

## TOPOGRAPHIC MAPPING AND THE HIGHWAY PROGRAM

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The earliest surveys made in this country, long before the US Geological Survey was organized, were conducted by special exploratory expeditions sent out by the early settlers and later by the War Department at the request of Congress to study and find transportation routes for the settlement of the territories lying beyond the borders of the developed lands along the Atlantic Coast. The first expeditions produced only very sketchy maps of the country, but they were invaluable as reconnaissance maps for the blazing of trails into the rich and undeveloped interior regions. As the population increased and the need for more agricultural lands and new territories developed, more surveys and mapping expeditions were organized. The location of transportation routes was always one of the primary purposes of these expeditions. Most of you are familiar with the expeditions of Lewis and Clark, followed by those of Wheeler, Hayden, King, and Powell, which resulted in small scale reconnaissance maps of vast areas of the then unknown regions of the United States.

The Geological Survey was organized in 1879 with the primary objective of making geologic investigations of the resources of the country. A prime necessity in such work was the preparation of topographic base maps on which to plot the result of the geologic

work. The first of these topographic maps to be produced were reconnaissance type topographic maps, usually at a scale of four miles to the inch, and a contour interval of 250 feet. The scale of 1:125,000, or two miles to the inch with a 100-foot contour interval was also widely used. These maps were a great aid in the development of the West. As the region became more populated, the need for larger scale maps was apparent, and about 1900 the scale of 1:62,500 or one mile per inch was adopted as the standard scale for a topographic map of the United States. At the present time, the highly developed industrial, agricultural, and urban areas are mapped for publication at 1:24,000 or 2,000 feet per inch.

The mapping operations of the Geological Survey have proceeded since the earliest days in a systematic program of completing the coverage of the entire United States. Funds to carry on an adequate program have never been made available and our mapping needs have been consistently far in excess of our ability to produce adequate topographic maps.

Figure 1 shows the status of topographic mapping in the United States. This index shows areas covered by published topographic maps of the Geological Survey and other agencies. Some additional areas have been covered by very old reconnaissance surveys which are now considered entirely inadequate for present

day use. Inquiries regarding the availability of topographic maps may be directed to the map information office of the U. S. Geologic Survey in Washington, D. C.

During the first World War, the need for maps aroused considerable interest, and the Temple Act was passed in 1923 authorizing the completion of the topographic mapping of the United States within a 20 year period. Funds to implement this legislation, however, were never appropriated.

During the recent World War, the national security was threatened and our military forces used all possible means to secure topographic map coverage of the strategic areas. This resulted in considerable map coverage, much of which unfortunately was substandard and faulty due to the extreme speed with which the work had to be performed and the inexperience of many of the operators.

