingers into the rear end of the

box It will in changing be found advisable to slightly tilt the box downwards.

The Eastman roll-holder is inserted into the camera in the same manner as the plate-holder. The exterior ring of the lens serves the purpose of altering the size of the aperture of the Iris diaphragm. The scale indicates the various apertures according to system found on pages 10-11.

For instantaneous exposures the largest size of stop is used, but in a very good light a smaller stop may be used, while for time exposures, in which

the exact length of time is more optional, one of the smaller stops may be employed, as the picture will thereby gain in depth of focus.

Direct the camera towards the subject to be taken, and sight the latter through the small hole of the sight, so as to place the principal object in the centre of the view to be taken, which will be indicated by the crossing point of the two wires. When the eye is brought close to the sight, the view bounded by the wire frame will be approximately two-thirds of that shown on the plate.

If the view includes architectural subjects, it is indispensable that the camera should be held absolutely level. This is easily done by bringing the vertical and horizontal wires of the finder exactly parallel with the lines of the buildings. In this way the operator is enabled, by slightly shifting the camera as required, to

obtain as well grouped a picture as possible.

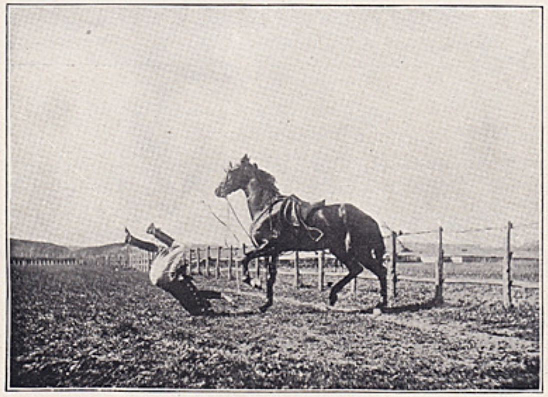
By pressing the lever *g* with the forefinger of the right hand, the shutter is released, and the slit will pass in front of the sensitive plate, thus effecting the exposure.

Then at once re-insert the slide of the plate-holder, taking care to hold the same as square as possible while inserting. If one *corner* be inserted, light may enter the dark slide through the crevice formed. It is not advisable to keep the plate-holder open (*i. e.* with the slide drawn out) any longer than is absolutely necessary, either before or after the exposure.

The manipulation of the changing box has already been described. Special instructions are issued for the use of the roll-holder.

The frame with ground glass serves for the purpose of accurately focusing near objects.

The lens (Goerz Double Anastigmat, Series III.) is fitted with an adjusting arrangement, and can be focused for subjects at various distances from the camera by means of the lever fitted to it. The scale on the lens indicates the distance in yards so as to dispense with the necessity of focusing on the ground glass, if the distance can be correctly estimated or paced off. When screwed in as far as it will go the lens is adjusted for universal focus. This is indicated by the sign for infinity (∞). In this position objects in middle distance will also be sufficiently sharp, and if the lens is of very short focus, even the foreground will be well defined. The limit of this plane of good definition depends on the focus of the lens, and on the aperture at which it is used. The longer the focus and the greater the aperture, the further will this limit be removed from the lens; the shorter the focus and the smaller the aperture, the nearer will it be brought.



The front board is adjustable both vertically and horizontally, in order to enable the operator to regulate the field of view from any given standpoint. More especially a "rise" of the front is employed in order to limit the foreground or bring any tall objects (a high building, for example) into the field.

In the case of time exposures, *i. e.*, exposures requiring a longer time than the minimum speed of the shutter will allow, it is necessary to fix the camera on a tripod. By means of our ball and socket joint, the camera may be placed in any position. Horizontal and vertical pictures may be taken without refixing the camera on the tripod, and the camera may be readily pointed in any direction. In architectural work, a photograph of an interior or the delicate tracing of an old ceiling may be secured without troublesome re-adjustment of the tripod. The advantages of a reversing back are therefore obtained without the bulk which such an addition always entails.

The roller shutter is then completely wound up by turning the knob *a*, while keeping the stop *h* pressed down, and the exposure is effected by removing and refixing the cap of the lens.

To provide for very brief time exposures (from 1/3 sec. to 1/20 sec.), *i. e.*, exposures too rapid for the use of the cap, and yet too long for the slowest speed of the blind, we recommend the use of the Thornton-Pickard shutter, which can be modified for this purpose. It is fitted to the hood of the lens and is easily detachable.

In order to fold up the apparatus, press the four "spreaders" or "stays" simultaneously inwards, and bring the front board up to the back part of the camera.

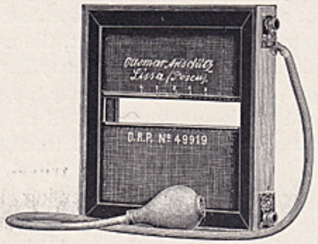
If it is desired to use the single combination of the lens, the special extension should be inserted in the grooves into which the plate-holders fit, and the front cell of the lens unscrewed by means of the key. Exposures should be made in the same way as for time exposures.

N. B.—When it is required to take off the lens for other purposes, it is important that it be first loosened from the inside of the camera. If this is not done there is danger of breaking the diaphragm pin.

The Goerz-Anschutz Focal-Plane Shutter

United States Patent, No. 37113

Patented in Great Britain, No. 16844.94; Germany, No. 49919; Austria, No. 44-5284; Hungary, No. 1183; France, No. 24181; Italy, No. 129; Belgium, No. 111666.



The Goerz-Anschutz Instantaneous Shutter, consisting of a roller blind with adjustable opening, as previously described, is supplied and fitted to other makes for cameras.

By altering the width of the slit the exposure can be varied within the widest ranges, from $\frac{1}{25}$ to $\frac{1}{1800}$ of a second.

No other make of shutter allows of such a large and sure adjustment of the exposure, and with no other construction can such sharply defined pictures of moving objects be obtained. With the Anschutz shutter, during the whole exposure the lighting power of the full opening of the objective is available, which is not the case in any other make.

The Anschutz shutter is therefore generally to be recommended and is quite indispensable for the photographing of very quickly moving objects, such as horses jumping and galloping, men diving or racing, sailing yachts, gymnasts, flying birds, etc.

The Anschutz shutter can be fitted to any reversible back camera. It is however necessary to send the camera to us in order to fit the shutter.

PRICES OF THE GOERZ-ANSCHUTZ FOCAL-PLANE SHUTTER

For Camera,	4 x 5	5 x 7	5 x 8	6½ x 8½	8 x 10	10 x 12
	$18.00	$22.00	$24.00	$26.00	$30.00	$38.00

Fitting shutter to any Camera $2.00 extra, *net*.

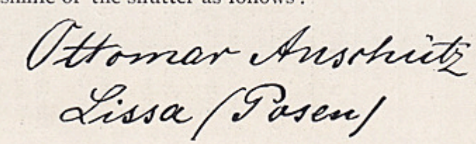
The Goerz-Anschutz Instantaneous shutter is operated exactly as described in the directions for using the Goerz-Anschutz Camera (pages 53 to 57).

EXPOSURE TABLE

Aperture of Slit.	Spring Tension.				
	1	3	5	8	10
1½ in.	1/25	1/35	1/50	1/65	1/75
1¼	1/30	1/45	1/60	1/80	1/90
1	1/35	1/55	1/75	1/100	1/112
¾	1/50	1/75	1/100	1/130	1/150
½	1/75	1/110	1/150	1/195	1/225
¼	1/150	1/250	1/300	1/390	1/450
⅛	1/300	1/450	1/600	1/780	1/900
1/16	1/600	1/900	1/1200	1/1560	1/1800

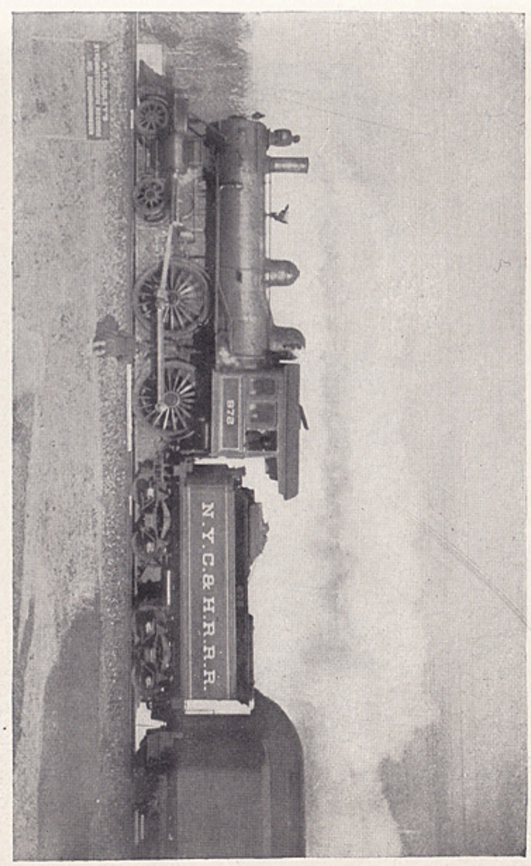
The blind of the shutter has a number of marks impressed upon it to facilitate the setting of the slit.

Every shutter bears a fac-simile of the shutter as follows:

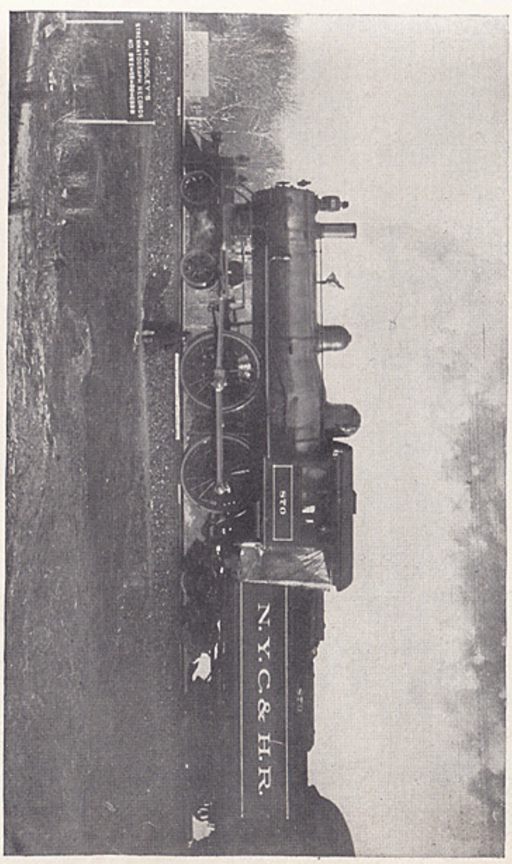


SIZES, WEIGHTS AND PRICES OF THE GOERZ-ANSCHUTZ FOLDING CAMERA

SIZES OF PLATES	3¼ x 4¼ in.		4 x 5 in.		5 x 7 in.		Stereoscopic Size 3½ x 7		7 x 9 in. (See note on page 52.)	
SIZES OF CAMERAS WHEN CLOSED	2⅜ x 5¼ x 6¼ in.		2⅜ x 6 x 7½		3 x 7⅜ x 9 in.		3½ x 6 x 9½		4⅛ x 9⅝ x 13¼ in.	
WEIGHT OF CAMERA AND LENS (about)	1 lb. 8 oz.		1 lb. 15 oz.		3 lb. 3 oz.		2 lb. 11 oz.		6 lb. 12 oz.	
Goerz-Anschutz Folding Camera, without lens		$30.00		$30.00		$39.50		$38.50		$62.75
Double Anastigmat, Series III., F:6.8 (In focusing mount)	No. 0	43.00	No. 1	51.50	No. 2	59.00	1 pair No. 0	88.50	No. 4	85.00
6 Double Plate-holders with aluminium mountings	@ 2.00	12.00	@ 2.00	12.00	@ 2.50	15.00	@ 2.50	15.00	@ 3.25	19.50
Leather Case (for camera with 6 Plate-holders, or with changing box, or Roll-holder)		4.00		4.00		5.00				
Double Anastigmat, Type B, Series I B, (in focusing mount)	No. 0	45.50	No. 1	52.50	No. 2	59.50	1 pair No. 0	93.50	No. 4	98.00
Plate-changing Box for 12 plates		11.00		11.00		13.75		13.75		
Eastman's Cartridge Film Roll-holder, to carry a roll of film for 12 exposures, which can be inserted or removed in broad daylight. Covered with fine leather like the Camera		6.00		6.00		7.50				
Metal Tripod		3.00		3.00		3.00		3.00		
Ball and Socket Joint		3.60		3.60		3.60		3.60		4.50
Extension for using the back combination of the lens only		10.90		10.90		14.50		16.25		20.00



"EMPIRE STATE EXPRESS." Speed, 44 miles per hour. 8.46 A. M., December 30, 1899.



