Instruction Book

FOR

THE
G-W PHOTO SLIDE RULE

By

C. G. GOODCHILD, Ph. D.

L. V. WHITNEY, Ph. D.

Sole Manufacturers
ACU-RULE MFG. CO.
ST. LOUIS, MO.

Sole Distributors
AREL INC.
ST. LOUIS, MO.

INTRODUCTION

The G-W PHOTO SLIDE RULE is the first comprehensive, detailed, and accurate slide rule with complete photographic notations. The photographer has now a specially designed slide rule equal in accuracy and value to the slide rules used by chemists, physicists, and other scientists.

The original purpose of the rule was to make available, in a convenient way, such scattered and new photographic information as would be useful and helpful to the serious-minded photographer. However, the rule was designed so that the beginner in photography, or the slide rule novice, could learn to use it quickly and effortlessly.

The probability of making successful photographs is enormously increased when all the necessary information can be determined in a rapid, convenient way without recourse to lengthy, complicated, and often inaccessible tables. The photographer can obtain all this information quickly, simply, and accurately with the G-W PHOTO SLIDE RULE.

OPERATIONAL INFORMATION

1. PICTURES WITH PHOTOFLASH LAMPS

The G-W PHOTO SLIDE RULE eliminates all the guess work and mental arithmetic formerly involved in the use of photoflash lamps.

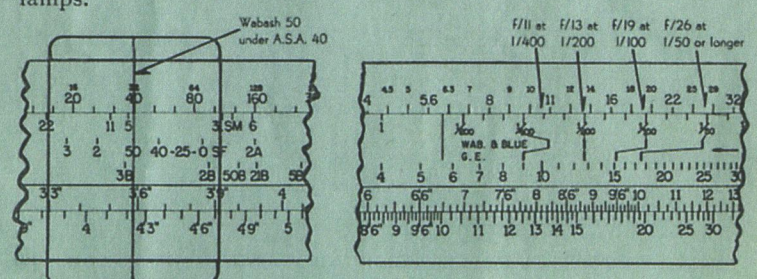

FIG. 1

To illustrate: suppose a Wabash 50 photoflash lamp is to be used with a film having an A.S.A. value of 40 (Weston 32). Use the artificial light side of the slider and set WABASH 50 under A.S.A. 40 as is shown in Fig. 1. All f-numbers and shutter speeds are now correct for a ten foot flashbulb to subject distance. The correct f-numbers may be read opposite the WABASH time scale: f/11 may be used at 1/400 second, f/13 at 1/200 second, f/19 at 1/100 second, or f/26 at 1/50 second or longer.

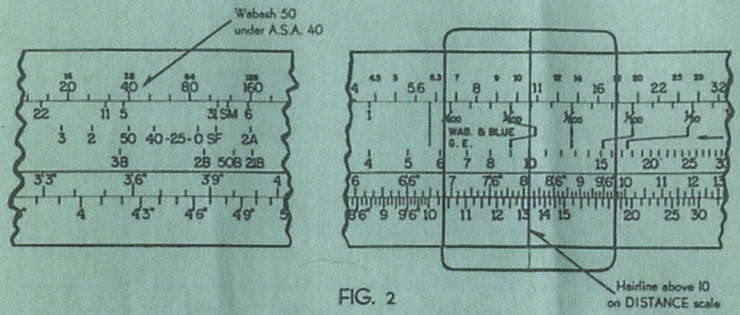

FIG. 2

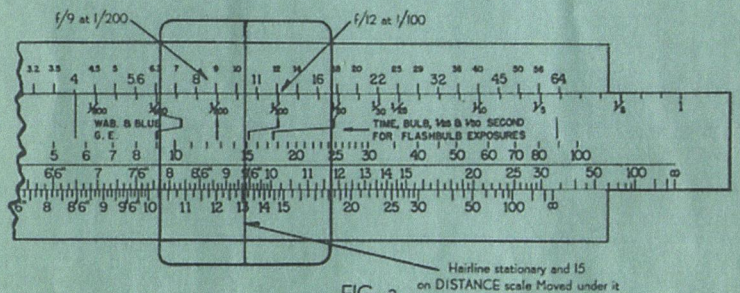

FIG. 3

If the flashbulb to subject distance is other than ten feet, for example 15 feet, the hairline should be set above the 10 on the DISTANCE scale, Fig. 2, and the slider moved until the 15 is under the hairline, Fig. 3. Exposures may be read as before: f/9 may be used at 1/200 second, etc.

If a G.E. bulb had been used the procedure would have been similar except that the G.E. time scale would have been used instead of the WABASH time scale.

2. PICTURES WITH SEVERAL LAMPS FLASHED SIMULTANEOUSLY

Suppose four Wabash 50 photoflash lamps were used instead of one as in the previous illustration. Assume that all lamps are at about the same distance from the subject and within about ten degrees of the axis. As before, suppose that this distance is 15 feet and that A.S.A. 40 film is used.

