

Report to the National Advisory Council on Historic Preservation

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Evaluation of the National Archives Program to Convert Nitrate Aerial Photographs of the United States to a Stable-Base Safety Film

ON 5 FEBRUARY 1981, a meeting was held at the National Archives and Records Service (NARS), General Services Administration (GSA), in Washington, D.C. to discuss its ongoing program of reproducing the 1930's and early 1940's nitrate aerial photographs of large areas of the country onto stable-base safety film, and to inspect the results of the new full-size (1:1), roll-to-roll conversions. The meeting was arranged by Thomas F. King, Director, Office of Cultural Resources, Advisory Council on Historic Preservation (ACHP), at the request of several professional organizations and agencies (King, n.d.). Present were Thomas R. Lyons of the National Park Service (NPS) on behalf of the Society of Professional Archeologists, Society for American Archeology, American Society for Conservation Archeology, National Association of State Archeologists, and American Society of Photogrammetry; Richard S. Williams, Jr. and Jane G. Ferrigno of the U.S. Geological Survey (USGS); Michael Quinn of the ACHP; and Charles E. Taylor of the Center for Cartographic and Architectural Archives, NARS, GSA. An inspection was undertaken in the interest of a diverse group of users who realized the scientific, historic, and legal value of this irreplaceable record.

The inspection team was given a brief tour of the facilities of the Center for Cartographic and Archi-

tectural Archives, a lengthy and comprehensive briefing on its functions and activities, and additional information on the history of problems associated with the conversion of the nitrate-base film to safety-base film. The hazards of storage and use of the inherently unstable nitrate film were explained in detail. We were then shown an example of the 1:1 conversions and were satisfied that very little resolution was being lost with this new procedure.

Specifically, we examined, on a light table, an original 9- by 9-inch nitrate aerial photographic negative and compared it with a full size (1:1) reproduction of it onto a safety film negative. The original negative was of poor quality and underexposed, being low in density and contrast. The duplicate negative was slightly denser overall and, upon inspection with a binocular microscope, appeared to be nearly identical to the original negative. Degradation of resolution was considered to be negligible. We concluded that the film duplication procedures now being followed by the National Archives are capable of faithful reproduction of even a poor original negative.

During the inspection we were shown examples of seriously deteriorated nitrate film exhibiting brittleness, bubbling, yellowing, separation of emulsion, and cracking. We were apprised of cases at

several archives where serious fires were caused by spontaneous combustion of nitrate film. The stages of nitrate film decomposition have been identified and are listed below:

"Principal stages of decomposition of nitrate film"
(from Raines, 1978)

First Stage—Amber discoloration with fading of the picture image (sometimes this discoloration shows as scattered spots).

Second Stage—The emulsion becomes adhesive and the film convolutions tend to stick together.

Third Stage—Rolls have annular portions which are soft, contain gas bubbles, and emit a noxious odor easily recognizable.

Fourth Stage—The entire film is soft, its convolutions welded into a single mass, and frequently its surface is covered with a viscous froth. A strong noxious odor is evident.

Fifth Stage—The film mass degenerates partially or entirely into a brownish acrid powder. This stage of decomposition is the most hazardous, as it has been proven to undergo spontaneous ignition at ambient temperatures as low as 106 degrees F (41 degrees C) and perhaps even lower (Cummings *et al.*, 1950).

Until all early nitrate photographs are converted to safety film, the problems of care and handling will only worsen. This includes not only aerial but also terrestrial (ground) photographs, such as the USGS extensive collection of historic photographs in Denver (Ostroff, 1977; Taylor, 1979; Williams, 1983). According to Charles E. Taylor of NARS, in due time all nitrate photography will reach the point of either irreversible deterioration or spontaneous combustion.

Private firms still storing but only infrequently using their own nitrate photographs could be offered incentives such as reimbursement for silver content or tax deductions for turning this material over to NARS or other appropriate repositories which could duplicate them onto safety film. Firms that still regularly use their nitrate photographs must be assured that a receiving archive will quickly convert their negatives to safety film and make them available for printing immediately. The public, institutions, and government agencies must be guaranteed that these important early (historic) photographs will be converted and preserved before the film deteriorates beyond the point of recovery onto safety film.