"DAY EXPRESS." Speed, 48 miles per hour. 10.47 A. M., December 30, 1899.

These pictures were made with No O, Series III., Goerz Lens, and Focal Plane Shutter, on 5x7 Plate, by P. H. Dudley, C.E., Ph.D., in the course of experiments carried on by him for the N. Y. C. & H. R. R.

❦ ❦ The Goerz ❦ ❦
Photo-Stereo Binocular

A Combination of an OPERA GLASS, a FIELD GLASS, and a PHOTOGRAPHIC CAMERA, Single or Stereoscopic

THERE are two things before all others which the tourist likes always to have with him—a field glass and a photographic camera. Through the progress of modern science and mechanical skill, both these instruments have now been brought to a remarkable state of perfection; and without doubt, each, in its way, is destined to become the inseparable companion of the traveler.

Convenience, however, usually compels us to take only one of these instruments, and to leave the other at home; for to carry both together is generally found to be too cumbersome. "As little baggage as possible," is the motto of the tourist, causing him to reluctantly leave many things behind which he otherwise would like to take along.

Nevertheless, every tourist outfit, to be complete, should include both camera AND field glass. If only one is taken, the time will surely come when the absence of the other will be greatly regretted. The telescope expands our view, brings the distant object clearly before our eyes, and often affords us immediate instruction as to our surroundings. The camera fixes permanently the scenes before us, and awakens pleasant recollections in after days by placing them again before our eyes. The two instruments are supplementary to each other; the one without the other can in nowise be regarded as complete.

The traveling public will therefore welcome with satisfaction an instrument which combines CAMERA AND FIELD GLASS IN ONE. Such an instrument is the Goerz Photo-Stereo Binocular, which we are now placing on the market.

The Photo-Stereo Binocular has the appearance of an ordinary opera glass. It is small, light, strongly made and very powerful. It forms at once an OPERA GLASS, FIELD GLASS, SINGLE CAMERA and STEREOSCOPIC CAMERA. With this little instrument the tourist is equipped for all eventualities. In the country it serves him as a field glass (magnifying $3\frac{1}{2}$ times), and as a camera for snapshots or on the tripod; and in town, when visiting the theatre, the same instrument serves him as an opera glass (magnifying $2\frac{1}{2}$ times).

The Photo-Stereo Binocular is furthermore admirably adapted for the cyclist by reason of its extreme compactness. It occupies very little space, and can be conveniently attached by clips to the handle bar, where it is in no way an impediment.

This little universal instrument, far from being a toy, is produced with the greatest possible care and perfection of workmanship. It is intended to be the traveling companion of the tourist, the explorer, the officer on land and seas, the hunter, the sportsman and the cyclist, and to whomsoever has an eye open for what is beautiful in nature and at home.

The original photographs obtained by means of the Photo-Stereo Binocular are $1\frac{3}{4}''\text{x}2''$; they are exceedingly sharp and admit of very considerable enlargement. The illustrations show that the enlargements are almost as perfectly sharp as the originals. Those, therefore, who so frequently expressed the desire to make small negatives, and yet obtain perfect, large images, find their wishes fully met by the

Goerz

Photo-Stereo

Binocular

DESCRIPTION

THE GOERZ PHOTO-STEREO BINOCULAR resembles much in appearance the ordinary opera glass. It consists principally of a pair of telescoping tubes, which serve as cameras or field glasses, as desired, according to the adjustment of the rotary lens holders, R R, fig. 5. At the lower end, the object-lenses are mounted in a hinged cover, D, which also

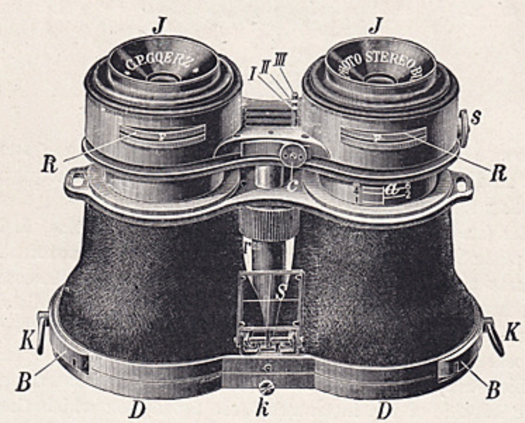


Fig. 5.

serves to contain and press the plateholders and the ground glass in proper position. At the upper, or eye-piece end of the instrument, the discs, R R, project outward sufficiently to revolve them, whereby either the theatre eye-pieces, the field glass eye-pieces or the photographic lenses can be placed in the axis of the instrument. The letters, T, F, and P, engraved on the edges of these discs, indicate which particular lens is set for use.

Fig. 6 shows how the ground glass and the plateholder are placed. Closing the cover, D, locks them firmly in position. To draw the slide of the plateholder, the rings, K, attached to the slide bars, B (fig. 5), are pulled outward,

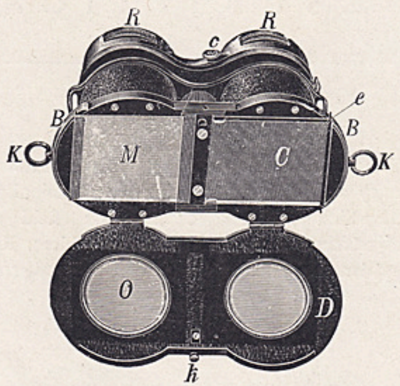


Fig. 6.

and fig. 8 shows this operation completed, indicating at the same time the notches, *n n*, made in the slide bars, B, for the purpose of engaging with the pins, e, projecting from the plateholders.

The shutter (see fig. 5) is provided with three setting pins, I. II. and III. Pin I., when pushed to the left, takes the two other pins automatically along with it, and sets the shutters of both sides as required for stereoscopic work.

When moving pin II. toward the left, pin I. will remain undisturbed at the right, but pin III. will follow in its course. This results in setting the shutter ready for exposure of the right hand plate, at the same time opening the left hand lens, which may now serve as a *focusing finder lens* on the ground glass inserted in the left side of the instrument (see fig. 6), on which the exact picture is visible up till the moment the exposure is made, and whereafter both shutters are closed.

Lastly, when moving pin III. to left, it will move alone, leaving both I. and II. at the right. The result is that both sides of the instrument are opened as required for its use as a theatre or field glass.

In whatever manner the shutter may have been set, it is released in all instances by a very slight pressure on the button, C (fig. 5).

The milled knob, s, at the right side of the shutter, regulates its speed, which is adjustable from 1-20 to 1-60 of a second.

Fig. 7 also shows at S a brilliant finder, by means of which the instrument may be properly levelled and the proper moment of exposure indicated. When

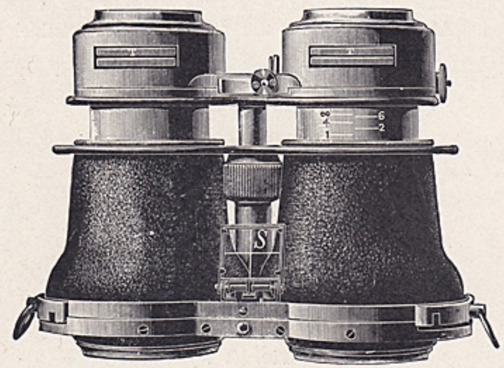


Fig. 7.

in use as a stereoscopic camera, the instrument is focused by means of a scale engraved in the right hand tube (see fig. 5).

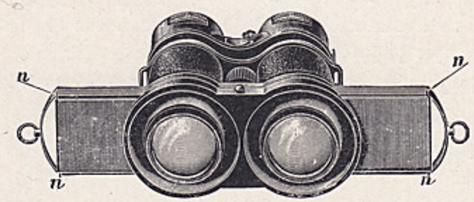


Fig. 8.

The plateholders, which are extremely light and absolutely light-tight are numbered in sets of 24 and carried in neat small leather wallets, in which they are arranged in lots of 3, each compartment being marked with the num-

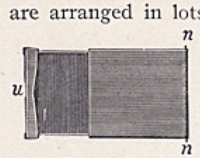


Fig. 9.

Fig. 10.

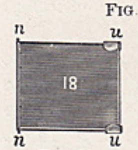


Fig. 11.

Fig. 13.

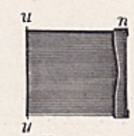


Fig. 12.

bers of the corresponding holders, by which means the risk of making two exposures on one plate is effectively eliminated.

Fig. 14 shows, at *m m*, the rotary stops which may be used in connection with the photo lenses. When the eye-pieces are in use, these stops are automatically locked. At *q* the nut for the tripod screw is visible.

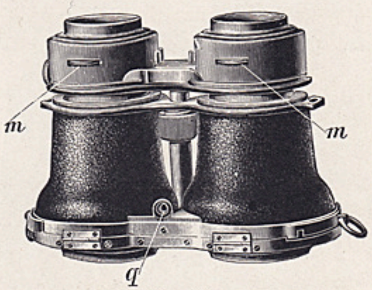


FIG. 14.

The Goerz Photo-Stereo Binocular

HAS

2½ times magnification as an Opera Glass,
3½ " " " a Field Glass,

and when used as a camera gives either instantaneous or time exposures for single or stereoscopic pictures, 1½" x 2".

The photographic lenses, accurately matched, are the well-known

Goerz Double Anastigmat Lenses

of 3" focus, especially made by us for these instruments.

The principal advantages are :

Very small size *Extreme lightness* *Perfect workmanship*
Simplicity *Universal utility and ease of manipulation.*

Weight, 9 ozs.; height, 3¾ in.

PRICES

Goerz Photo-Stereo Binocular, with two Goerz Double Anastigmat Lenses, 3" focus, magnifying as opera glass 2½ times; magnifying as field glass 3½ times; arranged for single and stereoscopic, time and instantaneous exposures, including finder, wallet with twenty-four plateholders and leather carrying case	$108 75
Code word........Stereostig.	
Extra wallets, each.	2 90
" plateholders, each	20
" wallet, with twenty-four holders complete..................	7 50
Walking-stick tripod, extra light, D. R. P. 111,368.....	12 50

INSTRUCTIONS FOR USE

A AS A THEATRE GLASS

In order to use the Goerz Photo-Stereo Binocular as a theatre glass, with 2½ times magnification, pin III. (fig. 15) is pushed toward the left, whereby both shutters are permanently opened. The rotary discs, R R, in either side should now be turned until the letter T appears in the middle of the visible part of the

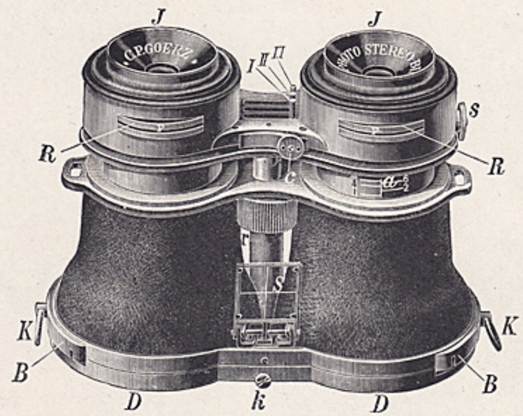


FIG. 15.

rim, in which position they will *snap* with sufficient resistance not to move by the ordinary use. The glass can now be focused by means of the little wheel, *r*, as any ordinary theatre glass.

B AS A FIELD GLASS

When the instrument is to serve as a field glass, with 3½ times magnification, pin III. is moved to the left as described, sub. A. The rotary discs are turned until the letters F are in the middle of the visible part of the rim and the catch is felt to snap in. Focusing is effected as explained, sub. A, by means of the small wheel *r*.

