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Multicolor Holographic Image Reconstruction with White-Light Illumination

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Color images have been obtained by wavefront reconstruction from a reflection volume hologram illuminated with ordinary white light. The hologram was recorded with coherent light at two wavelengths, 6328 Å and 4880 Å, from helium-neon and argon-ion lasers, respectively. Fig. 1 shows the white-light reconstructed image from such a hologram; the original subject was a color transparency. The hologram was formed in Kodak 649F emulsion.

A simple method of multicolor holography has previously been reported.¹ This method was based upon the formation of volume holograms which reconstructed by Bragg reflection from the planes formed in the emulsion. The wavefronts were reconstructed by illuminating the hologram with the same laser light used in recording and were observed on transmission through the hologram plate. With beam angles used to give transmission, the Kodak 649F emulsion was not thick enough to form holograms having the angular and spectral selectivities needed for good white-light reconstruction. A simple method for obtaining reflection volume holograms was recently described.² It showed that high-quality reconstructions could be obtained in a single color by reflection of white light from the hologram when, in the recording, the reference beam and the subject beam interfered at very large angles (160°–180°). Reflection holograms of two- and three-dimensional objects form an extension of basic ideas and work by Denisyuk³ in his generalization of Lippmann color photography⁴ and Gabor holograph.⁵

The ability to reconstruct multicolor holograms with white-light illumination adds a degree of flexibility to holography; we have now demonstrated the simplicity of obtaining this result. We have recorded reflection holograms both by "projection" and in diffused light, in a single color and in multiple colors. Fig. 2 illustrates one of the arrangements used to record the multicolor hologram. To insure minimum shrinkage of the emulsion in processing the hologram, we omitted the fixing of the emulsion as suggested by Ives.⁶ Any white light source rang-

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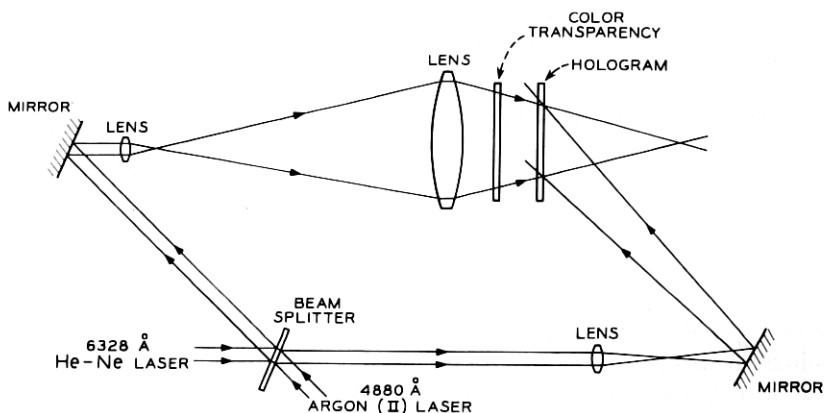


Fig. 2 — Arrangement for "projection" hologram formation.

ing from flashlight to sunlight can be used to obtain reconstructions as shown in Fig. 1. Particularly brilliant multicolor reconstructions were obtained when the light illuminating the subject was focused some distance behind the hologram plane. A similar result was reported in Ref. 2.

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Fig. 1 (Opposite page) — Early photograph of multicolor holographic image reconstructed with white light.

Note added in proof: The color of this photograph was shifted toward the blue. More faithful recording of the reconstructed wavefront has been obtained with a better choice of color film and angle of the reconstructing illumination.

