THE GOVERNMENT MAPPING PROGRAM IN A MAP-MINDED AGE[1]

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NOT so many years ago a traveler going from one city to another pulled up his horses and asked the way whenever he became the least bit uncertain about the road. To-day a young man driving from one sea-coast to another looks at his map of the airway as he passes over city after city without stopping except to refuel.

Can you imagine this present-day driver stopping to ask the way?

Whether in the air or on the highways or even on the water this motor-carried people uses maps as an aid to fast, sure travel.

Of course maps have been used and made by adventurers of all ages since first recorded history. There was a wonderful collection of maps in the library of Alexandria three thousand years ago. There are some fine examples of early cadastral maps on clay tablets in the British Museum which are more than four thousand years old. About six thousand years ago maps were made in Babylonia for taxation purposes.

These early maps were used mainly by explorers and scientists, but long before that time rude sketches on bark or sand or in mud or on walls were used by savages to convey ideas. It is this fact, that the untutored mind grasps ideas when presented in map form, which makes the maps of to-day so widely useful. They are still easily understood by all degrees of mentality. Even a four-year-old can learn facts from maps before she can read words.

No one can name all the present-day uses of maps. I quote from Colonel Robert R. McCormick, editor of the Chicago *Tribune,* to illustrate the general appreciation of the value of maps to-day.

A HUNDRED THOUSAND MEN COULDN'T HAVE GIVEN US WHAT THE MAP SHOWED INSTANTLY

In the late war, we often had to fire on batteries hidden by hills and screened overhead by timber growth. A hundred thousand men and millions of shells couldn't have won us the chance to see that battery and adjust our fire. But a pin prick in a good map—a little figuring with ruler and pencil—and we commenced dropping shells on the battery!

A proposition comes up to establish a new highway, barge line or air route. I might spend weeks plowing through books or visiting along the route, before I could form an opinion on it. But let me look at a few good maps showing physical features and economic resources along the route, and I can form a sound initial judgment as to prospects for success. The map has told me what I might have to send a dozen men to see.

Distance—intervening mountains or oceans—obstacles of time and space that would block the efforts of a thousand men to see—all these are swept away when you consult a good map.

You have the vision of thousands of aviators, scattered over thousands of miles, condensed on a single sheet. You can travel here and there—thousands of miles—in a fraction of a second. There before your eyes are the facts you want, without any non-essentials or obstacles obscuring your vision. And you can point out and prove to others instantly what you scarcely could hope to show in any other way.

For accurate grasp of facts—for a quick road to sound decisions—for solving a multitude of problems in business, politics and pursuits of pleasure, I say: *Give me first a good map.*

This testimonial to the value of maps is just a sample of the present-day appreciation of maps.

Maps are used to illustrate the day's news. If Byrd flies over the North or the South Pole, his course is shown by a clear sketch map. Each week during the construction season the papers publish a progress map showing road conditions in our states. The location of detours and various road types is shown. No news story of a shooting or an automobile wreck or a fire is complete without its map with a cross marking the exact spot. The maps used in news stories are usually what might be termed sketch or outline maps.

Better maps drawn to a larger scale are used by travelers. It is a very common sight to see people passing along the highways sure of the way because alongside the driver sits another person watching the road map. This form of back-seat driving is approved.

Similar maps are used in aeronautics. Air navigation maps are made in strips showing the country along the flight course and for about eighty miles of width. They show all features of interest to the aviator, such as elevations of land, rivers, railroads, highways, cities and towns, landing fields, magnetic declination, and obstructions to flying such as transmission lines. In passing it may be said that these maps are compiled from such sources as are available and are far from adequate in many respects.

Similar maps are used by business executives in

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planning and executing sales campaigns. For such purposes outline maps showing various statistical matter are also used.

Maps are popular to-day with interior decorators. They are hung on the living-room walls. The type of maps used for this purpose might be called the illuminated map. You have seen them with ships on the ocean and fish looking out of the water and deer and bears in the woods and Indians and horses and cattle in view. Such maps are pictorial in character. This style map is also used in advertising to induce the traveler or sportsman to take an interest in the advertised region or product.