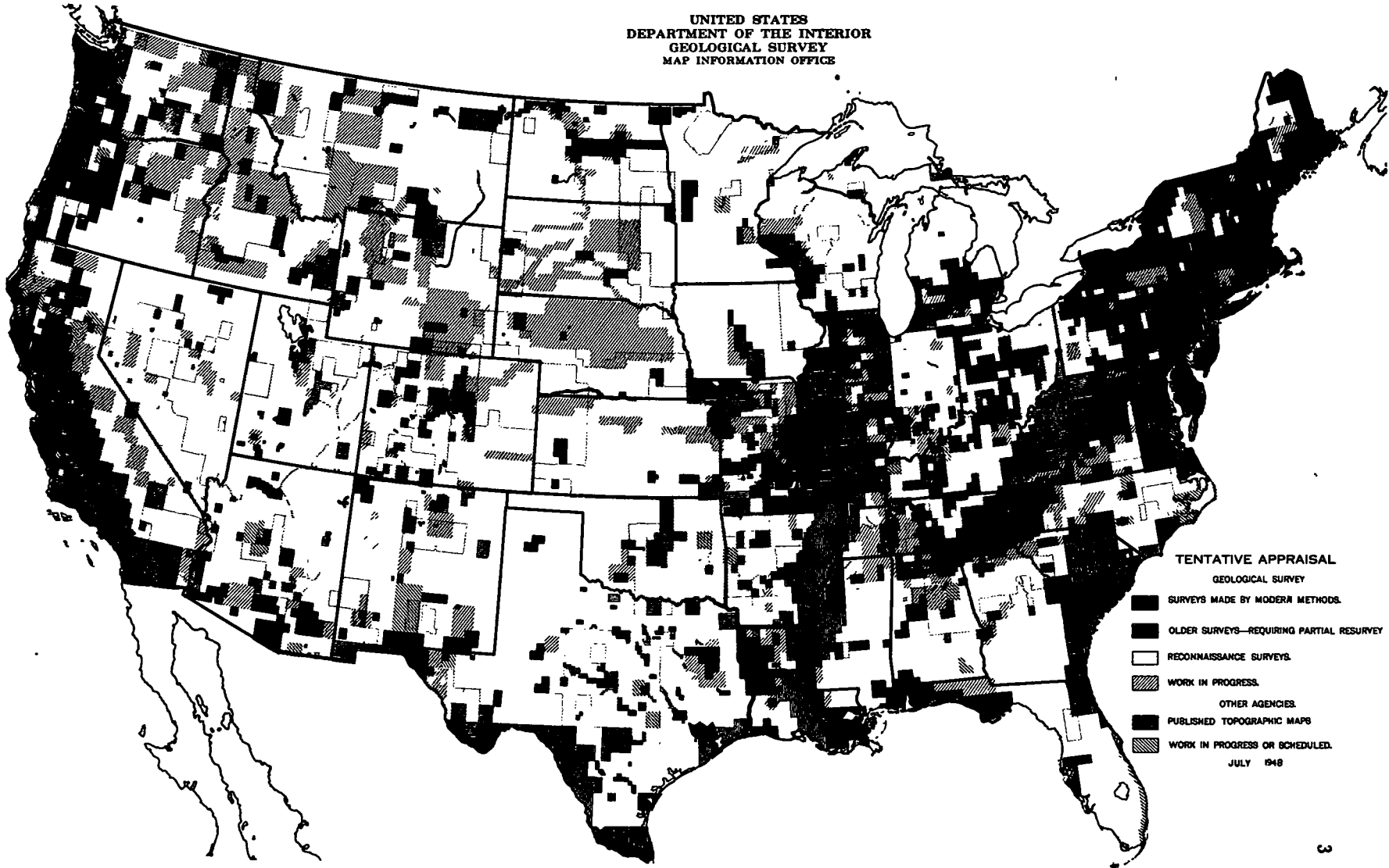
Within the past 10 years, the use of aerial photography in topographic mapping has been perfected to a point whereby adopted standards of accuracy can be more economically maintained and at the same time maps can be produced on a mass production basis. To fit in with this development, the Topographic Branch of the Geological Survey has been reorganized so as to take full advantage of the possibilities afforded for expanding our operations in accordance with these newest improvements in map making. Until the development of the multiplex and other photogrammetric processes to their present stage of perfection, the preparation of topographic maps was performed by a very select group of highly trained topographers who were thoroughly familiar with the various operations required in the preparation of a standard topographic map. These men were assigned specific areas in which they performed all the various functions

and operations required from supplementary control surveys, including triangulation and precise leveling, through the actual mapping, contouring, field checking, and final drafting stages. Under our new methods of mapping, the normal time schedule for a complete mapping operation is three years. The first year is devoted largely to the planning of the operations, securing of aerial photography, and similar preliminary steps, and the initiation of control surveys. The second year the actual compilation of the map is accomplished to the stages of final drafting; and the third year is required for final editing and publication of the manuscript.

Most of the operations performed by the Topographic Branch in the preparation of topographic maps are of such a nature that they can supply much valuable basic information to assist highway engineers in their various problems of planning transportation routes, and designing major highway systems as well as the actual location of highways. In this short paper, it is impossible to do more than mention a few of these items. I wish to call your attention, however, to some of the various classes of information and surveys which the Geological Survey has available for the benefit of those who are charged with the responsibilities of maintaining and improving highway transportation systems. A brief enumeration of some of these services includes the following:

1. In cooperation with the US Coast and Geodetic Survey which establishes the primary horizontal and vertical control nets, the Geological Survey established third and fourth order control required as a necessary base for the preparation of topographic maps. In

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Status Of Topographic Mapping In The United States

carrying out this work, triangulation stations are established for which the true geodetic position is determined. Level lines are run, and permanent bench marks established with correct elevations adjusted to the sea level datum. All of this information is recorded in such form that it is readily available to the highway engineers, and to federal and state agencies as well as private consulting engineers and private contractors.

