SEI

Exposure Photometer

Manufactured by SALFORD ELECTRICAL INSTRUMENTS LTD
Distributed by ILFORD LIMITED · ILFORD · ESSEX

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Exposure Photometer

A precision instrument for the determination of exposures in general photography, reversal processes, copying and enlarging, and for the accurate measurement of transmission and reflection densities, brightness and illumination levels and other factors of interest to illuminating engineers

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As efforts are constantly made to improve both designs and methods of manufacture, apparatus supplied may differ in details from the illustrations.

Contents

Introduction

The S.E.I. Photometer is the first commercial and practical instrument to be sold to the public which gives scientifically correct answers to the exposure problem. It is also the first exposure meter which allows full advantage to be taken of the fundamental approach upon which is based the new 'Exposure Index' Specification of the British Standards Institution No. 1380-1947, and its American counterpart A.S.A. Specification Z38.2.1 - 1947.

It is based on the Dunn and Plant 'Photometric Exposure Meter'—first described to the Royal Photographic Society in 1945 (*Photographic Journal*, **85B**, 114-119, Nov.-Dec. 1945).

The main attribute of the *S.E.I. Photometer* is its ability to measure selectively the brightness of very small areas at a distance over a great brightness range. It is thus not only applicable to the precision exposure determination of the most 'difficult' of photographic subjects but also to the solution of many problems in illuminating engineering.

The instrument contains its own comparison lamp which is set by the user to illuminate an internal comparison surface at a predetermined brightness level, the photoelectric cell and microammeter necessary for this self-calibrating feature also being contained within the body of the photometer.

For the illuminating engineer the instrument allows of the direct measurement of *brightness* (in foot-lamberts) and incident *illumination* (in foot-candles).

For the photographer the *S.E.I Photometer* measures with precision the brightness of a small area in the subject from the camera position and thus can measure the brightness range of the subject. By eliminating guesswork it enables the photographer to predict with certainty the character of his negatives. It has many other photographic uses, e.g. in projection printing, densitometry, etc.

For normal photographic work the subject is viewed through the telescope of the instrument and a small spot in the middle of the field of view is made to coincide with that part of the scene the brightness value of which is required. The photometric setting is then made by causing the brightness of the spot to match that of the selected area. The instrument possesses two outstanding advantages over most photographic exposure meters: it can be used to measure the brightness of very small areas in the scene, the spot in the field of view subtending an angle of only $\frac{1}{2}°$, and the range of brightness which may be measured is a million to one, accommodating dark surfaces in interiors and brilliantly lighted skies.

The *S.E.I. Photometer* is simple to use and has been made so as to reduce maintenance to a minimum. In order to become familiar with the instrument the following working instructions should be studied with care, preferably with the photometer at hand.

SEI

Exposure Photometer

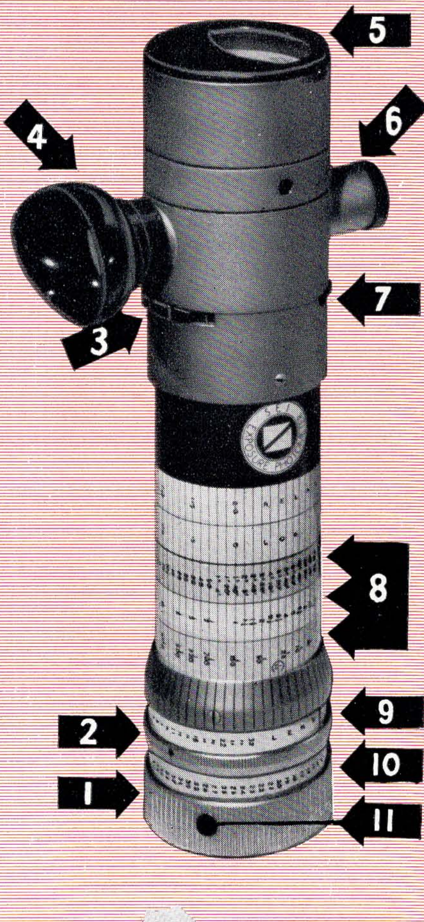
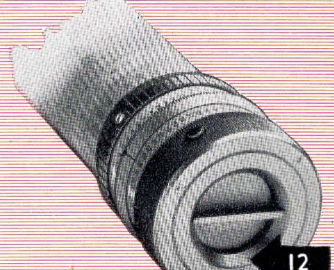


Fig. 1

KEY TO ILLUSTRATIONS

1. Operating ring
2. Setting ring for shadow or key-tone methods
3. Daylight or artificial light setting
4. Adjustable telescope eyepiece
5. Microammeter for standardising comparison lamp intensity
6. Telescope objective
7. Brightness range selector
8. Exposure time scales
9. Lens aperture scale
10. Film speed scale
11. Push button switch
12. Rheostat control



Working instructions
for estimating
camera exposures

Note: The instrument is supplied without a battery. Instructions for making it ready for use are given on page 13 under General Instructions.

TO DETERMINE CAMERA EXPOSURES FOR MAKING NEGATIVES IN GENERAL PHOTOGRAPHY.—See Fig. 1

1. Set the speed scale. For ordinary black and white *negative*-making set the *black* index mark on the narrow knurled ring (2) opposite the appropriate number on the speed scale (10). The meter is graduated in British Standard Logarithmic Exposure Indices. An appropriate allowance must be made for any factor known to reduce the effective film speed ; e.g. the use of certain fine grain developers, a shorter development time than that normally recommended, stale film, working by artificial light, etc. The following conversion table will enable the appropriate exposure index to be approximately derived from other speed systems:—

Working conversion table between speed systems.

