GOERZ LENSES

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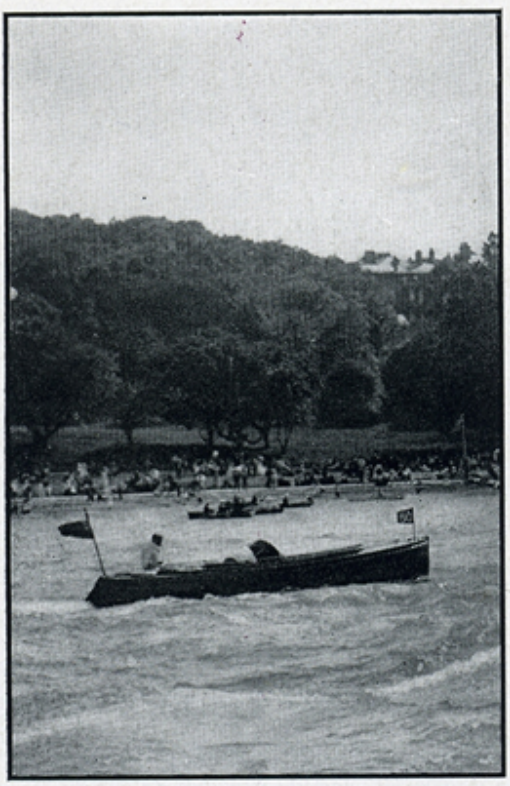


C. P. Goerz American Optical Company

OFFICE AND FACTORY

317 East Thirty-fourth Street, New York City

ANY camera is only as good as its lens. Upon this statement rests the fundamental starting point of all things photographic. Remember that however well designed, however perfect in workmanship your camera may be, and whatever useful adjustments it may have, all these are subsidiary to the lens. This point cannot be too strongly emphasized.

Ever since the GOERZ Company of Berlin, Germany, introduced the first symmetrical double anastigmat lens, now so well known the world over as the GOERZ Dagor, our scientific staff has endeavored to keep ahead in the development in other types of lenses and as a result of its twenty-five years of painstaking research work, we can now offer to the professional and amateur photographer quite a variety of photographic lenses. Each one is designed for some specific purpose, but all embody that standard of scientific skill and workmanship upon which the reputation of our firm has been established, namely, GOERZ QUALITY.

This is the reason why so many of the best known camera manufacturers of America, as well as Europe, are equipping their cameras with GOERZ Lenses. There is hardly any make of high grade camera that cannot be furnished with a GOERZ lens.

Under each separate heading devoted to the description of our lenses you will find a statement of the purpose for which each GOERZ lens was designed. Note these points carefully as they are vital to you in deciding upon the best for your special requirements. Whenever you are unable to come to a satisfactory decision, write us.

Remember, no one lens will do all sorts of photographic work—a special lens for special work gives the best results.

If for any reason your dealers cannot furnish you with your choice of a camera equipped with a GOERZ lens, we request that you communicate with us direct and we shall be pleased to recommend to you the most suitable camera and GOERZ lens for your particular work.

The Optics of Goerz Lenses

FOR those interested in photographic optics we will briefly discuss the subject of optics pertaining to the modern anastigmat lens, as thoroughly as space will permit. For additional information we we would recommend some of the numerous photographic publications that treat the matter more elaborately. The knowledge gained in this way will be of great assistance in the proper selection of a lens.

For the modern requirements in the photographic field the old-time rectilinear and portrait lenses have been largely supplanted by the highly corrected anastigmat type of lens. This is on account of certain defects in all the older types of lenses which render them not only unfit for solving any photographic problem calling for a combination of speed and covering power, but also incapable of giving critically sharp definition over an extended area.

The Aberrations most prevalent in the old-style lenses are spherical and chromatic aberration, astigmatism, curvature of field and distortion.

Spherical Aberration is the deviation in focus of the rays of light passing through the outer zones of the lens from that of the rays passing through the lens near its center, or axis, the various rays being focused in different planes. It results in general loss of definition and a fogged appearance in the negative.

Chromatic Aberration is of very similar character, and is explained by the fact that the violet and blue rays, which are most active on the sensitive emulsion of the plate or film, are focused by the lens in a different plane from the red and yellow rays, to which the eye is most sensitive. If a lens suffers from chromatic aberration, the image recorded on the plate will be blurred, notwithstanding that the eye may have observed a sharply defined image on the ground glass.

Astigmatism is the most serious defect in the old-style lenses. It shows itself in uncorrected lenses in such a manner that the horizontal and vertical lines of the object, although lying in the same plane in front of the lens, cannot be focused with equal sharpness at the same time on the ground glass. When the horizontal lines are sharply focused, it is necessary to move the ground glass forward or backward, in order to get the vertical lines sharp. This defect is principally visible along the margins of the plate, and results in a serious falling off of definition. Not until glass manufacturers had found a way of producing the so-called Jena glass—a material of entirely different properties from any glass previously known—were the opticians able to produce lens systems free from astigmatism. These lenses are known under the general name of anastigmats.

Curvature of Field is another common defect and it is found even in some modern anastigmat lenses. Theoretically, no lens has an absolutely flat field of

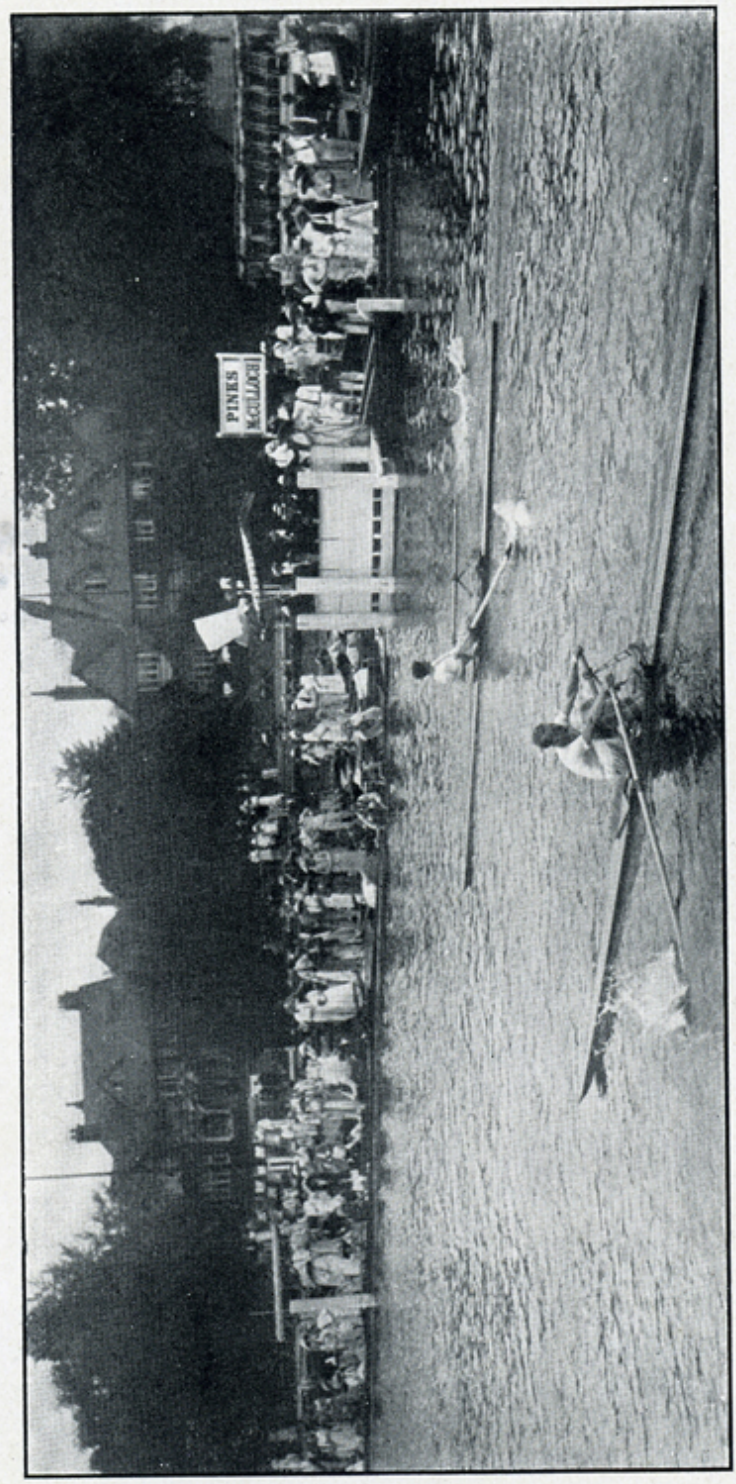
sharp definition, but in GOERZ Lenses the unevenness has been reduced to a negligible minimum. The remarkable flatness of field of GOERZ Lenses is one of the principal reasons for their popularity, and in fact, has placed our lenses in a class by themselves.