All settings previously described should be made, but, before reading the exposure, the hairline should be placed above the 1 of the No. 1 PHOTOFLOOD scale, Fig. 4. The slider should then be moved until four, the number of flash lamps which are used, appears under the hairline. Fig. 5 shows that f/18 at 1/200 second is a proper exposure under these conditions.

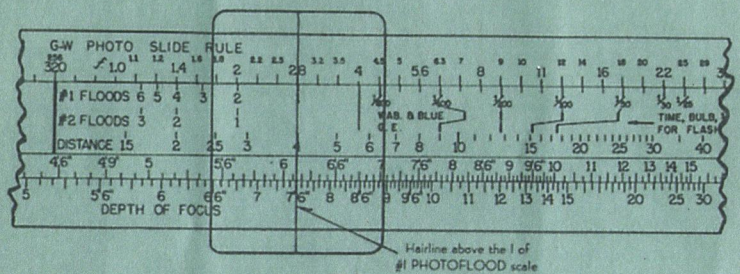

FIG. 4

If two lamps are used, both at the same distance from the subject, one on the picture axis and the other at about 45 degrees from the axis, exposures may be found by assuming that this combination is equivalent to one and one-half lamps.

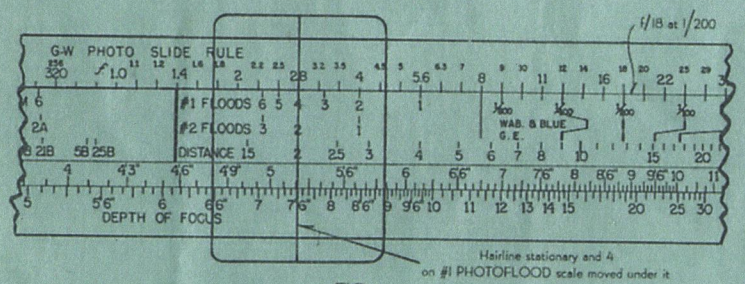

FIG. 5

3. PICTURES WITH PHOTOFLOOD LAMPS

The settings for photoflood lamps are similar to those for photoflash lamps, except that several photoflood lamps may be allowed for in one operation.

Suppose two No. 1 photoflood lamps, in good reflectors, are used with A.S.A. 80 film and that the lamp to subject distance is five feet. Set the 2 of the No. 1 PHOTOFLOOD scale opposite A.S.A. 80, Fig. 6. (If three No. 1 lamps had been used the 3 of the No. 1 PHOTOFLOOD scale would have been placed opposite A.S.A. 80, etc.). The rule is now set for a lamp to subject distance of 10 feet.

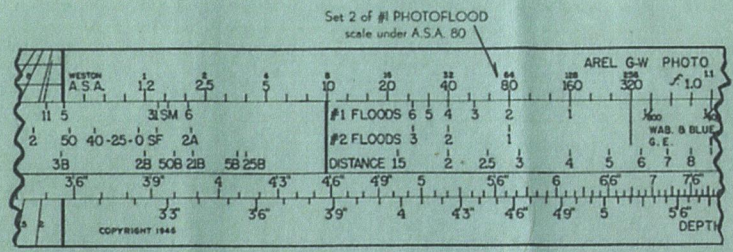

FIG. 6

Next, the hairline should be set above the 10 of the DISTANCE scale, Fig. 7, and the slider moved until the 5 is under the hairline. The regular black time scale now gives proper exposures, Fig. 8: f/4.5 may be used at 1/100 second, f/8 at 1/30 second, etc.

The settings for No. 2 photoflood lamps are exactly similar to those for No. 1 lamps except that the No. 2 PHOTOFLOOD scale is used instead of the No. 1 PHOTOFLOOD scale. If No. 4 photoflood lamps are used it need only be remembered that one No. 4 lamp is equivalent to two No. 2 lamps.

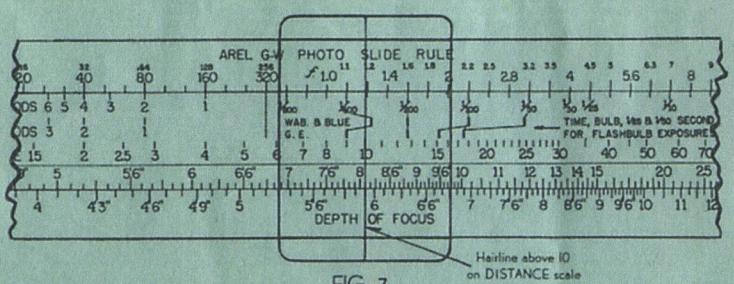

FIG. 7

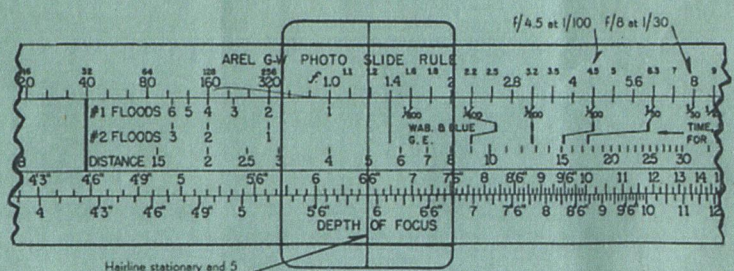

FIG. 8

4. DAYLIGHT PICTURES

Daylight intensity measurements are most accurately determined with a photoelectric meter. However, many successful pictures may be obtained by a careful observation of sky and subject conditions.