Relative Speed	Ilford Group	B.S.I. Ilford Scheiner	American Scheiner	DIN/10	British H & D	A.S.A. G.E. Weston	Wellcome*
1	A	16° 17° 18°	11° 12° 13°	6° 7° 8°	80 100 125	3 4 5	2/3 1/2 —
2	B	19° 20° 21°	14° 15° 16°	9° 10° 11°	160 200 250	6 8 10	1/3 1/4 —
4	C	22° 23° 24°	17° 18° 19°	12° 13° 14°	320 400 500	12 16 20	1/6 1/8 —
8	D	25° 26° 27°	20° 21° 22°	15° 16° 17°	640 800 1000	25 32 40	1/12 1/16 —
16	E	28° 29° 30°	23° 24° 25°	18° 19° 20°	1250 1600 2000	50 64 80	1/24 1/32 —
32	F	31° 32° 33°	26° 27° 28°	21° 22° 23°	2500 3200 4000	100 125 160	1/48 1/64 —
64	G	34° 35° 36°	29° 30° 31°	24° 25° 26°	5000 6400 8000	200 250 320	1/96 1/128 —
128	H	37° 38° 39°	32° 33° 34°	27° 28° 29°	10000 12500 16000	400 500 650	1/192 1/256 —

*Exposure factors as used in Wellcome Calculators prior to 1950.

2. Standardise the lamp intensity. Press the black switch button (11) in the broad knurled ring (1) at the bottom of the instrument. Note the position taken by the pointer of the microammeter (5) at the top. Make the pointer coincide with the standard mark by turning the recessed rheostat control (12), which will be found at the lower end of the barrel of the instrument. Release the switch button after standardising.

It should be noted that for ordinary purposes the " standard brightness " setting accuracy need not be too great. A setting above the red mark by one tenth of an inch causes an increased exposure equivalent to about one-third of a stop, and vice-versa. The slight drift of the microammeter pointer is due to the unavoidable drop and recovery of the battery voltage and can be minimised by keeping the switch button depressed only for the short time necessary to obtain the required brightness match.

3. Set the colour-of-the-light corrector. If working by *daylight* set the knurled disc (3) which is found under the eyepiece (4) of the telescope so that the *white* index mark is immediately under the telescope. If working in *ordinary artificial light* set this disc so that the *yellow* index mark is under the telescope.

4. View the subject. From the camera position look through the telescope (4) and (6) at the scene to be photographed.

5. Focus the eyepiece to your individual eyesight by sliding it along the barrel of the telescope. The object lens (6) also may be moved outwards if necessary for close work, but for ordinary use it should not be withdrawn.

6. Orient the spot. Make the black photometric spot in the middle of the view coincide with the image of the *darkest part of the scene in which detail is required.*

7. Match the spot. Press the switch button again and try to make the spot match the part of the scene selected by turning the broad knurled ring (1).

If the spot is always too dark or too light the subject image must be darkened or brightened by turning the knurled disc (7) to the appropriate range so that the photometric spot can be matched. This knurled disc will be found to carry three coloured index marks. One of these is to be set immediately under the middle of the telescope objective as follows :—

For ***bright*** areas use the ***blue*** index mark.

For ***normal*** areas use the ***white*** index mark.

For ***dark*** areas use the ***red*** index mark.

When bright areas are viewed and the blue index mark is in use, the shield round the eyepiece of the telescope must be close to the eye. In very bright light additional shielding with the hand above the eyepiece may also be helpful.

8. Read the time of exposure on the appropriate scale (8) in relation to the f/number scale (9), taking care to select the exposure time scale of the same colour as the index mark used for the operation described in the previous paragraph. For ' 16 frames ' cine work read off the stop on scale (9) against the cine index mark C$\frac{1}{32}$ on the appropriate scale (8), or against 1/50 sec. for ' 24 frames ' cameras.

Note : A small amount of general flare in the photometer objective is unavoidable. Within limits this is actually an advantage since it tends to compensate for the effect of flare in the camera (see " The Exposure Photometer and Modern Exposure Technique "—*Photographic Journal*, **88A**, 230, 1948). *Excessive* photometer flare should be avoided by matching on a ' darkest object ' which is not too near to a very bright area or light source.
For illuminating engineering work in which it is important to keep flare to a minimum an anti-flare tube attachment is available for mounting on the objective of the photometer telescope.

TO DETERMINE CAMERA EXPOSURES FOR REVERSAL WORK (Colour or Black and White)★

9. Set the speed scale by bringing the *white* index mark on the knurled ring (2) opposite the appropriate number on the speed scale (10). (See paragraph 1 for table of equivalent speed numbers).

10. Make the necessary adjustments described in paragraphs 2 (to standardise the lamp), 3 (to set the colour-of-the-light corrector), and 5 (to focus the telescope).

11. Orient the spot. Select for measurement *the most brightly lit white object* in the scene which is facing the main light source. If no such object exists an artificial highlight should be made by placing a piece of matt white paper or card so that it is illuminated in the same manner as the subject. The card surface should be at right angles to the direction of light from the main source in order to give the maximum brightness.

12. Match the spot. Make the photometric measurement of the highlight in the same way as described for the shadow area in paragraphs 6 and 7.

13. Read the exposure as described in paragraph 8. For ' 16 frames ' cine work read off the stop on scale (9) against the cine index mark (C $\frac{1}{32}$) on the appropriate scale (8), or against 1/50 sec. for ' 24 frames ' cameras.

