maps for america

U. S. GEOLOGICAL SURVEY

maps for

Cartographic products of the U. S. Geological Survey and others

Morris M. Thompson

A Centennial Volume
1879–1979

John Wesley Powell Federal Building

U.S. Department of the Interior
Geological Survey National Center
Reston, Virginia


120°
150°
180°
150°
120°
75°
45°
ATLANTIC OCEAN
GEOLOGICAL SURVEY
FINE FOR DISTURBING THIS MARK
ELEVATION ABOVE SEA
106 FEET
DATUM
1879
B.M.

america

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, *Secretary*

GEOLOGICAL SURVEY

H. William Menard, *Director*

Library of Congress Cataloging in Publication Data

Thompson, Morris Mordecai, 1912–
Maps for America.

Bibliography: p.
Includes index.
1. Cartography—United States. 2. United States. Geological Survey. I. Title.

GA405.T46 526'.0973 79–404

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Stock Number 024-001-03145-1

What is there in this richly endowed land of ours which may be dug, or gathered, or harvested, and made part of the wealth of America and of the world, and how and where does it lie?

CONGRESSMAN A. S. HEWITT, New York

Author of legislation establishing
the Geological Survey, 1879

FOREWORD

On the occasion of its Centennial Year, 1979, it is eminently fitting for the Geological Survey to publish a book on "Maps for America." Since its establishment, the Geological Survey has continuously carried on an extensive program of mapping to provide knowledge of the topography, geology, hydrology, and natural resources of our Nation.

This volume contains an organized presentation of information about the maps produced by the Geological Survey and other American organizations, public and private. Such maps are important tools for those in government and in private endeavors who are working to assure the wisest choices in managing the Nation's resources. They are particularly supportive of the Department of the Interior's role as the Nation's principal conservation agency.

H. William Menard

H. WILLIAM MENARD
Director

February 1979
U.S. Geological Survey

PREFACE

This book was first conceived as being devoted entirely to descriptions of the maps produced by the U.S. Geological Survey. As the project developed, however, it became clear that the story of maps is not complete unless it is properly set in the background of the American mapping effort as a whole. Extension of the scope of the book does not preclude placing emphasis on the Geological Survey mapping program, which is treated in full while other programs are treated only in sufficient detail to provide leads for exploring them elsewhere.

At the outset, let it be understood that this book is not intended to explain the detailed procedures for making maps. Procedures are described only to the extent needed for an understanding of map content. The primary objectives are to inform the map user of (1) the meaning of lines, colors, images, symbols, numbers, captions, and notes that appear on maps, (2) the possible errors and anomalies affecting the reliability and interpretation of maps, (3) the different kinds of maps and map data, and (4) the various sources of maps and related information.

Of necessity, this book is based on established practice and explains maps as they exist, not as they might be designed by you or me or anyone else. Therefore, do not expect any hitherto unknown cartographic devices to come to light here. The distinctive feature of the book is that the particular range of subjects included is covered in a single volume for the first time. The text is freely drawn from material already published in technical journals, special reports, leaflets, instruction manuals, and other similar sources. Likewise, the illustrations come from material already published; the map samples used as illustrations are, unless otherwise noted, taken from the Geological Survey 1: 24,000-scale 7.5-minute quadrangle map series.

Existing maps and related material, with few exceptions, refer to measurements in customary (inch-pound) units rather than metric units, although the change to metric units (SI) on certain new maps is proceeding rapidly. In a number of instances where the statement of quantities in both systems would serve no practical purpose, we have dispensed with the exercise of stating quantities in both metric and customary units. A table of metric equivalents for customary linear and areal measurements is given on page viii.

In many places I have changed the wording of previously published material only to the extent needed to adapt it to the new context. For the use of these materials I offer acknowledgment of sources (in the "Selected References"), and, I expect that the original authors will be pleased that their expositions are used without significant change.

Finally, I must warn that practices change. Discrepancies between what appears on a map and what is described in this book may result from changes in conditions, materials, or practices. In particular, map colors may differ in hue and intensity; the four-color process used in reproducing the illustrations in this text gives some degradation in quality from the original printing of most of the maps illustrated.

Cartography is a well-established science, but it is also an art and therefore subject to human judgment, discretion, and taste. Considering the dynamic nature of both the technology and the art of cartography, we need to remember that this book discusses the 1979 condition of "Maps for America." For tomorrow, we know only that it will be something else.

