EXPOSE FOR THE MIDDLE TONES

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Introduction

A good deal has been said and written since the yearly days of photography about "exposing for the Shadows . . ." for negative materials and "exposing for the highlights" for reversal materials. More recent thinking based upon the results of many years of practical testing has, however, led the writer to the conclusion that at least the latter hypothesis needs re-examining because its coverage is too narrow. A pointer in support of this, which is submitted for preliminary consideration, is that determining the exposure for reversal materials by any method which pegs the highlights alone covers only the particular case or more or less frontal subject lighting, and does not include the wider scope of directional side and *contre-jour* lighting.

The object of this brief contribution is therefore to put forward, in support of a rather different approach to this problem, a few observations which lead pointedly to the contention that the slogan (for reversal materials at least) ought instead to he: "Expose for the *middle* tones" ... or perhaps better still "Peg the middle tones". Associated with this, and also supporting it, is the fact that this basis is already implicit in the American Standard (and draft British Standard) covering the determination of film speeds for reversal materials[1]-[2]—though the connection may not be fully apparent without a little further thought and analysis.

If this contention is true for the general application of reversal materials, which inherently have much less effective exposure latitude for optimum results than applies to negative materials (including both colour and black-and-white in both categories), then the conclusion can hardly be avoided that at any rate for the general case it must be applicable to negative materials too. In saying this. there is no intention to quarrel with the modern trend to expose negative materials at the minimum level consistent with good overall tone reproduction when critically optimum resolution and freedom from graininess are required. But even in this more particular direction it is suggested that there is a very good case for adopting in practice an approach which is at once *simple and positive and sound in principle* (even if it is slightly limited in application coverage) rather than one which, although also simple and actually having a wider range of application, is less precise and involves the acceptance of a relatively uncontrolled proportion of mediocre results. The two methods referred to are (a) the *fully compensating* incident-light method and (b) the ordinary reflected-light approach (using either a , separate or built-in integrating reflected-light t exposure meter applied in the conventional way).

It has been found that to achieve the former advanced incident-light method behavior without complication, the incorporation of a *cardioid*[5] incident-light receptor is necessary; which must be treated as an idealized synthetic subject which merely means that it must be used in the same (maximum intensity) lighting as that falling on the subject and must be oriented to "look" in the subject-to-camera direction.

Let us, then, first of all consider the problem as it applies to reversal materials—and in particular to colour transparencies produced by this process, since the latter especially continue to enjoy considerable popularity in this field despite their, requiring the more critical exposure determination.

Scene and Film Range Relationship

The first aspect to examine is the relationship between the overall range of the scene to be photographed and the acceptance range of the film material for optimum tonal and colour reproduction.

Starting with a "scene" comprising a more-or-less single and uniform middle tone (e.g., one consisting mainly of, say, green grass and/or average red brickwork in frontal lighting); the result of directing towards such a scene a properly calibrated reflected- light exposure meter (separate or built-in) will obviously be satisfactory because a simple front-lit middle-tone subject such as this is, in effect, the "calibration condition" upon which by definition and specification the integrating reflected-light exposure meter is based. It will, in fact, no doubt be appreciated that the use of this well established approach when applied to any short-range scene will cause the predominant tonal area to be reproduced at or near to the logarithmic mid-point of the reversal material's reproduction range. This is, of course, entirely in order if the scene itself is a predominantly mid-range one as instanced above, or is one which would best be reproduced in the middle of the reproduction material's range anyhow.

Likewise if, for the exposure determination of the same middle tone short-range subject, a correctly calibrated and properly oriented incident-light meter is used (any type of incident-light receptor is adequate for short or normal range subjects in frontal lighting), then precisely the same exposure indication should be obtained; again because this is; what is required and implicitly follows from the calibration basis included in appropriate incident-light meter specifications.

If, however, our short-range subject is, for| example, an open snow scene (i.e., an "all bright" subject) instead of a middle-tone one, then clearly the reflected-light meter approach (since it will still result in a middle-tone reproduction) will underexpose such a scene: whereas the incident-light method will reproduce all the scene tones at their correct levels. The opposite effect (over-exposure with a reflected-light meter) will result in the case of "all dark" subjects."

When, however, the scene range expands—but in one direction only—from our original middle-tone say in the highlight direction which is the more common (e.g., including now an appreciable sky area of *well as* a green field or red-brick house), it does not need much imagination to appreciate that while the reflected-light meter needle response will rises accordingly, the incident-light meter, response will still not have changed. Since the latter unchanged meter reading is obviously what is required (the middle-tone green grass, etc.. still needs to be reproduced in the transparency where it was before and the lighter sky area needs to be reproduced at its own appropriately higher tonal level), the integrating reflected-light meter reading is again wrong (i.e it will again cause some measure of under-exposure) whereas the incident-light meter continues to give the correct result.