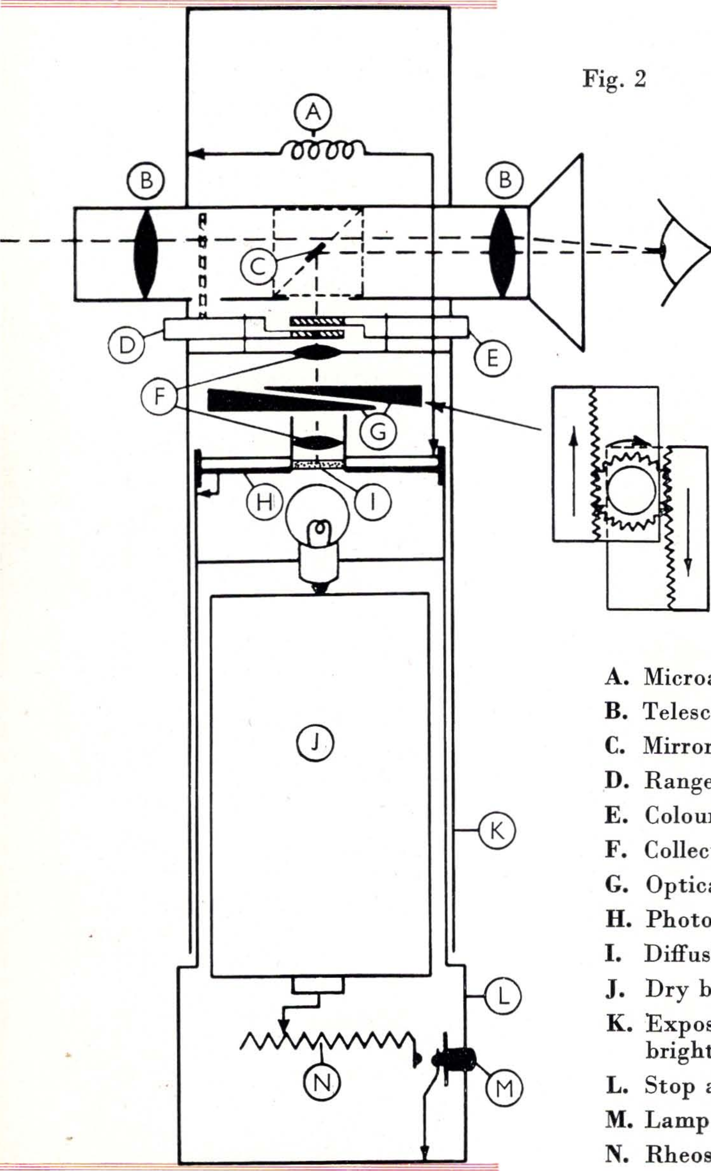
Principles of construction

The subject is viewed approximately full size, but inverted, through a simple telescope (B) (Fig. 2). By an adaptation of the Lummer-Brodhun cube, a small comparison spot (C) is superimposed on the centre of the image field, this spot subtending at the eye an angle of only $\frac{1}{2}°$. The spot is diffusely illuminated by a small electric lamp via a diffusing screen (I), the lamp being fed from a dry battery (J) through a rheostat (N).

★ *More comprehensive ' keytone ' and ' incident light ' methods of using the photometer for reversal work are described in a paper entitled " Exposure Technique for Reversal Materials "* (British Kinematography, **13**, 151, Nov. 1948). *See also 'Keytone Method ' under ' Other applications ' (page* 17).

Schematic diagram

Fig. 2



Method of driving wedges

A. Microammeter coil
B. Telescope lenses
C. Mirror ' spot '
D. Range shift disc
E. Colour matching disc
F. Collecting lenses
G. Optical wedges
H. Photo-electric cell
I. Diffusing screen
J. Dry battery
K. Exposure, density and brightness scales
L. Stop and film speed scales
M. Lamp switch
N. Rheostat

The lamp also illuminates a ring-shaped photo-electric cell (H) which is connected to a microammeter (A). By adjusting the rheostat, the needle of the microammeter can be made to coincide with a standardising mark so that the luminous output of the lamp, and consequently the brightness of the 'internal reference surface' (I), are always at a constant value. The instrument is therefore self-standardising.

Situated between the lamp and the spot are two opposed photometric wedges (G). These can be moved in opposition to one another by a rack and pinion mechanism operated by rotating the base (L) of the meter. The light reaching the comparison spot can in this way be varied through an intensity range of 100 to 1. Reduction of the brightness of subject or spot by the insertion of neutral filters attached to a range shift disc (D) provides a further increase of range up or down by factors of 100 thus giving the meter a total range of 1,000,000 to 1.

The range shift disc has three index marks. When the white mark is central under the object lens of the telescope, the meter is on its normal range, covering the deepest significant shadows of most outdoor subjects. When the red mark is central the meter is ready for dealing with objects of very low brightness. When the blue mark is central the meter is on its high range, which mainly covers highlight or keytone methods as described later.

The light from the lamp is yellowish in colour when compared with daylight. A colour-correcting filter is provided to make easy the comparison of brightness between spot and object. This is attached to the notched disc (E) which is situated immediately below the eye-piece of the telescope. This disc has two index marks, a yellow and a white. The white mark is for use in daylight and the yellow for light which is deficient in blue, such as ordinary electric light The calibration of the meter is unaffected by the movement of this disc. Note, however, that when the subject is illuminated by artificial light, the appropriate speed index should be used.

The photographic calibration of the instrument is such that when the *black* speed index mark is set against the correct B.S. exposure index for the material in use, the basic flare-free exposure relating to the subject area matched is 'pegged' at a point on the characteristic curve about two divisions (two-thirds of a stop) above the B.S. 1380 'fractional gradient' exposure index point. This 'safety factor' applies with average modern cameras, and has been found to be entirely satisfactory in practice. No additional safety factor applies to the *white* speed index mark since the exposure for reversal film must be at the correct *optimum* level, and not merely greater than a minimum value as in the making of negatives.

It may be of interest, however, to note the many advantages of keeping *negative* exposures as near to the minimum level as is practicable. These include—maximum arrestment of subject movement, maximum depth of field for a given exposure time, minimum halation, minimum loss of definition from light spread within the emulsion, minimum grain and short printing time.