Distortion is inaccuracy in recording the lines of the object, straight lines, for instance, being shown as slightly curved in the image, especially if they lie near the margins of the negative.

This aberration is present in all single meniscus lenses, and in many of the higher-priced lenses as well, *including some anastigmats of unsymmetrical construction.* The GOERZ DAGOR, CELOR, SYNTOR and HYPERGON *are symmetrical anastigmats; i.e.,* they consist of two similar combinations. *This construction insures complete freedom from distortion—a point of the greatest importance in selecting a lens for architectural and engineering photography, copying and legal photography of every description.* In the GOERZ DOGMAR, although of unsymmetrical design, there is absolutely no distortion of lines over the listed sizes of plates.

In our Double Anastigmat Lenses these various aberrations have been corrected to such a degree that GOERZ Lenses are recognized as a standard for excellence among the finest photographic lenses of today. The possessor of a GOERZ Lens is assured that his work will not suffer through any of the above-mentioned optical deficiencies. There are, however, other considerations to be taken into account in selecting a lens for any particular kind of photography. These considerations are discussed below.

Focal Length of a Lens—The equivalent focal length is the distance between a point in the lens system, called the second node, and the ground glass, when an object at infinity is in sharp focus. In symmetrical lenses this nodal point can be said to lie in the plane of the diaphragm between the two lens components. The focal length is then,


PINES
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for all practical purposes, the distance between the diaphragm in the lens and the ground glass, when a distant object is sharply focused. The choice of a lens of suitable focal length is important because:

First, the focal length determines the scale or the image size of the object photographed.

Second, the focal length of the lens used in relation to the size of the plate determines the angle view—that is, the amount of subject included in the picture. With the same size plate the angle decreases as the focal length increases.

Third, the focal length determines the *perspective* at which objects appear in the picture, and the selection of the proper focal length is, therefore, of prime importance in architectural, interior and portrait photography.

As mentioned above, the equivalent focus of a lens is obtained when focusing objects at infinity. When focusing objects at nearer distances the focal length of the same lens increases in a definite proportion, expressed by the formula:

$$\frac{a \times f}{a - f} = b$$

where "a" is the distance of the object, "f" the equivalent focus, and "b" the resulting or effective focal length. It will be seen that if we focus at an object which is only twice the equivalent focal length away from the center of

the lens, then the effective focus "b" of the lens has also increased to twice that of the equivalent focus, in which case the size of the image will be exactly the same as that of the object. Two other formulas are given here which express the inter-relation of object and image distance and focal length:

$$\text{Distance of object to center of lens} = (n+1)\,f$$

$$\text{Resulting focus} = \frac{(n+1)\,f}{n}$$

where "n" designates the scale which the size of the object bears to that of the image, and "f" is again equivalent focal length.

These Formulas will be found useful whenever the photographer is called upon to select the proper size of lens or plate to meet certain conditions, and we give here a few examples of their application.

1. An object is to be photographed 1-10th natural size, at an available distance between object and lens of 25 feet. What must be the focal length of the lens? *Answer*—Focal length must be 27.2 inches.

$$25 \text{ ft.} = 25 \times 12 \text{ in.} = (10+1)\,f$$
$$300 \text{ in.} = 11 \times f$$
$$300 \div 11 = 27.2 \text{ in.} = \text{focus of lens}$$

2. What will be the size of the head in a portrait if we photograph the sitter with a lens of 14 inches focus at a distance of 120 inches between camera and

sitter? *Answer*—Size of head will be 1.32 inches.

$$120 \text{ in.} = (n + 1)\ 14$$
$$n + 1 = \frac{120}{14} = 8.6$$
$$n = 7.6$$

Taking the average size of a head as 10 inches, a reduction of 7.6 times would give an image 1.32 inches in height.

3. What distance is required to take a standing figure (six feet tall) with a 14-inch lens on a 5 x 7 inch plate? *Answer*—Distance between sitter and lens, 182 inches.

Possible height of image on 5 x 7 plate = 6 in.

$$72 \div 6 = 12 = \text{reduction number } n$$
$$(12 + 1)\ f = 13 \times 14 = 182 \text{ in.}$$

Selection of Focal Length — For general purposes—and among these we would class amateur photography—the lens should have a focal length not shorter than the long side of the plate. Different requirements of photographic workers along special lines make necessary other focal lengths, and the most suitable one should be selected for each case.

For architectural photography, especially interiors, it is frequently necessary to use a wide angle lens: *i.e.*, a lens of shorter focal length than the long side of the plate for which it is listed.

The fact should here be noted that in photographs taken with short-focus

lenses, the perspective is apparently exaggerated: *i.e.,* objects in the background appear disproportionately small in comparison with those in the foreground. This is in the nature of an illusion; the perspective in a picture, like that in looking at the objects themselves, depends on the point of view. If a photograph taken with a three-inch lens could be viewed at a distance of three inches from the eyes, the exaggeration of perspective would disappear. But the eye is not able to see clearly at

such short distance, and it is therefore advisable to use for landscape and record photography a lens having a focal length equal, at least, to the normal distance at which we can see the picture distinctly, which is about ten inches. Many objects—for example, all kinds of furniture—appear in pleasing perspective only when they subtend a narrow angle in the field of vision or on the photographic plate. For such objects, a lens of relatively long focus should be selected—*e.g.,* a 19 or 24 inch lens for an 8 x 10 plate.

The Speed of a Lens depends on the amount of light it transmits, and is measured by the ratio of its effective aperture to its focal length; for instance, a lens with a speed of F : 6 has an effective aperture equal to one-sixth of its equivalent focus. The diameter of the free glass surface of the front of the lens must be equal, at least, to the effective aperture; but there are some lenses in which the glasses are larger than the effective aperture, and the diameter of a lens is in itself no criterion of its speed.

Neither is the opening of the iris diaphragm, with which all modern lenses are supplied, equivalent to the effective aperture. In anastigmats the opening may be either smaller or larger than the effective aperture, depending on the construction of the front lens system. In our various photographic lenses the front combinations are positive or converging elements, and the diameter of the diaphragm is less than the effective apertures, being, for instance, one-

twelfth smaller in the CELOR and SYNTOR and one-eighth in the DAGOR.

It is a general rule (subject to the above-mentioned qualification) that the opening of the diaphragm controls the speed of the lens. The engraved scale, which shows the relative diaphragm apertures serves, therefore, as a guide to exposures under any given conditions, and the numbers on this scale are often referred to as "speed numbers." There are different systems of designating diaphragm apertures. The best known are the "F" System and the Uniform System (U.S.), one or the other of which is used by all American lens manufacturers, and the Stolze System, adopted in Europe.

In the F system each figure shows the ratio between the lens aperture and the equivalent focus. For instance, if we stop down the lens to F: 11, it will work at an effective aperture equal to 1-11th of its focal length. The necessary exposures, however, do not vary in the same ratio as the F numbers, but in proportion to the squares of these numbers. In the Uniform System, the diaphragm figures increase in the same ratio as the required exposures. Although, in deference to custom, we designate the maximum speed of our lenses in the F values, our diaphragms are marked in the U. S. system, unless otherwise specified, in order to facilitate the calculation of exposures. If you know that 1-100th of a second gives you a satisfactory negative at U. S. 4 under certain conditions of light, you should give twice as long, or 1-50th of

a second at U. S. 8, four times as long, or 1-25th at U. S. 16, eight times as long at U. S. 32, and so on. The same principle is observed in marking diaphragm apertures according to the Stolze System, which is used on German-made GOERZ lenses. The table below shows a comparison of these three well known and universally adopted systems.

Uniform System U.S.	Corresponding F values	Stolze System as used on German-made Goerz Lenses
1	4	1.5
1.2	4.5	2
1.4	4.8	2.3
1.6	5	2.5
1.9	5.5	3
2.5	6.3	4
2.9	6.8	4.6
4	8	6
8	11.3	12
16	16	24
32	22.6	48
64	32	96
128	45	192
256	64	384

Inasmuch as the focus of a lens increases when focusing nearby objects, whereas the diameter of the effective opening of the lens remains the same, it follows that at short distances lenses work at less speed than that which they are listed for. This should receive due consideration by giving prolonged exposures when photographing nearby objects. For instance, when copying in natural size, a lens listed at a speed of, say, F : 8, operates only at a speed of about F : 16, thereby requiring four times the exposure necessary for a lens of an effective opening of F : 8.