The NARS assumed responsibility over 20 years ago for the custodianship of early nitrate aerial photographs that Federal agencies could no longer use or care for themselves (Reed, 1980). In 1962, it began accepting transfer of large holdings (nearly 2.8 million images) of 1930's and early 1940's aerial nitrate photographs taken by five agencies: Agricultural Stabilization and Conservation Service (ASCS), Soil Conservation Service (SCS), U.S. Forest Service (USFS), USGS, and U.S. Bureau of Reclamation

(USBR). The collections were acquired with the understanding that eventually they would be reproduced onto 70-mm safety film (Deutrich, 1976). A comprehensive inventory of these nitrate aerial acquisitions was published in 1971 by Charles E. Taylor and Richard E. Spurr in a 106-page pamphlet entitled *Aerial Photographs in the National Archives* (Special List No. 25). In their 1973 revision, Taylor and Spurr state: "These photographs, of about 85 percent of the contiguous land in the United States, provide a unique record of the physical and cultural landscape of the country during the period just before World War II. They constitute an important reference aid for studying changes in the natural environment and in rural and urban development that have occurred since then."

Since the Taylor and Spurr 1973 revision, however, NARS has acquired nitrate aerial photographs from at least three additional Federal agencies and a large collection of early safety film coverage from the military (Corbyn, 1979b, c, d; Ehrenberg, 1979). The U.S. Army Corps of Engineers turned over 53,000 cut nitrate negatives (1:20,000 scale) taken between 1929 and 1938, including coverage of the Missouri and lower Mississippi River Valleys. In June 1983, Charles E. Taylor (oral communication) learned that the U.S. Army Corps of Engineers had uncovered numerous rolls of nitrate aerial photographs of the United States from the 1920's and 1930's. The exact nature and quantity of this newly discovered photography has yet to be evaluated. It is hoped that it can be turned over to the Archives, however, in time to be processed by the end of 1983.

The National Archives received 8,800 negative exposures of coastline areas of the United States taken by the U.S. Hydrographic Office in 1935. The Bureau of Indian Affairs (BIA) transferred to the Archives 700 exposures (1:31,680 scale) taken between 1935 and 1937 of the Navajo and Pima-Papago Indian reservation areas in Arizona. The NARS also recently acquired from the Defense Intelligence Agency (DIA) 15,000 rolls of safety film negatives taken by the Army and Air Force between 1942 and 1960, at scales of 1:15,000 to 60,000, of various installations and some urban areas. Yet to be transferred to the Archives is the considerable coastal coverage (all on safety film) taken by the Department of Commerce, National Ocean Survey in the 1930's (and later). Duplicate sets of these are housed in Rockville, Maryland, and in the Suitland Record Center, also in Maryland.

The NARS began systematic duplication of the nitrate-base historic aerial photographs soon after the 1962 and later acquisitions. It was encouraged by continued concern that the detail on this important, but rapidly deteriorating, coverage of the United States be preserved for posterity. At the recommendation of the U.S. Navy, the major duplication effort on the nitrate film, represented primarily by

a 9- by 9-inch format, was carried out on 70-mm (2.75- by 2.75-inch) safety film. The advantage of the smaller format was that it required less storage space, an important cost-effective consideration. The nitrate originals were also scheduled for destruction after copying.

Several scientists involved with the study of early natural and cultural landscapes became quite concerned about the quality and utility of the 70-mm reductions. In 1975, Ron Corbyn, a National Park Service archeologist doing photointerpretive research at the NARS with nitrate negatives scheduled for destruction, informed officials there that the loss of resolution observed on the counterpart 70-mm reproductions was serious (Corbyn, 1976). He subsequently brought this problem to the attention of several national and state archaeological organizations, universities, state and Federal agencies, private companies, the American Society of Photogrammetry, and the Advisory Council on Historic Preservation (Corbyn, 1979a, c, d, e; 1980).

The National Archives halted its 70-mm-conversion program in 1975, after 75 percent of the original 2.8 million images were copied (Rhoads, 1979a, 1979c). Eventually, NARS came to acknowledge that the 70-mm reproductions were "less than satisfactory" and did not retain enough original detail to satisfy current research requirements (American Association of Geographers, 1981; Reed, 1980; Rhoads, 1979b, e; Warner, 1980). In January 1979, it formally suspended its practice of printing directly from the nitrate aerial negatives because of fire codes and safety regulations (Corbyn, 1979c, 1979d; Deutrich, 1979; Reed, 1980). For some time the Archives explored the possibility of using larger, 105-mm (4.13- by 4.13-inches) safety film reproductions (Reed, 1980; Rhoads, 1979a, b, c, d, e) as a substitute, but decided on the 1:1 actual size (9- by 9-inch) copies in 1980 (O'Neill, 1980; Warner, 1980). The latter, although more costly, were easier to reproduce and preserved more original detail.