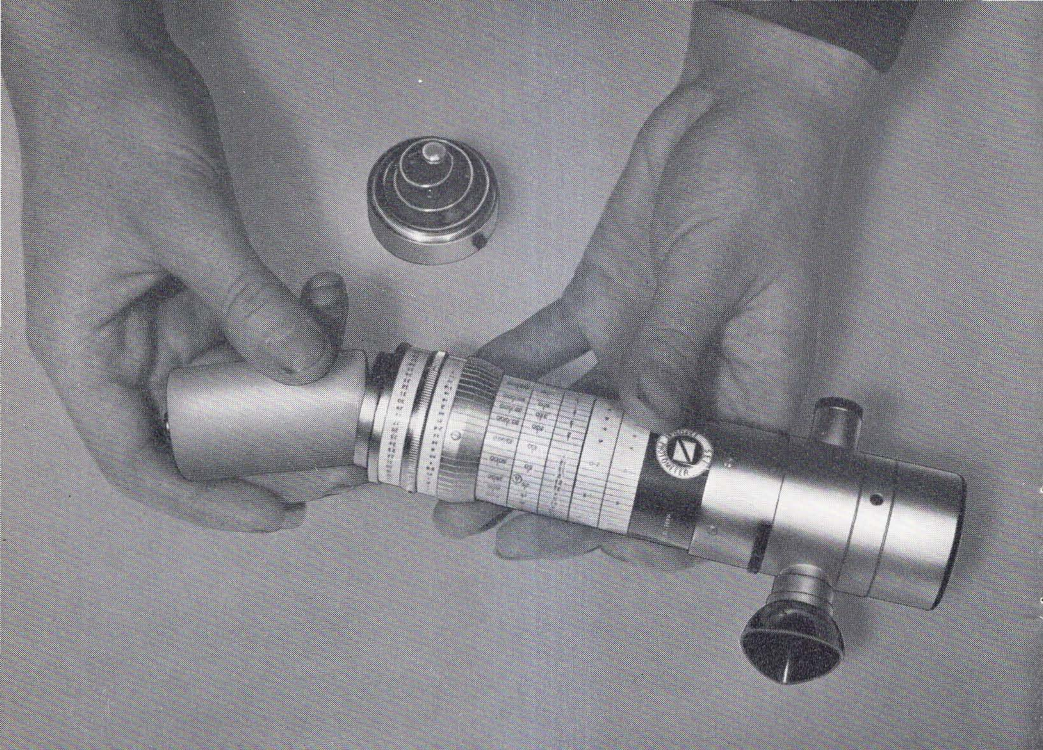
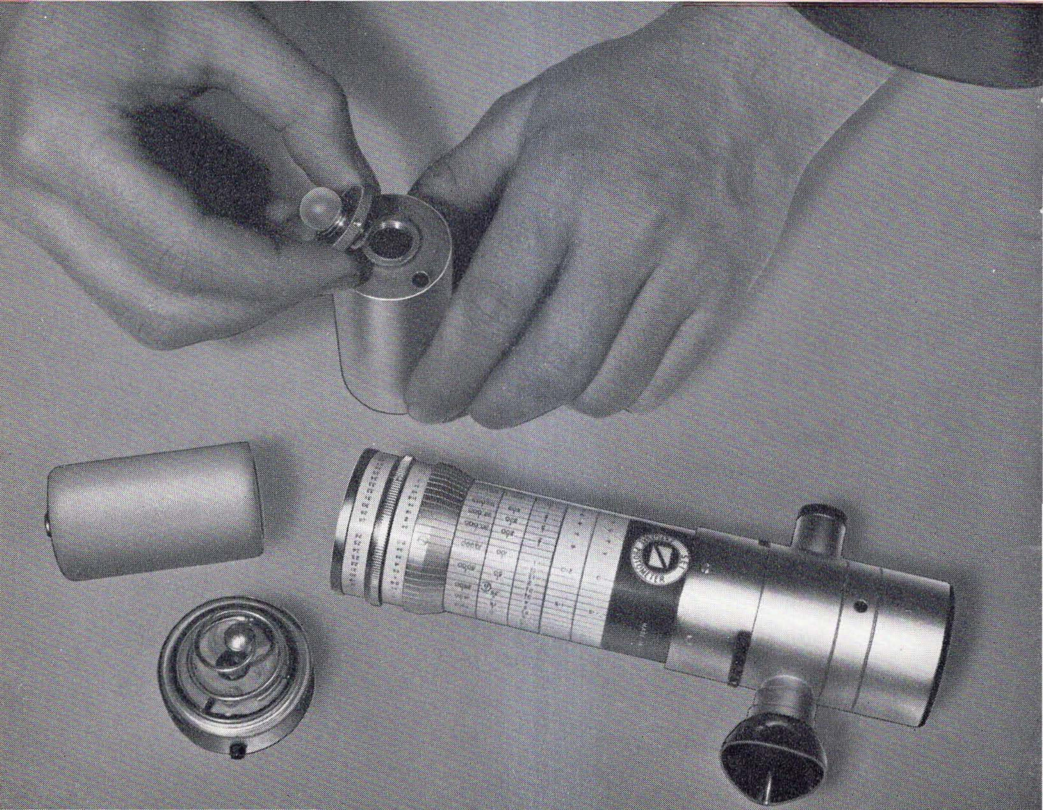


Fig. 3 *above*. Fig. 4 *below*.



General instructions for use and maintenance

GENERAL

Do not use the meter with a lighted cigarette in the mouth, otherwise accidental contact may damage the scales.
The filters, wedges and other optical parts of the instrument are easily damaged by handling. For this reason the top of the instrument is completely enclosed and should not be opened.
When not in use the meter should be stored so that it is not subjected to extremes of temperature or humidity. Care should also be taken to ensure that the meter is not kept where it can be affected by chemical fumes such as acid or solvent vapour.

BATTERY (see Fig. 3)

The battery to be used is a cylindrical one, size U.2. To ensure good contact choose a make without a pip on the centre brass terminal (e.g. G.E.C.). To prepare the battery for use, strip from it the insulating paper sleeve, clean both end contacting surfaces with emery cloth and smear these lightly with Vaseline.
Open the base of the photometer by holding fast the speed and lens aperture scales and unscrewing the bottom of the instrument by turning the broad knurled ring (1). Insert the battery into the cavity. Replace the base of the instrument.

WARNING :—The battery should be inspected frequently to make sure that no chemicals are exuding from it. This happens sometimes even with a fairly fresh battery, but with age and use the battery will always tend to give this trouble, and to avoid injury to the instrument it should be replaced. If the instrument is to be stored or left out of use, the battery must be removed.

