Auteur ou collectivité : Dallmeyer, Thomas Rudolphus
Auteur : Dallmeyer, Thomas Rudolphus (1859-1906)
Titre : The telephotographic lens

Adresse : London : J. H. Dallmeyer, ltd. 1892
Collation : 1 vol. ([6]-30 p.-6 f. de pl.) : ill., tabl. ; 25 cm
Cote : CNAM-BIB 4 Tu 52 (P.4)
Sujet(s) : Lentilles (optique) ; Téléphotographie (photographie) ; Objectifs photographiques
Note : Relié dans un recueil factice intitulé "Métrophotographie" ayant probablement appartenu à Aimé Laussedat, la table des pièces étant écrite de sa main, et utilisé comme outil de travail pour ses publications.
Langue : Anglais

Date de mise en ligne : 03/10/2014
Date de génération du PDF : 28/9/2017

Permalien : http://cnum.cnam.fr/redir?4TU52.4

Price, ONE SHILLING.

The Telephotographic Lens.

By

T. R. Dallmeyer,

F.R.A.S.,

M.R.I., &c.

Published by J. H. DALLMEYER, Ltd.,

25, Newman Street,

Oxford Street, London, W.

THE

TELEPHOTOGRAPHIC LENS.

BY

T. R. DALLMEYER, F.R.AS., M.R.I., &c.

PUBLISHED BY

J. H. DALLMEYER, LTD., 25, NEWMAN STREET, OXFORD STREET, LONDON, W.

THE
TELEPHOTOGRAPHIC LENS.

GENERAL INSTRUCTIONS FOR USING THE TELEPHOTOGRAPHIC LENS.

1 Determine the size of plate intended to be covered.

2 Consult table following; in the columns "Circle of Illumination at full aperture" find (in the small figures underneath) the size of plate decided upon.

3 In a horizontal line with this (in the first column) will be found the "Distance of the Focussing Screen from the back lens." The extra distance from the flange is given by a reference to the foot-note.

4 Focus very carefully by means of the Rack and Pinion on the *lens* mount.

5 If a smaller stop than full aperture be used, a somewhat greater extension is necessary; so that it is best to set the screen at a rather greater extension than is necessary for covering the plate at full aperture. The reduction in angle included, for smallest stop, is also given in the foot-note.

The focussing screen itself will readily show whether the plate be covered whatever stop be used. Longer extension of camera covers larger size of plate.

6 When the extension of camera has been determined, reference to the table will show (1) the corresponding focus and (2) the intensity at full aperture.

7 Knowing the intensity at full aperture (and hence the requisite exposure, according to the rapidity of the plate used) the notation adopted for the smaller apertures is so arranged that counting from the largest (full aperture) each succeeding smaller diaphragm or iris aperture, requires double the exposure of the one before. Seven apertures are given and the relative exposures for each in succession are therefore 1, 2, 4, 8, 16, 32, 64, whatever extension of camera be employed.

8 The three particular *examples* referred to in the table following by no mean define the limits of the construction. They indicate a useful mean as regards power, intensity, and angle included. By lessening the power, intensity and angle are increased, this being attained by the employment of weaker (or longer foci) negatives. By increasing the power, the reverse takes place.

THE TELE-PHOTOGRAPHIC LENS.

BY T. R. DALLMEYER.

A table included in a communication to the London and Provincial Photographic Association, June 2nd, 1892.

Angles Included, Corresponding Foci, and Camera Extension.

Distances of Focussing Screen from Compound Negatives or Back Foci (1).	No. 1. Angle included is practically constant, at full aperture equals 11°. 3 (2)			No. 2. Angle included is practically constant, at full aperture equals 12°. 3⅕ (2)			No. 3. Angle included is practically constant at full aperture equals 9° 2⅔ (2)		
	Corresponding Foci.	Intensity at Full Aperture.	Circle of Illumination at Full Aperture.	Corresponding Foci.	Intensity at Full Aperture.	Circle of Illumination at Full Aperture.	Corresponding Foci.	Intensity at Full Aperture.	Circle of Illumination at Full Aperture
Inches									
4	17½	1/11	3½	20	1/10	4¼			
5	21	1/13	4½	22½	1/11	4¾ 3¼ × 3¼			
6	24	1/15	5¼ 3¼ × 3¼	25	1/12.5	5¾ 4¼ × 3¼	34	1/12.4	5½ 4¼ × 3¼
8	30	1/19	6¾ 5 × 4	31½	1/16	7½ 5 × 4	42½	1/15	7 5 × 4
10	36	1/22	8¼ 6½ × 4¾	37	1/18.5	9¼ 6½ × 4¾	47½	1/17	8½ 6½ × 4¾
12	42	1/26	10	45	1/22.5	11 8½ × 6½	56½	1/20	10
14	48	1/30	11¾ 8½ × 6½	50	1/25	12¾	63	1/23	11¾ 8½ × 6½
16	54	1/33	13½ 10 × 8	57	1/28.5	14½ 10 × 8	71	1/26	13½ 10 × 8
18	60	1/37.5	15	62½	1/32	16¼ 12 × 10	78	1/28	15
20				69	1/35	18 13 × 11	85	1/30	16½ 12 × 10
22				76	1/38	19¾ 15 × 12	92	1/33	18 13 × 11
24				84	1/42	21¼	100	1/36	20 15 × 12
26							106	1/38	22¼
28							114	1/40	24¾ 18 × 16
30							124	1/45	27
40							157½	1/60	42 30 × 24

No. 1 tele-photographic lens consists of the patent stereographic (1·6 inches diameter) in conjunction with a compound negative $\frac{6}{10}$ of an inch diameter.

No. 2 tele-photographic lens consists of the 1B patent portrait (2 inches diameter) in conjunction with a compound negative $\frac{8}{10}$ of an inch diameter.

No. 3 tele-photographic lens consists of the 2B patent portrait (2¾ inches diameter) in conjunction with a compound negative 1 inch diameter.

(1) To obtain the distances from the *flange* to the focussing screen, add $3\frac{1}{4}$, 4, and 6 inches for Nos. 1, 2, and 3 respectively.

(2) The angle included is a constant for *one* aperture for any distance of focussing screen, but it diminishes as smaller diaphragms are employed.

The iris diaphragm is so arranged that for any initial extension (and corresponding intensity) each succeeding smaller aperture requires double the exposure of the next larger.

There are seven apertures, ranging from full aperture to the *smallest*, which requires sixty-four times the exposure required for full aperture.

The smallest aperture reduces the angles included at full aperture in Nos. 1, 2, and 3 to $8\frac{1}{2}$°, 9°, and $6\frac{1}{2}$° respectively.

The negative attachment can be supplied separately to the Patent Stereographic 1B patent 2B Patent Lenses and will have a set of Waterhouse diaphragms with apertures similar to those given by the iris diaphragms, and the same rule as to exposure, &c. will apply.

An additional Table showing the effect of employing weaker negatives with No. 1 and No. 2 positive systems described in the former table.

	No. 1 Positive with No. 2 Negative. Angle included at full aperture = 13° with smallest stop = 11°			No. 1 Positive with No. 3 Negative. Angle included at full aperture = 19° with smallest stop = 16°			No. 2 Positive with No 3 Negative. Angle included at full aperture = 14° with smallest stop = 10°		
Distance of focussing screen from back lens.	Corresponding foci.	Initial Intensity.	Diam. of circles of illumination with full aperture and smallest stop.	Corresponding foci.	Initial Intensity.	Diam. of circles of illumination with full aperture and smallest stop.	Corresponding foci.	Initial intensity.	Diam. of circles of illumination with full aperture and smallest stop.
6	25	$\frac{1}{16.6}$	6 4	19	$\frac{1}{12.6}$	7 $4\frac{1}{2}$	26	$\frac{1}{13}$	$6\frac{1}{2}$ $4\frac{1}{4}$
8	31	$\frac{1}{20}$	$7\frac{1}{2}$ 5	23	$\frac{1}{15.3}$	9 $6\frac{1}{2}$	32	$\frac{1}{16}$	$7\frac{1}{2}$ $5\frac{1}{4}$
10	35	$\frac{1}{23}$	9 $7\frac{1}{2}$	$27\frac{1}{2}$	$\frac{1}{18.3}$	$10\frac{1}{2}$ $8\frac{1}{4}$	36	$\frac{1}{18}$	9 $7\frac{1}{2}$
12	40	$\frac{1}{26.6}$	$10\frac{1}{2}$ $8\frac{1}{4}$	33	$\frac{1}{22}$	12 $9\frac{3}{4}$	42	$\frac{1}{21}$	$10\frac{1}{2}$ $8\frac{1}{4}$
14	46	$\frac{1}{30}$	12 $9\frac{1}{2}$	36	$\frac{1}{24}$	14 11	48	$\frac{1}{24}$	12 $9\frac{1}{2}$
16	52	$\frac{1}{34.6}$	14 11	40	$\frac{1}{26.6}$	16 $13\frac{1}{2}$	53	$\frac{1}{26.5}$	14 11
18	$57\frac{1}{2}$	$\frac{1}{38}$	16 $12\frac{1}{2}$	45	$\frac{1}{30}$	18 15	59	$\frac{1}{29.5}$	16 $12\frac{1}{2}$
20	62	$\frac{1}{40.1}$	18 14	50	$\frac{1}{33.3}$	$20\frac{1}{2}$ 16	64	$\frac{1}{32}$	$18\frac{1}{2}$ $14\frac{1}{2}$

To obtain distance from the flange to focussing screen, add 3·25 in. for the first, 3·5 in. for the second, and 4 in. for the third compound systems described in this table.

Table showing Diameters of Circles of Illumination necessary to cover current sizes of plates.

Sizes of Plates.	Diameters.	Sizes of Plates.	Diameters.
$3\frac{1}{4} \times 3\frac{1}{4}$ ...	4·6	15 × 12 ...	19·1
$4\frac{1}{4} \times 3\frac{1}{4}$ ...	5·4	18 × 16 ...	24·1
5 × 4 ...	6·5	22 × 20 ...	29·1
$6\frac{1}{2} \times 4\frac{3}{4}$ ...	8	25 × 21 ...	32·7
$8\frac{1}{2} \times 6\frac{1}{2}$ ...	10·7	30 × 24 ...	38·5
10 × 8 ...	13	34 × 34 ...	48·1
12 × 10 ...	15·7		

COMPOUND TELE-PHOTOGRAPHIC LENSES.