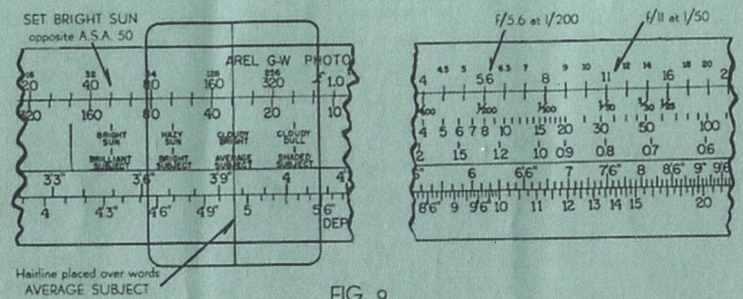

FIG. 9

Suppose Verichrome film, A.S.A. 50 daylight, is used; the sun is high in the sky and there are no clouds intervening. Use the daylight side of the slider and set BRIGHT SUN opposite A.S.A. 50, Fig. 9. Exposures are now correct for an average subject: f/5.6 may be used at 1/200 second, f/11 at 1/50 second, etc.

If the subject is bright, the hairline should be placed over the words AVERAGE SUBJECT, Fig. 9, and the slider moved until BRIGHT SUBJECT appears under the hairline, Fig. 10. Correct exposures are f/8 at 1/200 second, f/11 at 1/100 second, etc.

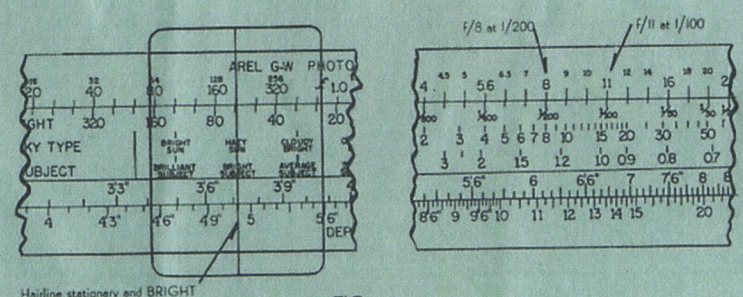

FIG. 10

Above the SKY TYPE scale appears the LIGHT value scale. These numbers are Weston meter light values, and when multiplied by ten they also represent the illumination in foot candles falling on the scene.

5. PICTURES WITH DAYLIGHT AND ARTIFICIAL LIGHT BALANCED

a. By adjustment of flashbulb to subject distance.

Many pictures taken in the sunlight are greatly improved if intense shadows are lessened by supplementary light sources. The photoflash lamp is very useful in this capacity; however, this light source is potentially so powerful that unless properly placed it will overpower the daylight and create a lighter principal object against a darkened moonlight-type background.

First determine the correct exposure for the daylight scene (either by the photoelectric exposure meter or by following the directions given in Part 4), and then calculate the correct position of the photoflash lamp to give this same exposure.

Suppose a G.E. No. 11 flash lamp is used to supplement daylight for photographing a bright subject under a bright sun. If Verichrome film is used, as in Part 4, the exposure should be f/11 at 1/100 second. Now use the artificial light side of the slider and match G.E. No. 11 with A.S.A. 25, the *tungsten* rating of Verichrome film. As already noted, the exposures shown for this setting are correct for a flashbulb to subject distance of 10 feet.

Finally, set the hairline above the 10 of the DISTANCE scale, Fig. 11, and adjust the slider until the 1/100 second of the G.E. time scale is opposite f/11, Fig. 12. The correct flashbulb to subject distance now appears under the hairline which in this case is seen to be about 13 feet.

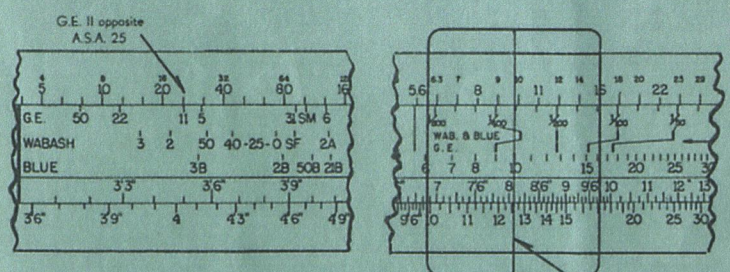

FIG. 11

b. By adjustment of shutter speed.