C THE GOERZ PHOTO-STEREO BINOCULAR AS A PHOTOGRAPHIC CAMERA

First bring the Double Anastigmat photographic lenses in position by turning the discs, R R, until the letter P appears in the middle of the visible part of the rim and the discs are felt to snap in. Now open the lower cover, D, by a light pressure of the knob, k, and insert the ground glass *with the ground side inwards* in the *left camera*. The side with the *wider* metal lining should be placed toward the middle of the instrument. Place a plateholder in the other side, being careful to turn the number outward and then close the cover, D. When the plateholder is properly inserted, its two little projecting prongs will engage in the notches, n n, of the slide bar, B. By means of the little wheel, *r*, located between the two cameras, the instrument should now be carefully focused either by means of the scale on the right tube, on which the distances are indicated in metres (1 Metre=$3\frac{1}{3}$ ft.) or by means of the ground glass on which the image will become visible by sliding pin II. toward the left, whereby at the same time the (safety) shutter on the other lens is set ready for operation.

Focusing should be done with all due attention, as the play-room for proper adjustment is only small, on account of the short focus of the lenses (3″). Their depth of focus, on the other hand, is enormous and when set on infinity (∞) all objects down to 20 ft. will be microscopically sharp. When using the smaller stops, sharpness reaches still considerably closer to the lenses.

When a *stereoscopic image* is required, the ground glass should now be removed and a plateholder (with the number outwards) inserted in its place, *and only in this case* pin I. should be moved also toward the left. For single pictures these latter operations are, of course, superfluous. By pulling the rings, K, of either or both plateholders away out until they are felt to stop, the plate or plates are ready for exposure.

The shutter is released in every instance, and whatever pin has been used for setting it, by depressing the little knob, *c*, which is attached to a small oscillating block. When the knob, *c*, is screwed out as much as it will go on this block it will give *instantaneous* exposures, whereas time exposures result when the knob, *c*, has been screwed all the way down in this block. In this case the shutter will remain open as long as the knob is kept depressed, and close directly on releasing the knob.

The duration of instantaneous exposures may be varied between 1-20 and 1-60 of a second, by means of the small wheel, s (fig. 5), at the right side of the instrument. When the screw on which this wheel is placed is flush with it, the exposure will be 1-20 sec., whereas it will be shortest when by turning the nut, s, the screw projects so far out that it will not move further. The middle position produces exposures of 1-40 sec.

As soon as the exposure is made the plate holder or holders are closed by pushing back the slide bars, B, and the cover can now be opened to remove and replace the holders for the next exposure.

We have constructed specially for use with the Photo-Stereo-Binocular, an extremely light and rigid walking-stick tripod, off which the handle is screwed and on which then the binocular can be supported. By simply drawing the tripod out of the walking-stick tube, the tripod legs are automatically extended and only need be spread apart to set it up. When placing the legs together again, sliding them back in the tube will again automatically telescope the legs. This construction is patented in Germany (D. R. P., 111,368) and applications in other countries are pending. When using the Photo-Stereo Binocular on this tripod it is recommended to lightly rest both hands on the instrument, keeping them there while making the exposure. This precaution completely prevents blurring by vibration of the camera.

The rotary stops are so arranged that they leave the lenses at full opening when turned aside to 0. They carry two smaller stops corresponding to F 11 and F 31 respectively. On bright, sunny days, or on the water, the use of stop F 11 is recommended; on overcast days the full opening should be used and the smallest stop should only be used for the purpose of increasing depth of focus when making time exposures. The relative times of exposure required for these three openings are—

0.	F 11.	F 31.
1.	2.	16.

The Goerz Photo-Stereo Binoculars are made of strong aluminium tubing neatly covered with fine grained leather, and are delivered in a sole leather carrying case with shoulder strap.

The eye-caps of all Photo-Stereo Binoculars are engraved as follows:
Photo-Stereo Binocle,
C. P. Goerz, Berlin.

And the side-bars carry the patent number
D. R. P., 101,609.

***The* GOERZ TRIEDER-BINOCULAR**

IS BEYOND QUESTION THE SUPERIOR OF ALL OTHERS,

Optically and Mechanically,

AND ITS

DEFINITION AND DEPTH OF FOCUS

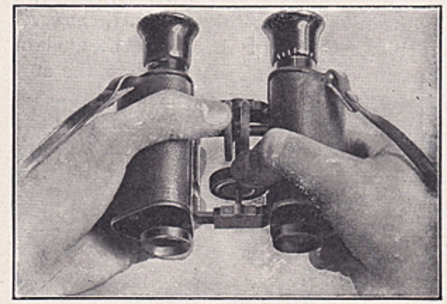
(Sometimes called stereoscopic effect) **is unapproachable.**

Note the rack and pinion adjustments for the focusing and the pupillary distance; also separate adjustment on right eye piece.

GOERZ TRIEDER-BINOCULAR

UNDER the above designation I have placed on the market a type of binocular, widely different from those almost exclusively in use thus far, and as the advantages derived from the principles underlying the construction of the Trieder-Binocular can be best appreciated by comparing them with the other existing systems, I will preface the account of their detail by a short description of the systems hitherto in use.

The ultimate purpose of all telescopes is to produce, at the proper distance and with sufficient magnifying power to render every detail distinct, the image of objects too far away to be clearly distinguished by the naked eye. We require, therefore, of a good telescope not only the optical perfection and proper lighting of the image, but also a wide angle of view and the necessary magnifying power. Should the glass be intended for use in the hand, then size and weight are important considerations. Optical science has attained a high degree of perfection in any one of these considerations, taken individually, but not until very recently has it been possible to combine them all with any chance of success.



Optical science teaches us that the conditions above mentioned are interdependent, and that improvement in one line usually necessitates a deficiency in another. A greater magnifying power, for instance, implies a smaller field of view, and to increase the brightness of the image we must enlarge the diameter of the object lens, and, therefore, the length of the entire instrument, rendering it correspondingly unwieldy. An extended angle of view can only be obtained by a limitation of the magnifying power, and so on. To reconcile these and similar antagonistic properties constitutes the main difficulty in the perfecting of the telescopic system, and is the problem which has taxed the knowledge and inventive powers of the most prominent opticians for nearly three centuries. By a study of the various types of telescopes we will show in what manner modern optics have solved this problem. To a clearer understanding of the subject, we will first define a few technical expressions.

A distant object appears much smaller to our eye than it really is, and this fictitious size we call its "apparent magnitude." The "apparent magnitude" is determined by the "angle of view," which is the angle formed by the rays of light striking our eye from the extreme points of the object. We see the distant church spire in Fig. I., A B, at the angle A O B. We also see here how two objects of varying heights, as the church spire and the tree, C D, can appear to

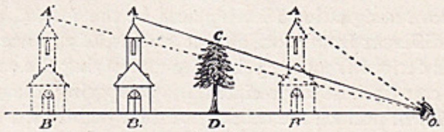


Fig. I.

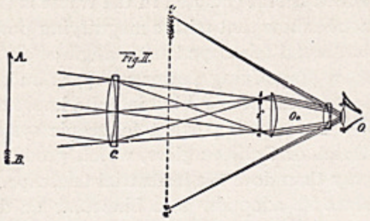
us at the same angle when at varying distances from our eye. The apparent magnitude of an object is dependent upon its actual magnitude, as well as upon its distance from the eye, therefore we judge of the actual magnitude by comparing the other two qualities. Fig. I. shows us how the apparent size diminishes as the object recedes from the eye, and the angle of view grows narrower (angle A' O B' is narrower than A O B') and how the angle widens as the object approaches.

Any optical system which endeavors to render the image of distant objects even more distinct than when seen by the naked eye, must do so by widening the angle of view. This process can be expressed in figures. A telescope has a 4x magnifying power if the object seen through it appears four times larger than when observed at the same distance by the naked eye. This is linear magnification, the magnifying of one dimension only. But as the object appears increased in height as well as width, we speak then of the superficial magnification,—the enlarging of both dimensions at once. This equals the square of the linear magnification, so that a linear magnifying power of 4x produces an image of sixteen times the original surface area.

Fig. II. shows us the path taken by the rays of light within the telescope.

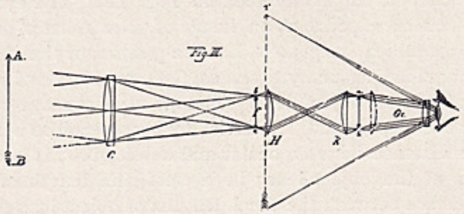
The telescope, in its simplest form, is a combination of lenses held together by a tube. The larger of the lenses, directed toward the object to be viewed and receiving the light emanating from it, is called the object lens or glass; the smaller lens, directed toward the eye of the observer, is called the ocular or eye lens. The object glass reflects, at its focal point, an image which is then magnified and transmitted to the eye by the ocular lens. The length of the tube must be adjustable within certain limits to allow of finding the proper focal length

of the ocular lens to that of the image thrown by the object lens. The rays falling from the object, A B, on the object lens, C, meet at the focal point, f, where an inverted image, b a, of the object is formed. The image is then seen through the ocular, which, acting as a magnifying glass, reflects to the eye an enlarged picture of the original object. But the ocular, being in reality only an ordinary magnifying glass, does not change the position of the pictures it reflects, so the image transmitted to the eye will be an inverted one. This description of glass is called the astronomical, or Kepler telescope, and is used exclusively for astronomical observations, where the inverting of the image is of no great consequence. All large modern astronomical telescopes are constructed on the above principles.



While the naked eye sees the object, A B, at a narrow angle, determined by the size of the object and its distance from the eye, so through the telescope the reflection, a'b', of the object is seen at the far wider angle a'O b'. The proportion of the reflected image to the object itself is the sum of the magnifying power of the telescope, or more simply, the magnifying power depends upon the proportion of the focal length of the object lens to that of the ocular. Fig. II. shows the length of a telescope of this kind, *i. e.*, the distance between object lens and ocular must be about equal to their added focal length, for the focal point of both is at f, where the rays of light reflect the image of the object without. The good points of the Kepler telescope are its extended field of view and the great brightness of image shown; its disadvantages lie in the inverting of the image and in the length oj the instrument. This last renders it entirely impracticable for use in the hand.

In the endeavor to utilize the good points of the astronomical telescope for terrestrial observations, where a correct position of the image is necessary, the



opticians of the seventeenth century introduced a second system of lenses between the original two, thereby reinverting the image at the focal point, f; for if the image at f is seen through another system of object glasses, instead of merely through the ordinary magnifying glass, the picture will make two revolutions instead of one, thereby regaining the original position of the object.

Fig. III. shows the path of the rays of light in the species of terrestrial telescope just described. The intervening lenses, H and K, the distance of which, then only a part of the picture will be enclosed in the frame, and the more we stretch the rubber the smaller the enclosed part will be.

The frame, then, represents the apparent field of view, the stretching of the rubber stands for the increasing magnifying power, and that part of the picture which is still enclosed in the frame is the actual field of view. The figures quoted above show that with a magnifying power of 12 diameters the field of view of the terrestrial telescope has an angle of 3.3°, and this is the minimum of construction. At a magnifying power of 15, or more, the field of view is so small that an instrument of this kind is quite impracticable for hand use.

Another important telescopic system is that used in the construction of the Dutch or Galilean glass, which produces a reinverted image in a much simpler way than does the terrestrial telescope. This is the oldest type of telescope, and since its adoption as a binocular or double glass—about the beginning of the last century—it has been in general use as a field, marine and opera glass.

