

SYMPOSIUM: "PHOTOGRAMMETRY IN HIGHWAY ENGINEERING"*

Wilbur H. Simonson, Public Roads Administration, Presiding

The following three papers were presented:

	page
1. Research Investigation of the Use of Aerial Photography for Highway Location in Massachusetts— <i>Elmer C. Houdlette</i>	79
2. Photogrammetry in Highway Engineering— <i>H. J. Spelman</i>	86
3. Ohio Adapts Aerial Photogrammetry to Highway Engineering— <i>Ralph J. Lehman</i>	91

INTRODUCTORY REMARKS

Mr. Simonson, Public Roads Administration, Washington, D. C.

There are *three* universal languages:

1. The *science* of figures, expressed in the world-wide use of mathematics;
2. The *principles* of harmony, expressed internationally in music; and
3. The *art* of photography, expressed universally in pictures.

Most of us may appreciate the fundamental fact that these three forms of language are the groundwork for progress in international understanding and good will. But—do we ever stop to appreciate and recognize the fact that photogrammetry makes full use of all *three*, either *directly or indirectly*, when proper application of the principles and the art and science of photogrammetry is made?

If we *recognize* these *universal* relationships, then must we not recognize also the fact that *PHOTOGRAMMETRY* can do much to *simplify* some of our problems? Is there any doubt that when we *SEE* problems more clearly, we get a better *UNDERSTANDING* of them, and—as a result of better understanding of mutual tasks—*cooperative relationships* may be furthered and *better results* obtained?

Three national highway organizations recognize the potential contributions that the art and science of photogrammetry might make in the solution of highway engineering and related land-use problems:

1. The Highway Research Board, 2101 Constitution Avenue, Washington, 25, D. C.
2. The American Association of State Highway Officials, 1220 National Press Building, Washington 4, D. C.
3. The Public Roads Administration, Federal Works Agency Building, Washington, D. C.

The mutual assistance of these and other agencies is doing much for the improvement of engineering methods and procedures. It is realized that new tools are needed for new tasks. Up-to-date highway departments are now forced to make use of every modern tool for improving the location and design of highways, and for expediting the construction programs in every State.

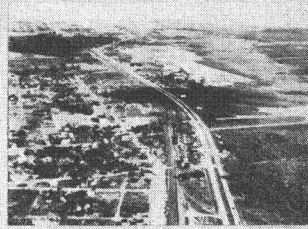
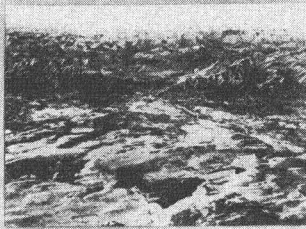
In 1943, the Committee on Roadside Development of the Highway Research Board initiated a study of the use of aerial surveys in engineering for complete highway development. For a report of this study, you are referred to pages 166-174 of the PROCEEDINGS of the Twenty-Fourth Annual Meeting of the High-

* Fifteenth Annual Meeting, American Society of Photogrammetry, Opening of Technical Session, Friday Morning, January 14, 1949.

way Research Board, December, 1944. This gives the historical background in the use of aerial photography for highways over a 20-year period. A résumé of more recent progress in some thirty States may be found also on pages 7 to 14 of the Report of the Committee on Roadside Development published in 1948 by the Highway Research Board.

The American Association of State Highway Officials has published articles from time to time in its Quarterly AMERICAN HIGHWAYS. An initial series appeared in the July and October, 1944, and the April, 1945 issues. An outstanding example of how aerial surveys expedite highway planning was presented by

AERIAL SURVEYS IMPLEMENT AND IMPROVE THE TRADITIONAL GROUND-SURVEY METHOD FOR MAKING HIGHWAY LOCATIONS IN FOUR STAGES



AERIAL SURVEYS PRODUCE A MINIATURE REPLICA OF FIELD CONDITIONS THAT:

1. FURNISHES A PICTORIAL RECORD OF TOPOGRAPHY AND LAND USE
2. BRINGS TOPOGRAPHY AND LAND USE INTO THE OFFICE FOR EXTENSIVE AND INTENSIVE STUDY
3. DEMONSTRATES THAT THE BEST HIGHWAY LOCATION HAS BEEN MADE

PUBLIC ROADS ADMINISTRATION
FEDERAL WORKS AGENCY

Courtesy Public Roads Administration.

Samuel Nelson, Deputy Chief Engineer, Palisades Interstate Park Commission, before the Committee on Road Design, AASHO, November 28-30, 1944, and published in the 1944 Group Meeting Book of the Association.

The Public Roads Administration has been using aerial photographs and topographic maps in its administration of highway work for many years. It may be of interest to point out that the first comprehensive use of aerial survey methods was made on the Mount Vernon Memorial Highway in 1927-1929 when the Public Roads Administration was charged by the Congress of the United States with the responsibility for completing this memorial construction in advance of

FIRST **AREA MAPPED** **STAGE**

○ A ← TERMINAL POINTS → ○ B

FOR RECONNAISSANCE OF AREA

AERIAL SURVEYS MAP THE AREA WHICH CONTAINS ALL POSSIBLE HIGHWAY ROUTES BETWEEN TERMINAL POINTS



1 - A WORKABLE SCALE IS ADOPTED.