The previous method may prove impractical if the required flashbulb to subject distance is too large (as when daylight intensity is low), or if this distance cannot be conveniently varied. In this case,

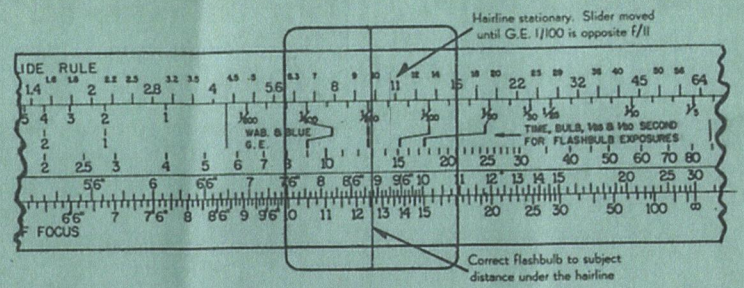

FIG. 12

the f-number used is that required by open flash exposure of the flash lamp, the shutter speed used is that sufficient to allow daylight to balance flash lamp intensity.

Suppose daylight intensity calls for 1/25 second at f/11 with Verichrome film, and a G.E. No. 11 lamp must be placed seven feet from the subject to fill in shadows.

Set G.E. No. 11 opposite A.S.A. 25, the Verichrome *tungsten* rating, and then set the hairline above the 10 of the DISTANCE scale, Fig. 11. Move the slider until the 7 appears under the hairline, Fig. 13. Opposite the G.E. open flash position read the f-number required for this picture which is about f/25.

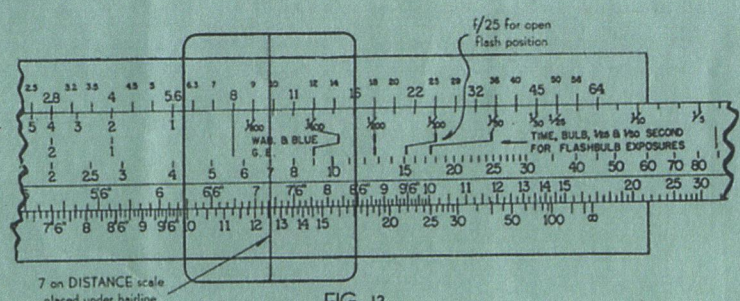

FIG. 13

Finally, move the slider until 1/25 second is opposite f/11, the daylight setting, and read the required shutter speed opposite f/25, Fig. 14. The proper camera setting for this picture is 1/5 second at f/25.

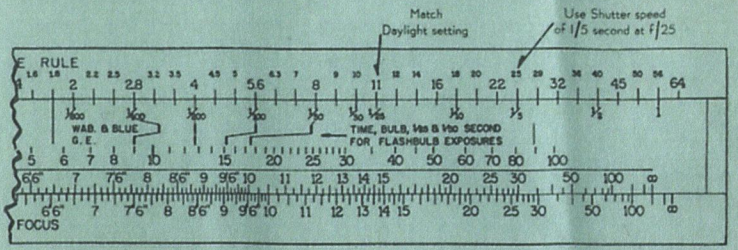

FIG. 14

6. DEPTH OF FOCUS DETERMINATIONS

The grid on the extreme left and the two identical bottom scales are used in depth of focus determinations. The horizontal lines of the grid represent the lens focal lengths (Note: 2″ is on bottom of rule; 2½″ on bottom of slider; 5″ on top of slider; 10″ on top of rule), while the slanting lines represent f-numbers.

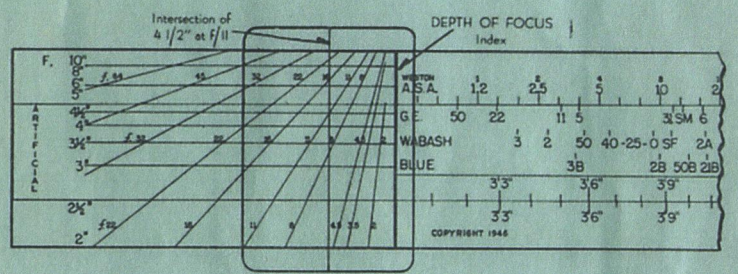

FIG. 15

Set the hairline over the intersection of the lens focal length and the f-number. In Fig. 15 the hairline is over the intersection of a 4½″ lens at f/11. Next move the slider until the depth of focus index appears under the hairline. See Fig. 16.