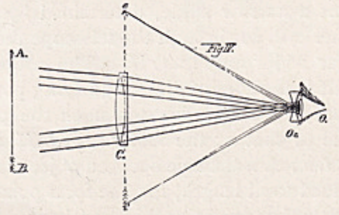


Fig. IV. shows the path taken by the rays of light in the Galilean glass. The light falling on the object lens, C, would reflect an inverted image of the object, A B, at the focal point of the object lens, which in this case is beyond the eye. But before this image can be formed, the rays of light converging toward it are caught up and broken by the Ocular Oc., a bi-concave or diverging lens, the form of which can be plainly seen in Fig. IV. The eye receiving these diverging rays sees at a point, a', an image of point A, at b' an image of B, so that the entire magnified image, a'b', has the position of the object, A B. The image, a'b', is magnified as many times as the focal length of the ocular can be contained in that of the object lens. The great advantage of a glass of this description over the Kepler and terrestrial telescopes can be seen at once. Its length, *i. e.*, the distance between ocular and object glass, is here even less than the focal length of the object lens; in a word, the length of the Galilean is equal to the difference between the focal lengths of object lens and ocular, while the length of the astronomical telescope must equal the sum of these two focal lengths, and in the terrestrial telescope there is the added length of the intervening lenses. The smaller size of the Galilean telescope, combined with its use as a binocular glass, are the only reasons of its universal employment, for it has many and serious faults. The field of view of the Galilean glass is bounded by a circle of rays, which penetrate from the periphery of the object lens through the ocular, full into the pupil of the eye. The field of view, therefore, other

conditions being equal, is exactly proportionate to the opening of the object lens, so it would seem easy to increase the extension of the former by a corresponding increase in the size of the latter. This, however, has its limitations. To retain the chief advantage of this system, its utility as a double or binocular glass, the size of the diameter of the object lens must be limited by the length of space between the eyes. Taking 60 mm. as a maximum of this space, the largest object lens allowable can have no greater diameter than 55 mm.—for we must allow a fraction of space for the setting. The field of view of an object glass this size is seen by the eye pressed close to the ocular at an angle of from 13 to 20 degrees. This is then the limit for the Galilean telescope, while the Kepler glass shows an angle of 40 degrees. But as it is not possible to place the ocular immediately at the eye of the observer, so the field of view of the Galilean glass diminishes exactly as the eye recedes from the ocular. Any increase of magnifying power increases this defect, so that the magnifying power of the Galilean telescope must, of necessity, be a very moderate one. At a magnifying power of 3 diameters an apparent angle of 18 degrees, therefore an actual angle of 6 degrees, can be obtained, but at a magnifying power of 10 diameters, the Galilean glass shows an apparent angle of little over 10 degrees, therefore an actual angle of 1 degree, an infinitesimal field of view. This places the Galilean glass at a great disadvantage when compared with other models. Other conditions being equal, an astronomical telescope, of from 4 to 6 diameters magnifying power, shows a field of view six times larger than that of the Galilean glass, at a power of 8 to 10 diameters, at least ten times larger; that is, an astronomical telescope with a magnifying power of 10 diameters would reflect the same superficial area as a Galilean glass magnifying only 4 diameters. In consequence, most opera glasses have, at a very slight magnifying power, not more than 2 or 3 diameters. The field of view of the Galilean glass is deficient in point of brightness as well. As a consequence of the optical effect of this construction, the light grows fainter from the center of the image outward, and any increase in magnifying power renders this defect more noticeable.

As a result of our investigation we may assert, therefore, that the Dutch or Galilean telescope gives us a handy and useful glass at a slight magnifying power, say not more than 4 diameters. But if we wish to increase the magnifying power the faults of this instrument become so apparent as to exclude it from practical use, while the good points of the astronomical or terrestrial telescope do not come into play until a magnifying power of 15 diameters or more is reached. Then, of course, the great size of the instrument utterly precludes its use in the hand. What we need, therefore, is some method of construction which will permit of a magnifying power of 5½ diameters in a convenient and handy form. A glass of this kind would prove extremely convenient for use in the army and navy, for hunters, tourists, theatres, race-courses, etc.

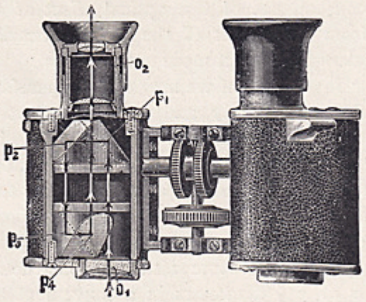
Our **Trieder-Binocular** fulfills these requirements in every possible way.

We have endeavored to combine the good points of the Galilean telescope (its small size and the binocular sights) with the more valuable optical qualities of the astronomical telescope, avoiding the deficiencies of either system.

The reinversion of the image, as obtained in the Galilean and terrestrial telescopes, is a primary consideration for an instrument designed for use in the hand. We will now explain how it has been possible to solve the difficulty and to combine two types so greatly at variance.

Experience teaches us that reinversion may be obtained by a system of prisms. Look at any object in a mirror lying flat before you, and you will find the reflection turned upside down. In a vertical mirror right and left are changed ; therefore a combination of mirrors will give a complete inversion of the reflected object. In optics such reflections are obtained by the far more effective prism surfaces. Therefore, if we combine an astronomical telescope, showing an inverted image, with a system of reflecting prisms, it is self-evident that the result will be a glass which, while retaining its good optical qualities, will give a reinverted image of the object observed. This idea of reinversion by means of reflecting prisms has been attempted some time ago in the construction of telescopes. The Geometrician and Optician Porro, who long understood the immense advantage of the prism system, endeavored, about the middle of the last century, to put his idea to practical proof. We say "endeavored" advisedly, for his trials were attended with no very great success, and many years of study and research in the overcoming of technical difficulties were necessary before the principles laid down by Porro could be put to practical use in their present perfection.

Goerz Trieder-Binocular No. 20



(One-half the natural size.)
FIG. V.

Fig. V. shows the inner construction and the optical effect of the **Goerz Trieder-Binocular.** O^1 is the object lens through which the rays of light enter the telescope. This object glass is constructed especially for the **Trieder-**

Binocular and shows a decided advance on the lenses thus far in use (Ger. Patent A. No. 11322, III, and Foreign Patents). It consists of two lenses of great optical power, cemented together perfectly, and allows of an unusual clearness of the image up to the extreme edges of the field of view. By means of this glass the angle of view may be extended to its greatest size (40°) without any detriment to the luminosity or to the distinctness of the image on its outer edges.

The "apparent" field of view of the Trieder is 40°; it is therefore 11% wider than that of the prismatic binoculars of other makers, which have only a 36° field. The apparent field of view may be obtained by multiplying the "actual" field of view by the magnifying power ; and conversely, the actual field of a telescope is equal to the apparent field divided by the magnifying power. Thus we have :

Apparent field of view	40°	40°	40°
Actual field of view	6.6°	4.4°	3.3°
Magnifying power	6x	9x	12x

Or practically expressed : At a distance of 1,000 feet, the observer commands a circle, the diameter of which with a

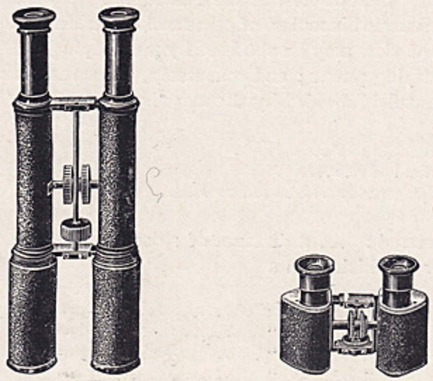
	Feet.
Magnifying power of	3 = 232
" "	6 = 116
" "	9 = 77
" "	12 = 58

The rays of light next strike through the object glass, or in the direction marked by the arrows, fall first on the uppermost of the two prisms, and are deflected by its surface, P^1 and P^2, at right angles to their previous course. This brings them to the lower prism, where two similar surfaces, P^3 and P^4, turn the rays upward again outside of the upper prism, directly into the ocular, O^2. The peculiar arrangement of the prisms, combined with the four-fold reflection, gives the desired reinversion of the image. The prism system allows of the future advantage of shortening the length of the astronomical telescope without the slightest deterioration of its optical qualities. We have explained that the length of the Kepler glass is equal to the sum of focal lengths of object lens and ocular or to the path of the rays between object lens and ocular. How this necessary length is reduced in the Trieder construction is shown by the arrows marking the path of the rays in Fig. V. The optical axis is drawn together in a zigzag line of right angles by the four-fold reflection, which reduces the distance between object glass and ocular by at least one-third.

Fig. VI. shows the difference in size between the terrestrial glass and a Trieder-Binocular of similar optical qualities.

The Trieder method of construction demands a high degree of technical perfection, as is shown by the fact that only until a few years ago was it possible to obtain the proper material for the reflecting prisms. Recent improvements in glass-making have at last given us a glass of sufficient purity and transparency.

For as the rays of light must pass not only through the two lenses, but through two double prisms (even more than the amount of glass to be traversed in the terrestrial telescope), there must be absolutely no absorption to weaken their intensity. But the construction of the prisms themselves demands as great technical skill as the making of the material. Those who have knowledge of practical optics know that the making of a perfectly even surface is one of the most



(Comparative size of the two types at equal magnifying power.)
Fig. VI.

difficult of all its problems. And this task has to be accomplished four times in every single Trieder glass, and the stronger the magnifying power the more noticeable does the slightest imperfection in the polished surface become.

Besides these difficulties, the Trieder glass requires an extremely exact concentration of the optical mediums, that is, a most perfect balancing of all its parts that the image thrown by the object lens may fall exactly vertical to the optical axis of the ocular. This is a most important consideration for the success of the glass. Naturally, the difficulty is doubled in a binocular glass, so that we can hardly wonder that the optical sciences of former years have not been able to cope satisfactorily with this problem of the reinverting prisms.

By the use of all the modern improvements in technical optics and mechanics, we have succeeded in overcoming these difficulties, and in manufacturing the Trieder-Binoculars in absolute perfection of construction. We believe that we here offer to the public a glass which will fulfil every requirement in a most satisfactory manner.

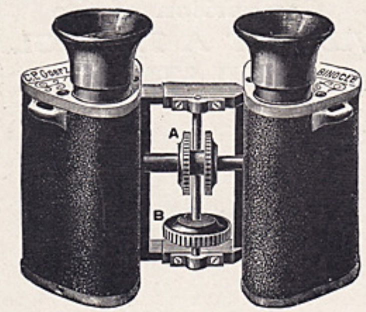
Every Binocular must bear this inscription:

C.P. GOERZ BERLIN

and this Trade Mark:

TRIEDER BINOCLE

Goerz Trieder-Binocular No. 30.



(½ the natural size.)
Fig. VII.

Goerz Trieder-Monoculars.

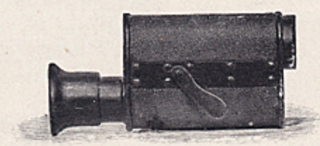


Fig. VIII.

BINOCULARS	No. 10	No. 20	No. 30	No. 40
Linear Magnification......................	3x	6x	9x	12x
Superficial Magnification..............	9x	36x	81x	144x
Actual Field of View..................	13.3°	6.7°	4.4°	3.3°
*Subjective Field of View.............	40°	40°	40°	40°
Code-word	Trias	Tribus	Trigon	Trio
Price.................................	$38.00	$46.00	$54.00	$62.00
MONOCULARS.				
Linear Magnification..................	3x	6x	9x	12x
Code-word.............................	Motaras	Motribus	Motrigon	Motrio
Price.................................	$15.50	$18.50	$21.50	$25.00

The actual and subjective field of view of the monoculars is equal to that of the corresponding binoculars.

* NOTE.—Special attention is called to the greater apparent field of view of the Goerz Trieder-Binoculars. See page 78.

Comparison of the FIELDS OF VIEW OF A FIELD GLASS OF THE OLD STYLE

FIG. IX.

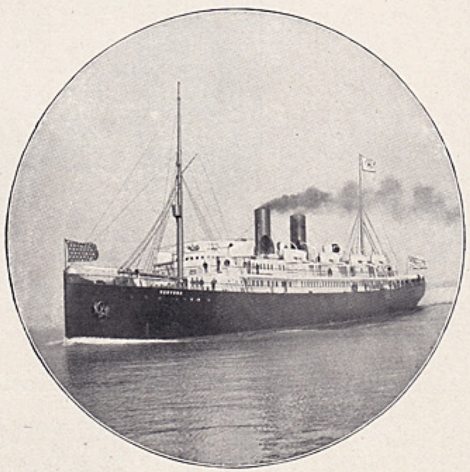


FIG. X.