These examples are, of course, only simple cases of the well-known inherent weakness of the integrating reflected-light meter—hence the manufacturer's usual instructions to "tilt the meter slightly". to avoid including in the reading too much skylight or other large or unduly intense highlight area or light source. But *how much* we are supposed to tilt the meter downwards (or sideways) is often the problem! Probably the most significant safeguard which protects the inexperienced photographer to practice (when using a separate meter, or a built-in one) is the extensive inclusion in the majority subjects photographed in the garden or on holiday of relatively large middle-tone areas on the one hand (already referred to above) and on the other the prevalence of fairly average tonal distribution in such scenes coupled with the simple (more-or- less frontal) lighting usually advised and largely adhered to. Both of these influences tend to "pull" the meter reading (rightly in *these* cases) towards the "average subject" basis for which it is designed and calibrated.

So far then, although the incident-light meter is already beginning to show an advantage, this is usually outweighed under frontal lighting conditions by the ability of the reflected-light meter nearly always to be used at the camera position—which indeed it has to be anyway in the case of built-in meters with fully automatic coupling. The yield of reasonably satisfactory results from this approach seems to be of the order of about 80%. provided that the over-all scene luminance range is kept within reasonable limits.

At this point it should be emphasized that the maximum effective scene range (i.e., at the focal plane) in more-or-less frontal (directional or diffuse) lighting is of the order of 25 to 1 since this corresponds with the maximum inherent luminance (surface brightness) range from a directly illuminated diffuse white surface down to a similarly illuminated diffuse black one (all coloured surfaces, of course, coming in between from a tonal—and therefore exposure—point of view). This happens to coincide closely with the overall acceptance range of reversal colour film for satisfactory reproduction in practice; which provides a second significant reason why so many satisfactory results are obtained by inexperienced photographers even when they fail to tilt the meter (or coupled-camera meter) sufficiently. The point here is that *under such simple lighting conditions* any overspill of scene range beyond the film acceptance range which does occur (owing, say, to the presence of *small* shadow areas in the scene) is usually not noticeable and can normally be neglected.

Now. however, we come to the attitude of the more advanced photographer (professional or amateur) who knows that the most striking and attractive results are not infrequently obtained by deliberately photographing subjects whose overall ranges do extend beyond the reversal film's nominal acceptance range.

Long-range Scenes

In practice long-range scenes are almost always associated with, and result from, the incidence of, directional side or back lighting, Still assuming the same light source intensity as before, the effect of such directional side or *centre-jour* lighting is obviously to introduce more-or-less strong shadows. The shadowed areas themselves can, of course, also include objects having a full luminance range from white down to black. While the brighter shadowed surfaces may well overlap some of the darker directly illuminated surfaces, the darker shadowed ones will not and this partial double-range effect can easily expand the overall range (from the directly illuminated 25 to 1) *downwards* by another 16 to 1 or so (i.e., by the equivalent of up to about four stops) under outdoor cloudless conditions in strong back lighting; giving an overall range of as much as 400 to 1 in some instances (see Fig. 1). Any directly illuminated diffuse white surfaces in the scene which can be "seen" by the camera will still have the same tonal level and significance that they would have in the previously considered front-lit scene, but at the lower end of the scale the additional range of (shadow) tones introduced by side or back lighting will also need recognition in practice for both objective and subjective reasons.

Objectively, detail in the shadows cannot merely be ignored by simply continuing to "expose for the highlights" as on the old basis. Subjectively, too, any side- or back-lit subject which is reproduced without recognition of the shadowed areas in some measure not only "looks wrong" but in practice also needs a progressive exposure increase in line with the increasing picture *area* ratio of "directly illuminated" to "shadowed" surfaces: In other words, the more the scene lighting angle increases (causing the shadows to get larger and larger relative to the total picture area, and the directly illuminated highlight, areas to become smaller and smaller) the greater the" exposure increase needs to be to give a "correct looking" result. This, of course, is entirely in line with common experience, but the optimum law connecting lighting angle with the increase of exposure needed to maintain consistent and subjectively satisfactory results throughout has only recently been developed.

Using an accurately calibrated flat-window incident-light meter (and camera), the exposure increase needed to give this subjectively optimum result was determined for a great many different types of scene and lighting conditions by a long-term testing program (over a period well exceeding ten years, in fact), and in practically every case the optimum exposure was found to be just about logarithmically halfway between the "highlight " (sun-direction reading) exposure and that *which* would be necessary if the exposure were to be based entirely on the light falling on the shadow side of the scene alone (camera-direction reading). This, briefly, resulted—as an interim' measure—in the introduction some years ago of the "duplex" (or "double reading") incident-light method or, alternatively, the "half angle" incident-light method applicable by more-or-less "flat window" incident-light meters; both of these methods having been extensively recommended in recent years for the exposure of colour reversal materials in particular. Eventually, however, the much simpler and more quickly applied *fully compensating "cardioid"* incident-light receptor was developed which is designed to give *the same photographic result but with a single camera-direction reading*, this method also, of course, having to be applied in the same maximum lighting as that falling on the subject.

Conclusions

It will therefore be seen (hat the fully-compensating method of exposure control is also in line with the earlier "duplex" method, based on *the middle way* between "exposing for the highlights" and "exposing for the shadows"; which in effect means sharing any excess scene range equally at both ends of the scale. To put it more simply still; it is based fundamentally on "exposing for the *middle* tones" or - perhaps easier to remember as a slogan—on *"pegging* the middle tones" . . . which brings us back full circle to the point where we started.