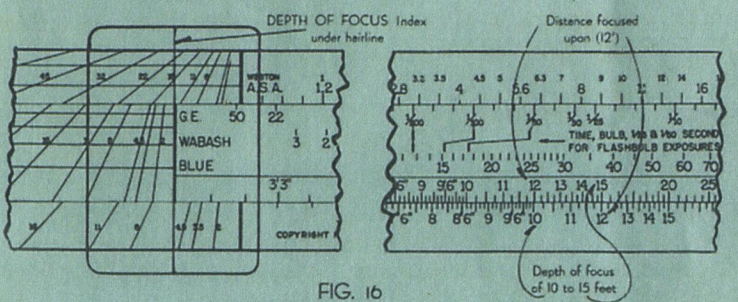

FIG. 16

Find the distance focused upon on both depth of focus scales. The numbers appearing opposite them give the depth of focus. In Fig. 16, for example, if the camera, having a 4½″ lens set at f/11, was focused on 12 feet, the picture would show everything from 10′ to 15′ in sharp, critical focus.

An alternate way of setting the depth of focus scale is to place the hairline over the depth of focus index, and then to adjust the slider until the intersection of the focal length and f-number is centered under the hairline, Fig. 17; the results obtained will be the same as before.

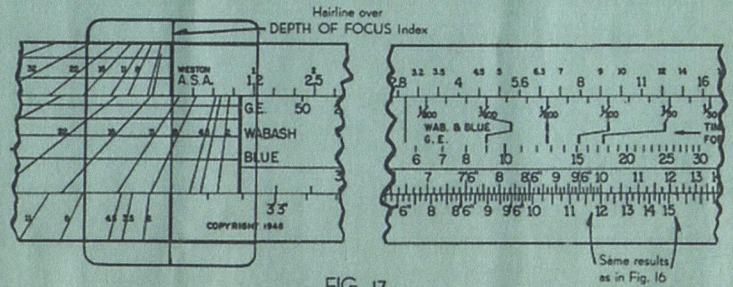

FIG. 17

Proper settings for lenses of longer than 10″ focal length are achieved by doubling the values of both the focal lengths and the f-numbers on the grid. For example, if the hairline was set for a 6″ lens at f/8 then this setting would be correct also for a 12″ lens at f/16.

Note: The depth of focus scale is designed for a circle of confusion of F/1750 on the negative.

7. THE REQUIRED F-NUMBER WITH ANY LENS FOR ANY DEPTH OF FOCUS

This manipulation is the converse of the previous one. The following considerations will, however, aid the solution of this photographic problem.

Suppose it is desired to photograph a scene extending 6′ to 12′ from a camera with a 5″ lens. What is the largest diaphragm opening that can be used, and on what distance must the camera be focused to give the stated depth of focus?

Move the slider until the same number appears opposite the 6′ and 12′ on the two scales. This number will be approximately 1/3 of the distance between the two points, and in this case is found to be 8 feet. Notice that the depth of focus index is at f/30 on the 5″ lens position.

Therefore, with the lens at f/30 and focused for a distance of 8′ everything from 6′ to 12′ will be in focus.

8. THE HYPERFOCAL DISTANCE

The hyperfocal distance is the focusing distance for which all objects from one-half this distance to infinity will be in focus. This distance is read directly from the DEPTH OF FOCUS scale and is given automatically with every depth of focus calculation.

If a 3″ lens is set at f/11, the hyperfocal distance, 40 feet, is found opposite the infinity mark, Fig. 18. It may be verified that if one had focused on 40 feet, everything from 20 feet to infinity would be in focus.

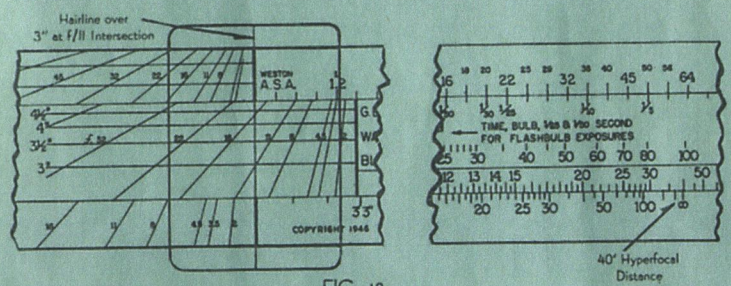

FIG. 18

9. CORRECTIONS FOR GREATER THAN NORMAL EXTENSIONS

The f-numbers engraved on the lens are exact only when the subject is at infinity. However, for all practical purposes, these f-numbers are sufficiently correct when the distance to the subject is more than about eight times the focal length of the lens. When close-up pictures are taken, by using extensible bellows or special extension tubes, the increased lens to film distance causes the f-numbers engraved on the lens to be incorrect.

Several methods of solving for greater than normal extension are given as follows:

a. Corrected setting by using lens to film distance.

Suppose that the subject requires an exposure equivalent to f/4 at 1/100 second, and that a 50 mm. lens is used at a total extension of 160 mm. from the film.