Newspapers take advantage of the wide-spread interest in maps by holding contests such as one recently put on by a Chicago paper for suggested new arrangement of the state boundaries to secure more equitable representation in the United States Senate. The author of this paper recently received a check for $100 for submitting such a map in the contest mentioned. The thousands of maps entered in that contest indicate the very general appreciation of maps.

The uses suggested so far in this paper, and only a very few have been listed, relate to a relatively low-grade or sketchy style of map. The purpose has been to show the wide-spread use of maps.

We now come to the specific uses of accurately made maps, maps prepared by engineers and used by engineers in their various enterprises. These uses will be considered in connection with a discussion of the various mapping agencies of the government and a brief review of mapping methods and the mapping program.

At this point it is well to mention that numerous agencies besides the federal government are in the business of preparing maps. These include various commercial map-selling organizations, state and local engineering organizations and the engineering forces of various industrial organizations. There is much evidence that the duplication of effort by these widely scattered mapping agencies, if saved, would more than pay for a well-considered governmental mapping program. It is also certain that if this wide diversity of mapping interests could know about and use all available mapping data, still more waste could be eliminated and money and time saved.

The following governmental agencies at Washington are users of maps: the Board of Surveys and Maps; Geographic Section Department of State; War Department—the General Staff M. I. D., Geographic Branch, Q. M. Corps, Construction Service, Chief of Engineers, Map Files, Intelligence Section, Reproduction Plant, Mississippi River Commission, Lake Survey, Air Corps, Bureau of Insular Affairs; Post Office—Topography Division; Navy—Hydrographic Office, Yards and Docks; Interior—General Land Office, Indian Service, Geological Survey, Reclamation Bureau, Park Service; Agriculture—Weather Bureau, Forest Service, Bureau of Chemistry and Soils, Soil Surveys, Biological Survey, Bureau of Public Roads, Division of Agricultural Engineering; Commerce—Aeronautics Branch, Bureau of Census Geographic Section, Foreign and Domestic Commerce Geographic Section, Coast and Geodetic Survey; also the Library of Congress; Government Printing Office, Superintendent of Documents; Interstate Commerce Commission, Map Section, Valuation, Land Section; International Boundary Commission, Canada; Federal Power Commission; Public Buildings and Public Parks; Pan American Union; District of Columbia, Assessor, Surveyor's Office, Public Library. The engineering forces of most of these governmental agencies are busy most of the time preparing and using accurate maps for specific purposes. It is the function of the Board of Surveys and Maps to correlate the various mapping activities to prevent overlapping and to eliminate waste by making the maps of each agency available to all the others. A complete topographic map of the United States is one of the crying needs of this generation, as most engineers know.

The federal government has been at work on a complete topographic map of territorial United States for more than fifty years. At the end of the last fiscal year, June 30, 1929, 43.6 per cent. of the United States had been mapped; 17,333 square miles were mapped during the year. There remains to be surveyed about 1,717,000 square miles of unmapped territory, and much of what was previously mapped is not up to standard. It is easy to see that at the present rate we can wait at least one hundred years for the completion of this mapping program. But the mapping program does not contemplate waiting one hundred years. Some years ago the Temple Act was passed which set twenty-five years as the limit. Several of those years have passed with no speeding up of the program. Now comes an administration familiar with the uses of and needs for topographic maps and insists on a program which if carried out will complete the topographic map according to present standards in eighteen years. The budget presented to Congress on December 4 by the president includes increased askings which have this eighteen-year program definitely in mind.

