COLOR PHOTOGRAPHY OF BIRDS

Over a year ago I described a synchroflash technique for making black and white photographs of birds.[1] The advantages of this method over a dependance on natural light were given. It was shown that with one flash lamp two feet from the subject apertures which normally would admit 1/20 to 1/40 the required light are possible at any given shutter speed. Photographs having great depth of field can be obtained in which the birds are identifiable, are not out of focus or blurred, and in which high aesthetic standards are maintained.

For the past two summers I have been photographing birds in color. The reasons for attempting color photography were several. In the first place the identification of many species of birds is entirely dependent on their color. In the second place it seemed possible to me to make a more faithful record of American birds by color photography than has been accomplished by painting. Since color prints were my aim the most logical method to use seemed at first to be that embodied in the color camera,

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1 Making Bird Studies, by Eliot Porter, Photo Technique, March, 1940.

for with this instrument separation negatives are made directly from the subject without any intermediate steps thus eliminating many cumulative errors that might be involved in the making of prints from transparencies. However, after some experimentation and further consideration of the problem I concluded that this is not the case. Color film may be exposed in any standard view camera having adjustments, not possible in a color camera, which greatly aid obtaining maximum depth of field. Separation negatives should be processed under the most exacting conditions for best results, while these conditions are rarely realizable in the field. Separations from transparencies, on the other hand, need not be made at once but can await the time when a suitable laboratory is available. The last and most serious objection to a color camera is that its filter factors are permanently fixed, probably at some compromise values necessitated by the construction of the optical system or to allow the use of different makes of film. When working with transparencies the filter factors can be precisely determined experimentally for the film and light source used.

When exposing Eastman Kodachrome film much greater precision is necessary in determining the exposure and adjusting the positions of the flash lamps than for

ordinary film. On Eastman Super-XX sheet film, Weston 64, good exposures are obtained at 1/200 second and the marked relative aperture f/45 with one G.E. No. 21 flash lamp in a reflector placed two feet from the subject. On the basis of this data the probable exposure of Eastman Daylight Type Kodachrome, Weston 10, may be calculated. The result is, with all other factors unchanged, a relative aperture in the neighborhood of f/18. Daylight Type Kodachrome requires the use of G.E. No. 21B daylight lamps. The blue lacquer on these bulbs reduces their output by 66 per cent but since for best lighting two lamps should be used, one on either side of the camera, the total output is diminished by only a third which can be compensated for by placing the reflectors a few inches closer to the subject. It is not safe, however, to depend on this calculation for correct exposures of Kodachrome. The final determination of the exact relative aperture must be made experimentally. The reason for this is that the exposure latitude of black and white film is much greater than that of color film. Thus, for Eastman Super-XX sheet film the exposure range is approximately 1 to 100. The brightness range of the significant parts of the subject is rarely greater than 1 to 16. Therefore, variations of exposure of 6 times or 500 per cent are permissible. On the other hand divergencies of more than

plus or minus 25 per cent from the correct exposure for Kodachrome will result in unsatisfactory transparencies.

The exposure data which follows is applicable only to the particular apparatus for which it was determined. It can serve merely as a rough guide for the establishment of the correct exposure for any other equipment. The camera which I use most frequently is a 9 x 12 cm. Linhof equipped with an 18.5 cm. focal length Zeiss Protar lens in a Compur shutter. Two G.E. No. 21B flash lamps in eleven inch, aluminum, Victor reflectors are placed one on either side of the camera with their rims 18 to 20 inches from the subject. The lamps are ignited by a 45 volt radio battery. The circuit is closed by the operation of a Kalart Micromatic synchronizer, which in turn is released by a special remote control trigger described elsewhere.[1] The exposure is always made at an 8 mm. aperture and 1/200 second. When photographing small birds the average bellows extention is 26 cm., therefore, the true relative aperture is approximately f/32. The film is Daylight Type Kodachrome.

The simplicity of the method may give the impression that photographs of birds are easily and quickly made.

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[1] Loc.cit.

But there are many factors, some within the control of the photographer and some not, that contribute to failure. The controlable factors are those pertaining to the equipment; those beyond control, to the subject. Since the conditions are much more exacting for the proper exposure of color than black and white film a lower percentage of success with the former is to be expected.