(Protected Dec. 1891).

	£	s.	d.
Patent Stereographic Lens with No. 1 Negative attachment (mounted in aluminium), Fitting Flange, No. 4	10	0	0
1 B Patent Portrait Lens, with No. 2 Negative attachment, (mounted in aluminium), Fitting Flange, No. 5	15	0	0
2 B Patent Portrait Lens, with No. 3 Negative attachment, (mounted in aluminium), Fitting Flange, No. 7	22	10	0

PARTICULARS OF NEGATIVE ELEMENTS.

No.		Mounted in Aluminium. £ s. d.	Mounted in Brass. £ s. d.
1	..	Price 5 0 0	3 15 0
2	..	6 10 0	4 10 0
3	..	9 0 0	6 10 0

DESCRIPTION:—These lenses are in every way superior to the simple form, though necessarily more bulky, but mounted in aluminium are quite light. The negative attachment projects inside the camera, the flange of the lens being one size larger than that for the lenses to which the attachment is made respectively.

By the employment of the greater number of elements, greater excellence in the results is attained, and distortion is reduced to a minimum, or practically eliminated.

The compound negative element consists of two symmetrical lenses, in appearance somewhat like the Rapid Rectilinear, but of negative focus, the lenses being so constructed that they can be mounted in close proximity to one another, thus attaining the maximum angle.

The new negative combinations supplied to the above-mentioned lenses respectively, have been chosen to give a sufficiently valuable increase in size of image, consistant with adequate illumination. Negatives of shorter foci can similarly be supplied to these lenses, but at the expense both of illumination and angle included.

These negative lenses can be adapted to existing or new portrait lenses of J. H. D's Patent Portrait Type. The reason of supplying these negatives to the Patent Portrait Form is fully described in the pamphlet on Tele-photographic lens by T. R. Dallmeyer, published at 25, Newman Street.

The choice and use of Photographic Lenses by J. H. Dallmeyer, 1/-
The Tele-photographic Lens by T. R. Dallmeyer, illustrated, .. 1/-
Catalogues gratis.

J. H. DALLMEYER, Ltd.,

25, Newman Street, Oxford Street, London, W.

PREFACE.

In issuing this pamphlet I have collected and included such published matter as I thought likely to be of *assistance or interest to photographers* in employing the Tele-photographic Lens, the construction and manner of its use being entirely new to them. I believe almost every question that can be put is answered in either the papers or discussions here reprinted.

Although the first and "Simple" form of Tele-photographic Lens described in some of the earlier articles has been superseded by the more perfect "Compound" system, the general principles involved are the same in both, and by including the papers on the former, the ground is more fully covered.

Controversy on the subject has merely elicited the fact that telescopes have in a few isolated instances been used in the past for photographing distant objects, chiefly the sun. Instances of the employment of a negative lens, or amplifier, in photo-micography have also been cited as a parallel construction. The late Peter Barlow was the originator of the method of amplification by the introduction of a negative element, and he employed it in the Astronomical Telescope, the well-known "Barlow Lens."

I have however particularly directed my attention to the matter of special constructions in photographic lenses for the purpose in hand, (see "Photography Annual," 1892, page 167, article and resumé of references by Chapman Jones, F.I.C., F.C.S.) and introduced a principle that has never in the past been employed in photographic lens-construction.

Further, the fact remains, and speaks for itself, that prior to my publications, there has been no work published in any country by authorities on "Photographic Optics" that has contained any reference, directly or indirectly, to Tele-Photographic Lenses.

I desire to record the fact that it was at the request of my friend Dr. Emerson, to aid him in recording incidents in Ornithology and Natural History generally, that the first Telephoto lens was constructed.

THOMAS R. DALLMEYER.

25, Newman Street, W.
August, 1892.

CONTENTS.

PLATE 1.

ST. MORITZ, SHOWING THE MOUNTAIN, PIZ LANGUARD, 15 MILES DISTANT.
Reduced from whole plate negative, and taken with an ordinary R.R. Lens, 11 inches equivalent focus.
Negative kindly lent by the EARL OF CRAWFORD AND BALCARRES, F.R.S.

PLATE 2.

PIZ LANGUARD, FROM ST. MORITZ.

From a photograph taken and kindly lent by the EARL OF CRAWFORD AND BALCARRES, F.R.S. Taken with the Tele-Photo Lens at a distance of 15 miles, and showing that what appears in the ordinary photograph to be one peak is really two peaks with a glacier running between them.

A NEW LENS.

(Reprinted from the "Photographic News," October 16, 1891.)

In our leading article last week "On Photographing Distant Objects," we pointed out how, by aid of a telescope, the camera might be made to yield comparatively large images of things far removed from it, and we incidentally called attention to an instrument contrived by M. Jaret to fit on to the hood of the ordinary lens, which had been designed for this class of work. We also drew attention to the circumstance that a certain picture published in a French journal which purported to be the offspring of this instrument, bore distinct evidence that it had been executed by a camera in close proximity to the object photographed, and not from a distant point of view as stated. Since the publication of our remarks, we have learnt that one of our foremost opticians, Mr. T. R. Dallmeyer, has for some little time been devoting himself to the production of a lens which shall be capable of giving large images of distant objects, without any extraordinary increase of the distance between lens and focussing screen.

The production of such an instrument would, by most men, be regarded as next to impossible, for, as every tyro knows, a large image means that the object represented must be as near the lens as possible, and that the camera must be lengthened out often to its fullest extent. But Mr. Dallmeyer has acheived this apparently impossible feat, and we have had an opportunity of examining the lens itself, and certain negatives which have been produced by its aid. Of the lens we are not at liberty to say more than that it is of large aperture, and that it consists of a double combination. But we need be under no reserve with regard to its capabilities, so far as they are at present known. Paradoxical as it seems to be, this lens will give a greatly magnified image of an object which is much farther away from it than is the lens from the focussing screen. This was demonstrated to us in the clearest manner. A lamp flame at a distance of about nine feet from the lens was focussed on the ground glass screen, while the lens was about two feet from the screen, and the resulting image was double the size of the original. These measurements do not profess to be exact, but they are approximately right. Or, to put it in another way, the photographer has now at his command a lens which needs a camera but two feet in length, but which will, under such conditions, give an image of the same size as if he were using a lens of one hundred inches focal length. In all previous attempts in this direction, it has been the custom to get a primary image and then to magnify it, but in the case before us the primary and greatly enlarged image is itself projected on the focussing screen.

As we pointed out last week, the photographer who attempts to employ a telescope with his camera finds himself restricted to the portrayal of inanimate things, for the simple reason that the exposure is so greatly prolonged by loss of light. With the new lens which Mr. Dallmeyer has constructed the loss of light is by no means excessive. In one picture* which he showed us, which was taken with a long-extension camera held in the

*The original negative was presented, through Captain Abney, to the Historical Collection in the British Museum.

hand, is seen a rook just about to settle on a tree top. The distance from tree to camera was, we are told, one hundred yards, and the image of the bird, which is clearly defined, measures, roughly speaking, one inch from wing to wing. It is very clear that this new form of lens will open up possibilities to the photographer which before its introduction were denied to him. We have occasionally heard of a camera being carried by sportsmen whose delight it is to track wild beasts to their lair. One such picture, we remember, was exhibited not long ago. It represented a wounded tiger which its captor had photographed just after he had favoured it with a bullet. Another picture was shown us of a buffalo moving through the underwood, his horns being just visible above the high grass; but the image was so small that the picture had a resemblance to those pictorial puzzles in which one is invited to "find" the leading incident. In that case the puzzle was to find the horns, so that the picture was after all a mere curiosity, as being probably the first photograph of a living buffalo which had ever been made. With the new lens, pictures of wild animals will be possible without going near enough to scare them away, and, perhaps we should add, without the risk of being scared by models who would certainly decline to "look pleasant." The naturalist will also find in this new photographic lens a means of recording the habits and movements of many creatures whose natural timidity forbids a near approach to their haunts.

We alluded last week to the great value which such an instrument would have in military operations, and now that it is demonstrated that distant images of large size can be secured with short exposures, there is no reason why the navy should not participate in its use. Pictures of passing ships and snap-shots at distant shores may often prove of value in strange waters, while those who delight in taking photographs of "white wings" need not go to sea for the purpose, but can fire away at them comfortably from the shore. It need hardly be said that, like the telescope, the field of the instrument is a resiricted one, but this will by no means diminish its usefulness. It will probably supplant the telescope to a great extent among amateur users of that instrument; for it will be possible to see the images of objects on a screen, while, at the same time, those images may be made permanent. There is also some hope that the lens will help in the construction of a real "detective" camera. What we mean is that suspicious individuals can be photographed without any near approach to their persons, and from the cover of a house. We shall look forward to the promised publication of the means which Mr. Dallmeyer has adopted in the construction of this lens, which we think bids fair to be the most important contribution to the optical side of photography which has been presented for some time.

TELESCOPIC PHOTOGRAPHY WITHOUT A TELESCOPE.

(*Reprinted from the "British Journal of Photography,"* October 16, 1891).

The application of the telescope to a photographic camera for obtaining large views of distant objects has been known and practised for many years. The subject seems to be arresting attention on the Continent, if we may judge from some of our foreign contemporaries, one of whom, the other day, gave two illustrations of which one showed a distant scene, in which a statue in the tiniest of dimensions was to be seen; the other showing what purported to be that same statue, now large and full of detail, taken from the same spot. But, however this may go down with the uneducated public, it only requires the slightest examination by any one conversant with perspective to ascertain that the so-called enlarged or telescopic view of the statue has, in reality, been printed from a negative taken within a few feet of the object, and that it is not a telescopic photograph at all.

We have before us two genuine telescopic photographs, taken without a telescope, on which we shall make a few remarks. The readers of our issue of last week may have observed among the list of patents one by Mr. T. R. Dallmeyer for "Improvement in Photographic Lenses." Although we are not yet authorised to state particulars of the construction of the new lens, we may say that it is simply a double combination, which has the property of producing any size of image from the minimum—when the plate is almost in contact with the back lens—by simply placing the plate at any distance whatever further away.

