Yu. N. Denisyuk. *Present state and prospects for development of holography with recording in three-dimensional media.* The present state of the theory of holography with recording in three-dimensional media and its practical applications is reviewed. A theory that considers the interaction of the radiation with the hologram in first approximation is adequate for qualitative explanation of the mechanism by which the hologram reconstructs the spatial configuration and spectral composition of the wave fields of the radiation registered on it.[1] The same approximation can be used to establish the relation between the structure of the three-dimensional hologram and that of the three-dimensional phase object. It can be shown that in this particular case, the structure of the three-dimensional hologram coincides exactly with the structure of the object after the latter's spatial-frequency spectrum has been filtered. As a result of this filtration, the outlines of the object in the coordinate space are blurred and the object, as it were, reaches the volume in which the hologram is registered.[2] It was found on further generalization of the "three-dimensional hologram" concept that the ability to reproduce wave fields pertains not only to standing, but also to traveling intensity waves that arise on interference between radiations of different wavelengths.[3] This effect can be used to create various radiation transformers. Studies of the possibility of creating a three-dimensional holographic memory gave considerable impetus to the development of three-dimensional holography.[4] In particular, directional transfer of energy from one of the waves interacting in the volume of the hologram to another was observed in the course of research on the recording of information in a lithium niobate crystal.[5] It has been proposed[6] that this effect be used to correct wave-front distortions. The development of a so-called dynamic holography, which takes account of effects resulting from the fact that the recording medium responds to light directly during recording, was begun for this purpose.[7]

Among the efforts to develop a more rigorous theory of the three-dimensional hologram, we should note the theory of coupled waves, which has been used to obtain analytic expressions for the diffraction efficiencies of the simplest volume holographic gratings.[8] The next step in the development of rigorous theory of the three-dimensional hologram was application of the dynamic theory of x-ray diffraction developed by P. Ewald. Using this theory, it is possible to determine the field of the radiation reproduced by the hologram when the structure of the latter is highly complex.[9-11] Progress in the development of photographic materials on which holograms can be recorded will do much to determine practical applications of holography with recording in three-dimensional media. One of the most common applications of this type of holography is the creation of imaging holograms that admit of reconstruction by an ordinary source of white light.[12] Such holograms are recorded on ultrahigh-resolution Lippmann photographic plates developed specifically for this purpose.[13-15] Successful developmental work is being done on applications of three-dimensional holography involving the production of holographic optical elements for various purposes—holographic lenses for transfer of images recorded in bichromated gelatin layers,[16] dispersion elements for optical resonators,[17] etc. With the development of the appropriate recording media, we may expect three-dimensional holographic memories for computers[4] and devices for correction of wavefront distortions.[3,6]

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Sh. D. Kakichashvili. *Polarization holography.* In its original form, the holographic method assumed the possibility of recording scalar intensity distributions.[1,2] Such recording is actually a polarization comparison of object and reference fields, and remains such also for reconstruction. As a result, an essential characteristic of the field scattered by the object—its polarization state—is not reporduced in the reconstruction process. Schematic solutions of this problem have been unsuccessful due to distortions that it is impossible in prin-