The complete topographic map of the United States is the work of two governmental services aided by various cooperating forces. The U. S. Coast and Geodetic Survey is engaged in mapping the coastal areas and a precise skeleton of first- and second-order

triangulation and levels covering the interior. This work is briefly explained by Major Wm. Bowie, chief of the division of geodesy, U. S. Coast and Geodetic Survey:

An organization to survey the coasts of the United States was formed in the early part of the nineteenth century and has, with only a short break, been in continuous existence. It was first called the "Coast Survey" and its activities were confined to the survey of the coast itself, the waters adjacent thereto and the small strip of land, a mile or two in width, extending back from the coast. All classes of work were done which were necessary for the construction of hydrographic or sailing charts. These classes consisted of the determination of latitude, longitude and aximuth, by observations on the stars, the measurements of base lines for the control of lengths of triangulation, triangulation extending from one astronomic station to the other, topographic surveys, hydrographic surveys to show the depths of the water, tidal observations, the direction and force of currents in tidal waters and determinations of the variation of the compass.

At first the Coast Survey operated only on the gulf and the Atlantic coasts, but shortly after the Mexican War, when California was added to our area, operations began on the Pacific coast. Shortly after the middle of the past century it was found desirable to connect the surveys of the Atlantic and the Pacific coasts by an arc of triangulation in order that the hydrographic charts could be placed in their proper relation with respect to their initial meridian and the equator. This arc of interior work, which was completed about 1895, was found to be of so great a value to surveyors and other engineers in the interior of the country that the name of the organization was changed to that of Coast and Geodetic Survey and its functions were enlarged so that the bureau's work would cover the execution of control surveys throughout the country.

The interior control surveys, triangulation or leveling, executed by the Coast and Geodetic Survey, are rated as first and second order. The first-order triangulation is of such accuracy that the closing errors of the triangles are approximately one second on an average, with about three seconds maximum closing error. Distances can be carried across country, by first-order triangulation, with an error not above one part in 200,000.

Second-order triangulation has closing errors which average about two seconds with a maximum closing error of about five seconds. Distances can be carried across country by second-order triangulation with errors seldom greater than about one part in 100,000.

First-order leveling, the most accurate used, has corrections of less than 0.15 mm per kilometer to close circuits. As a matter of fact, the average correction per kilometer is about 0.11 mm. This average correction is equivalent to 0.0006 feet per mile.

The Coast and Geodetic Survey is working towards the plan of having first- or second-order triangulation and leveling spread over the country to such an extent that the lines of leveling and arcs of triangulation will be spaced about 50 miles apart. The triangulation will be rigidly adjusted and final positions given to the several stations. The leveling also will be adjusted into the continental net, and the elevations furnished to the engineer will be referred to mean sea-level and will be standard or final. Intermediate areas will be filled in with control data by the U. S. Geological Survey.

The Coast and Geodetic Survey has a great spirit of loyalty among its personnel and a remarkable record for accuracy and scientific accomplishment. The topographic map itself is made in sheets of convenient size covering fifteen minutes of arc in latitude and longitude, or about thirteen miles by seventeen miles in this latitude, and made to a scale of one inch to one mile, or one to 62,500, and showing contours at twenty feet intervals. The surveys are made and maps prepared by the U. S. Geological Survey. The work is of a lower order than the network of first- and second-order surveys. The field work is carried on with great speed and efficiency.

Some of the earlier maps are now out of date on account of many natural and artificial changes in the surface features of the mapped areas. Many of these sheets were prepared in cooperation with local and state agencies and according to slightly varying standards, depending upon the purpose in the minds of the cooperating authorities.

It is now proposed to bring those sheets, which are obsolete, up to date and to map completely the remaining area without state or local aid except in cases where special conditions require expenditures in excess of the cost of the standard topographic sheets. These sheets are made according to standard regulations, and while they do not show 100 per cent. detail like a photographic mosaic, they do show surface conditions as engineers are accustomed to show them on maps of such a scale. Aerial photographs are now used as an aid in filling in topographical details. The air corps has cooperated in furnishing these.

In addition to the standard maps, special forms are prepared for individual purposes. For example, maps have been prepared of swampy regions in Florida and Wisconsin from aerial photographs showing all surface features but without contours. In 1928 a shaded relief and highway map of New Hampshire was compiled.