2 - THE WHOLE REGION IS STUDIED.



3 - ALL POSSIBLE HIGHWAY ROUTES ARE DETERMINED.

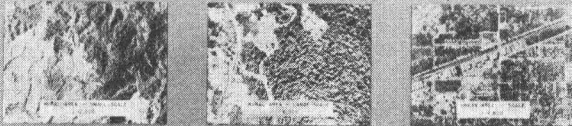
Courtesy Public Roads Administration.

ROUTE BANDS REPHOTOGRAPHED

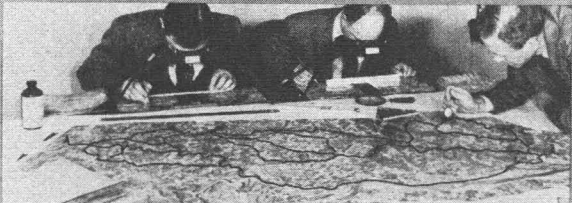
SECOND STAGE

FOR RECONNAISSANCE OF ALTERNATE ROUTES

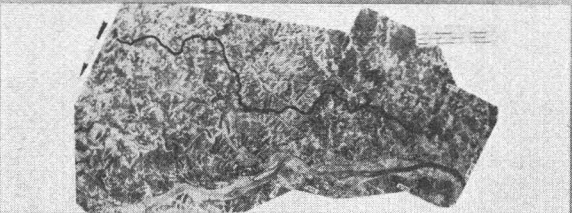
**AERIAL SURVEYS REPHOTOGRAPH
THE PROPER ROUTE BAND OF TOPOGRAPHY
FOR EACH POSSIBLE HIGHWAY ROUTE**



1 - EACH ROUTE BAND IS REPHOTOGRAPHED TO A LARGE SCALE.



2 - ALTERNATE HIGHWAY ROUTE BANDS ARE COMPARED.



3 - THE BEST ROUTE BAND IS SELECTED, CONSIDERING
TOPOGRAPHY AND LAND USE.

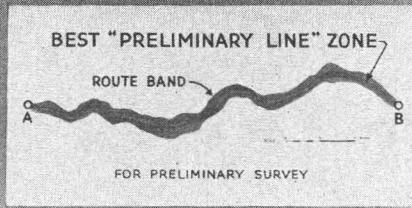
Courtesy Public Roads Administration.

the Bicentennial Celebration, the 200th Anniversary of the Birth of George Washington, on February 22, 1932.

An outline of procedures in aerial surveying and photogrammetric methods of mapping for highway engineering purposes was completed during 1948. This is pictured in the current exhibit of Public Roads Administration at your Fifteenth Annual Meeting. These stage procedures correlate the experience of a number of States and other cooperating agencies in the use of aerial surveying in highway planning, location, and design. Several State highway departments have reported on the advantages of aerial survey methods as a modern tool in

THIRD

STAGE



AERIAL SURVEYS LOCATE THE BEST "PRELIMINARY LINE" ZONE FOR THE HIGHWAY ON THE SELECTED ROUTE BAND OF TOPOGRAPHY



THE HIGHWAY "PRELIMINARY LINE" ZONE IS DESIGNED TO FIT TOPOGRAPHY AND LAND USE WITHIN THE ROUTE BAND

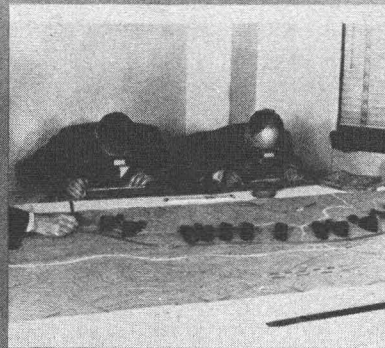
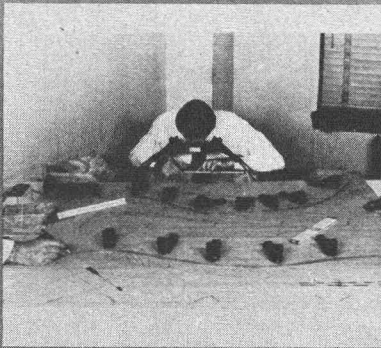
THE "PRELIMINARY LINE" ZONE MAY BE LAID OUT ON AERIAL PHOTOGRAPHS; A PRELIMINARY SURVEY MADE OF THE "PRELIMINARY LINE" ZONE ON THE GROUND. A LOCATION LINE PROJECTED ON A MAP OF THE "PRELIMINARY LINE" ZONE FROM THE PRELIMINARY SURVEY AND CONSTRUCTION QUANTITIES COMPUTED.

A LOCATION LINE MAY BE LAID OUT ON A LARGE-SCALE TOPOGRAPHIC MAP MADE FROM THE AERIAL PHOTOGRAPHS AND CONSTRUCTION QUANTITIES COMPUTED.