LAMP BULB (see Fig. 4)

To replace the lamp bulb unscrew the base and remove the battery. Withdraw the metal tube which lines the cavity in which the battery was situated. The bulb is mounted at the end of this tube lining. The battery sleeve has a hole in its upper end which engages with a pin in the body of the instrument so that the correct position is positively located. The bulb, which is a special type preset by means of a ring, screws into the end of the battery sleeve. Replacement preset bulbs are obtainable from Ilford Limited.
It should be noted that the lamp will rarely, if ever, actually burn out. After a very long life, however, it will eventually be found that even with a new battery more and more of the rheostat must be cut out in order to make the microammeter needle register with the red standardising mark. When this stage is reached the useful life of the lamp is ended, and it should be replaced as indicated above. Calibration accuracy is not affected as long as the microammeter needle can be set to the red mark.

Figs. 5 and 6. *The effect of brightness distribution on indicated exposure readings. The limiting brightness values occur in the bird and since the lighting remained unchanged the exposures should be the same. The area matched by the S.E.I. Photometer was the shadow between the eagle's legs*

The exposures were 2 secs. at f/5.6 on Ilford R.20 Special Rapid Panchromatic Plates, the latter and the prints being given identical treatment. A conventional photo-electric meter erroneously indicated 6 secs. for Fig. 5 and ½ sec. for Fig. 6 due to the misleading effect of the background brightness.

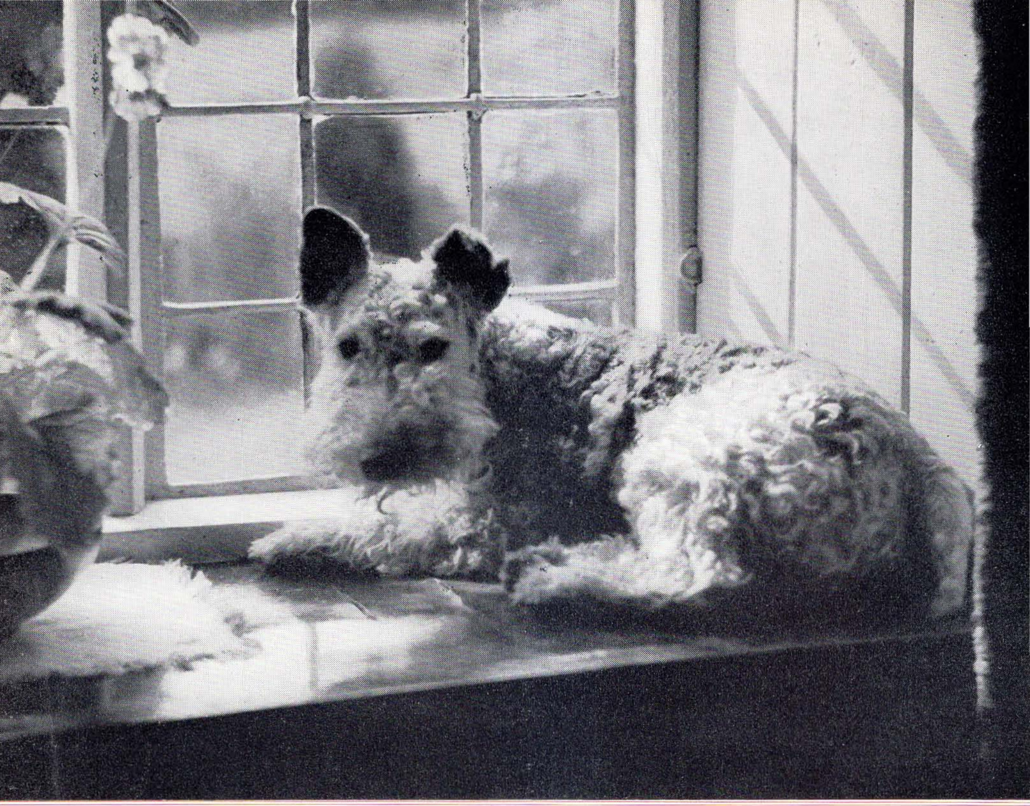


Fig. 7. *This is usually considered a most difficult type of subject. The rapidly changing reading on an ordinary photo-electric meter on moving it to or from the window will be appreciated—yet the required exposure within such limits remains unchanged. The S.E.I. Photometer gave a single definite reading of 1/25th sec. at f/5.6 on HP3 film (32°), based on the darkest shadow (see pages 7 and 8). The range was exactly 100 to 1.*

Other applications

ESTIMATING EXPOSURES BY HIGHLIGHT AND KEYTONE METHODS FOR NEGATIVE WORK

There are certain classes of subject for which, even when making negatives, ' highlight ' or ' keytone ' methods are more appropriate than the normal shadow method.

Highlight method. This applies mainly to subjects of extreme contrast for which only the brighter end of the tone scale is to be printed. Examples of such subjects are shown in Figs. 8, 11 and 12.

The *white* film speed index mark is set to the exposure index number and the *brightest* significant area in the subject is matched. The exposure is then read from the appropriate scale. This method should be used only for subjects of really extreme brightness range (greater than 100 to 1) for which highlight reproduction is required at the expense of shadow gradation.

The choice of the brightest part of the subject for photometric matching would lead to a gross under-estimate of exposure if the black speed index setting were used to relate aperture with exposure time. By using the white index mark the exposure which would have been indicated is multiplied by 100. This ensures that the negative will not be over exposed and yet will record detail in the subject from its brightest part to 1/100 of this brightness.

Keytone method. This method applies in the main to special subjects, often of normal range, where the emphasis is on consistent negative density for some specific tone level in the subject—particularly where the lighting is under the complete control of the operator as in commercial portraiture, motion picture studios, etc. In such work it is usual to ' peg ' the required keytone at a particular negative density, processing in such cases usually being under close and consistent control.

The principal keytone applicable to portraiture is the diffuse highlight of the human face. The average reflection factor of a normal face is about 0.3 (30%). Obviously such a tone level should not be placed at as high an exposure level as that which would result from the uncorrected use of the white film speed index mark. It should, in fact, be placed at a point equivalent to 30% of that level.

The necessary correction to effect this adjustment is done by simply setting the *white* film speed index mark to a higher exposure index number as indicated in the following table, depending upon the particular keytone to be matched. The corrections given are for keytones directly illuminated by the major light source.

Keytone corrections

(Applicable to the *white* film speed index mark only).