AND OF GOERZ TRIEDER-BINOCULAR OF THE SAME MAGNIFICATION.

The Trieder-Binoculars

are also excellent for

ASTRONOMICAL OBSERVATIONS

in all those cases in which only a moderate magnification is required.

Nos. 10 and 20 are especially recommended for the matching of

Variable Stars,

In consequence of their very great real field of view.

On clear moonless nights the Trieder-Binoculars show the following magnitude of stars sufficiently distinct to allow the valuing of brightness according to Argolander's method:

No. 10,	. .	Stars up to magnitude 5
No. 20,	. .	" " 8
No. 30,	. .	" " 8.5
No. 40,	. .	" " 9

Directions for Use.

The Trieder-Binocular is focused by means of a double wheel, *a*, with milled edges, operating on a system of rack-pinions. The oculars are pushed toward or away from the object glasses by means of the little wheel, *a*. (Fig. VII.) This final focusing, for both eyes at once, is a great improvement on the separate ocular focusing occasionally found in similar systems. The latter require a separate focusing for each eye every time the glass is directed on objects at varying distances, which can seldom be accomplished correctly, so the image loses in distinctness, and the eyes become fatigued.

The **right ocular** can be focused by itself to correct any **inequality in the eyes** of the user. First focus (with the wheel *a*) the left ocular on some distant, sharply defined object (telegraph wire, sign, brick wall, and the like). Leave glass in this position, and turn the frame, *o*, of the right ocular with the hand, until the object is properly focused for the right eye alone. The right ocular may be left in this position, and a mark on the frame will render repeated focusing unnecessary ; thus the position can always be found, even if the glass should have been turned by chance.

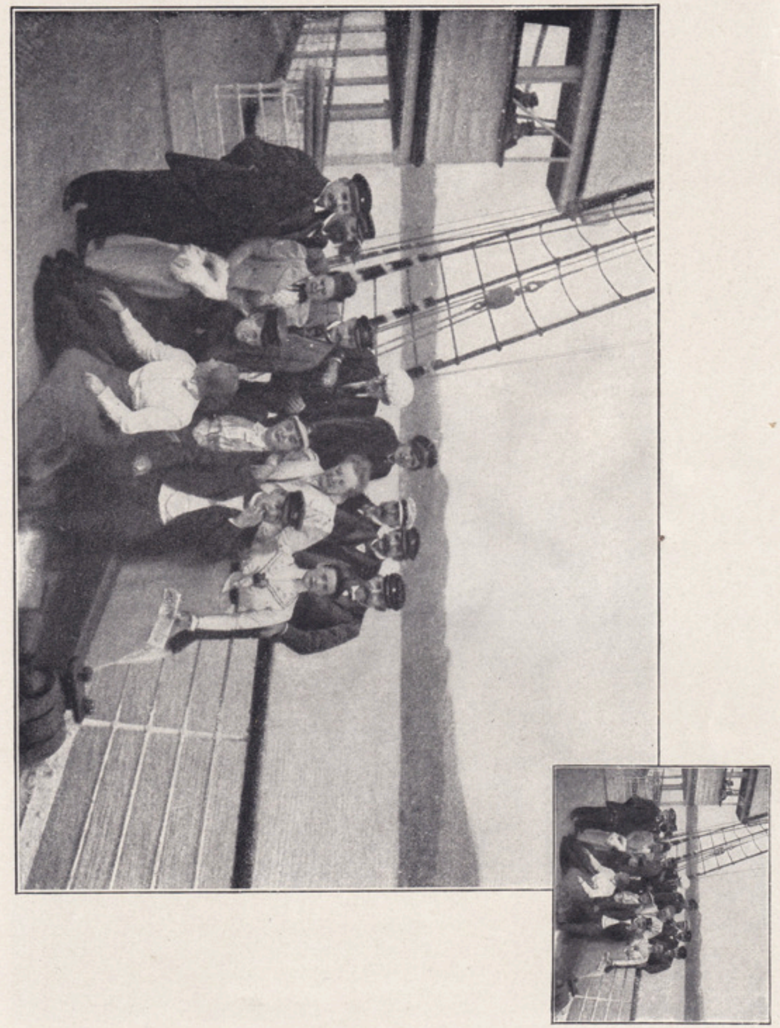
If the sight of both eyes is the same, then the right hand ocular must be kept in exactly the same position as the left. When this is the case, both oculars are even with the marks on the ocular tubes, or both touch the main body of the case. When the proper position of the oculars has been ascertained, the focusing of the entire glass can be managed by means of the little wheel, *a*.

These directions should be carefully read and followed, in order that a perfect image be obtained, and that no complaints of fatiguing the eye, or of showing blurred pictures may be made. As cases of eyes with differing sight are comparatively uncommon, the Binocular should always first be tried with the oculars in the same position. This is best in any case, except where a difference in the eyes is known to exist.

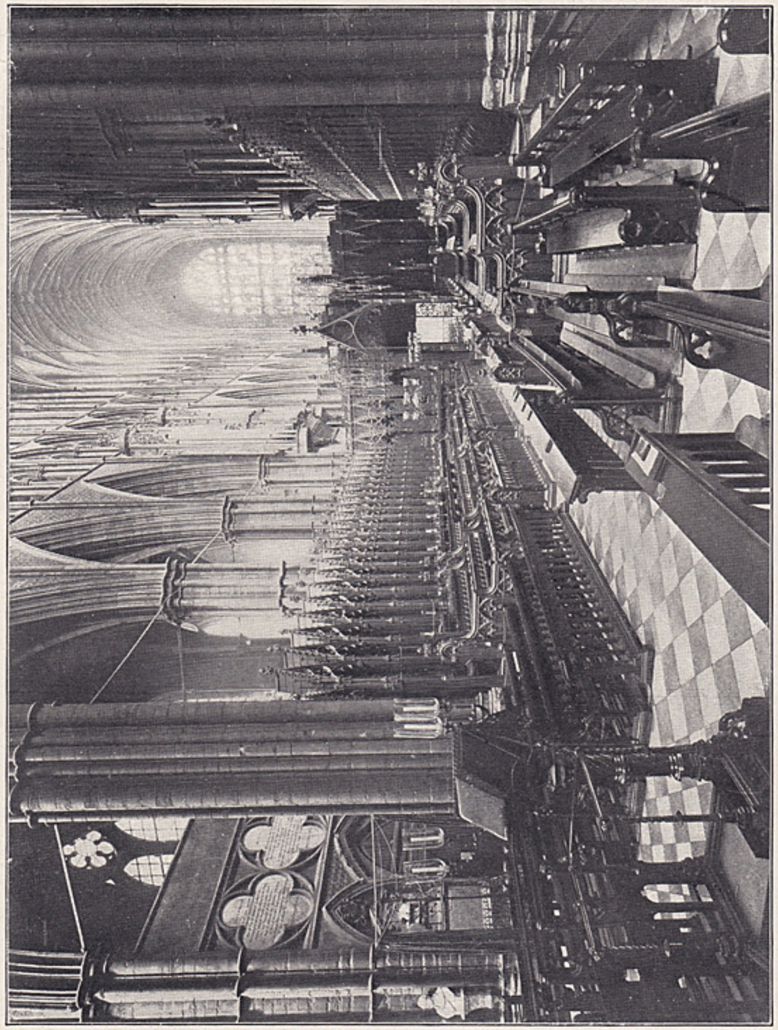
When the glass has been brought to a correct focus, the tubes can be pushed apart or together by means of the second wheel, *b*, until their distance one from another corresponds with the distance between the pupils of the eyes. When this distance is found, the circles seen by each eye separately will blend into a single one.

When the glass has been arranged properly for the eye of the owner, it may be left in this position, as the case holds the glass in any length.

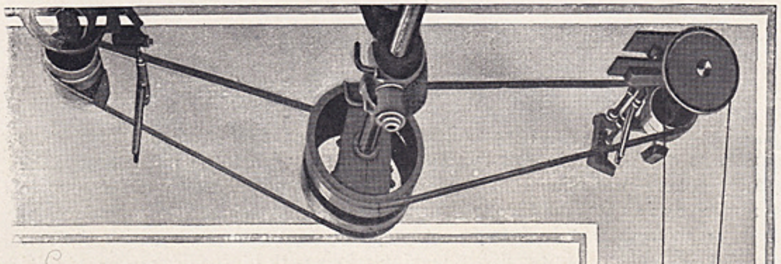
N. B.—Any meddling with the Trieder-Binocular must be strictly avoided, as the position of the various parts are changed thereby, and the glass rendered unfit for use. If nothing of this kind is attempted, the solid construction of the Binoculars guarantees good wear. Should any slight repairs be necessary, return the glass to the makers for this purpose.



Original and enlargement, reproduced from negative made with Goerz Photo-Stereo Binocular.



"WESTMINSTER ABBEY." Made on 6½ x 8½ Plate, with No. 1, Series III, Goerz Lens.

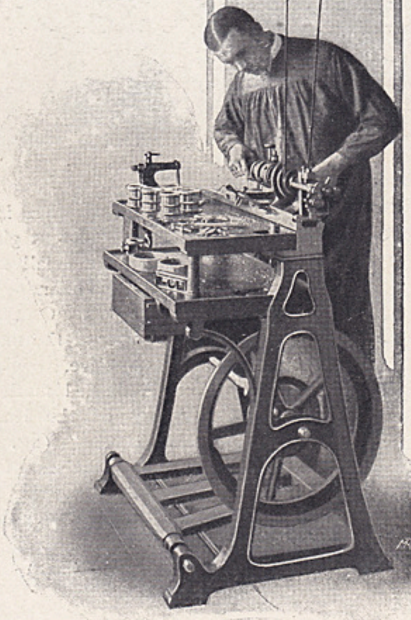


A TRIP

Through the

C. P. GOERZ

OPTICAL WORKS



At Friedenau

Germany

HOW A GOERZ LENS IS MADE.

The following brief account of the stages in the manufacture of photographic lenses, as carried on in our factory, can scarcely fail to be interesting to the photographer—professional or amateur. We, therefore, invite the reader to accompany us on a round through our workshops. We shall follow the development of a Goerz Double Anastigmat step by step, commencing with the raw glass block, and explain the divers manipulations with illustrations.

Before commencing the working, each block of glass as it comes from the glass works (fig. B) must have its physical properties examined. As everyone knows, a ray of light passing obliquely into glass is bent from its previous path. This is called the refraction of light. It is well known, too, that ordinary light—white light—is not a simple color, but is composed of a number of different colors.

Fig. B.

The breaking up of white light into its component colors — the rainbow colors—is visible to the eye when sunlight passes through a triangular glass block; that is, a prism. Further, the refraction of the different colors varies in different glasses, and it is, therefore, necessary to make a small sample prism from the rough glass block, and examine it with the Refractometer (fig. C) in this respect. On the exact determination of the refractive power of the material depends largely the value of the objective.

Fig. C.

A skilled mathematician then calculates the exact curves of the lens surfaces. The Goerz "Double Anastigmat" (fig. D) consists, in each of its front and back halves, of three pieces made of different kinds of glass. Suppose now that of the first delivery of the three glasses from the glass works one of the three has,

by some means, run short, it becomes necessary, in replacing this, to make fresh calculations of the curves, not only of the new lens but of the other two, because the optical qualities of two different

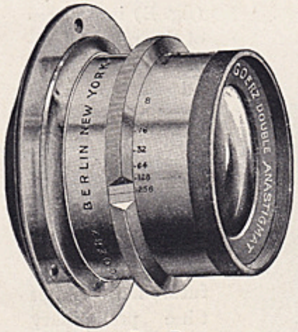


Fig. D.

makings of glass are never precisely the same. In a large factory this is continually happening, so that, considering the various sizes of Double Anastigmatic objectives manufactured the work requiring recalculation, and the work of calculating new lenses ne-

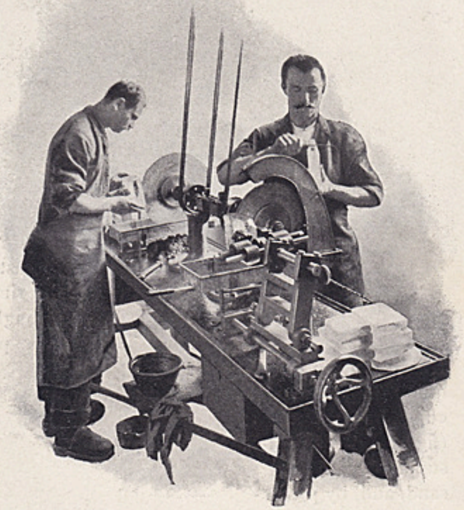


Fig. E.

cessitates a large staff of mathematicians.