As was mentioned briefly at the beginning of this contribution, a study of the recently introduced U.S.A. (and current British draft) Standards covering the determination of film speeds for reversal materials will show that these are based specifically on the logarithmic mid-point (E_m) of the practical range of the reproduction material's sensitometric characteristic curve; which I suggest also implicitly supports the adoption of the middle-tone approach, at least for these materials. (The writer nowadays almost invariably uses this method for negative materials (monochrome and colour) as well, and would not revert to any other except in special cases which call for the use of an exposure photometer). Fig. 1 includes the basic speed derivation curve from the above mentioned Standards, together with additional data in line with the present discourse.

In passing it might also be mentioned that the inclusion in future exposure meter Standards of appropriate data relating to the cardioid performance of fully-compensating incident-light exposure meters is already receiving attention; and the additional aspect of the different calibration equation constant applicable to such meters (i.e., higher by about the equivalent of two-thirds of a stop compared with that prescribed in the relevant section of the current A.S.A**.** exposure meter Standard) is. of course, also under review.

Before concluding it might be helpful to draw attention to the rather interesting parallel with sound reproduction which this investigation into photographic exposure control has revealed. This relates to the well known "cardioid" microphone-which has its maximum uni-directional sensitivity at 0° (i.e., axially in front of it), 50% sensitivity at 90°, then falling rapidly as the reversed axial direction is approached until it reaches zero at 180°. Sensitivity-wise the cardioid incident-light receptor behaves in the same way in respect of uni-directional incident-light, this characteristic providing the required correction function as already indicated.

To summarize, the translation of this theory into practice (which in this investigation was in the reverse order) will have been seen from the projected colour slides' and from Fig. 1 in diagrammatic form, to result in the correct reproduction *at all lighting angles, directional and diffuse,* of the *middle* tones. Firstly middle-tone short-range subjects are reproduced in the middle of the available film range, leaving unused tonal capacity at both ends of the film reproduction scale; the same approach also correctly pegging "all bright" and "all dark" short-range scenes at their appropriate tonal levels (these scene categories nowadays calling for little if any "contrast improving" correction because the longer scale range of modern reversal materials renders this less necessary). Secondly, normal full-range front-lit subjects in bright lighting are reproduced to occupy the whole of the effective film range. Thirdly, long-range subjects (progressively longer as the lighting angle increases) are reproduced to "spill over" equally beyond the film acceptance range at both ends: i.e., the middle normal-range "slice" of the longer overall scene range occupies the full film reproduction range, and the extreme highlights and the extreme shadows both overspill progressively more and more (but still more-or-less equally at both ends of the scale) as the lighting angle increases.

In order to check the validity of the above "middle tone" criterion in practice for application to reversal colour materials of different types and manufacture, a further systematic testing program has been conducted during the past summer using two similar .camera bodies with accurately calibrated shutters especially aligned with one another for this investigation. A single lens with an accurately calibrated lens aperture scale was used on both camera bodies. Numerous exposures were made covering a wide variety of different types of scene and subject lighting conditions using the daylight versions of Kodachrome IT, Kodachrome, Ilfochrome and Agfacolor 35mm films; in some case the same scene being photographed on all four films, and in others on two, using Kodachrome II as the monitor throughout. The slides illustrating this contribution during the symposium were all selected from these and were typical of the results as a whole.

Using the manufacturers' own film speed ratings, all the exposures were determined with a Weston Master IV exposure meter fitted with a Master IV Invercone; the fully-compensating (cardioid) performance of the latter (and the Master V Invercone, which is identical) representing the first commercial outcome of the development work and field testing programs referred to in this paper.

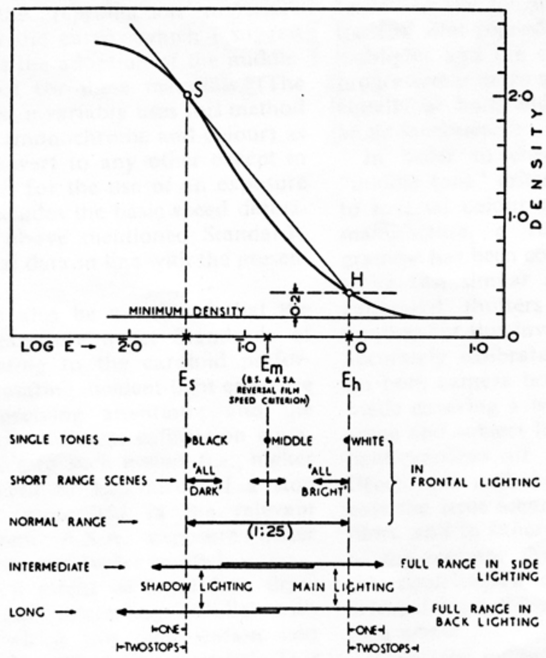

Fig. 1. Film speed criterion curve for reversal colour materials, with various centrally disposed scene ranges added to the Log-E co-ordinate