2. Aerial photography is used as one of the tools in preparing the modern topographic map. Wherever possible we use existing photographic coverage. To assist the Geological Survey in determining the existence of such aerial photography, a Map Information Office is maintained, one of whose functions is to obtain up-to-date information on the existence of all aerial photography in the United States by all federal agencies as well as state agencies and private concerns, when available. Where new photography is required, this is taken to specifications best suited for the mapping operations. Similar information is also maintained on aerial mosaics which have been compiled within the United States.

Figure 2 is a map of the United States showing the status of aerial photography.

3. In the preparation of topographic maps by modern photogrammetric methods, the compilation scale is much larger than the final publication scale. For example, Figure 3 is a small section of a print of the map manuscript near New Milford, Connecticut. The scale of Figure 3 is the same as the scale to which it was originally plotted, 1:5000. It will ultimately be published at 1:24000. In mountainous terrain the original plotting scale is generally smaller; for example, Figure 4 is a section of the map manuscript for Craigsville, Vir-

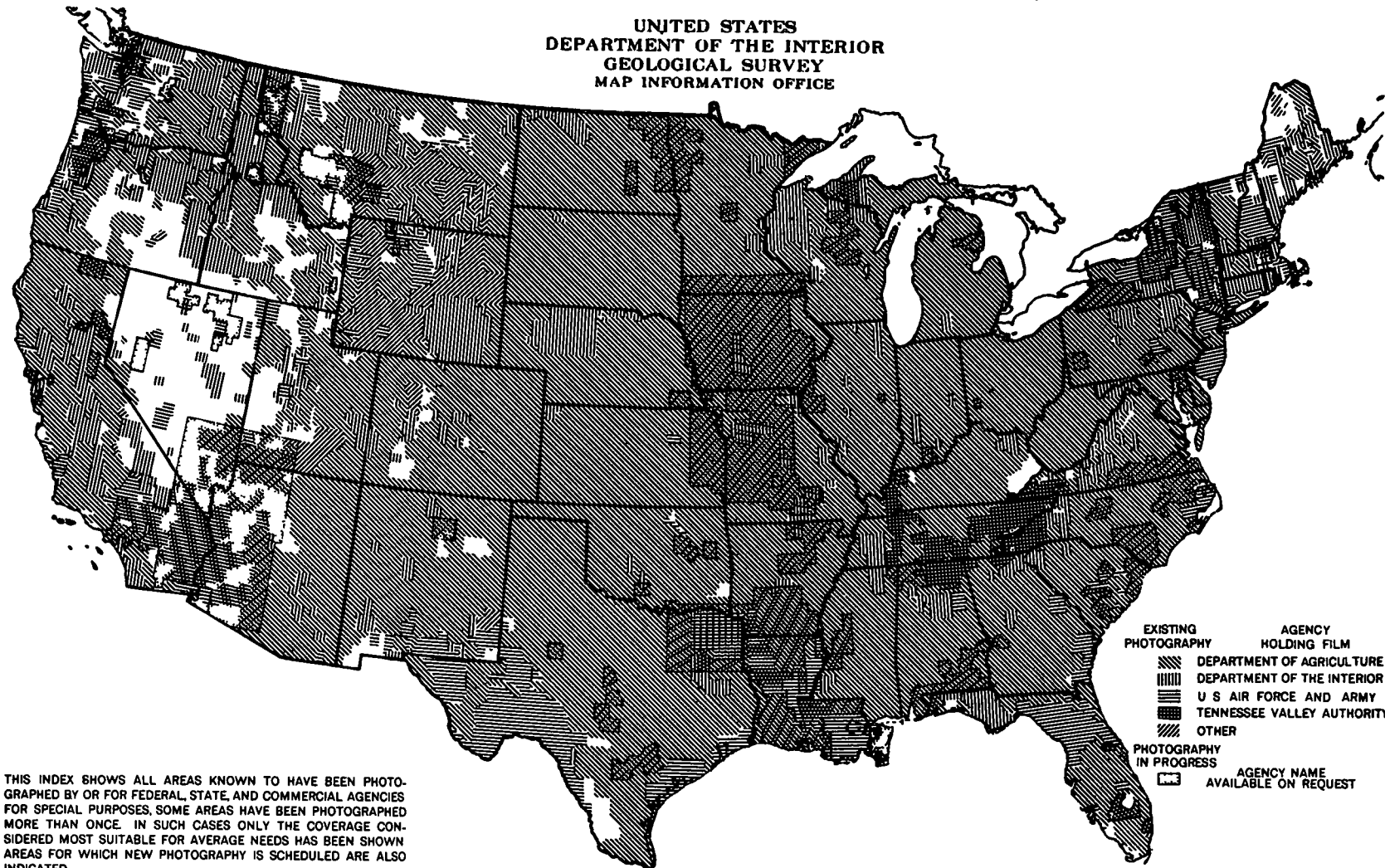
ginia, plotted at 1:15840 for publication at 1:62500. The manuscript is usually available in 12 to 18 months after the initiation of a project, and in some respects, it shows more detail than the final published map.