If, then, the lens has been designed in this theoretical way the actual manufacture can be proceeded with.

The work commences in a large workshop where the raw glass blocks are first roughly shaped. The glass must be of the best quality, as transparent as possible, and free from flaws and stresses. After this the blocks are cut by zinc discs fed with diamond dust

Fig. F.

(fig. E) into pieces of the required dimensions, and the edges are also roughly rounded with glass shears, so reducing the blocks to flat cylinders somewhat greater in diameter and higher than the future lens. After the preliminary shaping the grinding commences. The cylinder is reduced to the proper thickness upon rotating flat cast-iron discs (fig. F) fed with wet sand and the rim ground upon a suitably curved grinder. Then begins the rough grinding of the flat faces to the proper curves. The worker presses the glass firmly with both hands upon a quickly rotating cup-shaped grinder (fig. G) kept well supplied with wet sand, and, by properly distributing the pressure, takes care to grind all parts uniformly.

Fig. G.

The grinders (clearly shown in the foreground of fig. H) are made concave or convex according to the form of lens required. A special lathe with a radial support is used in making these grinders, and since upon

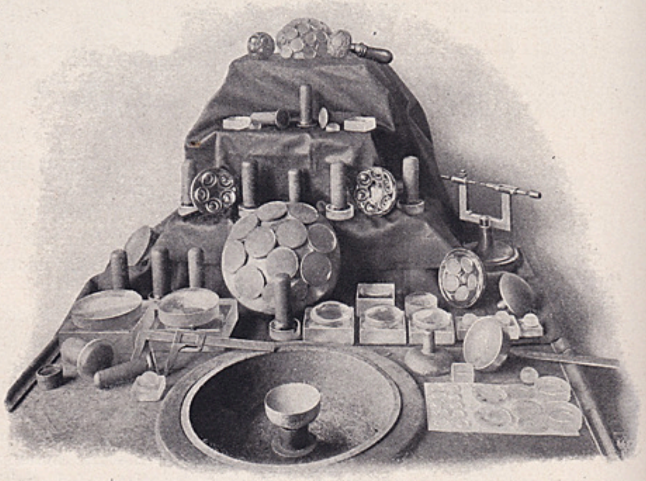


Fig. H.

their trueness depends the exactness of the lens ground, the greatest care must be exercised. During the operation they are frequently examined, and are finally carefully tested with special instruments. While in use, too, they are often examined, and when worn unevenly are at once withdrawn and corrected upon the special lathe. A skillful worker can, by properly distributing the pressure, keep his tool always exact until it becomes evenly worn out. Such a worker can on one tool grind from 100 to 200 lenses of medium size and hardness.

Fig. I.

During the rough grinding the curves and dimensions of the lens are frequently examined with gauges and callipers, and the process continued until they are correct. The gauges are brass plates cut to curves exactly opposite to those of the lens required; for a convex lens the gauge will be concave, and *vice versa*. In testing the lens curves, which with such a simple gauge can only be approximately

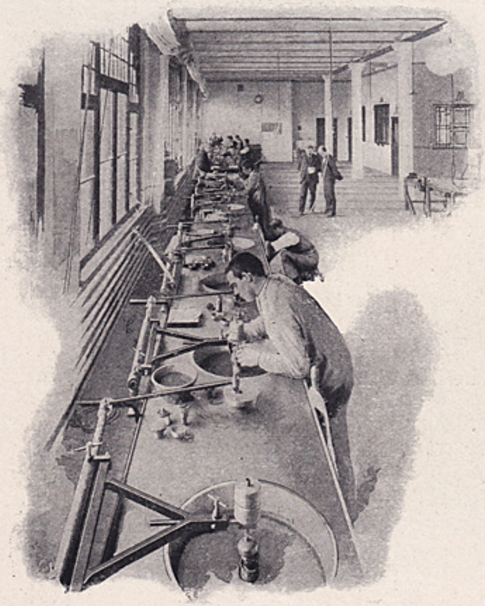


Fig. J.

done, the gauge is placed perpendicularly on the lens surface, and the worker observes whether it sits everywhere uniformly.

Fig. K.

The callipers consist of two pointed rods lying in line. One of these rods may be slid towards or from the other, and the displacement measured upon an attached scale (fig. I right). When the thickest part of the lens to be measured is brought between the points, and the sliding rod moved until the points just touch the glass, the thickness may be read off the scale with the aid of a vernier to 1/20. mm = 1/580 of inch.

As soon as the lens curves and diameter are approximately correct, the fine grinding and polishing process commences.

The rough grinding leaves the lens surface coarse and untransparent, and only after the second process does it become smooth and clear.

The second process is performed as before upon curved grinders (fig. I), but the lathes are driven by foot, since the skilled worker can produce such work more exactly in that way than by machinery.

It is difficult for the uninitiated to form any idea of the great accuracy required in the work of fine grinding. No known mechanical instrument is capable of making the measurements, and recourse must be had to a physical method,

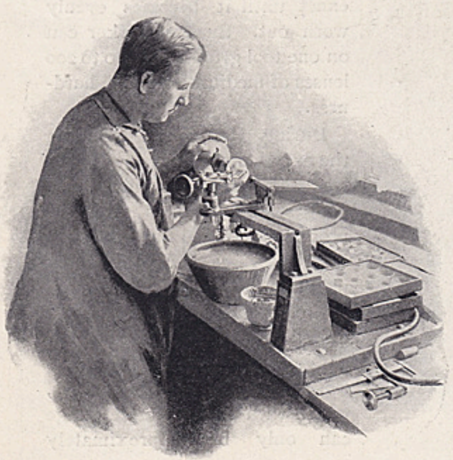


Fig. L.

to Newton's color rings, where advantage is taken of the known wave lengths of light, some of which are but 1/10,000 mm. = 1/250,000 of an inch. More on this subject will be said later on.

To enable the worker to press the lens uniformly on the rotating grinder a handle is cemented with a special sealing-wax composition to the back of the lens. A number of these handles with lenses attached are shown in fig. H, which represents a collection of the optical grinding tools. With lenses of small diameter and curvature, three, four or more are cemented upon the same handle (fig. H top and middle) and ground simultaneously, thus saving considerable time. To ensure each lens being ground or polished uniformly they are so arranged that all their upper surfaces lie in the same spherical surface.

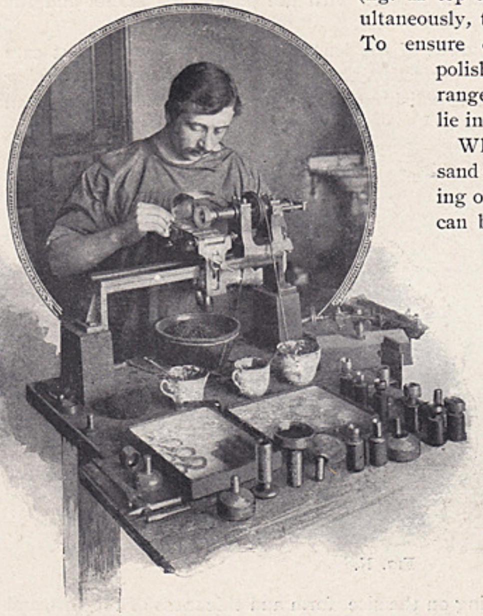


Fig. M.

While in the first process common sand is necessary, in the fine grinding only fine clean levigated emery can be used. It is fed into the grinding tool, mixed with water to a fine pasty condition. Five grades of emery, each finer than the previous, are used. The last and finest grade which is levigated for sixty minutes, and is, therefore, very fine grained, is used to bring the lens surface to the final mathematically exact curve.

In the various stages of the fine grinding the lens is frequently and carefully tested with the test glasses, which are blocks of glass ground out to curves exactly opposite to those of the required lens. The Superintendent further measures the curvature directly with the spherometer (fig. K).

By pressing the lens and test glass into close contact, after first carefully cleaning the surfaces, any ununiformity of the curves may be observed from the color, position and irregularity of the above-mentioned Newton rings. If only one uniform color is observable the surfaces correspond everywhere; but this happens rarely and for but a moment, since the smallest temperature differences distort the glass sufficiently to show the rings. A variation of 1/10,000 mm. = 1/250,000 of an inch (in practice quite negligable) is in this way at once detectable, and the "Goerz Double Anastigmats" are worked to this degree of accuracy.

When at length the lens has its proper form, it is polished with rouge upon the previous fine grinding tool, or upon large automatic machines (fig. J) until it becomes perfectly transparent.

The worker then covers the polishing tool with a layer of soft pitch from 3 to 5 mm. thick, and leaves an exact impression of the lens surface by pressing it down upon the pitch while still soft.

The pitch layer when cold is covered with the polishing medium and the tool set in rotation.

To preserve the proper curves of the lens is a matter of the greatest care and experience, and to ensure perfection they must be tested with increasing frequency by the test glass. The polishing process lasts considerably longer than

FIG. N.

the grinding, the time depending on the size, form and thickness of the lens, and to a great extent on the worker's skill.

Thick lenses are more easily polished than thin, small ones than large, and for a lens of 5 cm. diameter = 2 inches, about one day is required.

The finished lenses are now taken to the Superintendent, who examines each finally with the spherometer (fig. K). The principle of the spherometer for determining the radius of a lens surface consists in measuring the height of the spherical surface over a known base. The lens to be examined is placed on the known base in the spherometer, and a small contact rod presses from underneath gently and uniformly on the surface. The position of the contact rod, which is read by means of a micrometer, gives the desired height, and a further simple mathematical calculation determines the radius.

The Superintendent examines the glass finally for flaws. Small air bubbles have really no detrimental effect on the picture, merely cutting off a small fraction of the light, but flaws or stains reduce the value of the objective, and, indeed, often make it worthless.

In each process, from the beginning, there is a considerable proportion of rejected material, especially in the cutting out of the lens from the rough block. The less practiced workers also frequently spoil their work, thus increasing the final cost considerably, and considering that each modern "Anastigmat" consists of 6, 8 or 10 glasses there need be no surprise expressed at anastigmatic objectives being much dearer than aplanatic ones.

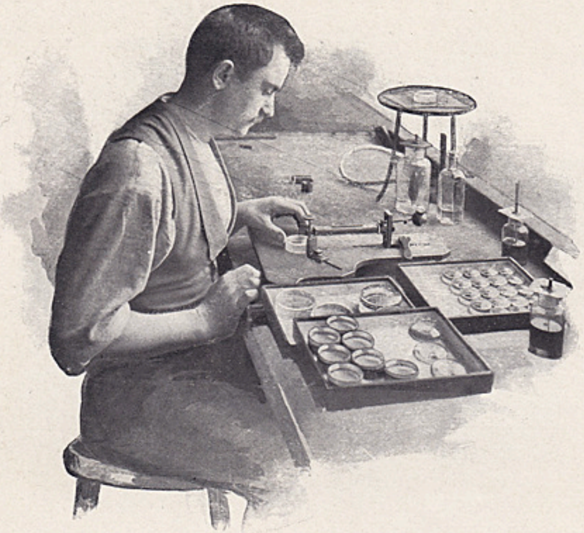


FIG. O.

We come now to the second chief stage in the progress of the objective—the fitting together of the various parts. The first process is the centering, that is, bringing the geometrical and optical axes into coincidence. This process, upon which the quality of the objective largely depends, is performed upon a truly rotating lathe spindle. The worker cements the lens on the spindle end, so that at first the optical axis of the lens and the geometrical axis of the spindle lie roughly in line; he then sets the spindle in rotation, and by eye observes the two reflections from the objective of some illuminated object, e. g., a window, cross wires, etc., rotate or remain still.