In all constructions for the production of large images hitherto accomplished, the principle involved has been that of the formation first of a primary image, which has been subsequently enlarged, and herein lies the difference between the invention we refer to and former constructions. We have seen the instrument, and also some examples of its capabilities; one, an instantaneous photograph of a crow in mid-air, about to settle on the top of a tree over 100 yards distant, the crow itself measuring three-quarters of an inch from tip to tip of its wings; the other a direct photograph of the sun three-quarters of an inch in diameter, and in both cases the extension of the camera from the anterior lens to the focussing screen only measured two feet. The image given is that produced by the ordinary photographic lenses—viz., primary and inverted. The great feature of this construction, that has never before existed in a photographic lens, is that a considerable distance can exist between the image and the anterior lens, and a much smaller distance between this and the screen, still giving a *magnified* image of the object. Its various applications will, in all probability, suggest themselves to our readers, but we understand that the instrument itself will be fully described by its inventor in the course of a month or so.

We have frequently dwelt upon the advantages that would accrue from such a combination. It may at first suggest itself to some that, having with an ordinary lens obtained a sharp negative of a distant object, it might afterwards be magnified by the ordinary processes of enlargement. But to do this to the extent now under consideration would ensure the granulation of the image with other possible film defects making themselves apparent. Hence the advantage of having the magnification done in air.

ON PHOTOGRAPHING DISTANT OBJECTS.

(Reprinted from the "Optician," October 15, 1891.)

Under this heading, our contemporary, the "Photographic News," call attention to a method of obtaining enlarged images of distant objects by combining a telescope with a photographic lens.

In our last issue we noted an application for a patent, by Mr. T. R. Dallmeyer, for "Improvements in Photographic Lenses."

Although we are not authorised to state the particulars of construction of the new instrument, we may inform our readers that it is simply a double-combination photographic lens, producing a direct magnified image of a distant object. In all former constructions, large images could only be produced by the formation first of a primary image, which was subsequently enlarged.

The great feature of Mr. Dallmeyer's invention lies in the fact that a considerable distance can separate the object and front combination of the lens, and a large image be attained by a surprisingly small separation between this lens and the focussing screen.

We have seen the instrument, and specimens of work done by it, one being an instantaneous picture of a crow about to settle on the top of a tree, 100 yards distant, the bird measuring on the picture $\frac{3}{4}$ of an inch from tip to tip of his outspread wings. Another proof shown to us was a direct photograph of the sun, three quarters of an inch in diameter. In each case, the separation between front lens and focussing sceen did not exceed 2 feet.

These results speak for themselves, and will suggest to our readers various applications of the new lens. We will merely call attention to its use in Astronomy, for obtaining direct large images of the sun, moon, and planets; and in natural science, by enabling the observer to photograph animals or birds at such a distance that they will not be frightened, and of such dimensions as to be of practical utility. The value of the invention to the medical profession cannot be ignored, as enabling the stages of disease and cure of the eye and other organs to be portrayed in a manner that has hitherto been an impossibility, Altogether, we venture to predict that this invention, when made public, will create a profound sensation among scientists and others. It is, without doubt, the greatest achievement in modern optics.

A NEW TELESCOPIC PHOTOGRAPHIC LENS.

By Thomas R. Dallmeyer.

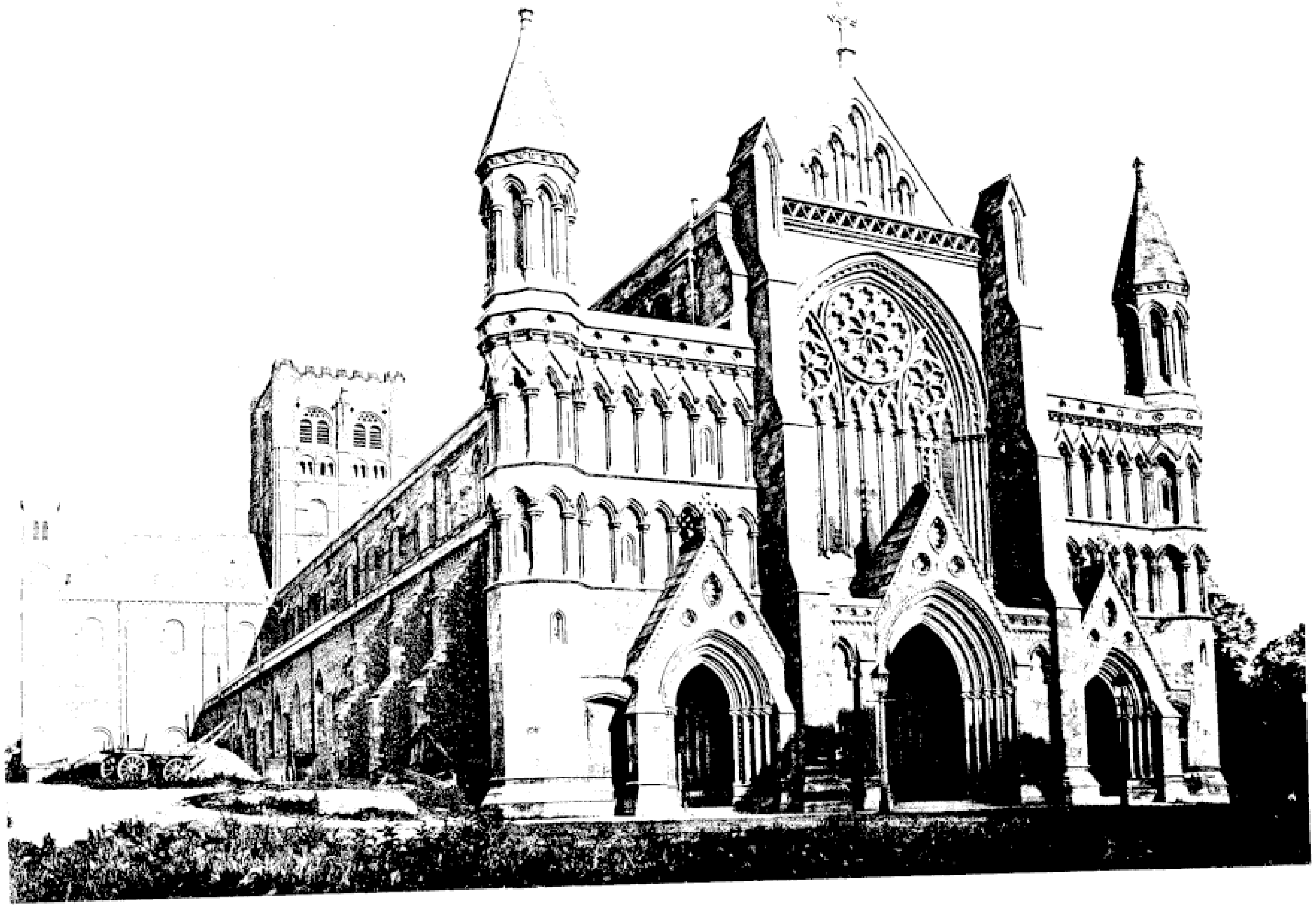
(Paper read on Thursday, December 10, Mr. Francis Cobb *in the Chair).*

(Reprinted from the "Camera Club Journal," January, 1892).

The object I have had in view, in the lens construction to which I invite your attention to-night, has been to produce large primary images, of sufficient brilliancy to be of practical value in rapid photography; there are also other advantages, to which I shall refer later on.

Hitherto only two methods of accomplishing the end in view have been employed, to produce large images: first the em-

PLATE 3.



ST. ALBAN'S ABBEY.

Taken with an ordinary wide-angle Lens of 8¼ in. focus, at the greatest distance possible, viz., 100 yards. This photograph serves to show the exaggerated and unsatisfactory perspective that occurs when the photograph is viewed at any other distance than that of the focal length of the lens. Negative kindly lent by J. TRIPPLIN, Esq.

ployment of very long focus positive ordinary lenses, and, second, the production of a primary image by one positive lens, and placing a secondary magnifier, or second positive lens, behind the plane of the primary image, which enlarges it more or less, according to its focal length, and its adjustment between the positions of the planes of the primary image, and that of the focussing screen, as in the photoheliograph, &c.

The first of the older methods has been seldom employed, except in Astronomical Photography, on account of its unwieldy dimensions, and the second method referred to is practically useless for ordinary photographic work, on account of the great loss of light involved, rendering the length of time necessary for proper exposures so great as to cause it to be almost prohibitive, except for inanimate objects.

The new lens, as you are already aware, is composed of only two elements, and the image given by it is primary and inverted. By the fact of the imagery being primary and inverted it looks, at first sight, anomalous that for equal extensions of camera, the image given by the new lens is several times larger than that given by an ordinary lens of hitherto known construction.

In comparing two lenses, no matter of what form of construction (when focussed upon a distant object), if the size of the image given by one is n times that given by the other, you are aware that the focus of the one is n times that of the other, provided, as before stated, the images compared are direct, primary, and inverted.

The focal length of a lens is measured, for practical purposes, by the distance between one of the principal planes passing through one of the nodal points of the lens towards the principal focal plane (where the image is received) and that plane.

In most lenses in existence the position of the principal plane referred to can be marked upon the lens-mount, and has already been suggested, first, I believe, by Mr. Warnerke, as an important addition to the measurement and description of lenses, as furnished by opticians. The most recent and important contribution, however, on this subject, was recently furnished by Professor Sylvanus Thompson in a very interesting paper, delivered on the 28th of November last, at the Society of Arts, and published in its Journal. In the case of the Rapid Rectilinear, for example, the nodal point referred to is not exactly at the diaphragm slot, but a little behind it; but in most lens-constructions in use the nodal point is within the mounting of the instrument.

In some, however, by the accidents of construction, it is slightly behind the lens, as, for example, in certain forms of deep Meniscus, and in others it is slightly in front or beyond the mount, as in Petzval's orthoscopic. I wish to call attention to the fact, that the object in introducing a negative element, in the Orthoscopic Lens referred to, was for the purpose of the cure of distortion, as its name signifies, although it was not perfectly accomplished, and the nodal point is thrown only slightly in front of the lens-mount, by the accident of construction. Mr. J. Traill Taylor has, I believe, already pointed out that this form of construction necessitated a slight enlargement of the image; but in his leading article in the *British Journal of Photography*, of the 16th of October, describing my new lens, he says: "We have frequently dwelt on the advantages that would accrue from such a construction."