In discussing the causes of difficulties those that involve equipment will be considered first. Of all troubles encountered synchronizer failure is of major importance. All synchronizers intended for use with foil or wire filled bulbs are devices for starting shutter action after a sufficient delay following the closing of an electrical circuit which includes one or more flash lamps. It is this delayed shutter action, necessitated by the characteristics of the lamps, which is at the root of most of the difficulties. The mechanisms of most synchronizers are either mechanical or electro-magnetic. When a mechanical instrument, such as that manufactured by the Kalart Company, is out of synchronization it is generally found, upon testing, that the shutter action is not sufficiently delayed in respect to the time of the flash. Often it is very difficult to increase the delay enough to accomplish perfect adjustment. The same situation prevails in the case of the two electro-magnetic instruments with which I have had experience.

They are the Heiland "Sol" and the Mendelsohn Universal synchronizers. But with these, and presumably with all other similar electro-magnetic devices, there is a further complication which makes them even more troublesome than their mechanical counterparts when used for this kind of photography. The speed of action of the electro-magnet depends on the current through the coil. Any resistance introduced into the circuit, whether in series or in parallel with the magnet, will change this current and consequently effect the adjustment of the synchronizer. Since flash lamps represent such resistance the adjustment is not, theoretically, the same for one lamp as for two, and proper synchronization for both black and white and for color film is not at the same time possible. The remote control switch cord, which should be 50 to 100 feet long, is a large resistance, which necessitates using a higher voltage source or one of special design. The Heiland Research Corporation has introduced a booster box containing a 4.5 volt, 80 amp. battery. It is constructed to operate the synchronizer and to ignite one or several lamps by a remote control switch without appreciably influencing the voltage drop and, therefore, without effecting the synchronizer adjustment. The timing of flash lamps is also influenced by voltage and resistance changes[2].

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[2] Characteristics of Photoflash Lamps by W. E. Forsythe and M. A. Easley, Photo Technique, May 1940

An increase in voltage across the filament or a decrease in the circuit resistance will decrease the time from closing the circuit to the peak of the flash. These relationships are made clearer by consideration of the following equations derived from Ohm's law. Figure 1 is a diagram of the circuit in which E is a voltage source, R_1 circuit resistance in series with the electro-magnet, R_2 the resistance of the electro-magnet, R_2', and two flash lamps, R_2'' and R_2''', in parallel with it. E_2' is the voltage across the lamps and the magnet. I_2' is the current through the magnetic coil.

$$1 \qquad I_2' \frac{E}{R_2'} \frac{R_2}{R_1 R_2}$$

$$2 \qquad E_2 E \frac{R_2}{R_1 R_2}$$

From equation 1 we see that increasing R_1 as by adding a remote control switch decreases I_2' and, therefore, makes necessary a readjustment of the synchronizer. A decrease in R_2 by increasing the number of lamps in parallel also decreases I_2'. Equation 2 shows us that the voltage across the lamp filaments is effected in a similar way by changes in R_1 and R_2. With mechanical synchronizers the voltage source is used solely for igniting the lamps and, therefore, is not subject to excessive loads. By using a high voltage battery they will operate satisfactorily for a long time. Finally,

synchronizers which attach to the shutter through the cable release opening have another disadvantage. Since they are not rigidly fastened but are held in place only by a short nipple or tapered thread the angle at which the plunger enters the shutter is subject to some variation. The adjustment of the synchronizer for many shutters depends to a large extent upon this angle. Therefore, an adjustment which is perfect for one position of the camera is imperfect for another. Tilting the camera up or down or extending the bellows may alter the synchronization by displacing the center of gravity of the synchronizer from its position at which the adjustments were made. It is advisable to hold such a synchronizer in one position as rigidly as possible by means of a clamp or spring.

The camera shutter is another source of failure in making either black and white or color photographs. Dirt or badly worn parts seriously effect the mechanism of the action so that its performance becomes erratic or is completely thrown out of synchronization with the flash lamps. It is obvious that in any kind of photography best results cannot be obtained with a shutter which is not clean and in good working order.

The flash lamps also are occasionally responsible for faulty exposure. Although they generally perform with great uniformity, lamps are infrequently encountered which

do not ignite at a low voltage but one well above the limit specified by the manufacturer. For this reason too I prefer to use a voltage considerably higher than the minimum recommended. When photographing with ordinary film if a lamp does not ignite the film can be used again since the exposure due to natural light is too slight to be effective. However, with Kodachrome when only one of two lamps ignites the film is sufficiently exposed to be ruined. Another infrequent fault of the G.E. No. 21 lamps is incomplete combustion of the foil, pieces of which are left adhering to the inside of the glass after ignition. These pieces act as screens cutting down the full effectiveness of the flash. Altogether there are about one per cent of these faulty bulbs.