Other sheets have been prepared in cooperation with cities to show complete details to a large scale for use in city and regional planning or tax assessment work.

Strip maps have been made of areas connecting

certain distant points. These maps show all features of importance in a study to determine the most feasible route between terminals. The route may be for a railroad, highway, canal or transmission line.

Taken as a whole, the topographic maps are of major importance in planning engineering projects and securing their efficient and economic operation. These projects include tunnels, bridges, city surveys and planning, highway development and extension, irrigation projects, hydroelectric developments, improvement of rivers for navigation, flood control of rivers and general topographic surveying and mapping where a knowledge of elevations and geographic positions is required. In fact, there is scarcely any human activity of an extensive nature that does not need for its proper execution a very accurate knowledge of the elevation and slope of the ground and the accurate distances between points.

All these activities are customarily started with a survey and the production of a map or maps. With a topographic map available any such project can be started without the expense of preliminary surveys. Any details needing amplification can be quickly and economically added to the standard sheets or to photostatic enlargements by taking them into the field as a plane table sheet or by comparing them with a set of quickly secured aerial photographs.

Paper locations are rapidly and economically made on standard topographic maps, and safe preliminary estimates are easily made therefrom. Such maps disclose valuable information to the geologist, mining engineer, soil surveyor, regional planner, valuation engineer, forester, realty appraiser, hydraulic engineer and practically all the fifty-seven varieties of engineers who practice "the science and art of directing the application of the science of mechanics in the economic utilization of the forces and materials of nature."

The government mapping program contemplates making such a standard topographic map available for the whole territorial United States in less than two decades. This is a consummation devoutly desired and urged by engineers and engineering societies throughout the country for many years. We can not afford to be without it. As Major Bowie says, "A large paper could be written on the use of surveying and mapping to eliminate waste in industry."

The estimated cost of this program is $5,000,000 for the control surveys and $50,000, 000 for the mapping, or about one fifth of what the United States expects to save on naval expenditures by participation in the London conference.

The following states are completely mapped: Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Ohio, Rhode Island, West Virginia and the District of Columbia. These states have shown their appreciation of the topographic map by furnishing funds to insure completion.

The European countries are ahead of us in the matter of map appreciation. This is probably due to the importance of maps in connection with wars and the tourist trade, apparently the two principal occupations of much of Europe. Those who travel must know their Baedeker. Those who fight must have maps to plan their campaigns. The close-knit European countries have long been completely mapped, but you will note that the more thickly populated of our states are also mapped.

The writer wants to interject a thought here that for present-day needs it may be desirable to raise the standards of the topographic sheets to provide a larger-scale map with perhaps five-foot contours and still greater accuracy of detail. It is a fact that the present standard map, while of almost incalculable value, is nevertheless on such a small scale as to be in effect practically a sketch.

It may be that with the advantages of present-day aerial methods the same estimated expenditures will provide a higher standard for future maps with a resulting greater usefulness and further elimination of waste.

We are living in an age when maps are a basic need. Our engineers have long appreciated the value of good maps. It looks as if our government had reached the stage when it too realized the importance of maps in the economical conduct of affairs.

If Congress carries out the provisions of the Temple Act we will have in the next eighteen years a complete topographic map of the United States at a cost of less than a tenth of our annual expenditure for the military establishment or one tenth of the special appropriation for new cruisers.

OBITUARY

JAMES ARTHUR HARRIS

JAMES ARTHUR HARRIS died at Minneapolis, on April 24, following an operation for appendicitis. He was born on September 20, 1880, at Plantsville, Athens County, Ohio, son of Jordan Thomas and Ida Ellen (Lambert) Harris. His parents having moved to Kansas he entered the university at Lawrence and graduated there with the degree of A.B. in 1901. Going to St. Louis, he was botanical assistant at the Missouri Botanic Garden from 1901 to 1903 (working in the summers at Lawrence) and librarian of the garden from 1904 to 1907. Meanwhile he had taken