Some highway departments are taking advantage of this service and are using these manuscripts in making highway reconnaissance surveys of alternate routes, and in some cases, preliminary location surveys. We have recently entered into a cooperative agreement with the State of North Carolina whereby they will use copies of our map manuscript in studying problems involving the redesign of the national system of interstate highways traversing the state.

Cooperative mapping projects are under way at the present time in 21 states, and this constitutes a major source of funds for our topographic surveys. Several of these mapping agreements are directly with State highway departments. In most of the other states the state geologist is the designated cooperator with strong support from the highway department. By these cooperative agreements, our mapping operations can be coordinated and timed to meet the specific highway requirements for topographic maps.

I wish to call your particular attention to an excellent article entitled "Aerial Surveys in Highway Location," written by Mr. William T. Pryor of the Public Roads Administration, which appeared in the December, 1946 issue of *Photogrammetric Engineering*. This article is an excellent description and analysis of various methods of using aerial photographs and topographic maps to assist in the solution of highway problems. The plans for the eastern extension of the Pennsylvania Turnpike were prepared from aerial surveys made in this way.

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THIS INDEX SHOWS ALL AREAS KNOWN TO HAVE BEEN PHOTOGRAPHED BY OR FOR FEDERAL, STATE, AND COMMERCIAL AGENCIES FOR SPECIAL PURPOSES, SOME AREAS HAVE BEEN PHOTOGRAPHED MORE THAN ONCE. IN SUCH CASES ONLY THE COVERAGE CONSIDERED MOST SUITABLE FOR AVERAGE NEEDS HAS BEEN SHOWN AREAS FOR WHICH NEW PHOTOGRAPHY IS SCHEDULED ARE ALSO INDICATED

- |                         |                                  |
|-------------------------|----------------------------------|
| EXISTING PHOTOGRAPHY    | AGENCY HOLDING FILM              |
|                         | DEPARTMENT OF AGRICULTURE        |
|                         | DEPARTMENT OF THE INTERIOR       |
|                         | U S AIR FORCE AND ARMY           |
|                         | TENNESSEE VALLEY AUTHORITY       |
|                         | OTHER                            |
| PHOTOGRAPHY IN PROGRESS | AGENCY NAME AVAILABLE ON REQUEST |
|                         |                                  |