By pushing the lens upon the soft cement he adjusts the position until on rotating the spindle the two reflections appear as nearly as possible to stand still. The final adjustment is done by means of a system of levers, with a ratio of 1 in 30, or even 1 in 50 (fig. L); that is, when the short arm moves, the end of the long arm magnifies the motion 30 or 50 times, according to the ratio.

The small arm, which ends in a small glass hard-steel ball, polished to prevent injury to the glass, is placed against the edge of the lens surface and rotated round the spindle. If the end of the long lever remains still the lens is correctly centered; that is, the axis of rotation and the optical axis coincide. If, however, the lever moves the lens must be shifted until the lever remains steady or very nearly so. When this occurs the cement is left to harden.

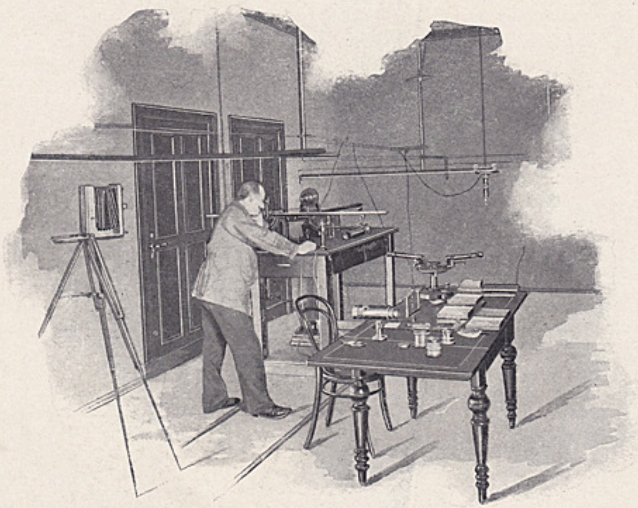


Fig. P.

The grinding of the rim now commences (fig. M). A special grinding tool is pressed against the rotating rim, so that when the operation is finished the optical axis is also the geometrical axis of the lens, and this is the direct intention in centering. When the proper lens diameter is reached the spindle is warmed and the lens removed.

It then passes to the cementing room where the parts of the objective are fitted together. In order to obtain good photographs the pieces of the objective halves must be most carefully united, any air spaces causing grave deficiencies. The Canada Balsam used as a cement is very clear, and reduces in no way the transparency of the lens. It is used only in the thinnest possible layers, rarely exceeding 1/25 mm. = 1/625 of an inch in thickness, so that the pieces lie almost

in contact. If the worker is sure the pieces are properly centered he carefully cleans the surfaces and covers them with warm Canada Balsam. He then presses them slightly together (fig. N) to press out all air bubbles, and so ensures a uniform thickness of the cement layer.

The objective is then placed under the arm of the leveling apparatus (fig. O) in order to bring the pieces centrally together. The lens edge, while lying on the platform, is pressed against two steel knobs, so that the lens is rotatable about its optical axis, without that axis changing its position. The small arm lever is now laid on the edge of the surface just as in centering, and on rotating

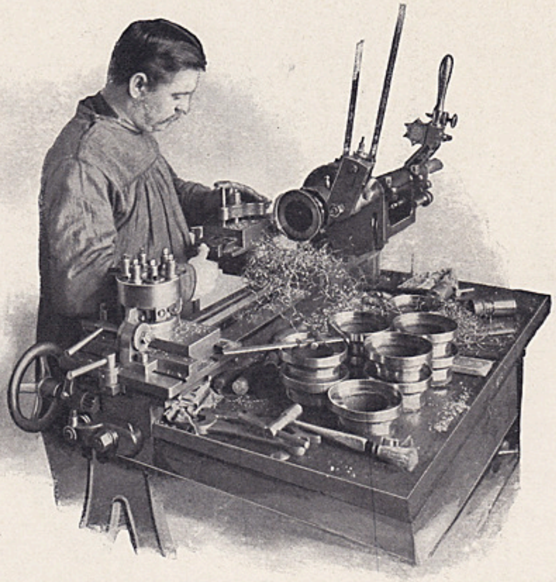


Fig. Q.

the glass by hand, the smallest irregularity in the position of the lenses is observable by watching a highly sensitive spirit-level placed on the long arm.

When the level remains steady the lenses are centrally cemented together, and until this is so the worker must lightly press the lenses where too high. To keep the cement soft during this operation the table of the instrument is uniformly heated. Only after the level remains steady can the worker bring the objective to the Superintendent as correctly cemented. The finished objective halves are now subject to exact optical tests. The apparatus (shown in fig. P) consists of an optical bench, fitted with an arrangement to hold any size of objective or part of objective. A system of lines, illuminated by a glow lamp and movable to right or left, is used as a test object. The picture of this object as thrown by the objective upon a ground glass screen, is examined by means of a high-power magnifying glass. The picture of the test object, when lying in the optical axis, is then examined for clear and sharp definition of the lines, for dimness, and to see whether or not the picture remains still while the glass is rotated about its optical axis. The test object is then moved to the right or left through a known angle which can be accurately adjusted and read, and the picture of the lines again examined.

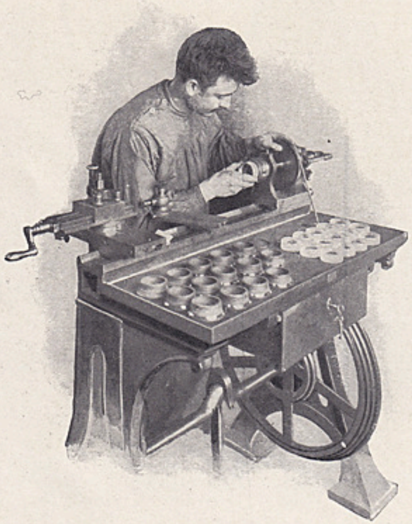


Fig. R.

When the objective halves have been thus thoroughly examined, and found to be good, the same apparatus is used for determining what separation of the halves will give the sharpest definition in the picture. This can be determined to 1/20 mm. = 1/500 of an inch. The separation is previously calculated, but in practice small corrections are always necessary since variations in the thickness of the balsam layer and of the objective are unavoidable.

As soon as the testing of the objective halves is finished, and the separation exactly determined, the parts are taken to the mechanical department to be fitted into their metal mountings. The making of the mountings is the third stage in the manufacture of an objective. The quality of the objective depends as much

upon the accuracy of the mounting as upon the workmanship of the glass, and in this stage quite as complicated machines as in the previous are necessary to make the numerous parts fit accurately together. In four large departments the rough castings are turned, the brass body tubing cut into lengths, and the shoulders soldered on ; the pieces screwed on special turret lathes (fig. Q), and finally the flange for holding the objective, fitted into place. When everything

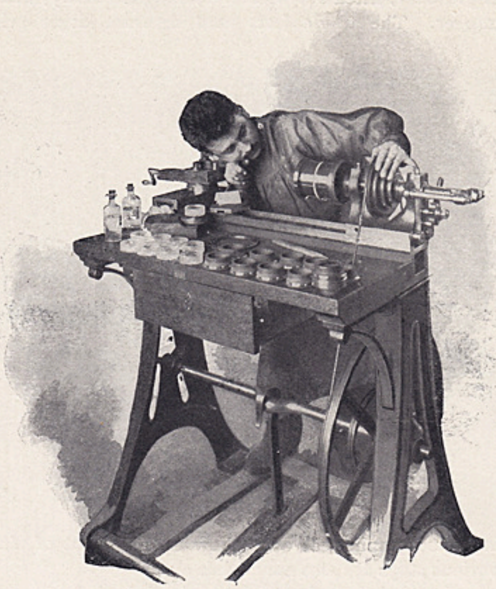


Fig. S.

is found to fit accurately the objective halves are placed into their respective mountings, and then both carefully fitted together (fig. S).

The last-mentioned work is one of the most important portions of the whole lens-making industry.

The calculations of the mathematician and the perfect work of the optician is either preserved or ruined by the mechanic.

The barrel must conform exactly to the calculations of the mathematician as regards separation, etc., and the centering of the front and rear combinations in the barrel, *separately* and *together* (figs. R and S), must be as accurately performed as that of the optician mentioned on previous pages. If this should not be done then all the work spoken of on previous pages has gone for naught.

The objective comes once more to the testing apparatus to be examined optically, as a whole, just in the same way as before described, and only when the picture of the test lines shows within an angle of 60° the same sharpness as at the axis the objective is considered good. It is now taken to another department where it undergoes the final process of having the firm's name and other necessary engraving done. In order to test the capabilities of the objective more practically than is possible with the previous apparatus, a large studio (63 feet long, fig. T) is provided, fitted out with everything necessary, and directed by a skilled photographer. The test objects used here are larger printed screens,

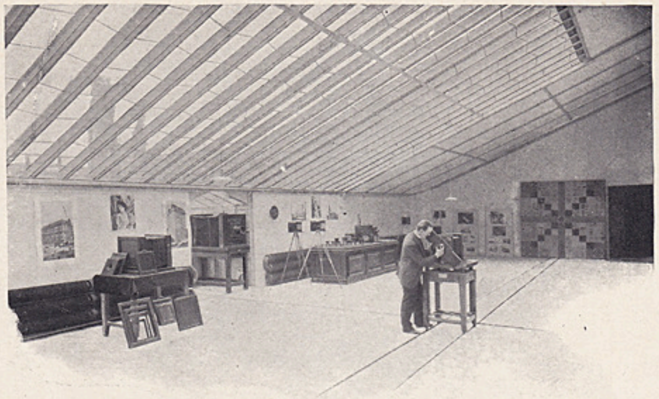


Fig. T.

which, on being photographed, at once show up any want of sharpness. The effects of the various stops are also examined.

These repeated tests ensure that each lens is of the same degree of excellence and that the buyer receives a perfect lens in every way superior to other makes of the same design and construction.

LP1308

C. P. Goerz Optical Works,
New York.

January 1st, 1904.

IMPORTANT NOTICE.

Owing to a considerable reduction in the cost of manufacture of **Goerz Sector Shutters,** we are enabled to announce that from this date the price of the smaller sizes will be $17.00 and that of the larger sizes will be $20.00. At the reduced prices this highly superior make of shutter becomes preferable to all other makes now on the market. **We are prepared to fit lenses of other manufacturers to these Sector Shutters,** in which case a charge ranging from $1.00 to $1.50 for fitting will be made.

No charge for fitting **Sector Shutters** to our own **Goerz Lenses.**

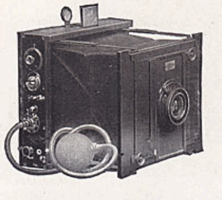
Size of Shutter.	For GOERZ LENSES. Series III.	Series IB	Series IC	Price.
0	Double-Anastigmat III. – 0 F. $6.^8$	....	....	$ 17.00
1	Double-Anastigmat III. – 1 F. $6.^8$	....	I c–0 F:$6.^3$	17.00
2	Double-Anastigmat III. – 2 F. $6.^8$	....	I c–1 F:$6.^3$	17.00
3	Double-Anastigmat III. – 3 F. $6.^8$	I B–0 F:$4.^8$	I c–2 F:$6.^3$	17.00
4	Double-Anastigmat III. – 4 F. $6.^8$	I B–1 F:$4.^8$	I c–3 F:$6.^3$	20.00
5	Double-Anastigmat III. – 5 F. $6.^8$	I B–2 F:$4.^8$	I c–4 F:$6.^3$	20.00
6	Double-Anastigmat III. – 6 F. $7.^2$	I B–3 F:$5.^5$	I c–5 F:$7.^2$	20.00

Cost of fitting, $1.00 to $1.50 each according to size, when fitted to lenses of other makers. The original lens tube is not altered, and will be returned.

All Sector Shutters including the largest size have a speed of 1/150 of a second.

Exposures varying from 1-500 to 1-1000 of a second. Price Lists Free.