Reflectance of keytone matched%	Typical keytones	Keytone correction to basic film speed
100	Magnesium carbonate block (' Standard White ') Fresh snow Sunset cloud fringes (not too near to sun)*	Nominal B.S. logarithmic exposure index number
80	White blotting paper Matt white card Clean white paint	+1°
65	Slightly weathered white paint	+2°
50	Old weathered white paint	+3°
40		+4°
30	Normal face tone (diffuse highlight)	+5°
25		+6°
20	Bronzed face tone (diffuse highlight)	+7°

* For sunsets with reversal colour film give double the indicated exposure (colour sensitivity correction).

For example, to place a normal facial highlight at its nominal relative brightness level of 30% when using a film having a B.S. exposure index of 29°, the white index should be set at 29+5=34°, the diffuse facial highlight being accordingly matched with the photometer (See Fig. 13).

Should the density level resulting from the above technique be found to be too high or too low for the particular purpose required, the setting for future exposures can, of course, be raised or lowered accordingly.

It may be of interest to note that this is the essence of the more comprehensive method recommended for reversal (monochrome and colour) work and referred to earlier in the footnote on page 9.

COPYING

The difficulties inherent in copying are due to the small latitude in exposure and to the inability of the eye to judge whether the copyboard is evenly illuminated. These difficulties are especially noticeable when process plates are used, but are easily countered with the S.E.I. Photometer.

It is essential that the emulsion speed should be accurately known and usually this entails an experimental determination.

For line work, the highlight method is used and the exposure must give adequate background density in the negative. Over exposure must be avoided however, because this leads to loss of detail in the finer lines.

As a rough guide to the order of exposure index numbers applicable to line work, 24° has been found about correct for Ilford N.40 Process Plates in ordinary 100 watt tungsten lighting when using the *white* film speed index mark and matching the white background of a black printed original. The usual allowance for camera extension must, of course, be made (i.e. the indicated exposure must be increased as the square of the ratio :— ' negative-to-lens-distance ' ÷ ' lens-focal-length '). It is probable that a slightly different exposure index number may be necessary for each emulsion batch.

For continuous-tone work, normal emulsions are used and the exposures are based on the shadow method. (See Fig. 15).

PROJECTION PRINTING

The application of the photometer to the determination of exposures for enlarging (or reducing) saves much time and material once the principles are understood.

The exposure is assessed by matching a given part of the image on the easel, and to obtain consistent results it is necessary always to use a constant diffuse white surface, say a piece of clean white blotting paper, on the easel. The reading is then, in effect, a relative measure of the light which will fall on the bromide paper when this is substituted for the blotting paper. Because of this no account has to be taken of the lens aperture, degree of enlargement, size or type of illuminant or type of negative in use—*except* that any variation of negative image or light source *colour* from those used initially to determine the paper speed may cause an error. If such variations cannot be avoided an allowance must be made. The yellower the negative or light source the longer will be the exposure required.

Assuming constant colour and development conditions, the use of the photometer will, within wide limits, result in the measured image area always being reproduced in the print at a constant tone level.

There are three general methods of using a photometer for this work, (a) matching the brightest significant image tone, (b) matching the darkest significant image tone and (c) matching some specific image tone between (a) and (b). The latter method can be used when experience is gained. A contact print from a step-wedge made on the easel in the enlarger illumination can give useful information, the resulting stepped print tone values being directly related to subsequent keytone readings of the projected images of negatives to be printed. Apart from this, it has been shown conclusively that method (a) gives a far higher percentage of successful results than method (b). (See "The Control of Photographic Printing by Measured Characteristics of the Negative" by Jones & Nelson—*J. Opt. Soc. Amer*, **32**, 558, Oct. 1942). The following working instructions are therefore based on this method :—

1. *To determine the paper speed.* Select any average full range negative which is known to give a good print on the particular grade of bromide paper under consideration.

   Find by trial the exposure required to give the best possible print from this negative on a piece of paper from the batch concerned.

   Under the same conditions match the brightest part of the image, using a piece of clean white blotting paper on the easel and switching off any safelight which might otherwise illuminate the easel and influence the reading. When matching from about one foot away the image will be sharp when the black objective end of the photometer telescope is pulled out to its limit. The 'red' range setting will usually be found appropriate, with the colour-of-the-light index set at yellow if an ordinary tungsten enlarging lamp is used.

   On the appropriate exposure-time scale find the exposure time given to the above trial print. Then the paper speed *applying to this method* will be the number on the 'film speed' scale which is found against this exposure time, the lens aperture scale being ignored.

2. *To find the printing exposure.* Set up the equipment ready to make the required print. Using a piece of clean white blotting paper on the easel match the brightest part of the image as in 1 above.

   Read off the required exposure on the appropriate exposure-time scale against the 'speed' of the paper as found under 1 above.

   Replace the blotting paper by the printing paper and proceed in the normal manner.

   For negatives of exceptionally harshly lit subjects it may occasionally be necessary to ignore small areas which have no gradation and which can be allowed to print dead black.

Determination of required paper grade. Readings can be made of the darkest as well as of the brightest part of the image and the ratio of the readings can be related to the exposure scale of the paper as can previously have been determined from a step-wedge test made by contact printing on the easel. In order to ensure complete absence of photometer flare when measuring the darkest part of the image it is advisable to place over the blotting paper a piece of black paper in which a small hole has been made and so located that the hole just uncovers the dark part of the image to be matched.

Printing control. When the relationship between image brightness and print density has been established, the photometer can be used to estimate the degree of over or under printing of portions of the image for control purposes.

DENSITOMETRY

Special accessories are available for conveniently using the S.E.I. Exposure Photometer as a densitometer for transparencies and prints. A booklet describing the general arrangement and use of these accessories is available on request.

Brightness and illumination measurements

For light readings generally, the small screw in the graduated tapered ring which appears opposite film speed 27° is the index mark against which the scale values are read.

Brightness. The readings can be made against this index mark on the appropriate exposure scale by taking the reciprocal of the exposure reading. This gives the brightness directly in foot-lamberts.