Now, the main object of this invention has been to *purposely* throw the nodal point, from which the focus is actually measured, to any distance I choose in front of the lens itself into space, thus attaining a large direct image, without the necessity of a bulky and long extension apparatus. This, then is the principle of the construction, and I will now proceed to demonstrate the manner which it is arrived at, as also point out the possibilities that the construction permits of, qualities that have never existed in any former lens.

The anterior element is a positive lens, preferably of large aperture and short focus; the posterior lens is a negative element of some *fractional* portion of the focal length of the anterior positive lens (in Petzval's Orthoscopic it was more than twice the focus). Roughly, the shorter the focus of the posterior lens as compared with that of the anterior lens, the greater is the size (for a given extension of camera) of the enlarged primary image produced.

I have said that the anterior lens should be preferably of large aperture and short focus: it is self-evident, as in ordinary constructions, the larger the aperture the greater will be the rapidity; and the reason of its being preferably of short focus lies in the fact that the absolute distance between the planes of its own focus for parallel rays on the one hand, and a near object on the other, is, of course, less with a short focus lens than with a lens of long focus.

A similarity between this construction and the Galilean Telescope was referred to lately in a French paper, the *Photo Gazette*, by M. Wallon. This, as I pointed out to M. Wallon, of course, is not so absolutely, in that the rays emerging from the Galilean Telescope are divergent, and not convergent; but by a correct adjustment of the two elements composing the new lens, it *can* be employed as a Galilean Telescope, as I described to Mr. Traill Taylor, in the latter part of September.

Referring to the figure, if the negative lens B be placed at proper distances from the positive lens A, the rays can be made to emerge parallel, divergent or convergent.

For the purpose of forming an image for any given position of the focussing screen, they must be made convergent, producing a direct primary inverted image.

It is immaterial what position may be chosen for the plane upon which the image is to be received; it may be either in close proximity to the posterior lens, or removed to any distance whatever further away; but in order to focus, it is essential that a correct distance be given between the two elements of the lens itself; in other words, a correct adjustment of their separation, focussing always being most easily and sometimes necessarily accomplished in this manner (Fig. 1). For example, supposing the lens were focussed upon a very distant object—say the sun—with the focussing screen set at a given distance, it would be impossible by any adjustment whatever of the focussing screen to find a plane where the instrument would come to focus for very near objects (Fig. 2).

Fig. 1

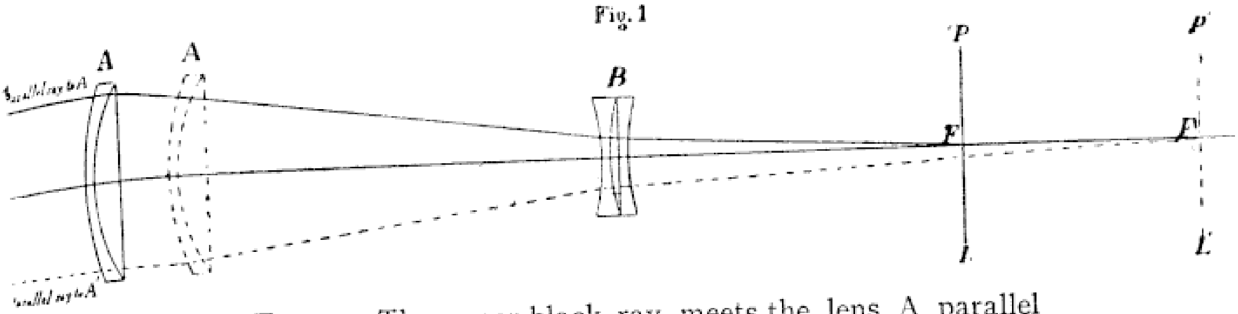


Fig. 1.—The upper black ray meets the lens A parallel to the axis, and by a proper adjustment between A and B, comes to focus at F upon the plate P L. If P L be removed further from the lens B to take the position P′ L′, the lens A will have to be moved slightly nearer to B and take the position A′.

The lower dotted line represents a parallel ray falling upon A′, which passes through the negative lens B, and coming to focus upon the new position of the plate P′ L′, at F′.

Fig. 2

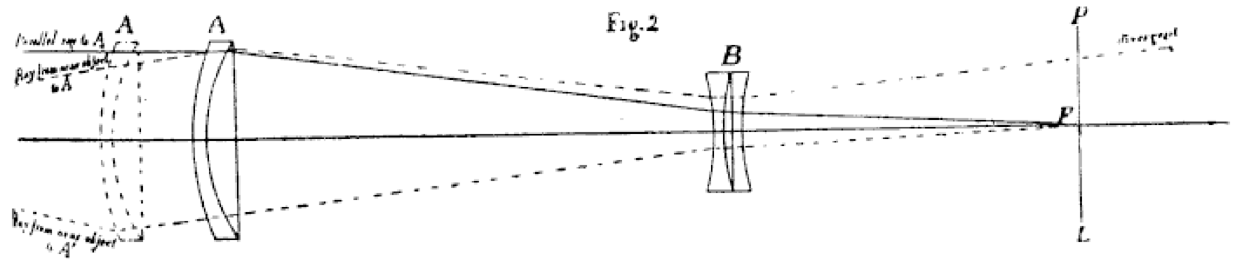


Fig. 2.—On the upper side of the axis a parallel ray to A finds its focus as in the dark line on the plate at F. If, however some ray from a near object falls upon the lens A in the direction of the dotted line, after passing through the lens B, is found divergent, and no positive focus is obtainable.

In the lower half of the figure, however, A is presumed to take a proper position in A′ when the ray from the near object passing through A′ and also through the negative lens B finds its focus upon the plate in the fixed position chosen, at F.

Near objects with the lenses in their former adjusted or fixed position would send the rays from such objects, after passing through the entire lens, divergent and not convergent.

On the other hand, if the separation were adjusted between the two elements for a near object, and it was then pointed towards a distant object, it would be found equally impossible to find any position for the focussing screen, in which the focus could be observed, except as before stated by an alteration between the separation of the component elements of the lens itself.

It is evident that the longer the focus of the positive element in the construction, the greater would have to be the separation between the two elements for near or distant planes.

In this construction there is then no limit to the size of the image that can be obtained, a slight adjustment in the separation of the two elements producing the correct focus on the screen, be it near or distant from the lens itself; but it must be borne in mind that the greater the separation between the plane of the focussing screen and the lens, the less is the rapidity that can be attained (Fig. 1).

I will now call your attention to the question of rapidity. Supposing the screen be placed at a distance of 10 inches from an ordinary lens, and a distant object focussed, say the lens has a focus for parallel rays of 12 inches, if the new lens be made to take its place, and the same object be focussed, it will be found that the image produced is five times larger with the new lens than with the ordinary one, you know then that you are practically, and to all intents and purposes, employing a lens of 60 inches focus!

The question naturally asked is, What will be the rapidity? The answer is, that you have to consider the front lens placed at distance of 60 inches from the the focussing screen; in other words, the nodal point is thrown forward outside the lens to a distance of 60 inches from the focussing screen (Fig. 3).

Fig. 3

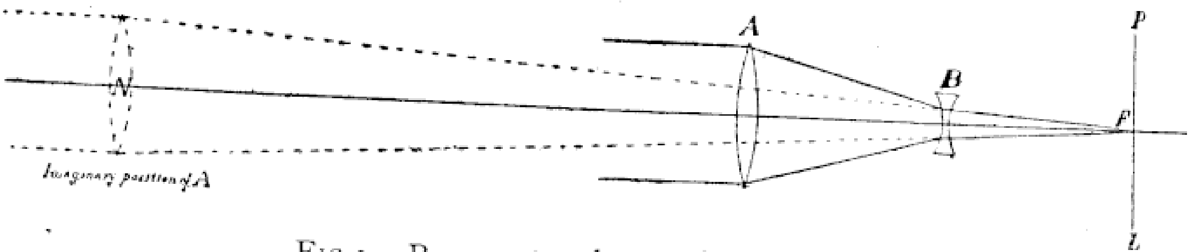


FIG 3.—Represents a beam of rays passing through the two component elements, A and B coming to focus upon the plate P L. To estimate the rapidity it is necessary to consider the full aperture placed at the principal focal plane passing through the nodal point at N; A is thus made to take up an imaginary position. The position of the nodal changes for different positions of the plate P L.

It is evident to you then that too much stress cannot be laid upon the desirability of large aperture for the anterior positive lens.

In the case cited, supposing the lens to be of 3 inches aperture, you would then be working at an intensity of *f*/20.

In employing this lens, conditions of light will naturally suggest whether it be advisable to employ moderate amplification by having the focussing screen near the lens, the nodal point being thrown moderately forward or whether the conditions are such as to have a considerable distance between the lens and the focussing screen, and thus throw the nodal point, by the focal adjustment, a long way in front of the lens.

I repeat again that the difference between this and former constructions lies in the fact that any focus that one may choose to employ can be obtained from the minimum (dependent upon the ratio between the foci of the elements), when the plate is close to the posterior lens, up to a maximum, controlled solely by the length of the camera extension possible.

As in the case of the telescope. the greater the magnification required, the less becomes the angle included, and there is very little difference with one and the same instrument in *the angle* included for moderate amplification or great amplification ; but of course, *more of the plate* is covered when it is removed further and further away from the posterior lens.

[The principle employed has a useful bearing on the subject of telescope construction, enabling very much higher powers to be employed on short telescopes.]

I shall feel indebted for any suggestions that may be made by you as to what may be advantageous for any particular applications you may have in view.

With regard to the Hand Camera, in which the back lens is, say 5 inches from the plate, what focus would you like such a construction to represent ?

Then, again, for covering larger plates, what is the minimum extension and minimum angle that will be required ?

Again, for the sportsman or naturalist, what is about the most convenient length and dimension of plate of Box Camera, to carry ?

It will doubtless be interesting to many to know that the applications of this lens to Astronomical Photography are easily accomplished, and, moreover, valuable I think.

The negative of the moon that is before you was taken with the first rough lens I completed, with an extension of only 28 inches. I look upon it more as an example of possibilities in size and rapidity of action than definition (that, as you see, I have subsequently attained), although as it is, it has been, I am pleased to say, favourably criticised by persons whose judgments I highly value.

In connection with this instrument, I should like to point out that the optical finish required is necessarily that of the finest polish bestowed upon astronomical work ; for, the greater the size of image chosen, the more are any slight optical defects exaggerated.