A

OR

B

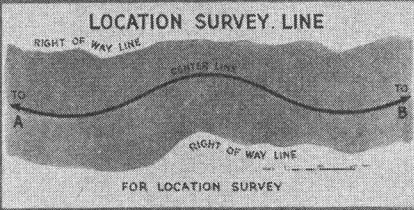


Courtesy Public Roads Administration.



obtaining full information and in making complete data readily available for the sound solution of complex highway problems.

There is increasing interest among the engineering colleges in aerial survey methods. The Inter-American Highway Engineering Conference sponsored by The American Road Builders' Association, with the cooperation of the Department of State, Public Roads Administration, The Office of Inter-American Affairs and The Pan American Highway Confederation, included this timely topic on its agenda. Chapters on aerial surveying are now included in the latest editions of civil engineering and surveying handbooks, such as: 1. American Civil

FOURTH STAGE



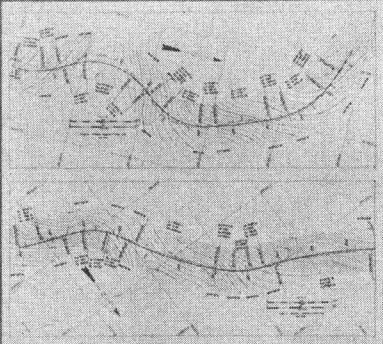
AERIAL SURVEYS HAVE SUPPLIED COMPLETE INFORMATION FOR THE LOCATION SURVEY LINE

THE HIGHWAY LOCATION LINE DETERMINED IN THE THIRD STAGE IS STAKED ON THE GROUND. THE HIGHWAY IS NOW READY FOR CONSTRUCTION

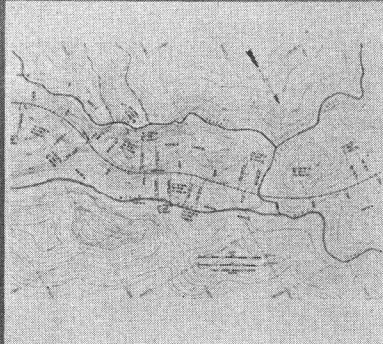
FROM THE LOCATION LINE PROJECTED UPON THE "PRELIMINARY LINE" ZONE MAPPED BY THE PRELIMINARY SURVEY.

A



FROM THE LOCATION LINE PROJECTED UPON THE LARGE-SCALE TOPOGRAPHIC MAP

B



OR

Courtesy Public Roads Administration.

Engineers' Handbook, 2. Breed and Hosmer's Higher Surveying, and, 3. John Clayton Tracy's Surveying, Theory and Practice (1947).

A series of three papers by outstanding men of experience forms the symposium on photogrammetry in highway engineering at this morning's technical session.

The first paper deals with research investigations and findings which translate the science of theory of photogrammetry into everyday highway practice. A joint research program was undertaken by the Institute of Geographical Ex-

ploration of Harvard University and the Massachusetts Department of Public Works to determine how specifications for aerial contract work should be drawn so that the resulting pictures would be of maximum value for location studies.

The second paper makes evident the use of photographs for interpretation and approximate measurements in the study of highway locations and land-use relationships. We are familiar with the old Chinese Proverb that "A picture is worth a thousand words." Another old Chinese Proverb has it that—"A voyage of a thousand miles is started by taking *one step*." The first simple steps in the use of aerial survey methods in highway engineering are described by the author of the second paper.

As reported on page 34 of the Annual Report of the Public Roads Administration for the Fiscal Year 1948, the Ohio State Department of Highways organized an aerial survey section equipped to give effective assistance in highway planning and development. The author of the third paper in this Symposium gives you a picture of how the State of Ohio is integrating photogrammetric techniques into organized highway engineering procedures and practices.

In brief: in this series of three papers, each of the authors helps us to see and to understand that the main function of the aerial photograph is to supply an up-to-date surface inventory showing the relationship of obstacles, man-made or natural, to the proposed right-of-way. Much depends upon seeing the highway as a whole for a sound solution.

USE OF AERIAL PHOTOGRAPHY FOR HIGHWAY LOCATION IN MASSACHUSETTS

*Elmer C. Houdlette, Director of Surveys,
Massachusetts Department of Public Works*

THIS paper concerns an investigation of certain aspects of aerial photography and their applications to highway design and location work in Massachusetts. The Department of Public Works has used aerial surveys of various kinds in the past, however it was believed that full advantage had not been taken of all the potentialities of the new medium. Accordingly it was decided to try to determine, in so far as possible in the limited time available, how specifications should be drawn so that the resulting pictures would be of maximum value to the Project Division.

In order to obtain the desired information, a contract was entered into between the Massachusetts Department of Public Works and Harvard University in December 1946. Under the terms of this contract, aerial photographs were taken along designated routes where actual planning was in progress. The resulting pictures were then used by the engineers on the various projects. The advantages or disadvantages of a particular type of photograph were then determined through actual experience, so that drawbacks would be eliminated and advantages included in future work.

Particular effort was made to arrange the program in such a way as to obtain data on the following problems:

1. The most suitable scale.
 - (a) Taking scale
 - (b) Degree of enlargement.
2. The most suitable focal length.
3. The most suitable season.