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COLOR PHOTOGRAPHY — METHODS AND APPLICATIONS IN BIOLOGY

RALPH O. MARTS

Color photography by the screen-plate method belongs to the additive processes. The principle is based upon the fact that all color variations can be obtained by the mixing of the three primary colors — red, green and blue.

It is not the purpose of this paper, however, to present a discussion of various screen-plates, but rather to show some of the results which may be obtained by the use of such media. The Lumiere Autochrome Plate or the Agfa Color Plate, either of which may be easily obtained from photographic supply houses, can be used for the taking of natural color transparency pictures with one single exposure. Agfa plates were used by the writer. It is a well known fact that the Agfa Color Plate is in most respects entirely analogous with the Autochrome, both in its preparation and use. However, by reason of the fact that its color separation screen is composed of droplets of pure color dyes instead of dyed starch grains the Agfa color-screen transmits a higher percentage of incident light. The separate elements of this screen are arranged in an irregular mosaic of extremely fine particles which are colored red, green and blue respectively. When looked through, light from the individual elements undergoes mixing in the human eye and the plate shows a neutral gray color. The diameter of the individual color particles averages 12 microns or  $5/100,000$  of an inch, and there are more than 3,750,000 elements per square inch.

It is absolutely essential, in color photography more than in any other branch of the work, that the lens should be corrected so that all light rays are brought to the same focus. For photomicrographic work an optical system with apochromatic objectives, aplanatic condensers and compensating eyepieces is necessary, as only with this arrangement can the plates produce all colors with the same definition.

The sensitive surface of the plate is an extremely thin panchromatic emulsion. As in the case of all other panchromatic emulsions the characteristic preponderance of the activity of the blue-violet light, and of the invisible ultra-violet rays exists, so that it is necessary to use a correcting or compensating filter which renders the colors correctly in their relative values. The color of the light is of the utmost importance, if there is to be a correct color rendering. The proper filters are supplied by the manufacturers for various light sources and must be used if good results are obtained.

The plates are always put into holders with the glass side towards the lens and the sensitive surface away from it. This must be allowed for in focusing and in all cases focusing should be done with the filter in position unless a special Zeiss A-Ducar Filter is used. In color work particularly a sharp image is very essential.

Agfa Color Plates require 60 to 80 times as long an exposure as ordinary plates with a rating of 250 H & D. Contrasty lighted pictures give the most pleasing results. An under-exposed plate is too opaque and its colors dull. When light is good the reproduction of the colors of the original is extremely true to nature. Thus correct exposures and good lighting are the essentials of good color photography, as color contrasts take the place of the usual light and shade.

The handling of color plates is not a matter of particular difficulty, at least for the worker accustomed to manipulating plates and solutions in the dark. The development of color plates is complete in three operations: (1) the development of the negative, (2) the reversal of the negative, and (3) the development of the positive. Solutions must be carefully prepared. Until the second step of the process a dull green safelight may be used, but it is preferable to use none at all or to use a desensitizer. If a desensitizer such as Aurantia or Pinacryptol Yellow is used then the entire procedure of development may be carried on with a clear red or orange light.

The screen-plate process is applicable in the reproduction of landscapes, portraits, objects, colored originals, and in technical and scientific work. It is in photomicrography that one of its most important applications exists, by virtue of the fact that it gives results which are remarkably true to the original and literally accurate. It is an indispensable aid to scientists, especially so, since even the worker lacking in artistic skill can make rapid records of transient subjects. Even under the best conditions the usual black and white photomicrographs, such as are generally employed, can only reproduce the color of an object in relation to its tonal value of brightness, and for this reason will not always give intelligible records. On the other hand, a photomicrograph in natural colors furnishes a substitute which renders a reproduction that is extremely true to the original.

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