STATUS OF AERIAL PHOTOGRAPHY IN THE UNITED STATES

Figure 2

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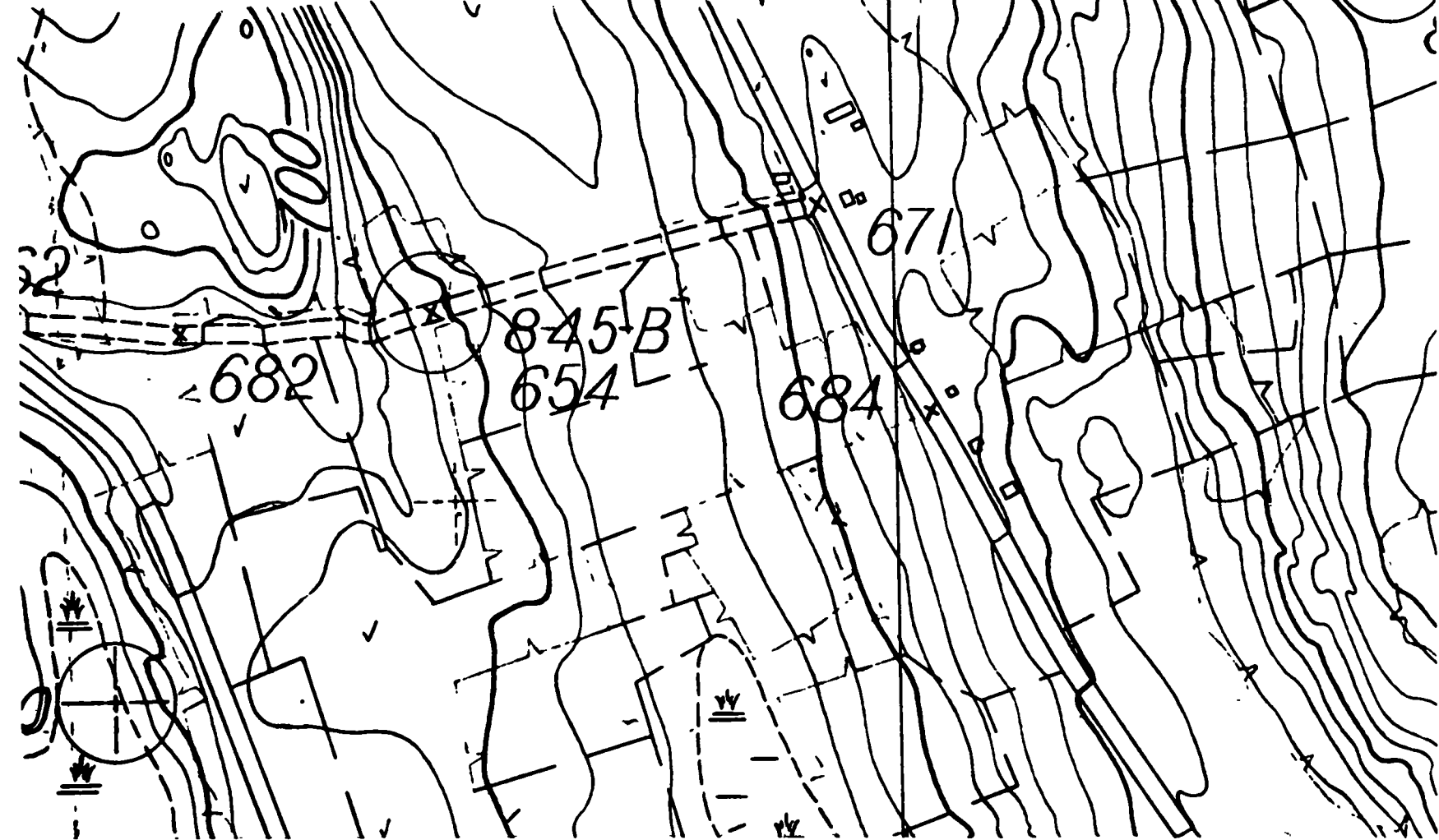


Figure 3. Full Size Section of Map Manuscript - New Milford, Conn.  
Plotted Scale 1:5000 for Publication at 1:24000- Contour Interval, 10 ft.