For accurate work the log. foot-lambert scale should be used. The scaled values (0 to 2.0) refer to the 'white' range. When on the 'blue' range read as 2.0 to 4.0 and on the 'red' range as $\bar{2}.0$ to 0.

Illumination. The surface of a block of magnesium carbonate is internationally accepted as 'standard white' and has a nominal reflectance of 100% (actually its average for the visible spectrum is 98.3%).

To measure the incident illumination place the 'standard white' surface at the required position and measure its brightness as above. Since, virtually, this surface reflects diffusely 100% of the incident light the reading in foot-lamberts is the same as the illumination in foot-candles.

Reflection factor. To determine the reflection factor of a surface, first measure the brightness of the surface concerned and then that of the 'standard white' surface when placed in the same position. The ratio of these two readings (in foot-lamberts) gives the reflection factor. If the more accurate log. foot-lambert scale is used, subtract the higher reading from the lower (resulting in a negative log. characteristic) and find the anti-log.

The following table gives the relationship between some brightness units in common use and shows where they come with respect to the three ranges on the photometer.

Approximate Relationships of Different Brightness Units

(1 foot–lambert=0.318 candles/sq. foot=0.00221 candles/sq. inch= 3.43 candles/sq. metre).

Photometer range	Log foot–lamberts	Foot–lamberts	Candles/sq. foot
Low	$\bar{2}.0$	0.01 (1/100)	0.0032 (1/314)
(red index) ..	$\bar{1}.0$	0.1 (1/10)	0.032 (1/31)
Normal	0	1	0.32 (1/3)
(white index)	1.0	10	3.2
High	2.0	100	32
(blue index)	3.0	1000	320
	4.0	10000	3200
Values for interpolation between any of the above, the decimal place to be adjusted as required ..	0	1	0.32
	.1	1.3	0.4
	.2	1.6	0.5
	.3	2	0.63
	.4	2.5	0.8
	.5	3.2	1.0
	.6	4	1.3
	.7	5	1.6
	.8	6.3	2.0
	.9	8	2.5
	1.0	10	3.2

Other definitions used in Illuminating Engineering will be found in B.S. 230.

Projection screen brightness. A valuable use of the photometer to the still or motion picture projectionist is in the checking *from the projector* of the screen brightness.

B.S. 1404–1947 lays down the limits for 35 mm. film projection as 8 to 16 foot-lamberts with the projector running but with no film in the gate.

For sub-standard film or lantern slide projection, where the room is often darker than the commercial cinema, experience suggests that a slightly lower figure may be permissible, but for really satisfactory projection quality, particularly for colour, the level should not be allowed to fall below 5 foot-lamberts. This applies to average films or slides.

Examples of exposure estimation

The following examples illustrate subjects in which accurate exposure estimation with the S.E.I. Exposure Photometer is straightforward, but without which varying degrees of difficulty would arise. The examples include subjects having :—

(a) long range, requiring accurate exposure.

(b) extreme brightness distribution, requiring selective exposure.

(c) controlled illumination where control of brightness range is necessary for satisfactory results.

(d) low levels of illumination.

It will be seen that there is nothing photographically abnormal in any of the subjects illustrated, yet they defeat existing types of exposure meter. A little experience will confirm that the S.E.I. Photometer surmounts all such problems with ease and indicates exposures which are uniformly reliable and accurate.

Fig. 8 *above*. Fig. 9 *below*.

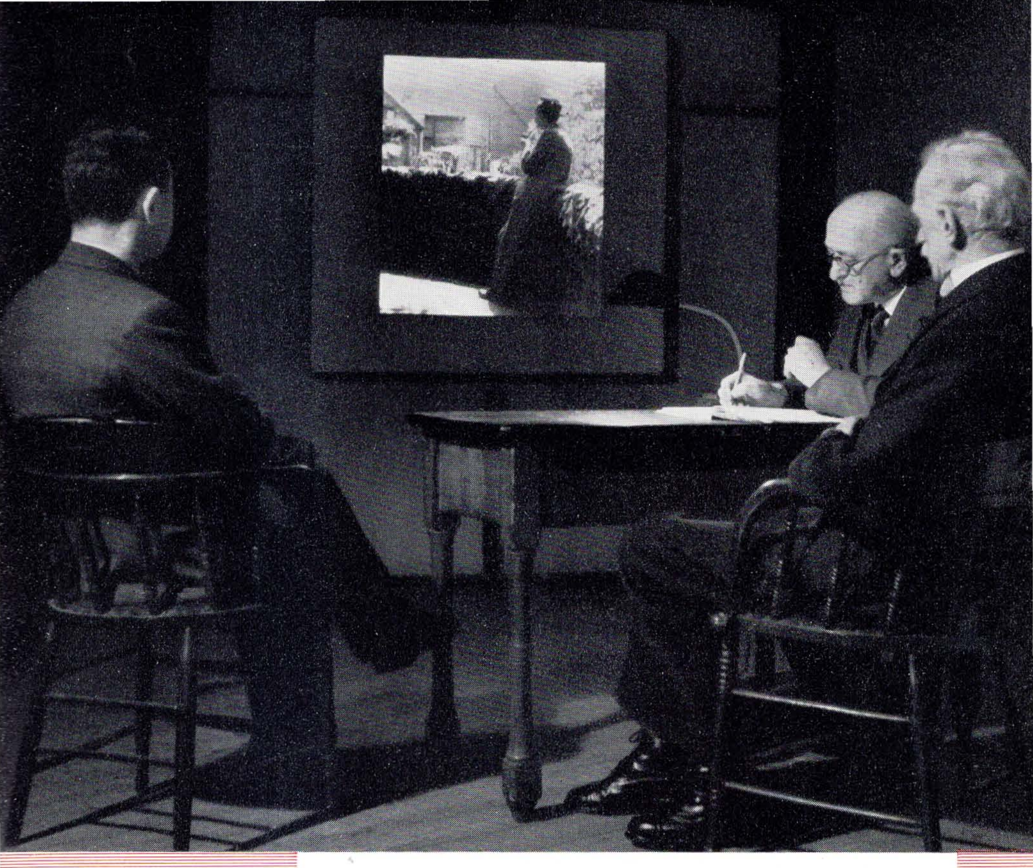


Fig. 10. *This is not a combination print but is a straightforward photograph of the judging of a lantern slide competition. The room was darkened except for a small auxiliary light used to illuminate the figures. The range measured by the S.E.I. Photometer from the highlight on the screen to the dark foreground shadows was originally over 250 to 1. The reflection range of glazed glossy paper being only 50 to 1, the projector illumination was accordingly reduced to give this ratio. The exposure of 15 seconds at f/8 on HP3 film was then determined by the shadow method as described on pages 7 and 8.*