It is possible that the application of short focus concave lenses, such as myoptic spectacle eyes, in connection with rapid portrait lenses (that in themselves will form the positive elements), will suggest itself to your minds.

Uncorrected lenses in this application will, I may say, cause disappointment ; but I am engaged upon the construction of a properly corrected series of negative elements that may be employed in connection with rapid short focus portrait lenses, whose construction and correction I am responsible for, so that many who have practically placed their very rapid short-focus portrait lenses upon the shelf, will now find a new and interesting application for them.

In conclusion, I may say that I have endeavoured, in this new lens, to reduce the bulk, weight, and loss of light to a minimum ; and, while thanking you, Gentlemen, for the very kind hearing you have accorded me, I hope that you yourselves may perchance find the instrument as interesting in its various applications as its conception and construction have been to me.

Previous to reading his paper, Mr. Dallmeyer exhibited two sets of negatives of distant objects, taken from one and the same point of view, with a 10×8 rapid rectilinear lens of 13 inches focus, and the new lens, with the same extension of camera: One set shown represented a church a quarter of a mile distant, and another set representing the Alexandra Palace Station, the distance in this case being estimated at somewhat over a mile. In both instances the images produced by the new lens were five times (linear) greater than the corresponding images produced by the rapid rectilinear lens. Other negatives were also shown; the magnification and fine definition with the new lens was the subject of much comment and admiration by the members present.

To practically illustrate the properties of the instrument, Mr. Dallmeyer had placed two cameras at a distance of about 20 feet from a small oil lamp, on which were fixed respectively a 15-inch "long-focus landscape lens," and the new "tele-photographic lens." It was clearly demonstrated that with equal extensions of camera, the image of the flame on the ground-glass was five times greater in the case of the new lens than in that of the ordinary "long focus" lens; with a greater extension of camera for the new lens the image was very much larger.

In the course of the paper, lantern slides, representing sheep and horses, taken from 250 yards to ¼ mile off, were also shown. In the case of the sheep, comparision slides, taken from the same point of view, with a 15 × 12 rapid rectilinear of 20 inches focus, and the new lens, were shown, the effect of comparision being very striking. These transparencies represented instantaneous work in dull weather, but were very favourably commented on by the audience. A transparency from a negative of the October full moon was also much admired.

A COMPOUND TELE-PHOTOGRAPHIC LENS.

By Mr. T. R. Dallmeyer.

(Address given on Thursday, March 10, Mr. F. Machell Smith *in the Chair.)*

(Reprinted from the "Camera Club Journal," March, 1892.)

Last December I had the pleasure of bringing under your notice the first and simplest form of Tele-photographic Lens, consisting of only two combinations. I mentioned in that paper that the subject of adapting a negative system of lenses to rapid portrait combinations was occupying my attention, and it is to this work that I beg leave to invite your attention this evening.

The simple form with single (cemented) positive and negative elements is replaced in the Compound Lens by a complete Portrait Lens, taking the place of or becoming the positive element, and a negative symmetrical combination taking the place of or becoming the negative element.

In Fig 1, any form of aplanatic, single front P, by itself, can only define properly in the axis, so that it is necessary to ascribe a proper form to the negative element N, used in conjunction with the particular form of positive element chosen, in order to attain marginal definition.

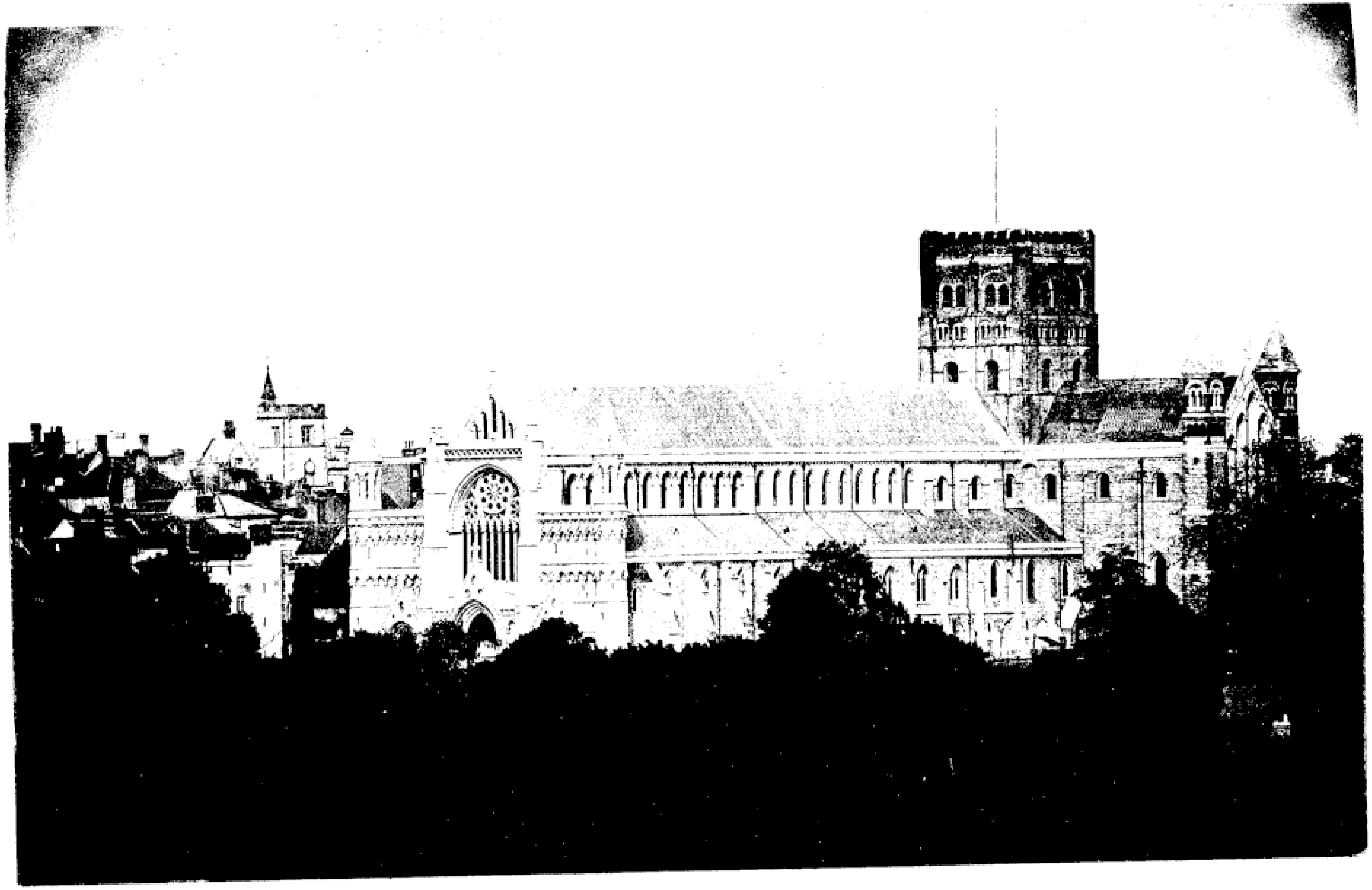
In the instrument that I have already introduced to you I have endeavoured to accomplish the best possible, consistent with the least expenditure of optical means. One of the main drawbacks to this simple form is that if the lens be strained to its ut-

PLATE 4.

ST. ALBAN'S ABBEY.

Taken at a distance of 1,400 yards (ordnance map measurement) with an ordinary View Lens of 20 in. focus.

PLATE 5.



ST. ALBAN'S ABBEY.

From the same point of view as Plate 4. Taken with the Tele-Photo Lens. Plates 4 and 5 are reduced from 12 × 10 untouched negatives taken by the Author, and in the original of this Plate the time is clearly shown on the clock tower (distant one mile), though quite indistinguishable by the naked eye.

most, or the lens be used upon a plate that it will only just cover, marginal (pincushion) distortion is too marked to be admissible, for architecture at any rate, and in this form of lens it cannot be eliminated.

Again, in an optical construction of this kind, in which the rays converge from the positive element on to the negative at such varying degrees of obliquity, if the system be aplanatic for one definite extension of camera, or again, one particular plane, the same system cannot be perfectly corrected for any other extension of camera, or when focussed for any other than the particular plane. To remove the outstanding aberration it would be necessary to employ a diaphragm, quickly reducing thereby both angle included and rapidity.

The object I have had in view in the compound lens before you has been to eliminate both these defects, and it is hardly to be wondered at that with so many more elements at one's disposal, that considerable improvements are possible.

Fig. 2 represents the compound form, the positive element being a complete portrait lens (of my late father's design), and the negative a "rapid rectilinear" of short negative focus.

Fig. 1

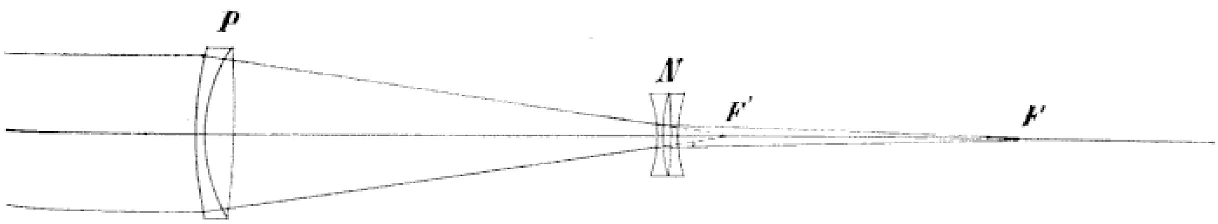
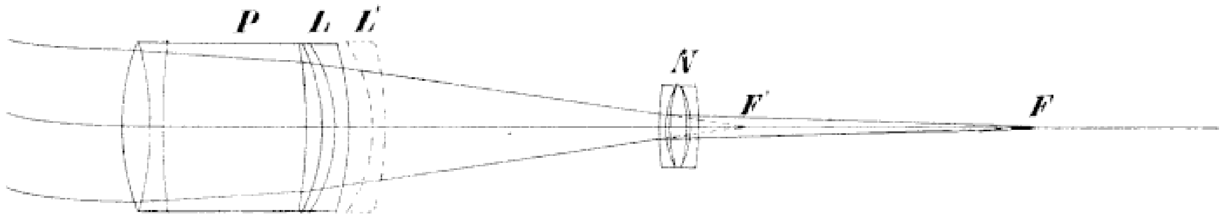


Fig. 2



The portrait combination must be rapid (of large aperture) and preferably of short focus, on the score of portability.