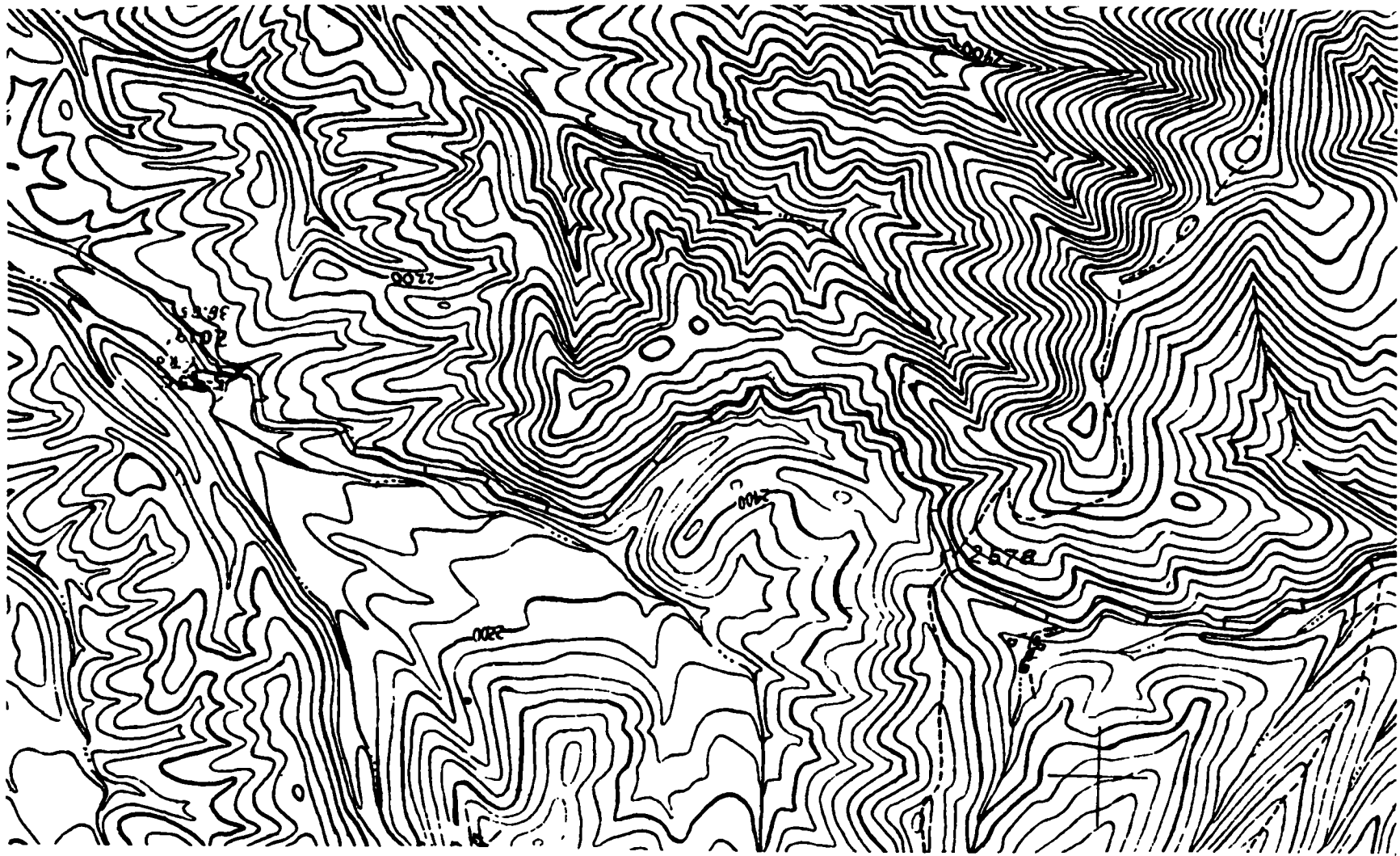


Figure 4. Full Size Section of Map Manuscript- Craigsville, Va. No. 1  
Plotted Scale 1:15840 for Publication at 1:62500 - Contour Interval 40 ft.

larly anxious to conduct its operation so as to be of maximum service to the various other State and federal agencies. We have proposed a 20-yr. mapping program to complete the topographic mapping of the entire United States. The accomplishment of this goal will require the increasing of our operations to three times the present magnitude. The federal mapping program is strongly supported by many highway people, particularly in the states of California, Missouri, Illinois, Wisconsin, Michigan, and North Carolina. In many states topographic surveys are a dominant factor in highway planning, location, and design. As the location of highways becomes more difficult and costly, adequate topographic maps are more essential to aid the highway engineer in selecting the most economical and feasible route. Many state highway departments and the Public Roads Administration are familiar with our services and are making full use of this information. We heartily invite inquiries and suggestions from any of you as to how our work can be made more effective to assist you in the important problem of supplying more adequate transportation for the ever increasing demand of the Nation.

Note: The Geological Survey, will furnish upon request any of the following published maps with descriptive text describing map information of particular interest to highway engineers and map users.

1. United States Map scale 1:5,000,000, (28" x 42"), showing Status of Topographic Mapping. All Status of Topographic Mapping. All mapping by the U.S. Geological Survey is shown in red and that by agencies in green with an appraisal as to the adequacy of these maps for present requirements.

2. United States Map, scale 1:5,000,000, (28" x 42"), showing the Status of Aerial Photography, which is an inventory of areas that have been photographed by the various federal agencies.

3. United States Map, scale 1:5,000,000, (28" x 42"), showing the Status of Aerial Mosaics or Photo-Maps which is an index of mosaics of areas of general interest and indicating the scale of the mosaics, the date of the photography and the agency holding the mosaic negatives. Any of these maps may be obtained by making a request to the Map Information Office of the United States Geological Survey, Washington 25, D.C.