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ULTRA-HIGH-ALTITUDE PHOTOGRAPHY COMPILATION EVALUATION*

by

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CONTENTS

ILLUSTRATIONS

ABSTRACT

Black and white photography, taken at a flight height of approximately 117, 000 feet with a 6-inch focal length camera over a portion of Clark County, Nevada, was compiled into a topographic map with a Kelsh plotter. Analyses indicated that horizontal and vertical accuracy could be attained to meet National Map Accuracy Standards for compiling maps at 1:250, 000 scale and possibly at 1:62, 500

FOREWORD

This letter describes a feasibility study of stereoscopic compilation with ultra-high-altitude photographs. The study was conducted in the U. S. Geological Survey's Topographic Division under the direction of the Research Leader for Space Technology Applications. The experimental map was compiled by the Division's Branch of Special Maps, Silver Spring, Md. The testing and evaluation were performed by personnel of the Office of Research and Technical Standards at the McLean, Va. Research Center.

1.0 INTRODUCTION

For a realistic evaluation of a cartographic compilation system an analysis of the product of the system is necessary. Therefore, the logical approach in this study was to compile all planimetric and hypsographic features that could be seen in the stereomodels formed by these photographs and to test the compiled results for cartographic content and geometric accuracy.

2.0 PRECEDURE

2.1 Compilation

The photographs were takes at a flight height of approximately 117, 000 feet with a 6-inch focal length camera over a portion of Clark County, Nevada. The compilation instrument was a Kelsh plotter with a 760-mm optimum projection distance. Since the base-height ratio of successive exposures was much too small, the first, fourth, and seventh exposures in the sequence were used to form the pair of models used for compilation. This arrangement provided a base-height ratio of 0.67 and a model scale of 1:96, 000. The base-height ration normally used in the USGS for mapping with vertical photographs is 0.63. The planimetric features and 100-foot interval contours were drawn at model scale. Vertical and horizontal control was derived from published maps.

2.2 Testing

2.2.1 Map Content. --The compiled results, fig. 1, were compared with features shown on published 1:250, 000-scale and 1:62, 500-scale maps of the area for an evaluation of the cartographic content of the experimental map.

2.2.2 Accuracy. --Horizontal positions of selected well defined points on the experimental map were compared with positions of corresponding points on published maps or with known geodetic positions. Vertical accuracy was evaluated by comparison of photogrammetric elevations with published map elevations. The models were reset in a digitized Kelsh plotter after compilation

and semianalytical adjustments were made for several additional horizontal and vertical points to develop a stronger statistical test sample.

3.0 RESULTS

3.1 Compilation

The detail achieved in compilation of topographic shapes appears to be suitable for 1:250,000-series maps but not for 1:62,500-scale maps. The compiled drainage and cultural features were incomplete in some areas. Hence, the experimental compilation could not meet the content requirements for 1:250,000-series maps unless larger-scale photographs or other source data were used for adding detail.

Coverage--The two models covered a rectangular area approximately 27 miles long by 25 miles wide, equivalent in area to 12 - 7-1/2 minute quadrangles. See figure 2 for comparative coverage.

3.2 Accuracy

Based on photogrammetric measurememts at 36 test points (27 points measured by conventional Kelsh plotter and 9 by digitized Kelsh plotter) the vertical root-mean-square error was 24.5 feet. The horizontal root-mean-square error at the 9 test points was 63.5 feet.

4.0 DISCUSSION

4.1 Horizontal Accuracy

The limited test sample is not adequate for a reliable statistical evaluation of the horizontal accuracy of the compilation. However, the root-mean-square error of the points tested is sufficient to meet the requirements of the Natioanl Map Accuracy Standards for 1:96,000-scale maps. At this scale, National Map Accuracy Standards require that 90% of the points be within 150 feet of correct position. By statistical theory the root-mean-square error equivalent to this specification is approximately 91 feet.