This is corrected to the best possible degree in itself throughout the field, and so again is the negative rectilinear. By this means you attain better quality of definition throughout the entire field, and, moreover, reduce distortion to a minimum.

I wish to state here that, in optical constructions generally, it does not necessarily follow that the best results are invariably attained from combining elements in such a manner that each portion of the entire system has its aberration reduced to a minimum in the component parts of that system. In several of the most interesting forms of compound lenses there exists in one part a very great amount of uncorrected aberration of one kind that is counterbalanced by aberration of an opposite nature in other parts of the lens-construction.

In the particular construction before you, however, it is necessary that each element shall be corrected as far as possible in itself; but, as before stated, as the rays coming from the positive element converge upon the negative element at such varying degrees of obliquity, it is essential, in order to attain perfect correction under the varying circumstances in which such a lens may be used, that some simple means be given to make it perfectly corrected under these varying conditions. In the compound system this means is given in employing the patent form of portrait lens, with adjustable separation in the components of the back combination. The entire lens system is corrected and without aberration (when the back lens L is screwed home) for a near object, and by slightly unscrewing this lens, as at L/, the whole lens system may be free from aberration for any plane up to parallel rays, the amount of unscrewing being in fact for these varying planes included by about one turn of the back cell.

This matter might strike one at first as being trivial, but it is not so, in that the only other means of eliminating this aberration is by the employment of diaphragms, which not only rapidly decrease the working intensity of the instrument, but also very materially affect the angle included, which is perhaps the more important consideration of the two.

There is another matter to which I should like again to call your attention, and that is the amount of magnification that can be attained. With one and the same instrument it can be increased by extra extension of camera, but another method is to employ negative combinations of shorter foci, whereby the lens represents, for equal extensions of camera, lenses of greater focal length than with "weaker" negative lenses. It must be borne in mind that with the more powerful negative lenses both angle and rapidity are sacrificed.

I have tried to make a generally useful instrument, including the greatest angle possible and rapidity consistent with a focus corresponding to four or five times that of an ordinary lens with the same camera extension, but it is a simple matter to either increase or decrease the corresponding focus of the system, increase of focus being attained at the sacrifice of both rapidity and angle included, and *vice versa*.

Some questions and discussion followed, and much interest was excited by the exhibition of some examples produced, with the use of Mr. Dallmeyer's lens, by Messrs. F. Mackenzie and Annan. These prints were representations of a building at 500 yards distance, and No. 1, done with the ordinary R.R. lens, 14// extension gave the house $\frac{3}{4}$ of an inch (linear measurement); No. 2, done with compound Tele-photo lens, 14// extension from flange (really 9// from back lens), gave the house as $2\frac{1}{2}$//, whilst No. 3, on a 15// × 12// plate (same subject), with 30// extension from back lens, gave the house as $6\frac{1}{8}$//.

Notwithstanding the great distance, the minute particulars and detail of the picture were very remarkable.*

MONTHLY TECHNICAL MEETING.

Mr. J. TRAILL TAYLOR, *in the Chair.*

(Reprinted from the Journal of the Photographic Society, April 30, 1892.)

Mr. T. R. DALLMEYER described the new form of his tele-photographic lens. He said he had already described, and the members would have seen in the photographic journals, the principle on which the new lens was constructed; but there were one or two points in connection with it to which he would like to call attention. The original form of the lens constructed had only a single front, corrected in itself and free from aberration, and, used in connection with the corrected single back, the instrument as a whole was also corrected for parallel rays. Any single corrected lens, for parallel rays would define in the centre, but in the eccentrical pencils the aberration was most pronounced. So that in this form of lens with a single front, it was necessary to give to the back lens used in conjunction with it, such a form that by the eccentrical pencils passing through it they were in themselves also corrected, and the best possible result obtained on the plane on which the image was received. A lens of this sort, with a powerful negative, unfortunately produced, when used to the full extent, a rather extreme form of pincushion distortion; and therefore if the whole plate was to be employed with such a lens for architectural purposes it had a drawback which could not be overcome whatever form be ascribed to it. Moreover, this form of lens had another drawback, viz., that if it be corrected for parallel rays it would be found that if some nearer object were focussed for, which would elongate the pencil of rays from the front combination, a different portion of the negative element was employed, and it was no longer aplanatic. To avoid this Mr. Dallmeyer had constructed the new lens to be aplanatic in itself, for a near object, but giving the means, when used for more distant objects of correcting that aberration by employing the portrait lens that was constructed originally by his late father. In this lens, if the negative—which was a symmetrical double combination, although of negative focus—were corrected for a near object, and the image given were aplanatic; if used for parallel rays would be found that considerable amount of negative spherical aberration was outstanding, and it was only necessary to slightly unscrew the posterior lens in its cell to counteract it, so that it was possible to employ the full aperture for a distant as well as for a near object without producing any aberration whatever. That was of great moment in the particular consideration, in that to be of any real practical value it was necessary to include at any rate some few degrees of angle. Of course 10 degrees might not always be necessary. In most achromatic telescopes, for example, with an object glass of intensity of 1 to 15 or 1 to 12 power, if a negative Barlow lens were used in conjunction with it, it would be understood that

*The most recent and striking example of Telephotography is a photograph of Mont Blanc taken from Geneva (by M. F. Boissonas) a distance of 70 kilomètres (44 miles) on a plate 14 × 9, giving great detail of rock strata and snow forms, and is shown in comparison with the same subject taken by an ordinary long-focus lens. This subject to half scale has just been reprinted in the "Photographic News."

in the length of such a tube, it would be impossible to include more than a degree or two, which was practically useless for any but astronomical work. Referring to the older form, which he represented only by a single and positive and negative lens, if a diaphragm were employed, the angle was very materially reduced and if the aberration were not corrected for the full aperture, not only would rapidity be lost by employing a diaphragm, but there would also be very considerable loss of angle. In an ordinary lens the angle was only slightly reduced by employing smaller stops, but in this lens the cutting down of the lens reduced the angle to a great extent. It was to be regretted that, in employing an opera glass they had not their eyes farther apart, or they would have a much greater field by employing object glasses of greater diameter. The eyes were limited to about $2\frac{6}{8}$ inches in separation, otherwise one might employ very much larger object glasses in an opera glass, but they were limited in that direction by the separation of the eyes. In the use of this type of telephoto lens it would be clear that by reducing the aperture the field was also reduced very much. Mr. Dallmeyer illustrated his remarks by diagrams on the blackboard, and having touched on the points of rapidity and aberration and field—which he said he considered the main items—he handed round three photographs by Mr. McKenzie, of Glasgow, to illustrate the powers of the new lens. The first was taken with an ordinary lens of 14-inch focus. The second was taken with a lens which was exhibited with an extension from the lens of 14 inches, which really meant from the back glass about 9 inches; and the same lens was also employed for the third and largest of the pictures, taken on a 15 by 12 plate at an extension of 30 inches. No details as to exposure had been sent by Mr. McKenzie, but with the lens used at greater extension of camera of course there would be considerably longer exposures.

The CHAIRMAN remarked that he had tried the lens and found that the exposure required was really wonderfully little.

Mr. DALLMEYER said with regard to the question of exposure, supposing an image one inch in measurement was obtained for a 10-inch lens; if the image on the plate were, say, 5 inches, it was practically equivalent to a 50-inch lens, with the same aperture in each case; so that it was easy enough after placing the screen at any particular distance to calculate what the relative rapidity would be in the two cases.

The CHAIRMAN said there was very little difficulty in estimating the exposure requisite by inspecting the image on the ground glass, and judging by experience. The exposure was wonderfully less than might be anticipated. It would be thought if there were an inch aperture, and the lens were adjusted to work, say, as the equivalent of 6 feet focus, that that was the ratio, but it was not.

Mr. DALLMEYER said the same aperture would be maintained with the difference of foci. One point about which he was frequently questioned was whether it was possible to obtain very much greater amplification with a shorter extension of camera. This was a simple matter. If instead of making the negative lens of comparatively shallow curves, it were made very much deeper, and of shorter focus, of course a very much greater degree of amplification could be obtained.

The CHAIRMAN said two things had been obtained. One was the application to the telescopic form of the existing portrait lens, preferably with the Dallmeyer back in contradistinction to Petzval back. The second was the compound symmetrical back lens instead of the old Galilean eye-piece. These were two important things that placed Mr. Dallmeyer's lens in the position of something quite new.

Mr. DALLMEYER was pleased that the Chairman saw the point. He would like to say that a *single* back used in conjunction with a portrait lens would really be of little use, because the eccentrical pencils could not be corrected by a single back at all adequately.

The CHAIRMAN thought it was a good, sound, effective instrument.

Mr. CHAPMAN JONES asked whether the exposure was not simply proportional to the area of the image?

Mr. DALLMEYER said that was practically what it came to.

The CHAIRMAN, addressing Mr. A. Cowan, said, referring to the picture by Mr. McKenzie of Glasgow, supposing it had been taken with a short focus camera and an ordinary lens—reasonably sharp of course—and enlarged up to the size of the large picture shown by Mr. Dallmeyer; what would be the difference as regarded definition?

Mr. A. COWAN said it would not be so good.

Mr. DALLMEYER agreed, and said that was the test of the value of the principle of its construction. If an enlargement could be made equally good there would be no use for the instrument. In some examples which he had exhibited elsewhere the negatives shewed results which certainly could not be seen with the eye, and moreover could not be discerned with an opera glass. One was a photograph of Alexandra Palace Railway Station, taken at a distance of nearly a mile, and the words "Alexandra Palace" could be read on the negative, but they could not be seen with an opera glass, so that there was no doubt about the advantage accruing from direct work. He said he would be prepared to supply the new negative lens to any of the patent lenses, and explained the method of adaptation.

The CHAIRMAN asked Mr. W. England whether from his experience of photographing in Switzerland he thought such a lens as that described would be a useful addition to the *impedimenta?*

Mr. W. ENGLAND did not think it would be necessary to enlarge the views to such an extent.

Mr. DALLMEYER explained that any enlargement might be obtained—1½, or 2, or 3, or 10—as much as was desired. It all depended on the extension of the camera. The camera screen could be placed not at one fixed distance, but anywhere, and then the rack and pinion on the lens used to focus.