Anastigmats of extreme speed are necessarily more bulky than those of moderate speed, and they cannot be fitted to some of the smaller hand cameras. Extreme speed also involves a sacrifice in covering power, and in depth of focus when the lens is used wide open. The latter implies the necessity of greater care in focusing with the CELOR and DOGMAR than with the DAGOR and SYNTOR, when the lenses are used at their full aperture. For most amateur work a speed of F : 6.8 is sufficient, and as lenses for general photography we especially recommend our DAGOR and SYNTOR to the amateur. The CELOR and DOGMAR are, however, admirably adapted to portraiture in the home or studio, to news photography with focal plane shutter cameras, and to many kinds of outdoor photography under unfavorable conditions of light.

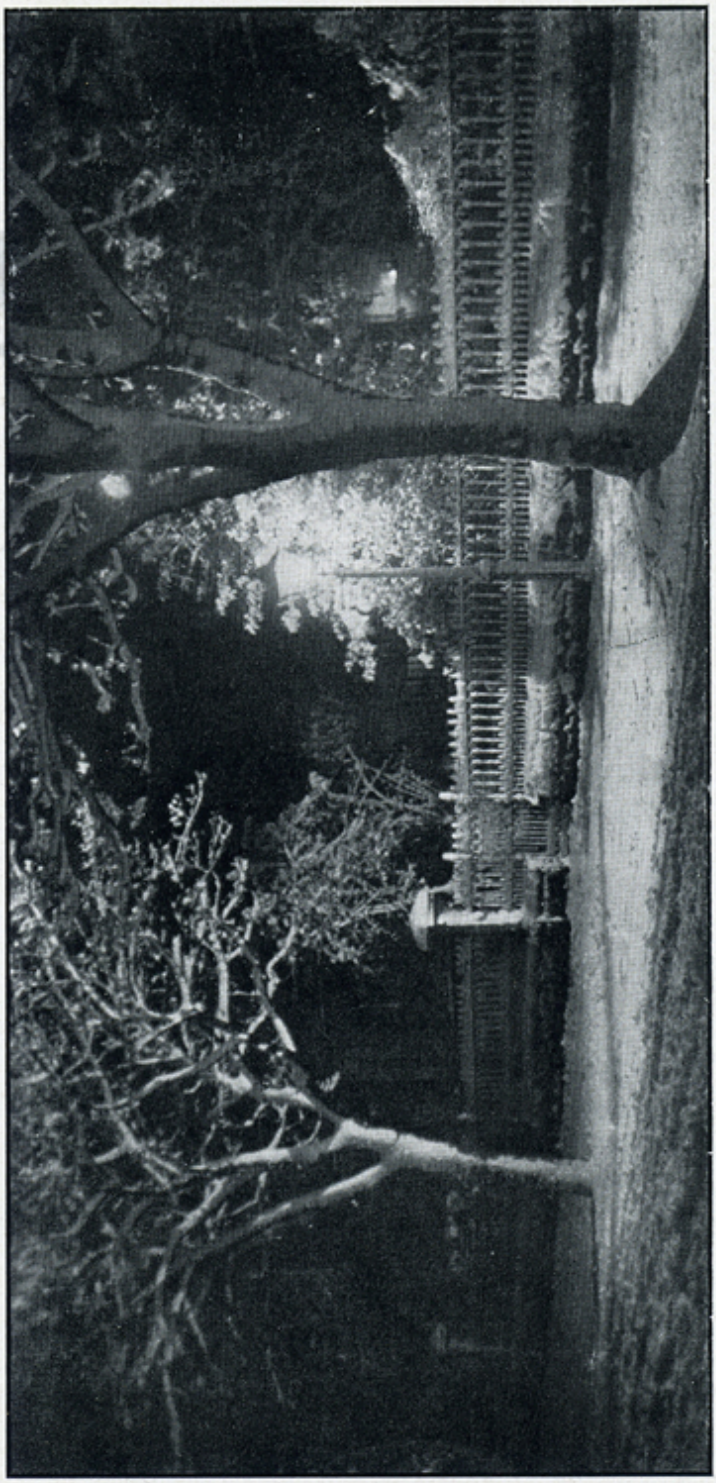
Covering Power is the ability of a lens to evenly illuminate and define an image over its entire circle of illumina-

tion. The field of a lens being circular in form, the largest plate which may be used is such as can be set in this field without cutting off the corners. GOERZ DAGOR Lenses are celebrated for their most remarkable covering power; they will embrace an angle of view to 90°, making them most satisfactory for wide angle work. A DAGOR No. 1, for instance, listed for the 4 x 5 plate, will almost cover an 8 x 10 plate when smaller diaphragm stops are used.

For photographing "skyscrapers" and large manufacturing plants, and for interior views in cramped situations, it is necessary to employ a special lens intended exclusively for wide angle work. The HYPERGON with the star diaphragm cuts an angle of 135° and the form without the star, 110°.

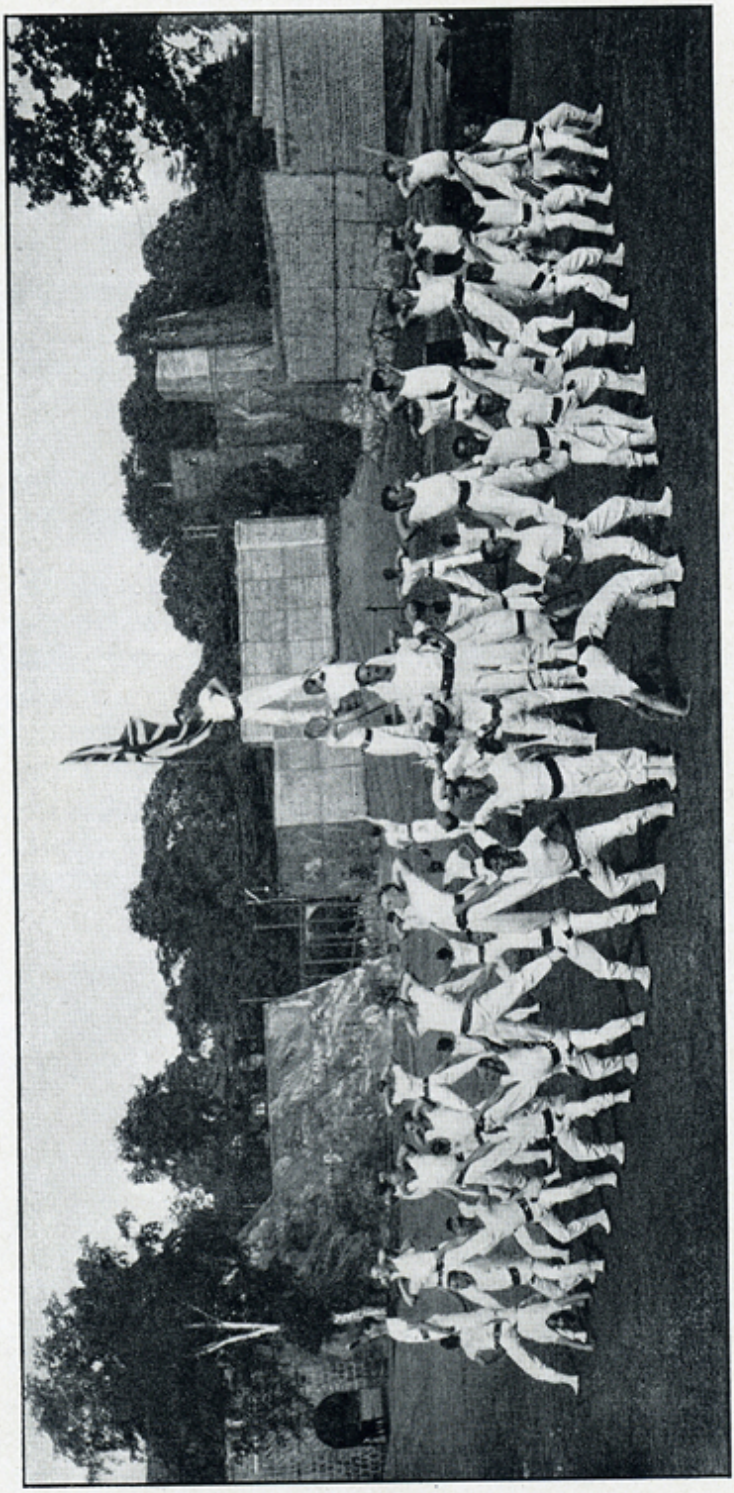
The Depth of Field, also termed depth of focus, expresses the range within which a lens will reproduce near and distant objects sufficiently sharp on the negative plate. Theoretically, a lens can only image sharply on the ground glass or negative plate objects lying in one plane in front of the lens. We find, nevertheless, that objects at different distances appear equally sharp in the picture; and the reason for this is that our eyes are unable to discover the very slight unsharpness with which these objects have been imaged by the lens. It is approximately correct, therefore, to speak of the depth of field of a lens.