Fig. 8. *This is typically a scene where the lighter tones must be correctly reproduced but where the shadows and street lamps must be ignored owing to the extreme range. The exposure was not recorded but would be determined by the highlight method based on the gradations in the distant snow-clad mountain (see page 17).*

Fig. 9. *The exposure for this interior might be based on the back of one of the pews, but in view of the obviously long brightness range a check would be made on the brightest part of the near right hand pillar to ensure that the range was not excessive. If this was found to be more than about 100 to 1 the highlight method (page 17) would be used to be sure of retaining the delicate highlight gradations.*

The photometer could also have been used here from floor level to determine (by the normal shadow method) the exposures required for photographs of the mural decorations on the ceiling.

Fig. 11 (*above*). *Here is another illustration of extreme range where the highlight method was used to ensure correct reproduction of the lighter tones. The exposure was 50 secs. at f/8 on HP3 film. The dark foreground tones were deliberately ignored in the knowledge that they were well outside the film latitude (see page 17).*

Fig. 12 (*right*). *This snow scene was taken on a moonlight night with the additional aid of a low power street lamp. The exposure, based on the brightest area in the snow (see page 17), was 80 secs. at f/8 on HP3 film. An interesting point, which shows how the accommodation of the eye makes it a very bad judge of brightness values, is that the brightest snow in this scene was found to have the same brightness as that of a shadowed area below the keyboard of a dark rosewood piano in a normally lit lounge.*

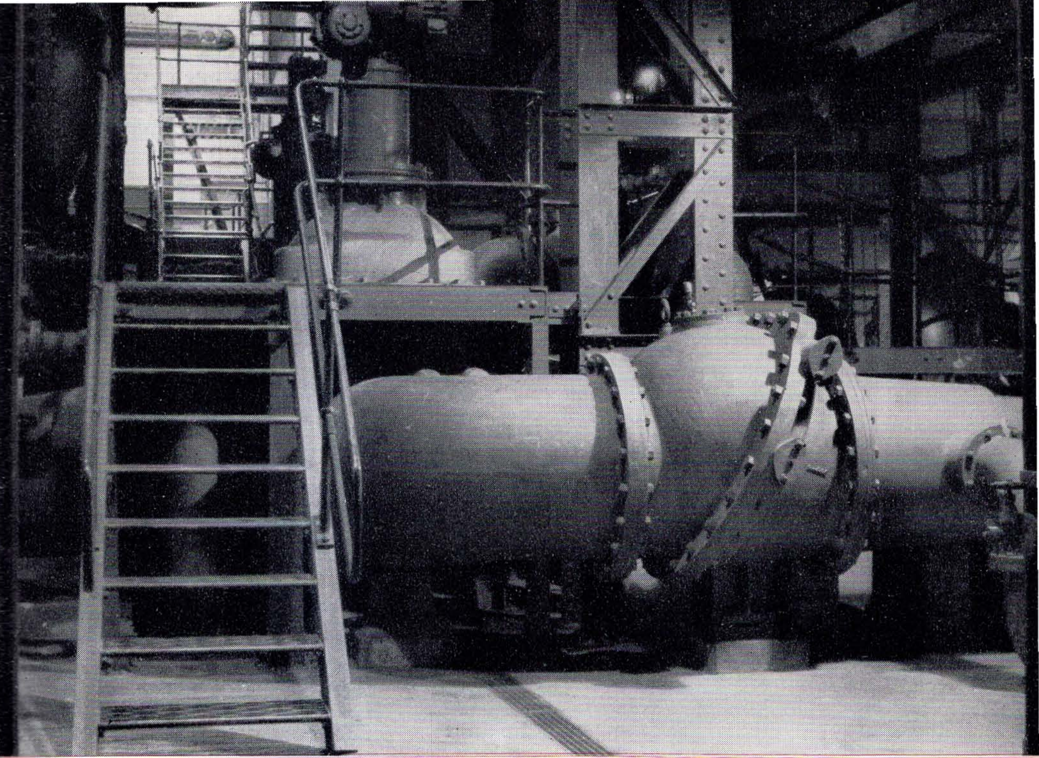


Fig. 14 (*above*). *Industrial interiors, with or without auxiliary lighting, are all well within the scope of the S.E.I. Photometer. The existing artificial lighting was used here, the exposure being 20 secs. at f/11 on HP3 film. The shadow method was used, the 'spot' being matched on the shadowed area on the left. No reading could be obtained from an ordinary photo-electric meter.* (*See normal working instructions on page 7*).

Fig. 13. *This illustrates the application of the keytone technique described on pages 17 and 18. For such 'controlled lighting' subjects the* white *film speed index mark is set to the B.S. logarithmic exposure index + 5° keytone correction for a normal face tone. The photometer spot is matched on the brightest part of the face, which results in a consistent negative face tone density at a controlled level. An identical exposure would have been indicated in this case by matching on the cigarette but using a keytone correction of + 1° instead of + 5°.*

IMPROVED RENDERING OF CLOUDS AND COLOUR BRIGHTNESS

Photographed on non-colour-sensitive material.

Photographed on Panchromatic material with a Delta Filter (Ilford Filter No. 109)

Fig. 15. *This page from 'Panchromatism', containing half-tone blocks and printed matter, was copied on an Ilford Special Rapid Plate. The exposure used for the copy negative was kept to the minimum by using the shadow method. The 'spot' was matched on the darkest part of the illustration. Daylight illumination was used, care being taken to avoid reflections. The exposure was 10 seconds at f/32 (see page 19).*

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