The CHAIRMAN said the function of the rack and pinion was to determine the enlargement. After determining the extension, if the view was not quite big enough the screen could be moved further back and the object focussed again.

Mr. DALLMEYER explained that pictures of any size could be obtained with the same lens.

The CHAIRMAN asked whether it could be adapted to the rapid rectilinear form of lenses ?

Mr. DALLMEYER said not favourably, the focus would be too long. It was only really adapted to the portrait form. There would be no angle if adapted to lens 1 to 8. Really 1 to 3 was the best possible. It was possible to get about 10 degrees with moderate amplification and rapidity. Greater amplification could be obtained, as already explained, but the angle included and rapidity both became less.

Mr. ENGLAND asked whether the lens could be stopped down to any extent ?

Mr. DALLMEYER said it could be stopped down, but then the field was lost, and that was the advantage of using the patent back. If the aperture was cut down it was like making the lens a slow lens, that is to say, a small aperture to a long focus. With small apertures less angle could be secured. What was necessary was to maintain the full aperture in every case, and maintain the full angle. The size of large lens would cover any plate, with sufficient extension of camera.

A vote of thanks was accorded to Mr. Dallmeyer for his lucid explanation of what was, the Chairman said, a very important addition to their resources.

DALLMEYER'S TELE-PHOTOGRAPHIC LENS.

BY W. E. DEBENHAM.

(Reprinted from the "Photographic Work," June 10, 1892.)

This lens will probably cause more surprise from its characteristic being so unlike other lenses that have previously been commercially introduced, than the anastigmats already described. It strikes the photographer as very remarkable to see, with a camera of (say) 15 inches extension, an image of a size that requires a lens having a focal length of three or four times that amount. The general construction of the lens is analogous to the Galilean telescope, but there are differences such as make it more suitable to ordinary photographic use. The positive lens *may* be almost any ordinary photographic objective, but that which is adopted as most convenient is the well-known 2B with the "diffusion" or re-introduction of spherical aberration arrangement, obtained by unscrewing the back lens. The object in the present instance is not to introduce, but to more perfectly eliminate, the spherical aberration which the special supplementary lens in certain positions would make evident.

This special supplementary lens is a negative one having the external surfaces slightly convex. It is placed in a tube which is attached to the flange of the positive lens, and *not* to the lens tube itself. This is important, as it allows the distance between the positive and the negative supplementary lens to be varied, and by varying the distance, images of greater or less magnitude are obtained. As a matter convenience, the whole system is not moved together in focussing, but the camera is drawn out as much as is thought to be required, and then the positive lens is focussed by its own rack-and-pinion, whilst the negative lens remains unmoved.

Another reason for selecting a portrait combination as the positive lens is, that it is necessary, in order to include a moderate angle of field, that the front lens should be large, and not at a great distance from the negative lens. If the negative lens is so placed as only slightly to enlarge the image, the field will be seen to be very much cut down. A slight degree of enlargement, such as supposed, is not, however, the object of the lens, but its utility comes in when a considerable degree of enlargement is desired, say to get an image of two or three times the size that would be possible with a given extension of camera and an ordinary lens. Objects which, from their distance, come smaller than is desired, and which it is wished to photograph so as to fill the picture, are the special subjects for this instrument.

The focal field of the lens is somewhat curved in the contrary direction to that obtaining lenses generally ; that is to say, it is convex towards the lens. This peculiarity tends to better definition all over when the subject—as with a building viewed at an angle, and in many other cases—is, about its centre, in a nearer plane than towards the margin.

Photographs taken with a long focussed lens, and examined at a distance less than that of the focus of the lens, exhibit the one case dependent on the defining power of the lens when it is possible that more detail can be seen in the photograph than in the object itself. It is not found, however, that there is anything to object to in this fact, but the contrary. We sometimes take an opera glass to see distant objects more clearly, and find pleasure in doing so. The tele-photo lens is a step in the same direction. It is well to recognise that with this, as with a powerful telescope lens, a very slight tremor shows badly, and it is desirable to have the camera and stand very rigid, and to guard against even a slight amount of wind.

A THEORETICAL CONSIDERATION BEARING ON THE PRACTICAL UTILITY OF THE TELE-PHOTOGRAPHIC LENS.

BY T. R. DALLMEYER, F.R.A.S.

(Reprinted from the "Photographic Work," July 8, 1892.)

After the meeting of the London and Provincial Association at which I was invited to explain this type of lens, the Editor of PHOTOGRAPHIC WORK asked me for a short explanatory article in connection with the introduction and cure of aberration under varying conditions of incident rays on lens systems. This I will try to do in as simple language as possible.

The cue to the whole reasoning may be gathered from the fact that, although the well-known 'crossed lens,' whose radii are as 1 : 6 (when made from a glass whose refractive index is 1·5), is the best possible form to ascribe to a lens for *parallel* incident rays, the "crossed lens" would not be the best form if, say, the conjugate foci were to be equidistant from the lens, for in this case (and for glass of all refractive indices) the least aberration would be produced by an equi-convex lens.

In constructing a negative aplanatic compound to be used in conjunction with portrait lenses, it was necessary to bear in mind that the conditions of incidence on the negative system would vary very considerably for two causes: First, the variation arising from the chosen plane of image, or the distance of the screen from the negative for any fixed object; and, secondly, the variation in the incidences on the negative system for a fixed distance of focal plane with objects at varying distances. It became evident that in order to attain freedom from outstanding aberration in all conditions of use, one or other of the combined positive and negative systems must be provided with some easily variable corrector.

It is generally known that if a lens be corrected for strictly parallel rays, that if it be focussed upon a near object, that negative spherical aberration is visible, and becomes more easily noticeable the greater the focal length of the system. (Compare the corrections of an astronomical telescope when focussed on a star and a near test object.)

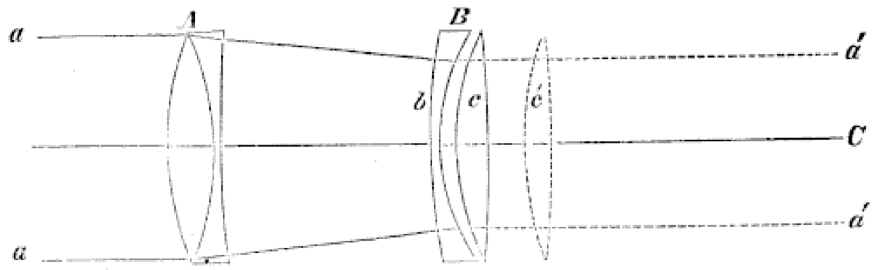
Now the tele-photographic lens has as its equivalent (in a short compass) a lens of long focus, the equivalent length of this focus becoming greater the higher the power of the negative system (or the shorter its focal length) employed with a positive system of given focal length. Here, then, an analogy is to be expected to the corrections observable in astronomical object glasses, but, as a matter of fact, the alterations in the corrections are reversed. That is to say, if the tele-photographic lens were corrected for parallel rays for a particular extension of camera, any nearer plane would be accompanied by *positive* spherical aberration. Further, if the extension of camera for a particular object be considerable, and the entire compound lens system be here free from any outstanding aberration, it will be found that if the plate be placed closer to the lens, *positive* spherical aberration again will be thus introduced. Now as there is tendency to introduce *positive* spherical aberration, both for a *close* contact with plate and also for the *near approach* of object, I determined to construct the negative system free from aberration when the compound instrument is focussed for a near object (say, for equal magnification), and the shortest extension of camera likely to be employed (say to cover the quarter-plate). Thus, any object more distant, or any greater extension of camera, would continually tend (in whatever degree employed) to introduce *negative* spherical aberration, and to cure this, one must have the means at command of gradually introducing, to the degree required, a counterbalancing amount of *positive* spherical aberration to present the image distinct and free from aberration through all planes up to parallel rays.

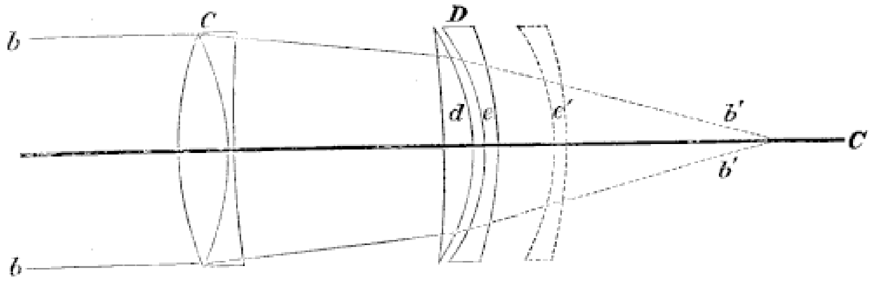
In my late father's patented form of portrait lens, this power is given by slightly removing the back flint from the adjacent back crown, although the power there obtained was for the intentional purpose of departing from fine definition over one plane (when used intact) to a more general *softness* (by unscrewing the the back flint) when used for portraiture, if desired. (Fig. 2).

In the compound tele-photographic lens I have utilised the same possibility of introducing this aberration for an opposite purpose—viz., to obtain sharpness through every plane that may be focussed for.

The work of tele-photography is identical in purpose with that of telescopy, and the utmost sharpness is the desideratum. Next in importance to sharpness is *aperture*; that, in tele-photography, means not only rapidity, but the angle included; and, as I have pointed out in former papers, the only other way in a tele-photographic lens to cure it of aberration for varying distances of the plane focussed for, is by the use of the diaphragm, that is very detrimental to both rapidity and angle included.

To make the matter, perhaps, still more intelligible, in fig. 1, the rays that leave the third glass of the Petzval portrait lens (B flint) emerge practically parallel, and are taken up by the fourth (C crown) in the compound system to form the positive image.





In the portrait lens employed in the compound tele-photographic lens, herein referred to as the positive system, fig. 2, the rays are strongly convergent from the third (D crown) glass, and are corrected and brought to a proper focus by the fourth (E flint) to form a positive image.

It is clear that separating the elements (the third and fourth glasses) of the back combination of Petzval's combination can have no effect on outstanding aberration, and with this form of portrait lens as the positive system the entire compound system would not supply the means of correction required. In my late father's form, however, by separating the flint (fourth) from the crown (third), it may be said, in popular language, that the converging beam from the crown uses less diameter of the flint, and the system is therefore under-corrected for spherical aberration, and positive spherical aberration is introduced according to the amount of unscrewing employed.