This is a fixed quality in all lenses, and depends simply on the relation between the focal length and the aperture of the lens. In general it decreases as



the focal length and size of aperture increases. Of two lenses with the same speed but of unequal focal length the one of shorter focal length will have the greater depth. Of two lenses of the same focal length but of unequal speed, the slower one will have the greater depth, *but if both are stopped down to the same aperture the depth will then be equal.* Depth of focus can always be obtained by stopping down the diaphragm, but this, of course, means loss of speed and proportional increase of exposure. It will thus be noted that when using fast lenses of rather long focus, at their full opening, it is impossible to obtain both far and near objects equally sharp on a plate. The question of depth of field is of great importance when photographing, for instance, street scenes with objects at various distances from the camera. For such subjects, pocket cameras with short-focus lenses possess a great advantage over bulkier outfits. In photographing street scenes and crowds, successful results can be obtained with the Vest Pocket Tenax and Coat Pocket Tenax, under conditions that could not possibly be met with larger cameras, owing to the necessity of stopping down longer-focus lenses to secure depth of field, thereby necessitating too long exposure to stop motion in the negative.

Angle of View—For landscape work and portrait photography an angle of view of about 40° will usually be sufficient. For street scenes and general photography an angle of view of 40° to 60° should be selected. For interiors, any



angle of view up to 90° may be used to advantage. Wider angles, from 90° to 135° should be included in a photograph only in case of necessity, as the exaggerated perspective explained before is annoying to the eyes in extreme wide-angle views.

Use of Lenses for Enlargements—When using lenses for enlarging it is well to use them in reverse position, with the front lens towards the enlarged picture, except in the case of strictly symmetrical lenses, which may be used in either position with equally good results.

If artificial light is used for enlarging, care must be taken to prevent the lens from becoming unduly heated. The leaves of the iris diaphragm are of rubber or fiberoid, which is easily affected by heat, and in the case of cemented lenses, the cement may also suffer from excessive heat. Screen the lens from the light except during the time necessary for the exposure.

Cemented vs. Uncemented Lenses—Some time ago the leading lens manufacturers of Europe appointed a committee to investigate carefully the relative merits of cemented and uncemented lenses. From their report it appears that each system has its advantages, and it was found to be impossible to give one type the preference over the other.

Air Bubbles or Bells in Lenses—Almost every modern anastigmat lens shows in some of its component parts minute air bells or bubbles. The exacting purchaser is often inclined to refuse acceptance of such lenses, believing the presence of these bubbles to be a defect. It is, however, impossible to obtain from the manufacturers of the so-called Jena glass this material entirely free from bubbles; and, furthermore, the presence of a few air bubbles does not in any way affect the work of the lens. We would be pleased to send on request a communication from the glass manufacturers on this subject. Until the manu-

facturers succeed in avoiding the bubbles in these special grades of optical glass, their presence is rather a guarantee of quality than otherwise.

The Care of Lenses—All lenses should be cleaned from time to time, but with proper care, as the adjustment of an anastigmat is easily disturbed by careless handling. Dust the surfaces first with a perfectly clean camel's-hair brush, which every photographer ought to have especially for that purpose. Then wipe them with a piece of old, soft linen (an old cambric handkerchief that has been laundered several times will answer admirably). Never use any acid or other strong fluid on the glass surface of your lens or it will be ruined. We have had to repolish many anastigmats which had been thus damaged.

In all our cemented lenses, such as the DAGOR and PANTAR, the clamp ring which holds the glasses in their cells *must not be removed,* or the centering will be disturbed. In the CELOR, DOGMAR, SYNTOR and HYPAR the cell rings, which hold the inner or negative lenses, serve in some instances as clamp rings for the front or positive lens elements. They may be unscrewed in order to get at the inside surfaces. If the front or back lenses are taken out of their seat for cleaning, great care must be taken to replace the lens *with its stronger curved surface toward the outside.*

The surfaces of all lenses may become oxidized in the course of years, through exposure to the air. This condition is indicated by an iridescent reflection from the glass surface. To pre-

vent oxidation, keep the lens capped when not in use and remove at once any moisture which condenses on it. Surface oxidation can be removed by repolishing the lens. All repairs to anastigmat lenses should be entrusted to the manufacturers of the lens, as they only are equipped with the necessary test glasses and tools for this delicate work. Any attempt at repairs by others may result in the complete loss of the lens. Our New York factory is fully equipped for repolishing and repairing GOERZ Lenses, but we do not repair lenses of other makes.

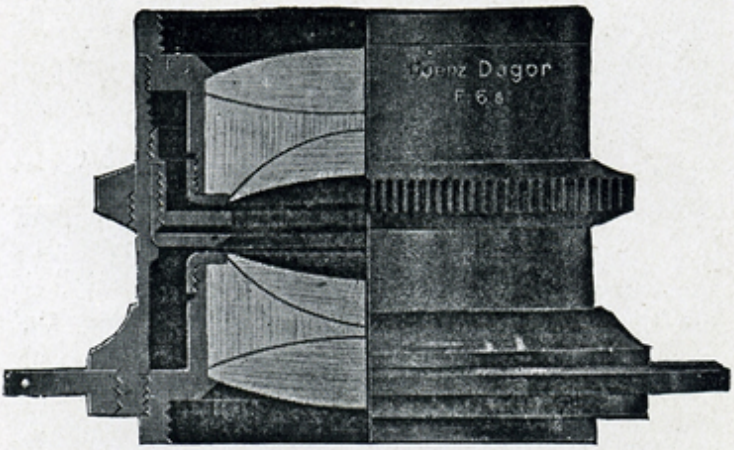
Our experience proves that when this work is done by others, the results are usually unsatisfactory.

Goerz
Dagor Anastigmat F:6.8

THERE is no lens which will do everything equally well, but there is one lens which will do the greatest number of things best, and that lens is the DAGOR. The superiority of the DAGOR as a general purpose lens is conceded by prominent amateur and professional photographers the world over. It has been imitated but never equaled.

The DAGOR consists of two symmetrical combinations, each combination made up of three elements which are cemented together.

DAGOR Lenses can be fitted to almost all makes and sizes of cameras. The smaller sizes, on account of their light weight and compact construction, are especially suitable for small hand cameras, kodaks, etc., as they insure a wealth and sharpness of detail which makes it possible to secure perfect en-



largements from the smallest negatives.

The DAGOR is an all-around lens for landscapes, architecture, groups, portraits, interiors, nature photography, scientific work and commercial photography. Its speed of F:6.8 has been found by experience to be fast enough for focal plane photography of races, athletic events, etc., giving satisfactory negatives under good conditions of light, with the shortest exposures yet attained in shutter construction.

Each Goerz Dagor Double Anastigmat Comprises

1. *A rapid lens,* for general purposes —landscapes, portraiture, commercial photography, architectural subjects, flashlights, copying and enlarging, etc., working at full aperture with extreme sharpness to the edges of the plate for which it is constructed.

2. *A wide angle lens,* when small apertures are employed for buildings, interiors, large groups, etc., sharply covering a much larger plate than the size for which it is listed.

3. *A long-focus lens,* for securing larger images of distant objects, when the front or back combination is used alone. The single combinations have nearly double the focal length of the complete lens. They require but little stopping down, and can be used for "snap-shots" in sunlight; the exposure should be about four times as long as when using the whole lens.