Unfortunately, an estimated 500,000 to 600,000 exposures of nitrate aerial photographs were destroyed before the 70-mm conversion program was halted in 1975 (Reed, 1980; Rhoads, 1979d). The coverages for the States of Georgia, Idaho, Illinois, Iowa, Kansas, South Carolina, South Dakota, Texas, and part of Oklahoma are preserved only on the reduced image 70-mm format safety film (Corbyn, 1979a, c, d). The nitrate aerial photographs for all of Utah and part of Washington were lost before any conversion in a 29 August 1977 fire (Ehrenberg, 1979) originating with nitrate motion picture film (Reed, 1980).

At one point, NARS agreed to transfer nitrate photographs, after their conversion to safety film, to states wishing to carry out their own duplication and storage (Deutrich, 1979; Reed, 1980; O'Neill, 1980). Prior to the 1:1 conversion program, one State, Michigan, secured an agreement for the transfer

and archiving of its own coverage (Bigelow, 1979). The NARS subsequently become concerned about liability in case of accident during transfer of the nitrate film. As a result of the February 1981 inspection of the new 1:1 conversions, we concluded that such transfers are unnecessary to ensure preservation of the images. In fact, in light of the excellent quality of the 1:1 conversions, the dangers of storing nitrate film, and the inevitability of continued decomposition, we see no reason to attempt to preserve the nitrate films after conversion.

The Department of Interior has six bureaus for which ready access to historic aerial photographs is important to a variety of research projects related to their missions and responsibilities. They are the USGS, NPS, USBR, BIA, Bureau of Land Management (BLM), and Office of Surface Mining (OSM). Both the USGS and the USBR have produced sets of nitrate aerial photographs that are listed in the 1971 and 1973 NARS pamphlets by Taylor and Spurr. The USGS, as mentioned previously, has a large number (approximately 100,000) of nitrate-base terrestrial, cut-film photographic negatives. This invaluable historic record is being stored at the USGS Photo Library at the Denver Federal Center until it can be duplicated onto stable-base safety film for use in research by agencies and the public. USGS involvement in the storage and duplication of nitrate-base film (aerial and terrestrial) has been reviewed by a number of individuals (Ostroff, 1977; Raines, 1978; Taylor, 1979; Williams, 1983).

During the past two years (1981-1983), the NARS made exceptional progress with the full size (1:1), roll-to-roll duplication of its nitrate aerial photography holdings. About 90 percent of this task is now complete. Except for approximately 40,000 cut nitrate negatives, equivalent to about 400 rolls, the NARS expects to have the remaining film duplicated by the end of calendar year 1983 (C. E. Taylor, oral communication, 1983). By this time, the Department of Defense (DOD) will have duplicated about 25 percent of the nitrate holdings (including the 1:1 safety film copy examined by the inspection team on 5, February 1981). The DIA reportedly did an outstanding job in the initial copying of nitrate film that was in the worst condition. During the past two years, the NARS also contracted directly with Photo Science, Inc. of Gaithersburg, Maryland and the Environmental Protection Agency (EPA) for duplication services. By the end of 1983, Photo Science, Inc. will have duplicated about 50 percent and EPA about 25 percent of the nitrate aerial photography (C. E. Taylor, oral communication, 1983).

Between 30 to 40 percent of the 1:1 film duplicated thus far is now available for printing. The remainder is being inspected and shelved and should be available by the end of 1983. Information may be obtained by writing to the following address: Center for Cartographic and Architectural Archives, National Archives and Records Service, 7th and

Pennsylvania Avenues, N.W., Washington, D.C. 20408. Requested print coverage can be delineated on 1:24,000-scale, 7¹/₂ minute quadrangle maps published by the USGS.

In summary, the 5, February 1981 evaluation of the NARS nitrate aerial photograph conversion program indicates that the full size, 1:1 duplication onto safety film is being carried out in a manner that should be acceptable to all current and future users of this photography. We recommended that the Archives convert the remainder of this extensive original coverage of the country in the 1930's and 1940's to full size safety film as soon as possible so that government agencies, institutions, and the public will have immediate access to these historic aerial photographs. We also recommended that it take steps to insure that the reproduction standards for the 1:1 copies examined during the inspection be maintained throughout the conversion process. The National Archives has conscientiously responded to these recommendations and will have accomplished a difficult and tedious task in a highly professional manner by the end of 1983. Their efforts are worthy of the highest commendation by all involved in the preservation and use of this historical aerial photography.

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