Now, carry the same popular reasoning to the entire compound system :—For a near object, the positive system is further removed from the negative system (by the law of conjugate foci) than is the case for parallel rays. In the latter case, *more* again of the system may be said to be employed than in the former, and hence, to make it equably aplanatic for the distant object, we must not now allow the adjustable (negative) back lens in the positive system (or portrait lens) to have so much power, and therefore unscrew it or slightly separate it from its adjacent crown, and introduce an amount of positive spherical aberration necessary to counterbalance the greater negative spherical aberration influence we have obtained from the negative system in the entire compound lens. A similar argument applies to the conditions of the plane of the plate being near or more distant from the entire lens.

As a matter of fact, about one entire revolution of the back cell of the portrait lens will make the corrections necessary for the entire compound system to be free from outstanding aberration, for a near object up to parallel rays. At the meeting referred to, a sound argument was made in reference to the choice of solid cameras in windy weather when using the tele-photographic lens, for you practically have hold of the short end of the lever, and small tremor is of much more moment than in employing an ordinary lens requiring the same extension of camera. As to what has been said with regard to definition obtainable in the climate of this country, I have publicly proved that by tele-photography one can see more, whatever the conditions of atmosphere, by the use of the tele-photographic lens, than can be got from ordinary negatives taken under identical conditions, and subsequently enlarged to the same dimensions of image. This is particularly noticeable when one sees on a negative made by the tele-photographic lens what could certainly not be seen by the eye, under identical, or even more favourable conditions of atmosphere. Naturally, if there is time to *choose* atmospheric conditions, the clearer the air the better.

PLATE 6.

Both pictures are taken from the same standpoint. In the smaller, the cattle are at a distance of 200 yards and are taken with a Lens of 20 in. focus. In the larger picture the cattle are at a distance of 300 yards, atmosphere hazy, but cattle and part of field illuminated by a passing gleam of sunlight. This, the larger photo, serves to show the truer rendering of distance obtainable by the Tele-Photo Lens, as against the dwarfed appearance shown in the smaller picture.

GENERAL INSTRUCTIONS FOR USING THE TELE-PHOTOGRAPHIC LENS.

1 Determine the size of plate intended to be covered.

2 Consult table following; in the columns "Circle of Illumination at full aperture" find (in the small figures underneath) the size of plate decided upon.

3 In a horizontal line with this (in the first column) will be found the "Distance of the Focussing Screen from the back lens." The extra distance from the flange is given by a reference to to the foot-note.

4 Focus very carefully by means of the Rack and Pinion on the *lens* mount.

5 If a smaller stop than full aperture be used, a somewhat greater extension is necessary; so that it is best to set the screen at a rather greater extension than is necessary for covering the plate at full aperture. The reduction in angle included, for smallest stop, is also given in the foot-note.

The focussing screen itself will readily show whether the plate be covered whatever stop be used. Longer extension of camera covers larger size of plate.

6 When the extension of camera has been determined, reference to the table will show (1) the corresponding focus and (2) the intensity at full aperture.

7 Knowing the intensity at full aperture (and hence the requisite exposure, according to the rapidity of the plate used) the notation adopted for the smaller apertures is so arranged that counting from the largest (full aperture) each succeeding smaller diaphragm or iris aperture, requires double the exposure of the one before. Seven apertures are given and the relative exposures for each in succession are therefore 1, 2, 4, 8, 16, 32, 64, whatever extension of camera be employed.

8 The three particular *examples* referred to in the table following by no means define the limits of the construction. They indicate a useful mean as regards power, intensity, and angle included. By lessening the power, intensity and angle are increased, this being attained by the employment of weaker (or longer foci) negatives. By increasing the power, the reverse takes place.

THE TELE-PHOTOGRAPHIC LENS.

BY T. R. DALLMEYER.

At able included in a communication to the London and Provincial Photographic Association, June 2nd, 1892.

Angles Included, Corresponding Foci, and Camera Extension.

Distances of Focussing Screen from Compound Negatives or Back Foci (1).	No. 1. Angle included is 3 practically constant, at full aperture equals 11°. (2)			No. 2. Angle included is 3⅕ practically constant, at full aperture equals 12°. (2)			No. 3. Angle included is 2⅔ practically constant, at full aperture equals 9°. (2)		
	Corresponding Foci.	Intensity at Full Aperture.	Circle of Illumination at Full Aperture.	Corresponding Foci.	Intensity at Full Aperture.	Circle of Illumination at Full Aperture.	Corresponding Foci.	Intensity at Full Aperture.	Circle of Illumination at Full Aperture.
Inches.									
4	17½	1/11	3½	20	1/10	4¼			
5	21	1/13	4½	22½	1/11	4¾ 3¼×3¼			
6	24	1/15	5¼ 3¼×3¼	25	1/12.5	5¾ 4¼×3¼	34	1/12.4	5½ 4¼×3¼
8	30	1/19	6¾ 5×4	31½	1/16	7½ 5×4	42½	1/15	7 5×4
10	36	1/22	8¼ 6½×4¾	37	1/18.5	9¼ 6½×4¾	47½	1/17	8½ 6½×4¾
12	42	1/26	10	45	1/22.5	11 8½×6½	56½	1/20	10
14	48	1/30	11¾ 8½×6½	50	1/25	12¾	63	1/23	11¾ 8½×6½
16	54	1/33	13½ 10×8	57	1/28.5	14½ 10×8	71	1/26	13½ 10×8
18	60	1/37.5	15	62½	1/32	16¼ 12×10	78	1/28	15
20				69	1/35	18 13×11	85	1/30	16½ 12×10
22				76	1/38	19¾ 15×12	92	1/33	18 13×11
24				84	1/42	21¼	100	1/36	20 15×12
26							106	1/38	22¼
28							114	1/40	24¾ 18×16
30							124	1/45	27
40							157½	1/60	42 30×24

No. 1 tele-photographic lens consists of the patent stereo graphic (1·6 inches diameter) in conjunction with a compound negative $\frac{6}{10}$ of an inch diameter.

No. 2 tele-photographic lens consists of the 1B patent portrait (2 inches diameter) in conjunction with a compound negative $\frac{8}{10}$ of an inch diameter.

No. 3 tele-photographic lens consists of the 2B patent portrait ($2\frac{3}{4}$ inches diameter) in conjunction with a compound negative 1 inch diameter.

(1) To obtain the distances from the *flange* to the focussing screen, add $3\frac{1}{4}$, 4, and 6 inches for Nos. 1, 2, and 3 respectively.

(2) The angle included is a constant for *one* aperture for any distance of focussing screen, but it diminishes as smaller diaphragms are employed.

The iris diaphragm is so arranged that for any initial extension (and corresponding intensity) each succeeding smaller aperture requires double the exposure of the next larger.

There are seven apertures, ranging from full aperture to the *smallest*, which requires sixty-four times the exposure required for full aperture.

The smallest aperture reduces the angles included at full aperture in Nos. 1, 2, and 3 to $8\frac{1}{2}°$, $9°$, and $6\frac{1}{2}°$ respectively.

An additional Table showing the effect of employing weaker negatives with No. 1 and No. 2 positive systems described in the former table.

	No. 1 Positive with No. 2 Negative. Angle included at full aperture = 13° with smallest stop = 11°			No. 1 Positive with No. 3 Negative. Angle included at full aperture = 19° with smallest stop = 16°			No. 2 Positive with No 3 Negative. Angle included at full aperture = 14° with smallest stop = 10°		
Distance of focussing screen from back lens.	Corresponding foci.	Initial Intensity.	Diam. of circles of illumination with full aperture and smallest stop.	Corresponding foci.	Initial Intensity.	Diam. of circles of illumination with full aperture and smallest stop.	Corresponding foci.	Initial intensity.	Diam. of circles of illumination with full aperture and smallest stop.
6	25	$\frac{1}{16.6}$	6 4	19	$\frac{1}{12.6}$	7 $4\frac{1}{2}$	26	$\frac{1}{13}$	$6\frac{1}{2}$ $4\frac{1}{4}$
8	31	$\frac{1}{20}$	$7\frac{1}{2}$ 5	23	$\frac{1}{15.3}$	9 $6\frac{1}{2}$	32	$\frac{1}{16}$	$7\frac{1}{2}$ $5\frac{1}{4}$
10	35	$\frac{1}{23}$	9 $7\frac{1}{2}$	$27\frac{1}{2}$	$\frac{1}{18.3}$	$10\frac{1}{2}$ $8\frac{1}{4}$	36	$\frac{1}{18}$	9 $7\frac{1}{2}$
12	40	$\frac{1}{26.6}$	$10\frac{1}{2}$ $8\frac{1}{4}$	33	$\frac{1}{22}$	12 $9\frac{3}{4}$	42	$\frac{1}{21}$	$10\frac{1}{2}$ $8\frac{1}{4}$
14	46	$\frac{1}{30}$	12 $9\frac{1}{2}$	36	$\frac{1}{24}$	14 11	48	$\frac{1}{24}$	12 $9\frac{1}{2}$
16	52	$\frac{1}{34.6}$	14 11	40	$\frac{1}{26.6}$	16 $13\frac{1}{2}$	53	$\frac{1}{26.5}$	14 11
18	$57\frac{1}{2}$	$\frac{1}{38}$	16 $12\frac{1}{2}$	45	$\frac{1}{30}$	18 15	59	$\frac{1}{29.5}$	16 $12\frac{1}{2}$
20	62	$\frac{1}{40.1}$	18 14	50	$\frac{1}{33.3}$	$20\frac{1}{2}$ 16	64	$\frac{1}{32}$	$18\frac{1}{2}$ $14\frac{1}{2}$

To obtain distance from the flange to focussing screen, add 3·25 in. for the first, 3·5 in. for the second, and 4 in. for the third compound systems described in this table.

Table showing Diameters of Circles of Illumination necessary to cover current sizes of plates.

Sizes of Plates.	Diameters.
$3\frac{1}{4} \times 3\frac{1}{4}$	4·6
$4\frac{1}{4} \times 3\frac{1}{4}$	5·4
5×4	6·5
$6\frac{1}{2} \times 4\frac{3}{4}$	8
$8\frac{1}{2} \times 6\frac{1}{2}$	10·7
10×8	13
12×10	15·7
15×12	19·1
18×16	24·1
22×20	29·1
25×21	32·7
30×24	38·5
34×34	48·1