Astigmatism is completely corrected in the DAGOR, with the result that, even at full aperture, the image is as sharp

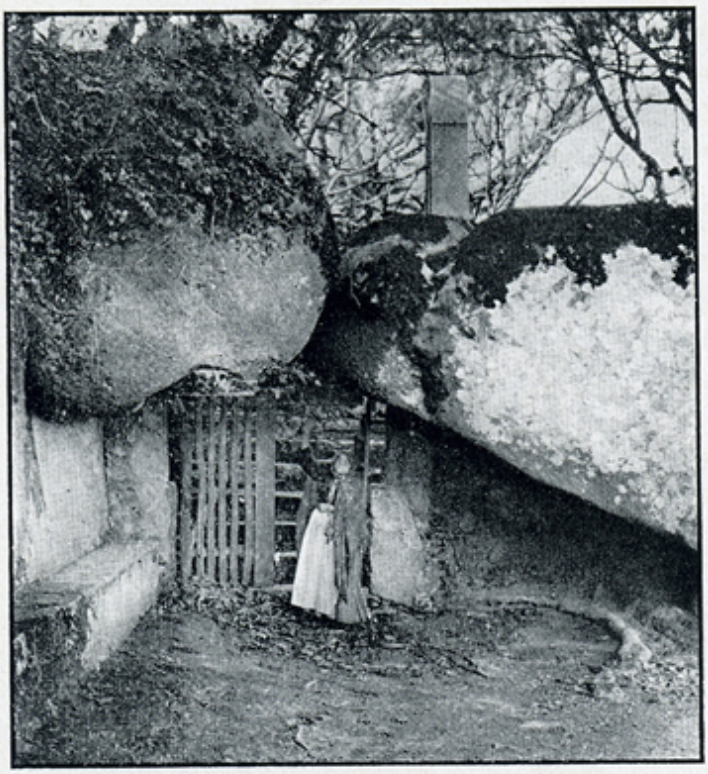
at the edges as at the center. The curvature of field is practically eliminated within an angle of 72°; that is, in wide angle work, that part of the image comprised within an angle of 72° is perfectly flat, affording minutely sharp definition. The co-existence of these two essential qualities, perfect anastigmatism and flatness of field, gives these lenses supremacy over all other types.

The DAGOR is free from internal reflections, and the image produced is accordingly brilliant and free from flare. On this account we especially recommend this lens for flashlight work, and also for landscape photography, in which the general rule that the source of light should be back of the camera must frequently be disregarded.

The two combinations of the lens are placed in close proximity, so that there is no falling off in illumination towards the edges of the plate or film. Each combination is spherically and chromatically corrected for the axial and oblique rays, even at a large stop.

By reason of the symmetrical construction of the DAGOR, which consists of two identical combinations, the image is perfectly orthoscopic under all conditions: That is, straight lines in the object are rendered as straight lines in the image, not as curves. This quality recommends the DAGOR as the best possible lens for copying maps, charts, mechanical drawings, etc., and for legal photography of every description. It is also invaluable in architectural photography and for many branches of commercial work.

The Dagor as a Wide-Angle Lens—The exceptionally fine correction of the GOERZ DAGOR Lenses over their entire light circle, and the wonderful covering power obtained as a result, make possible the use of the DAGOR as a wide-angle lens, on a larger plate, up to an angle of 90°. They will give perfect



definition over the whole image subtended by this angle when the smaller stops are used. Their brilliant illumination at the wider apertures is of great assistance in composing the view on the ground glass and in focusing; in which respect the DAGOR is greatly preferable to the ordinary wide-angle lenses, which allow only a maximum aperture of about F : 16.

Prices of Dagor Lenses

Number	Equivalent Focus, Inches	In Barrel Iris Diaphragm	With Sector Shutter	With Compound Shutter
0000	1⅝	$30.00	$43.50	$41.00
000	2⅜	30.00	43.50	41.00
000a	3	31.00	44.50	42.00
00	3½	32.00	45.50	43.00
0*	4¾	33.50	47.00	44.50
1*	6	40.00	53.50	52.50
2	7	46.00	59.50	58.50
3	8¼	56.00	69.50	70.00
4	9½	67.00	83.00	81.00
5	10¾	81.00	97.00	98.00
6	12	96.00	112.00	113.00
7	14	126.00	.....	144.50
7a	16½	163.00	.....	181.50
8	19	197.00	.....	225.00
9	24	292.00	.....	.....
10	30	480.00	.....	.....
11	35	950.00	.....	.....

*For Kodaks and other small hand cameras we supply No. 0a and No. 1a of 5 inches and 6½ inches focus at the same prices as the No. 0 and No. 1 Dagor respectively.

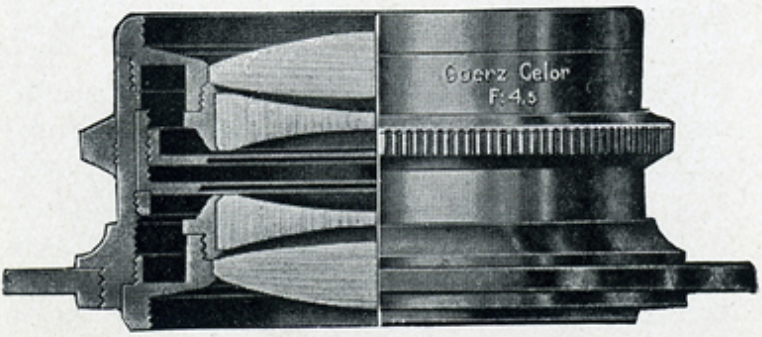
Goerz Celor
Anastigmat F:4.5—F:5.5

THE CELOR is a double anastigmatic lens of symmetrical construction. Each combination is made up of two thin glasses separated by an air space. The loss of light through absorption is, therefore, very small.

The CELOR is an ideal lens for portraits in room or studio, for the highest speed work, copying and enlarging; natural color photography; telephotography; also for landscapes and views. Every CELOR Lens will cut sharply the size of plate for which it is listed.

There are in the market several anastigmat lenses working at a great relative aperture. Theoretically, their speed leaves nothing to be desired, but when they are used at their full aperture the extent of the field sharply covered is very limited.

A fast lens, to be really serviceable for general photographic work, should not only possess speed, but should at the same time cut sharply at full aper-



ture an image contained within 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 CELOR Lens combines these properties. It not only meets the requirements of the up-to-date studio as a lens for portraits and small groups, but it is also an ideal lens for high-speed photography with focal plane cameras and small pocket cameras in all kinds of weather.

We claim that CELOR Lenses are superior to all other anastigmats of equal aperture because of their larger field of sharp definition at full aperture. This is sometimes of advantage to the portraitist, because it enables him to select a lens of shorter focal length, where the length of the studio is limited. It means a gain in depth of focus and in actual working speed.

For Natural Color Photography on the new Autochrome plates the CELOR Lenses are particularly adapted. Not only does their great speed recommend them for this work, but also their very perfect chromatic correction, which insures equal sharpness for all colors composing the image.

Their chromatic correction makes them also suitable for reproduction work by the three-color process.

The CELOR makes high-speed photography possible under conditions which were formerly prohibitive. We especially recommend it to newspaper photographers and others who have to secure printable negatives regardless of weather and time of day.

It is also an excellent lens for home portraits, having much greater covering power in comparison with its bulk and weight than the older types of portrait lenses. The reputation of the CELOR as an all-around studio lens is thoroughly established, and it is used by a large proportion of the professional portrait photographers of Europe and America. While it is not so fast as the HYPAR, it has speed enough for portraits under the average skylight, and it is preferable to the HYPAR for all work calling for critical definition over a comparatively wide angle of view.

The depth of focus of the CELOR at full aperture is naturally limited; but if stopped down, it will have the same depth at the same aperture as will a DAGOR of equal focal length. The covering power of the CELOR includes an angle of 64° to 70°, as compared with 72° to 90° in the DAGOR. The single combinations of the CELOR, having nearly twice the focal length of the complete lens, can be used for long-distance photography, but require more stopping down than in the case of the DAGOR.

Prices of Celor Lenses

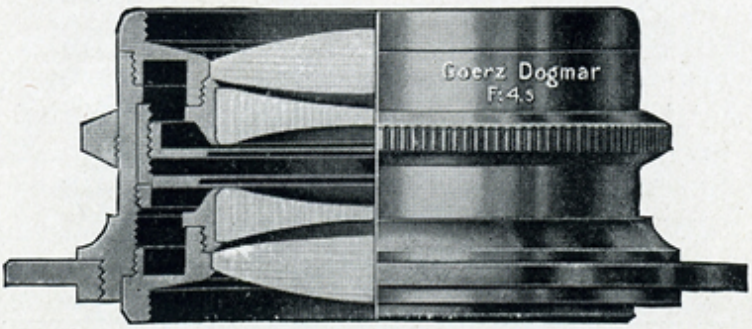
Number	Equivalent Focus, Inches	In Barrel Iris Diaphragm	With Sector Shutter	With Compound Shutter
000	2⅜	$31.00	$44.50	$42.00
000a	3	32.00	45.50	43.00
00	3½	34.00	47.50	45.00
0*	4¾	36.00	49.50	48.50
1	6	42.00	55.50	56.00
2	7	49.00	65.00	63.00
3	8¼	60.00	76.00	77.00
4	9½	81.00	.....	99.50
5	10¾	97.00	.....	115.50
6	12	Discont'd	.....	.....
7	14	146.00	.....	.....
7a	16½	187.00	.....	.....
8	19	220.00	.....	.....