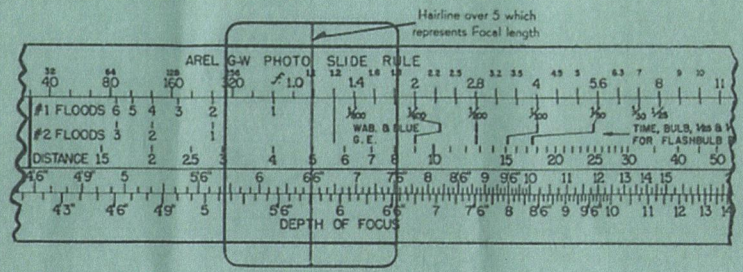

FIG. 19

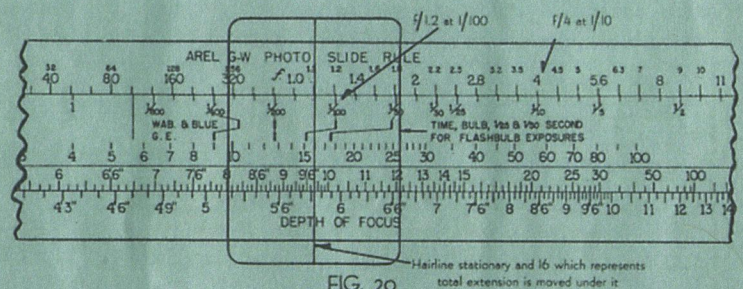

FIG. 20

Set f/4 opposite 1/100 second and, using the DISTANCE scale, place the hairline over the 5 which represents the focal length, Fig. 19. Adjust the slider until the 16 representing total extension is under the hairline, Fig. 20. All proper camera settings may now be read: 1/100 second may be used with a setting of about f/1.2, 1/10 second with f/4, etc.

Note that if f/1.2 is used the true f-number is still f/4. It is also obvious that if the original f-number, f/4, is used the shutter time has been multiplied by about ten.

b. Corrected setting using magnification factor.

Suppose the subject requires an exposure equivalent to f/6.3 at 1/50 second and the magnification factor is 4 X. Set f/6.3 opposite 1/50 second and place the hairline over the DISTANCE scale index,

Fig. 21. Then move the slider until 5, the number which is *larger by one* than the magnification factor, appears under the hairline, Fig. 22. Read proper settings: 1/10 second at f/2.8, 1/2 second at f/6.3, etc.

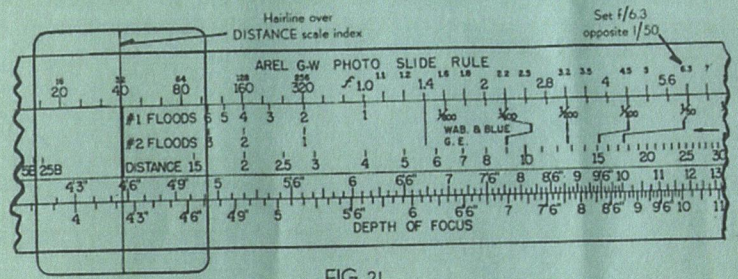

FIG. 21

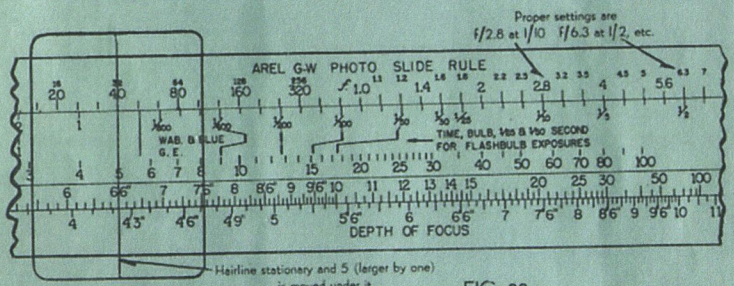

FIG. 22

A similar procedure may be used for enlarging when the correct exposure is known for one degree of enlargement, and the correct setting is required for a different degree of enlargement. Instead of setting the hairline originally on the DISTANCE scale index, set it above the number which is *larger by one* than the first magnification factor. The remaining procedure is the same as above.

c. Solving for the effective f-number.

In close-up photography it may be necessary to know the effective f-number of the lens when the camera diaphragm is stopped down as much as possible to obtain the maximum depth of focus.

Suppose a 2" lens at f/25 were used with a lens to film distance of 5". Set the focal length of the lens (using the DISTANCE scale) opposite the f-number; move the hairline to the number on the DISTANCE scale which represents the lens to film distance, Fig. 23. The effective f-number is now found under the hairline on the f-number scale and in this case is about f/64.