Variations in color rendering in Kodachrome, which has been correctly exposed, occasionally occurs, due possibly to differences between different lots of the film, to slight changes in the processing conditions, or to variations in the blue lacquer on the No. 21B lamps. Thus, some Daylight Type films, all of which were exposed identically on the same day to the same subject, may be distinctly bluer than others. These variations are generally not very noticable. However, when Type B Kodachrome is used faulty color rendering is more serious. The use of Type B film has not up to this point been mentioned because of special considerations involved. It will now be discussed.

Type B Kodachrome, which is balanced for a color temperature of 3200° K, may be used for making synchroflash photographs of small subjects close to the camera, even though they are in bright sunlight, without danger of faulty color rendering on this account. In the instruction booklet for Kodachrome Professional Films packed with each box of Kodachrome is given an exposure table for synchroflash photography. For exposures at 1/200 second with one G.E. Mazda Photoflash Lamp No. 21 (clear bulb) the guide number 45 is given. With a lamp-to-subject distance of two feet the relative aperture is approximately f/22. I have found empirically that for my apparatus using two lamps 20 inches from the subject a marked relative aperture of f/22, or, taking the bellows extention into account, a true relative aperture of f/32 gives correct exposure. Let us now consider the exposure of Type B film to subjects in bright sunlight. The brightness of a colored object such as green leaves in noon summer sun is about 200 candles per square foot. Therefore, Type B Kodachrome, Weston speed 6, requires the relative aperture f/2.8 at a shutter speed of 1/200 second. Since in practice exposures are made at f/32, a relative aperture which admits only 0.77 per cent as much light as the larger aperture, it is apparent that the film will not be appreciably

effected by sunlight. To express this relationship in other terms, the brightness of an object for correct exposure of this film at f/32 and 1/200 second must be approximately 26,000 candles per square foot.

It is now clear that any faulty color rendering which occurs in Type B Kodachrome used for synchroflash photography of birds is not due to the admixture of sunlight with artificial light. There are, however, other obvious causes of poor color. The Kodachrome instruction booklet specifically recommends the use of the Wratten No. 2A filter with Type B film and G.E. Mazda Photoflash Lamp No. 21. This recommendation is also made by the General Electric Company and as far as I know was never changed during the time when the General Electric Company were covering their lamps with a yellow lacquer, the presence of which never served any useful purpose. Type B film exposed through the 2A filter with these lamps was much too yellow, without the filter much too blue. When questioned directly the Eastman Kodak Company admitted that the 2A filter was not correct and recommended as a compromise the CC-15 filter which transmits slightly too much violet light. Recently the General Electric Company has changed the lacquer so that the 2A filter gives much more nearly the right color compensation, but still it is not correct. The same

subject photographed on both types of film is quite differently rendered. On the basis of subjective judgement the rendering by Daylight Type film seems the best. It is to be hoped that the Eastman Kodak Company and the General Electric Company will in the future adopt a policy in regard to such recommendations which will not mislead their customers.

We now come to the consideration of those factors pertaining to the subject which contribute to failure. The most important of these is motion of the birds. Even though the photographs are taken at 1/200 second it is necessary to be very careful to make exposures only when the birds are not moving otherwise they will be blurred and fine detail will be lost. Regard should also be given to the position of the birds in relation to the field of the camera. If this factor is neglected the photographs obtained will not show the birds to best advantage and the composition will be poor. It is sometimes impossible to get good pictures of a particular bird because it will not come to its nest from the most favorable direction. Bad weather also interferes with bird photography. Not only does rain make picture taking almost impossible but wind spoils many exposures because of motion of foliage, the bird's feathers or even the whole subject.

Finally, many bird's nests are plundered before they can be photographed.

There are two lines of probable future development that promise solutions of many of the above discussed difficulties of synchroflash photography. First, there is the recent introduction of the General Electric SM flash lamps[3], which, having a much shorter ignition time lag, greatly simplify the problem of synchronization. Though their light output is much less than the foil filled lamps their small size makes possible the use of more efficient reflectors. Also since they burn faster a larger percentage of their output is used at high shutter speeds. Second, development of the Edgerton high speed strobotron flash unit in the direction of greater light output and more compact units may eventually do away with all failures resulting from motion. There seems little doubt that high speed photography with artificial light will assume ever greater importance in many photographic fields. Nature photographers should not neglect these inovations. The Eastman Kodak Company has just announced a portable Kodatron unit, which, when used with a special film called Kodatron Panchromatic permits exposures of small subjects

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[3]The New SM Flashlamp, by Don J. Mohler, Photo Technique, April, 1941

at the smallest apertures. The color temperature of the flash tubes is said to be 5600° K or very nearly that for which Daylight Type Kodachrome is balanced. The correct aperture for exposing Kodachrome will have to be determined empirically.