*For Kodaks and other small hand cameras we supply No. 0a of 5 inches focus at the same price as the No. 0 Celor.

Goerz
Dogmar Anastigmat F:4.5

OUR new GOERZ DOGMAR LENS is a source of great pride to us. In it our mathematicians have evolved points of superiority which are absolutely new and proven to be perfect in actual practice. Already this new lens is forging ahead and making fast friends among photographers throughout the country. Here again GOERZ quality is the irresistible power which is making this lens universally popular. For a lens of its speed the DOGMAR F: 4.5 is very compact and can be used to advantage on hand or reflecting cameras which can accommodate a larger lens than the regular equipment.

This new GOERZ Lens is a convertible anastigmat consisting of two pairs of uncemented glasses. The two combinations, which can be used separately at the smaller stops, are of different focal length, offering the advantage of three focal lengths in one lens. The available focal lengths are in the following ratio: Double Combination, 100; Back Com-



bination, 158; Front Combination, 192. The extreme speed of F:4.5, can seldom be obtained in a lens without a serious sacrifice of covering power; but in the DOGMAR the corrections are so thorough that its negatives show remarkably fine definition to the corners of the plates for which the various focal lengths are recommended. In this new lens our mathematicians have also succeeded in correcting almost completely the troublesome phenomena known as *coma,* generally present in high-speed anastigmats and responsible for the tendency of many fast lenses to produce flat or fogged negatives.

Owing to the practical elimination of *coma,* the DOGMAR—even when used wide open—affords images of sparkling brilliancy. The lens is equally free from

Prices of Dogmar Lenses, F:4.5 Series

Number	Equivalent Focus Inches	In Barrel, Iris Diaphragm	With Compound Shutter
000	2⅜	$34.00	$45.00
000a	3	34.00	45.00
00	4	35.00	46.00
0	5	36.00	49.00
0a	5¼	38.00	52.00
1	6	43.00	57.00
1a	6½	48.00	62.00
2	7	53.00	70.00
3	8¼	66.00	83.00
4	9½	96.00	115.00
5	10¾	124.00	143.00
6 (F:5.5)	12	116.00	134.50

flare, and produces no distortion of lines over the listed sizes of plates. They give an even illumination over the whole plate. The DOGMAR F:4.5 is recommended for natural color photography. Each combination, used separately, makes an ideal lens for landscapes and artistic portraiture.

Goerz Dogmar F:6.3

WE supply a DOGMAR F:6.3 which has found great favor among hand camera users who possess instruments of adjustable bellows extension. This lens has the same perfect optical corrections of the F:4.5 DOGMAR, and is still more compact in construction and weight. Each lens affords three different focal lengths. The available focal lengths are in the following ratio: Double Combination, 100; Back Combination, 170; Front Combination, 186. The DOGMAR F:6.3 is the ideal lens for all double extension hand cameras of similar construction to the Goerz Manufoc, Taro and Roll Film Tenax. Unusually brilliant negatives are obtainable with the DOGMAR F:6.3 and owing to its speed it may be used under unfavorable weather conditions with every certainty of success. This lens is an ideal GOERZ equipment for the amateur. We call particular attention to the DOGMAR F:6.3 owing to the fact that this lens mounted in a Compound shutter is the maximum speed equipment that can be fitted to standard Kodaks. The usual front board equipment

on these cameras will not accommodate our DOGMAR F: 4.5 and shutter. While the double extension cameras will permit the use of the three focal lengths of the DOGMAR F: 6.3, nevertheless we have found many who use this lens on single extension instruments on account of its speed and brilliancy. With it the efficiency of any camera will be increased and it will enable the amateur and professional alike to produce *results*.

Prices of Dogmar Lenses, F:6.3 Series

Number	Equivalent Focus, Inches	In Barrel Iris Diaphragm	With Compound Shutter
000	2⅜	$27.00	$38.00
000a	3	27.00	38.00
00	4	28.00	39.00
0	5	30.00	41.00
1	6	33.00	46.00
1a	6½	40.00	53.00
2	7	46.00	60.00
3	8¼	56.00	70.00

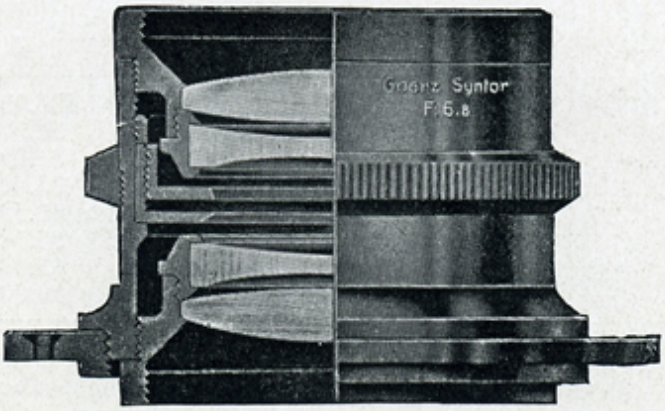
Goerz
Syntor Anastigmat F:6.8

THE GOERZ SYNTOR double anastigmat is particularly intended for use on hand cameras. It meets the demand for an inexpensive but thoroughly efficient anastigmat. It is only made up to the No. 6 size (12 inches focal length).

The SYNTOR Lens is perfectly corrected for spherical, chromatic and astigmatic aberrations; and the single combinations are brought very close together, insuring thereby a most even light distribution over the whole plate. Even at full aperture the SYNTOR is entirely free from coma and central spherical aberration.

The angle of sharp definition with the largest stop is 64°, increasing to 70° with smaller apertures.

The SYNTOR consists of two symmetrical uncemented combinations, and each combination can be used singly with a medium or small stop as a valu-



able landscape lens of approximately double the focal length of the complete objective.

The amateur photographer who wishes an anastigmat lens for his hand camera, but does not care to invest heavily, will find the SYNTOR *a very satisfactory lens. It will cover sharply the size plate for which it is listed.*

Although the GOERZ SYNTOR is offered at a comparatively low price, it must not be classed or confused with other cheap lenses, as it represents the same high-grade workmanship necessary to produce our DAGOR, DOGMAR and CELOR Lenses. Its simplified construction is the principal reason that permits of its moderate price. The quality of this lens places it in a class decidedly its own among the lower priced lenses.

Prices of Syntor Lenses

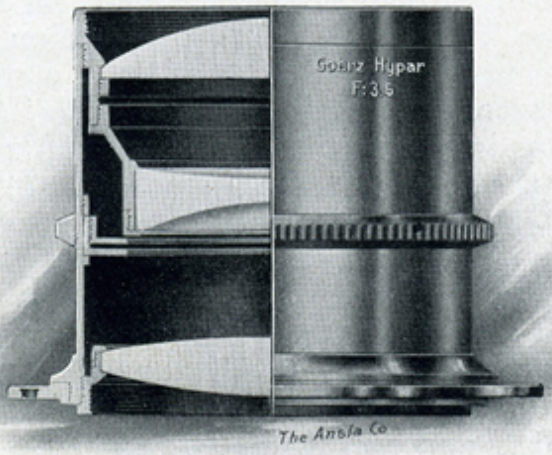
Number	Equivalent Focus, Inches	In Barrel Iris Diaphragm	With Sector Shutter	With Compound Shutter
000a	3	$20.00	$33.50	$31.00
00	3½	20.50	34.00	31.50
0*	4¾	21.00	34.50	32.00
1*	6	24.00	37.50	36.50
2	7	29.00	42.50	41.50
3	8¼	41.00	54.50	55.00
4	9½	49.00	65.00	63.00
6	12	65.00	81.00	82.00

*For Kodaks and other small hand cameras we supply No. 0a and No. 1a of 5 and 6½ inches focus, respectively, at the same prices as the No. 0 and No. 1 Syntor.

Goerz Portrait Hypar F:3.5 and F:4.5

THE introduction of a new GOERZ Portrait Lens is an event of more than passing interest to the photographic fraternity. It is, therefore, with special pleasure that we direct the attention of photographers to our new PORTRAIT HYPAR lens. This new lens is our answer to a definite demand from the profession for a GOERZ Anastigmat intended exclusively for portraiture and working at the widest possible aperture.