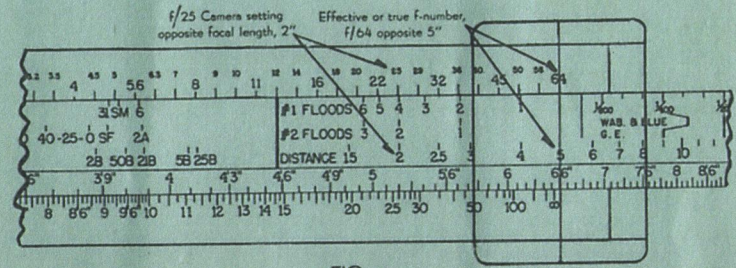

FIG. 23

If the same 2" lens at f/25 were used with a lens to film distance of 9" the effective f-number would be off scale. In this case mentally multiply all numbers on the f-number scale by ten and proceed as before.

10. CORRECTIONS FOR FILTER FACTORS

The use of filters in photography usually necessitates an increase in the exposure because of light absorption by the filter. The older methods of determining the corrected exposure involve mental calculations which often lead to serious errors. These errors are not possible with the slide rule and perfect exposures are obtained every time.

Suppose a 7X filter is to be used to take a photograph whose correct unfiltered exposure time is 1/200 second at f/11. Set the 1/200 second opposite f/11 and move the hairline to the heavy-lined FILTER-TIME FACTORS index, Fig. 24. Next, move the slider until the number 7 of the FILTER-TIME FACTORS scale is under the hairline, Fig. 25. All combinations of correct exposure are now given and 1/200 second could be used at about f/4, or 1/25 second could be used at 1/11.

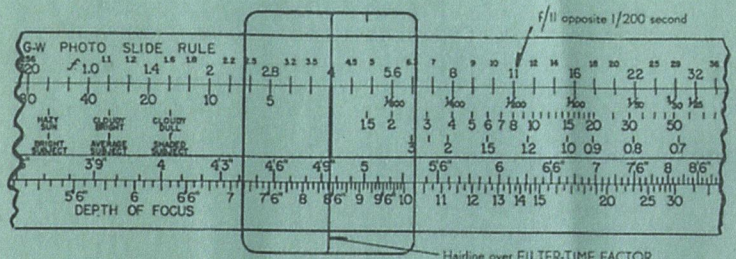

FIG. 24

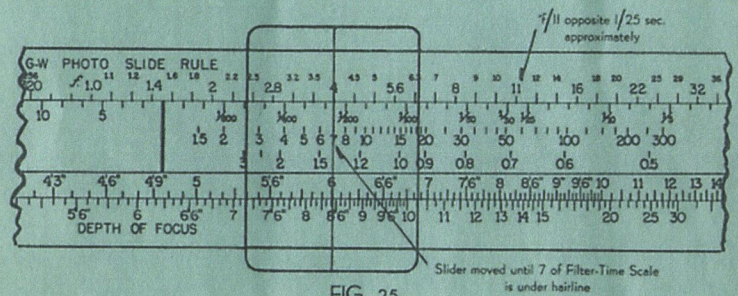

FIG. 25

11. THE f-NUMBER FOR THE USUAL MOVIE CAMERA

The shutter speed, 1/30 second, for the usual movie camera is shown in red. The movie photographer need only remember that with either daylight or photoflood illumination the proper f-number is to be found opposite this mark.

12. FILM SPEEDS

The face of the rule shows film speeds in both the A.S.A and Weston ratings. A portion of this scale is illustrated below:

WESTON	8	[	10	12	]	16	[	20	25	]	32	[	40	50	]
A.S.A.	10	[	12	16	]	20	[	25	32	]	40	[	50	64	]

WESTON	64	[	80	100	]	125	[	160							
A.S.A.	64	[	80	100	128	]	160								

The numbers in brackets are not printed on the rule itself.

On the back side of the rule some of the most popular films with their tungsten and daylight ratings are listed. Space is provided for the writing in of any other film speeds desired.

Kodachrome A is listed as tungsten A.S.A. 6. According to recommended specifications on exposures, speeds ranging from about 6 to 12 may be used for this film.

It must be remembered that in all cases there are variations in individual equipment, subject matter and results desired; hence exposures more or less than those indicated may be preferred.

A more extended list of film speeds as given by film manufacturers follows on page 18.

13. THE SOLUTION OF THE GENERAL LENS EQUATION

It is sometimes desirable to calculate the lens to film distance when the lens to object distance is known. Those familiar with the mathematics of lenses will immediately recognize this as a solution of the equation:

$$\frac{1}{P} + \frac{1}{Q} = \frac{1}{F}$$

where P is lens to object distance, Q lens to film distance, and F the focal length of the lens.

Suppose a 6″ lens is 15″ from the subject. Set the 6 opposite the 15 on the DEPTH OF FOCUS scale, and opposite the infinity mark find the lens to film distance which is 10″, Fig. 26.