GOERZ CAMERAS



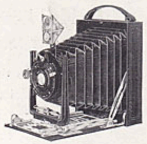
GOERZ FOLDING CAMERA "ANGO"

This is a beautifully finished hand or tripod camera in which compact construction is combined with high efficiency for a great variety of work. It has an improved focal plane shutter giving exposures of 1-10 to 1-1000 of a second, and automatic bulb exposures of 1-2 to 5 seconds. It may be fitted with a film-pack adapter if desired, and when our special Extension Back is added it is an ideal outfit for long-distance photography with our Telephoto Lenses or the single combinations of the Dagor and Celor. Price with Dagor lens, including one holder:

3¼x4¼, $91.00; 4x5, $100.00; 3¼x5½, $106.00; 5x7, $116.00. With Celor lens, $2.00 additional.

THE GOERZ MANUFOC TENAX

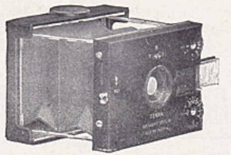
The **MANUFOC TENAX** is a small folding camera with adjustable bellows and double base extension. The metal parts are of aluminum and the camera is elegantly finished throughout. It is provided with a falling and rising front and a special **TENAX** compound shutter giving exposures from 1 second to 1-200 of a second, as well as time and bulb exposures. The single combinations of our lenses may be used with it, and a film-pack adapter may be supplied. Price, including three single plate holders of black metal:



3¼x4¼, Celor Lens, $74.00; Dagor, $71.00; Syntor, $56.00.
3¼x5½, Dagor Lens, $87.00; Syntor, $69.00.

New sizes, 4x5 and 5x7, will be ready by Spring of 1912

NEW GOERZ VEST POCKET CAMERA "TENAX"



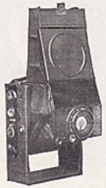
The general favor with which our Vest Pocket Tenax was received has led us still further to improve its efficiency. The new model has a compound shutter operated at time, bulb and adjustable speed up to 1-250 of a second, and an iris diaphragm marked in the F system. Its size when closed is only ¾x2¾x3½ inches. It takes plates 1¾x2⅜ inches; and on this small negative our anastigmat lenses imprint such a wealth of detail that 5x7 enlargements cannot be distinguished from contact prints. We can supply plates, enlarging apparatus, supplementary portrait attachments, etc., especially for this camera, and a film-pack adapter may be added. Price includes six nickel plate holders in a purse case.

With Celor lens, $76.00; with Dagor, $75.00; with Syntor, $57.00.

New size, using plates 2¼x3¼, will be ready in Spring of 1912

GOERZ FOLDING REFLEX CAMERA

The reflecting mirror type of camera enables the photographer to compose his picture on the ground glass and focus the image up to the instant of exposure. The Goerz Folding Reflex combines all the improvements found in the latest of these cameras with a compactness of construction in striking contrast to the unwieldy size and shape of other reflecting cameras. It has the same focal plane shutter, focusing mount for lens, etc., as the Ango, and takes the regular Ango Plate Holders or film-pack adapter. Price, 4x5 size only, with Dagor or Celor Lens, $170.00, including one holder.



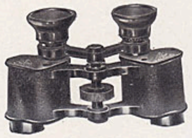
C. P. GOERZ AMERICAN OPTICAL CO.
317 EAST 34th STREET, NEW YORK, N. Y.

GOERZ BINOCULARS

THE NEO

This is an excellent prism glass for general use, giving increased stereoscopic effect and possessing great luminosity, as its objective lenses are larger than those of former types. It has simultaneous focusing adjustment, and separate adjustment of one eyepiece to compensate for any difference in the eyes of the user. Made in three magnifications.

Price: 6 X, $46.00. 8 X, $50.00. 12 X, $68.00.



THE NEO.

THE HELINOX

THE HELINOX

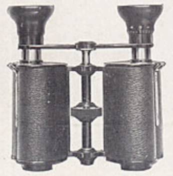
This is the finest of glasses for use either by day or night. Constructed on the same general lines as the Neo, its very large objective glasses and prism combination afford the greatest possible illumination and stereoscopic effect, making it the ideal glass for the mariner, hunter, mountaineer and astronomer. It has simultaneous focusing adjustment and one of its eyepieces permits separate adjustment to compensate for any difference in the eyes of the user.

Price: 6 X, $58.00. 8 X, $68.00.

THE PAGOR

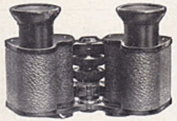
This is the smallest and lightest prism glass of its kind and the most compact binocular suitable for general use. The 6 X and 8 X models are only 3¼ inches high and weigh about 9 ounces. The Pagor affords sharp definition over a large field of view and the images which it renders are crisp and clear. Its small size makes it especially desirable for travel, sports and all outdoor uses for which a larger glass would be too bulky; and we recommend it especially for ladies' use.

Price: 6 X, $40.00. 8 X, $43.00. 10 X, $46.00.



THE PAGOR

THE FAGO



THE NEW MODEL "FAGO" THEATRE BINOCULAR

The "Fago" theatre binocular, 3½ X, is made on the same principle as our other prism field glasses. It has pupillary and focusing adjustments, and though only 2½ x 3½ inches in size, it greatly excels the ordinary opera glasses in field of view. Price, $40.00.

C. P. GOERZ AMERICAN OPTICAL CO.
317 EAST 34th STREET, NEW YORK, N. Y.

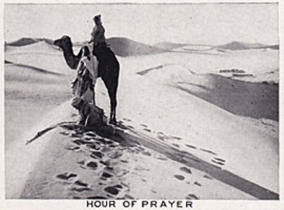
Dealers' Distributing Agencies: Central West—BURKE & JAMES, Chicago. Pacific States—HIRSCH & KAISER, San Francisco

LP1308

GOERZ

LENSES, CAMERAS BINOCULARS

COPYRIGHT, BY PICTORIAL NEWS CO. N.Y. PANORAMA VIEW OF WEST POINT MADE WITH GOERZ DAGOR LENS NO 6



HOUR OF PRAYER

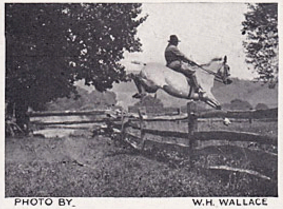
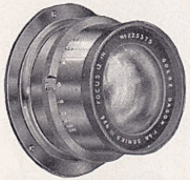


PHOTO BY W.H. WALLACE



DAGOR
F 6.8

The Dagor is a symmetrical anastigmat made up of two cemented combinations. It is the best lens for general photography ever made, and is fast enough for portraits and highest speed photography under good conditions. At full aperture it covers very sharply the plate for which it is listed; when stopped down, it covers a much larger plate and cuts an angle of 90°, making it a perfect wide angle lens for buildings, interiors, etc. Its single combinations may be used with medium stops for securing large images of distant objects. The **DAGOR** may be fitted to almost any camera. It is a universal lens for the amateur and commercial photographer, traveler and scientist.

	*No.	Equivalent Focus Inches	Size of Plate sharply covered at: F. 6.8 U.S.: 2.9 Inches	F: 32 U. S.: 64 Inches	Price with: Iris Diaphragm barrel	X L Sector Shutter	Compound Shutter
F.6.8.	0000	1⅝	1⅝x1⅝	2x2¾	$34.00	$49.00	$46.00
	000	2⅜	2⅜x2⅜	2¾x3½	34.00	49.00	46.00
	00	3½	3x3	4x5	35.50	50.50	47.50
	0	4¾	3¼x4¼	5x7	*37.50	52.50	49.50
	1	6	4x5	6½x8½	*45.00	60.00	59.50
	2	7	5x7	8x10	51.50	66.50	67.75
	3	8¼	5x8	10x12	62.50	77.50	78.75
	4	9½	6½x8½	11x14	75.50	93.50	91.75
	5	10¾	7x9	12x16	91.00	109.00	111.00
	6	12	8x10	16x18	107.00	125.00	127.00
F.7.7	7	14	10x12	18x22	140.00		162.00
	7*a*	16½	11x14	20x24	182.00	Ibso Shutter	
	8	19	12x15	22x25	219.00		
	9	24	16x18	24x30	325.00	No. 0	$45.50
	10	30	18x22	30x36	539.00	No. 1	53.00
	11	35	22x25	34x44	1070.00	No. 1*a*	53.00

*For 3 A Folding Pocket Kodaks we provide a Dagor of 6½ inch focus at same price in place of our regular No. 1. We also supply the No. 0 in 5-inch focus for Kodaks in place of the regular No. 0.

For stereoscopic views the lenses are matched at an extra charge of $2.50.

HARBOR AT MENTONE

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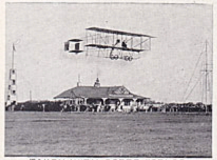
WHITE STUDIO



TAKEN WITH GOERZ "CELOR

CELOR LENS UNDER UNFAVORABLE LIGHT CONDITIONS

CELOR
F 4.5-5.5

The **CELOR** is a double anastigmat of symmetrical construction, each combination of which is made up of two thin glasses separated by an air space, allowing a maximum of light to pass. It is the favorite lens for news photography, assuring results regardless of weather, and is specially recommended for highest speed work in connection with reflecting mirror cameras. In home portraiture its efficiency is greater than that of any other lens, and in its larger sizes it is an ideal studio lens in use by many celebrated photographers. Its single combination may be used as a long-focus lens, with a small stop.

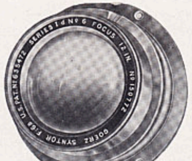
No.	Equivalent Focus Inches	Relative Opening	Size of Plate: Full Opening Inches	F: 16 U. S.: 16 Inches	Price with Iris Diaphragm Barrel
000	2⅜	F 4.5	1½x2½	2x2½	$34.50
00	3½	F 4.8	2½x3½	4x4	38.00
0	4¾	F 4.8	3¼x4¼	3x5	*40.00
1	6	F 4.8	4x5	5x7	47.00
2	7	F 4.8	5x7	5x8	54.50
3	8¼	F 5.	5x8	6½x8½	67.00
4	9½	F 5.	6½x8½	7x9	90.50
5	10¾	F 5.	7x9	8x10	108.50
6	12	F 5.5	8x10	10x12	126.50
7	14	F 5.5	10x12	12x15	163.00
7*a*	16½	F 5.5	11x14	13x17	208.50
8	19	F 5.5	12x15	16x18	245.00

*We also furnish the No. 0 lens in 5-inch focus for kodaks.

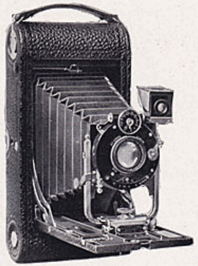
XL Sector Shutter for No. 000, 00, 0, 1..$15.00; for No. 2, 3..$18.00.

Compound Shutter for No. 000, 00.....$12.00; No. 0.........$14.50; No. 1....................$16.25. For larger sizes, see general catalog.

GOERZ SYNTOR F 6.8
The Ideal Lens for your KODAK or other small Hand Camera



The Syntor meets the demand for an inexpensive but thoroughly efficient anastigmat for Kodaks and other hand cameras. It is designed along the same lines as the Celor. Its speed is equal to that of the Dagor, though it is not so useful as the latter for wide angle photography. Its angle of sharp definition with the largest stop is 64°, increasing to 70° with smaller apertures. Each combination may be used singly as a valuable landscape lens of about double the focal length of the complete objective. The Syntor is a true anastigmat, perfectly corrected for spherical, chromatic and astigmatic aberrations. It cuts sharply the plate for which it is listed; and, though it is sold at a low price, it is of established **GOERZ** quality and must not be confused with other cheap lenses on the market. The Syntor is made only up to the No. 6 size (12 inches focal length).



No.	Equivalent Focus Inches	Plate Cut Sharp at F:6'8 Inches	Price with: Iris Diaphragm barrel	X L Sector Shutter	Compound Shutter
*0	4¾	3½x4½	$23.50	$38.50	$35.50
*1	6	4x5	27.00	42.00	41.50
2	7	5x7	32.50	47.50	47.00
3	8¼	5x8	45.50	60.50	61.75
4	9½	6½x8½	54.50	72.50	70.75
6	12	8x10	72.50	90.50	92.50

With Ibso Shutter

No. 0, $31.50 No. 1, $35.00 No. 1A, $35.00

*For 3A Folding Pocket Kodaks we provide a Syntor of 6½ inch focus at same price in place of our regular No. 1. We also provide the No. 0 in 5 inch focus for Kodaks.