The HYPAR is an unsymmetrical anastigmat consisting of three single elements—one negative and two positive—and loss of light through absorption is reduced by this type of construction to an extreme minimum. The utmost care is taken in selecting glass for the lens, not only as to its composition and re-



fractive index, but as to clearness, freedom from striæ and durability.

The HYPAR is free from internal reflections, permitting portraits to be taken against the light, if desired.

The PORTRAIT HYPAR works at a speed of F: 4.5—fast enough for instantaneous exposures in the studio—in all sizes, from fourteen to twenty-four inches focal length.

Twelve and fourteen inch sizes working at the extreme speed of F: 3.5 can also be supplied. These are especially suitable for home portraiture.

The PORTRAIT HYPAR meets the requirements of photographers who wish a lens equally efficient for standard commercial portraiture and for the impressionistic rendering of character which distinguishes the work of the greatest photographic portrait artists of today.

It is not a special lens for producing a "fuzzy" lack of definition; but it blends the outlines and tone gradations of the masses of light and shade so as to produce exquisite modeling, together with just that degree of softness of definition which distinguishes an artistic from a mechanical reproduction. Experience has proved that such a medium softness of definition appeals to the most intelligent and prosperous patrons of the modern studio.

Although the Goerz HYPAR is an ideal lens for portraiture, in the strict sense of the term, it is not intended to supersede the CELOR as a studio lens.

The extra speed of the HYPAR is an advantage, especially in child photography, and to all portraitists who prefer

to photograph their sitters unawares. The attainment of this speed, however, involves some reduction of covering power. The HYPAR F: 3.5 cuts an angle of about 35° and the HYPAR F: 4.5, 45°. Either of these angles of view is sufficient for portraits and single figures; but the CELOR, with its effective angle of 64°-70°—greater than that of any other high-speed anastigmat—is recommended to the photographer who is obliged to use the same lens for portraits, groups and occasional commercial work.

Prices of Portrait Hypar Lenses

Number	Equivalent Focus Inches	Speed	Barrel Iris Diaphragm
6	12	F: 3.5	$179.00
7	14	F: 3.5	245.00
7	14	F: 4.5	156.00
7a	16½	F: 4.5	196.00
8	19	F: 4.5	261.00
9	24	F: 4.5	489.00

Goerz Kino Hypar F:3.5

We call special attention to our KINO HYPAR lens which has won pronounced success in the motion picture field. Our special motion picture accessories, together with the KINO HYPAR are fully described in a booklet which we will gladly send to all those who are interested.

Goerz Pantar Sets

THE continued demand for a convertible GOERZ Anastigmat has led us to place on the market the GOERZ PANTAR. We supply the PANTAR only in special sets as listed below, each set consisting of one lens barrel and three single combinations, which may be used separately or any two together.

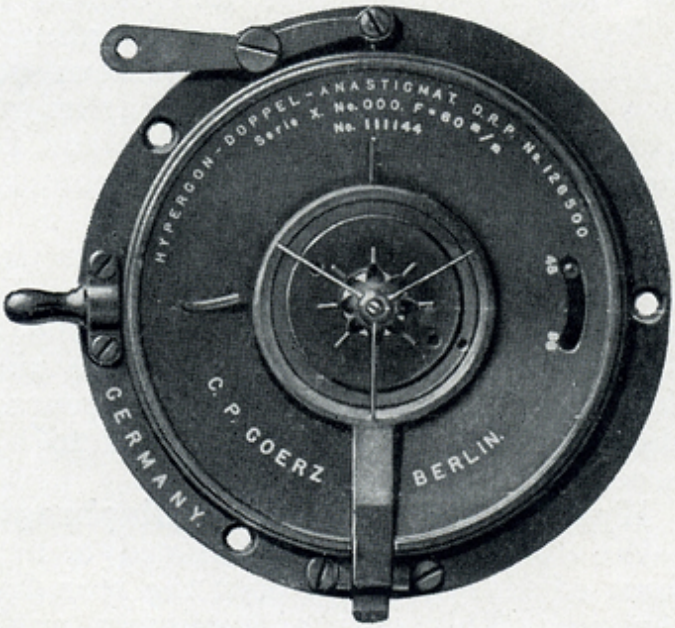
By providing himself with a PANTAR set, the photographer secures six different anastigmats at a price no greater than that frequently charged for one. The advantage of this is apparent. The range of usefulness of any hand or view camera of long bellows extension can be increased to a maximum by securing a PANTAR set. It is especially useful for landscape and architectural photography.

Most of the standard shutters can be fitted to the PANTAR and full particulars as to shutter equipment will be given upon request. The prices given below include three PANTAR combinations and one lens barrel, in a neat leather case.

Prices of Pantar Sets

4x5 Set (12 in., 9½ in., and 7 in. lenses). .	$85.00
5x7 Set (14 in., 12 in., and 9½ in. lenses). .	98.00
7x9 Set (19 in., 16½ in., and 14 in. lenses). .	150.00

Prices of extra 12-inch lens for 4x5 Set, $16.00; extra 14 inch lens for 5x7 Set, $20.00; extra 19 inch lens for 7x9 Set, $38.00. By combining two Pantar combinations of the same focal length, a symmetrical anastigmat with a speed of F: 6.3 is obtained.



Goerz
Hypergon F:22—F:31

THE HYPERGON has for several years held a unique place among wide-angle lenses on account of its incomparable covering power. It is a symmetrical double anastigmat, consisting of two very thin hemispherical single glasses. Astigmatism, spherical aberration and curvature of field are completely corrected, and the definition is sharp to the very edges of the plate. The chromatic aberration is not corrected, but is eliminated after focusing by the use of the smaller diaphragm stop, F: 31. The symmetrical design of the HYPERGON insures complete freedom from distortion of straight

lines. The diminution of light toward the margin of the image, unavoidable in a lens cutting such an extraordinary angle, is corrected by an ingenious device in the form of a star diaphragm, which is rotated in front of the lens, by means of a bulb and tube attachment, during a part of the exposure.

The HYPERGON is a special lens for wide-angle interiors, landscapes, architectural and panoramic pictures, and it should not be purchased with the idea that it can be used as a lens for general photography. It cannot be fitted to between-the-lens shutters.

Hypergon Without Star Diaphragm—We have recently introduced a new form of HYPERGON without the star diaphragm. This cuts a maximum angle of 110° and requires no special adjustment to equalize the illumination. This lens can be attached to most view cameras without special fitting. It can be used for instantaneous cap exposures and flashlights, as well as time exposures.

This lens would be a valuable addition to the equipment of the commercial photographer.

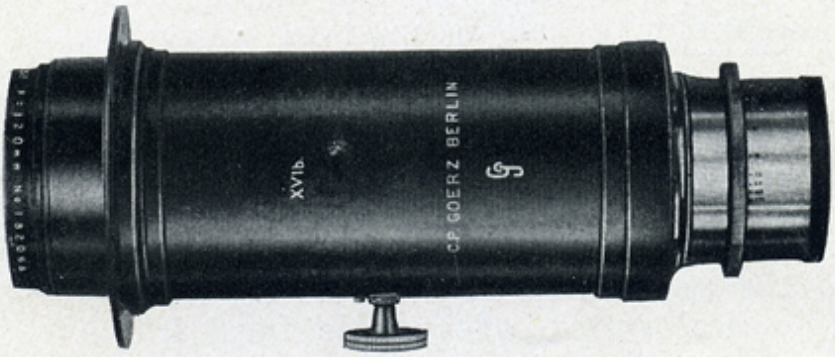
Prices of Hypergon Lenses

Number	Equivalent Focus, Inches	In Barrel
000 with Star	2⅜	$39.00
000a " "	3	44.00
00 " "	3½	47.00
0 " "	4¾	55.50
1 " "	6	65.00
2a " "	7⅞	81.50

Goerz Telephoto Lenses

A TELEPHOTO lens is a photographic telescope. It consists of a negative lens and an adjustable tube and is used in connection with the regular photographic lens. The Telephoto lens and tube is screwed into the lens board and the regular lens is then attached to the front of the Telephoto tube. Through a rack and pinion the separation between the two lenses may be varied, and an optical system of variable focal length —from three to eight times that of the regular lens—is thereby obtained.