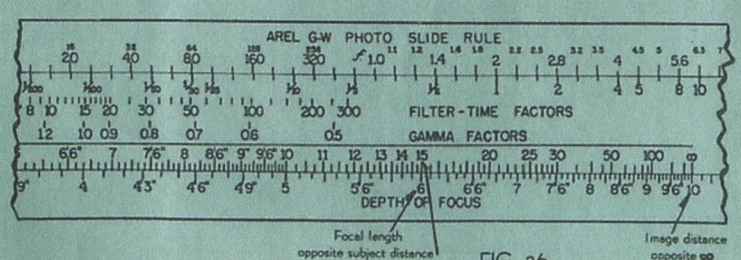

FIG. 26

Notice that the numbers of the DEPTH OF FOCUS scale may be interpreted as inches or centimeters instead of feet.

AMERICAN STANDARDS ASSOCIATION, A.S.A., FILM SPEEDS

	KODAK	D	T	ANSCO	D	T	DUPONT DEFENDER	D	T
35 MM. AND BANTAM	Super XX	100	64	Ultra Speed Pan	100	64	Superior 2	50	32
	Plus X	50	32	Supreme	50	32	Superior 3	100	64
	Panatomic X	25	16						
ROLLS AND FILM PACK	Super XX	100	80	Superpan Press	100	80			
	Plus X	50	32	Supreme	50	32			
	Verichrome	50	25	Plenachrome	50	25			
	Super Ortho-Press	100	50						
SHEET FILMS	Tri X Pan	200	160	Triple S Pan	200	160	Arrow Pan	100	64
	Super XX Pan	100	64	Superpan Press	100	64	XF Pan	50	32
	Panatomic X	32	20	Isopan	50	32	XF Ortho	50	20
	Ortho X	125	64	Superpan Portrait	50	32	Ortho 7	100	64
	Super Panc. Pr. B	125	100	Triple S Ortho	125	64	Pentagon	25	10
	Super Panc. Press Sports Type	250	200	Super Sensitive Plenachrome	50	25	F. G. Pan	25	16
	Portrait Pan	50	32	Commercial Pan	25	12	Portrait	32	20
	Super-Ortho Press	100	50	Commercial Ortho	25	12	Commercial	16	4
	Super Speed Ortho Portrait	50	25	Commercial	25	6			
	Commercial Ortho	32	10						
	Commercial (and Matte)	25	6						
COLOR FILMS	Kodacolor roll	25	...	Roll and 35 mm.					
	Kodachrome Prof.			Daylight type	10	...			
	Daylight type	12	...	Tungsten type		10			
	Type B	5*	8	16 mm.					
	Kodachrome			Daylight type	10	...			
	Daylight type	10	4*	Tungsten type		12			
	Type A	10*	12	Sheet film					
				Daylight type	8	...			
				Tungsten type		8			

*With recommended filter.

14. GAMMA CONTROL INFORMATION

Correct exposure is only a preliminary step in the whole sequence of photographic procedure which leads ultimately to the positive print on paper. The inherent contrast of photographic paper is much less than that of film. For this reason, some papers are made in several degrees of contrast. In other papers, among which are some of the best, only one grade of contrast is manufactured. The photographer should usually control his technique to produce negatives which match some established normal paper contrast. One of the two main factors influencing this negative control is (1) the *brightness range of the scene* to be photographed. Little can be done about this variable, in daylight, except to measure it. To do this, measure the light reflected from the brightest object and the light reflected from the darkest object; the ratio of bright to dark is the scene brightness range. The other variable is (2) the *gamma* to which the negative is developed. The photographer can control this variable. The film manufacturer supplies development data, stating time, temperature and methods of agitation to produce the required gamma with proper film-developer combinations. The gamma value is obtained from the G-W PHOTO SLIDE RULE by setting the index of the FILTER-TIME FACTORS scale under the lowest light reading of the scene, which is set on the A.S.A. or Weston film speed scales, and then moving the hairline to the highest light value of the scene. The proper gamma to develop that particular negative to fit the normal grade of paper contrast is now found under the hairline on the GAMMA FACTORS scale.

In Fig. 27, a typical illustration of this manipulation is shown. The lowest light value of the scene was found to be four on a photoelectric exposure meter; the highest value was 128 on the same meter. The proper gamma to develop this negative is 0.8 and this value is found under the hairline.

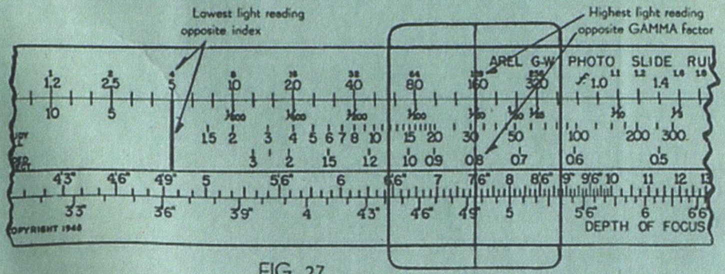

FIG. 27