4.2 Vertical Accuracy

The root-mean-square vertical error of 24.5 feet corresponds by National Map Accuracy Standards statistical criteria to a contour interval of 81 feet (24.5 x 2 x 1.65). If the allowable horizontal shift of 150 ft. was applied to the test points, this value of the allowable contour interval would be considerable lower, possible 50 feet.

5.0 CONCLUSIONS

Results of the limited research described above indicate that ultra-high-altitude photographs may be useful for compiling maps at 1:250, 000 scale and possibly at 1:62, 500 scales. However, more information is needed to determine the extent of their usefulness for mapping.

Because of their broad unit coverage, these photographs may be applicable in an aerotriangulation procedure which would provide data for orienting lower-flight-height photographs to be used for compilation. They may also be useful for compiling skeletal planimetric bases to which additional map detail may be added from other source data.

6.0 RECOMMENDATIONS

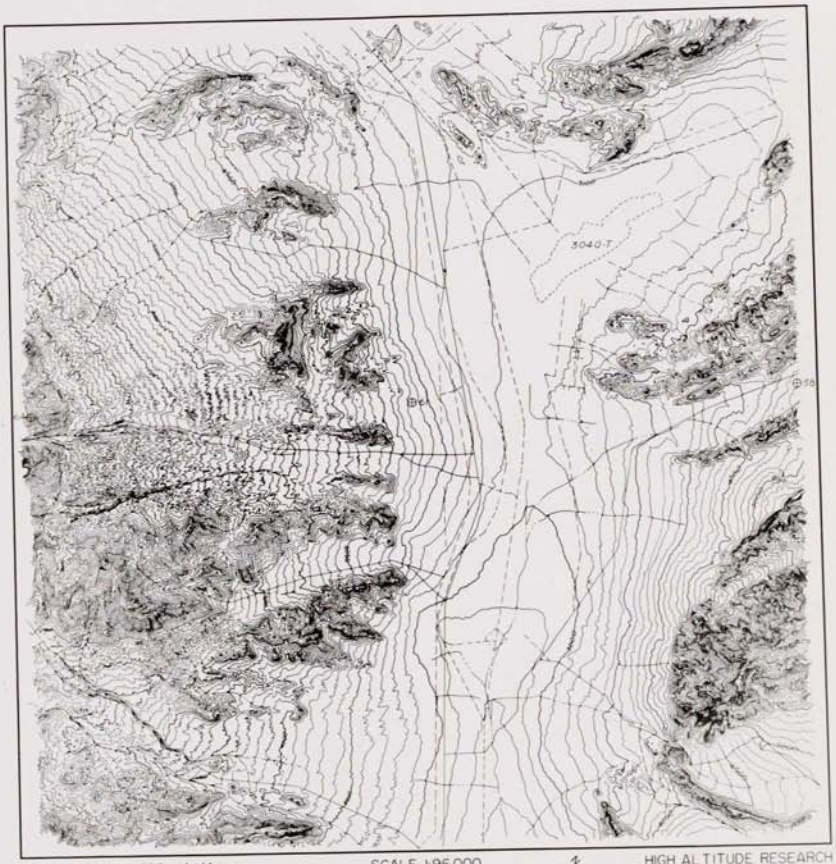
If this type of photography becomes readily available, further research is recommended to find ways to apply it effectively in map compilation. Further testing is needed along the following lines.

1. Obtain coverage over a large test-site for extensive accuracy testing.

2. Obtain coverage over areas with diversified cultural details to evaluate planimetric compilation capability.

3. Compile experimental maps with various plotters especially the high C-factor mechanical projection types.

4. Test the feasibility of using these photographs to perform aerotriangulation for large-scale mapping.



Compiled By Branch Of Special Maps
Topographic Division, U.S.G.S. · July, 1965
Photography · May, 1963

SCALE 1:96,000
Contour Interval 100 Feet
REPRODUCTION SCALE 1:222,700

HIGH ALTITUDE RESEARCH
NEVADA

Fig. 1

FIG. 1