The Telephoto lens has, besides the wide range of focal lengths, the further advantage that the required bellows extensions are in all cases considerably shorter than the resulting focal lengths of the optical system would indicate. Objects at great distances—as, for instance, inaccessible mountain peaks—and also architectural details, birds and other animals, can be photographed with a short-bellows camera on a comparatively large scale. The necessary exposure increases with the square of the magnification; *e.g.,* if the tele-system is adjusted for an increase in the focal length of three times, an increase in exposure of nine times over that necessary for the regular lens alone would be required. When using our Telephoto lenses in connection with our high-grade CELOR and DOGMAR anastigmats, instantaneous exposures at moderate magnifications are possible.



Prices of Telephoto Lenses

Focus of Negative Lens	Prices of Negative Lens in Rack and Pinion Tube to Fit			
	Dagor No		Celor or Dogmar F: 4.5	
1⅝	00	$26.00	00	$26.00
2⅜	0	30.00	0	30.00
2⅜	1	31.00	1	33.00
3	1	36.00	1	37.50
2⅜	2	33.00	2	34.50
3	2	39.00	2	39.50
3	3	41.00	3	41.00
3½	3	47.00	3	47.00
3½	4	47.00	4	47.00
3½	5	51.00	5	52.00
4¾	5	64.00	5	64.00
4¾	6	65.00	6	65.00
6	7	84.00	7	84.00

When Telephoto Lenses are ordered on trial a net charge of $3.00 (for special fitting required) is made if for any reason they are returned to us.

COVERING POWER OF

GOERZ LENSES

BELIEVING that a concise set of tables showing the focal length and covering power (at full opening and at the smaller stops) of GOERZ LENSES would prove of value to those interested in GOERZ GOODS, we have added this supplement for insertion in our new LENS BOOKLET.

Dagor F6.8-F7.7

Number	Equivalent Focus Inches	Relative Opening	Size of Plate Covered Sharply at	
			Full Opening Inches	F32 Inches
0000	1⅝	F6.8	1⅝x1⅝	2x2¾
000	2⅜	F6.8	2⅜x2⅜	2¾x3½
000a	3	F6.8	2¾x2¾	3¼x4¼
00	3½	F6.8	3x3	4x5
0	4¾	F6.8	3¼x4¼	5x7
1	6	F6.8	4x5	6½x8½
2	7	F6.8	5x7	8x10
3	8¼	F6.8	5x8	10x12
4	9½	F6 8	6½x8½	11x14
5	10¾	F6.8	7x9	12x16
6	12	F6 8	8x10	16x18
7	14	F7.7	10x12	18x22
7a	16½	F7.7	11x14	20x24
8	19	F7.7	12x15	22x25
9	24	F7.7	16x18	24x30
10	30	F7.7	18x22	30x36
11	35	F7.7	22x25	34x44

Celor F4.5-F5.5

Number	Equivalent Focus Inches	Relative Opening	Size of Plate Covered Sharply at	
			Full Opening Inches	F16 Inches
000	2⅜	F4.5	1½x2½	2x2½
000a	3	F4.5	2x3	2½x3½
00	3½	F4.8	2½x3½	3x4
0	4¾	F4.8	3¼x4¼	4x5
1	6	F4.8	4x5	5x7
2	7	F4.8	5x7	6x8
3	8¼	F5	5x8	6½x8½
4	9½	F5	6½x8½	7x9
5	10¾	F5	7x9	8x10
6	12	F5.5	8x10	10x12
7	14	F5.5	10x12	12x15
7a	16½	F5.5	11x14	13x17
8	19	F5.5	12x15	16x18

Syntor F6.8

Number	Equivalent Focus Inches	Relative Opening	Size of Plate Covered Sharply at	
			Full Opening Inches	F16 Inches
000a	3	F6.8	2¼x2¾	2½x3½
00	3½	F6.8	2½x3½	3x4
0	4¾	F6.8	3¼x4¼	4x5
1	6	F6.8	4x5	5x7
2	7	F6.8	5x7	6x8
3	8¼	F6.8	5x8	6½x8½
4	9½	F6.8	6½x8½	7x9
6	12	F6.8	8x10	10x12

Dogmar F4.5

Number	Equivalent Focus Inches	Relative Opening	Size of Plate Sharply Covered at	
			Full Opening Inches	F16 Inches
000	2⅜	F4.5	1¾x2	2x2¼
000a	3	F4.5	1¾x2⅜	2¼x2¾
00	4	F4 5	2½x3½	2¾x3¾
0	5	F4 5	3¼x4¼	3½x4½
0a	5¼	F4.5	3¼x4¼	3½x4¾
1	6	F4.5	3½x4¾	4x5
1a	6½	F4.5	4x5	4x6
2	7	F4 5	4x6	4½x6½
3	8¼	F4.5	5x7	5x8
4	9½	F4.5	5x8	6½x8½
5	10¾	F4.5	6½x8½	7x9
6	12	F5.5	8x10	9x11

Pant

Focus of Single Lenses	Speed	Angle of View	Focus of Single Lenses
4x5 { 12	F:12.5	24°	5x7 { 14
4x5 { 9½	F:12.5	29°	5x7 { 12
4x5 { 7	F:12.5	38°	5x7 { 9½

Combination	Focus	Speed	Angle	Combination	F
12+9½	6	F:7.2	44°	14+12	
12+7	5¼	F:9	50°	14+9½	
9½+7	4⅝	F:7.2	56°	12+9½	

Dogmar F6.3

Number	Equivalent Focus Inches	Relative Opening	Size of Plate Sharply Covered at	
			Full Opening Inches	F16 Inches
000	2⅜	F6.3	1¾x2	2x2¼
000a	3	F6.3	1¾x2⅜	2¼x2¾
00	4	F6.3	2½x3½	2¾x3¾
0	5	F6.3	3¼x4¼	3½x4½
1	6	F6.3	4x5	4½x5½
1a	6½	F6.3	4x6	5x7
2	7	F6.3	5x7	5x8
3	8¼	F6.3	5x8	6x8

Hypergon F22-F31

Number	Equivalent Focus Inches	Hole in Lens Board in Inches	Diameter of Flange	Plate Covered Sharp at F31
*000	2⅜	2-7/16	3	5x7
*000a	3	2-7/16	3	8x10
*00	3½	3-9/16	4¼	10x12
*0	4¾	3-9/16	4¼	12x16
*1	6	4-3/16	5	16x20
*2a	7⅞	7	7¾	24x28
†000a	3	1¼	2	5x7
†00	3½	1½	2⅛	6½x8½
†0	4¾	2	2⅝	8x10

* 135°; † 110°

tar Sets

Speed	Angle of View	Focus of Single Lenses	Speed	Angle of View
F:12.5	28°	7x9 { 19	F:12.5	28°
F:12.5	33°	7x9 { 16½	F:12.5	32°
F:12.5	41°	7x9 { 14	F:12.5	37°

Focus	Speed	Angle	Combination	Focus	Speed	Angle
7½	F:6.8	51°	19+16½	10	F:6.8	50°
6½	F:7.7	57°	19+14	9¼	F:7.2	54°
6	F:7.2	61°	16½+14	8¾	F:6.8	57°

Portrait Hypar F3.5-F4.5

Number	Equivalent Focus Inches	Relative Opening	Size of Plate Sharply Covered at Full Opening Inches	
6	12	F3.5	5x7	(C. D. V.) (Cabinet)
7	14	F3.5	5x7	(C. D. V.)
7	14	F4.5	6x8	(Cabinet) (Boudoir)
7a	16½	F4.5	6½x8½	(Boudoir)
8	19	F4.5	7x9½	(Imperial)
9	24	F4.5	10x12	

Telephoto

Focus of		Magnification		Approximate Bellows Extension		Size of Plate Covered With	
Positive Lens Inches	Negative Lens Inches	From	To	For lowest Power Inches	For highest Power Inches	Lowest Magnification Ins.	Highest Magnification Ins.
3½	1⅝	3x	8x	3¼	11⅜	2⅜x3¼	6½x8½
4¾	2⅜	3x	8x	5	16⅞	3½x4¾	10x12
6	2⅜	3x	8x	5	16⅞	3½x4¾	10x12
6	3	3x	8x	6½	21½	4x5	12x16
7	2⅜	3x	8x	5	16⅞	3¼x4¼	10x12
7	3	3x	8x	6½	21½	4x5	12x16
8¼	3	3x	9x	6½	24½	4x5	12x16
8¼	3½	3x	8x	8	25½	5x7	12x16
9½	3½	3x	9x	8	29	4¾x6½	16x20
10¾	3½	3x	9x	8	29	4¾x6½	16x20
10¾	4¾	3x	7x	11	30	7x9	20x24
12	4¾	3x	8x	11	34¾	7x9	20x24
14	6	3x	7x	14	38	9x12	24x28