MORRIS M. THOMPSON

February 1979

MAPS for America

Cartographic Products of the
U.S. Geological Survey and Others

FIGURE 1. Drawn by Aaron Arrowsmith and entitled "A Map Exhibiting all the New Discoveries in the Interior Part of North America," this 1814 edition is considered an outstanding example of early American mapping. *(Reproduction courtesy of the Carnegie Institution of Washington.)*

TABLE OF CONTENTS

SI units		U.S. equivalents	
LINEAR MEASURES			
millimeter (mm)	=	0.039 37	inch (in)
meter (m)	=	3.281	feet (ft)
	=	1.094	yards (yd)
kilometer (km)	=	0.621 4	mile (mi)
	=	0.540 0	nautical mile (nmi)
AREAL MEASURES			
centimeter^2 (cm^2)	=	0.155 0	inch^2 (in^2)
meter^2 (m^2)	=	10.76	feet^2 (ft^2)
	=	1.196	yards^2 (yd^2)
	=	0.000 247 1	acre
hectometer^2 (hm^2)	=	2.471	acres
	=	0.003 861	section (640 acres or 1 mi^2)
kilometer^2 (km^2)	=	0.386 1	mile^2 (mi^2)

1:

Development of American Mapping

". . . the Federal Government formally recognized [in 1807] a new responsibility: The development and dissemination of maps and charts to promote the safety and welfare of the people."

Survey of the Coast

When President Thomas Jefferson signed a bill on February 10, 1807, establishing the Survey of the Coast, the Federal Government formally recognized a new responsibility: The development and dissemination of maps and charts to promote the safety and welfare of the people (fig. 1). The primary motivation in the enactment of this legislation was an urgent need to provide safety for mariners, ships, passengers, and cargoes. The waterborne commerce of the Atlantic Coast was the young Nation's lifeblood; but without complete information on the location of reefs, wrecks, and other navigational hazards, shipwrecks were all too frequent (fig. 2). Because the new Survey was important to the economic well-being of the Nation, as well as to the safety of its citizens, it was placed under the Treasury Department which was then headed by Albert Gallatin. The organization retained the name Survey of the Coast until 1836 when it was renamed U.S. Coast Survey. From 1878 until 1970 it was known as the U.S. Coast and Geodetic Survey, the name which appears on thousands of maps and charts produced during those 92 years. In 1970, the organization was incorporated into the National Oceanic and Atmospheric Administration, Department of Commerce, and the name was changed to National Ocean Survey.

With the establishment of the Survey of the Coast, the first requirement was to select a qualified person to head the agency. On the basis of proposals for organizing the Survey submitted by several men of high scientific reputation, President Jefferson appointed Ferdinand R. Hassler as the first Superintendent. This was a fortunate appointment, for Hassler was a man of inventive genius, keen insight, and rare initiative, who established and maintained extremely high standards. Thus, the Survey of the Coast began with a firm foundation upon which it and its descendant agencies have built a continuing tradition of careful and accurate operation.

Ferdinand Hassler, often called the "father of the Coast Survey," was a Swiss engineer who came to the United States in 1805 to become a professor of mathematics at the new U.S. Military Academy at West Point. The proposal which led to his appointment in 1807 to head the Survey of the Coast called for dividing the agency into three branches—geodesy, topography (of the coast), and hydrography. As the geodetic (precision surveying) operation controlled the value of the topographic and hydrographic operations, he assigned first priority to geodesy.

Because of lack of funds, the disruption of the War of 1812, and political juggling of the agency, the Survey of the Coast was unable to mount a substantial program until 1832. At that time, Hassler returned from a 14-year break in his superintendency, and significant work was undertaken in all three branches. The available techniques (fig. 3) were crude by today's standards—geodesy by huge, clumsy theodolites and astronomical instruments, topography by planetable, and hydrography by lead-line soundings from a sailing vessel—but the results were excellent because of the rigid requirements of Hassler's directives. By the time Hassler died in 1843, Coast Survey triangulation extended from Rhode Island to Chesapeake Bay, embracing an area of 9,000 mi^2 (23,300 km^2) containing a network of 1,200 geodetic stations. Topographic mapping was completed along 1,600 mi (2,575 km) of shoreline. Completed hydrographic surveys included New York Bay, Long Island Sound, Delaware Bay, and the Delaware River. Hassler's legacy was a scientifically sound base upon which succeeding generations of the Coast Survey could build (fig. 4).

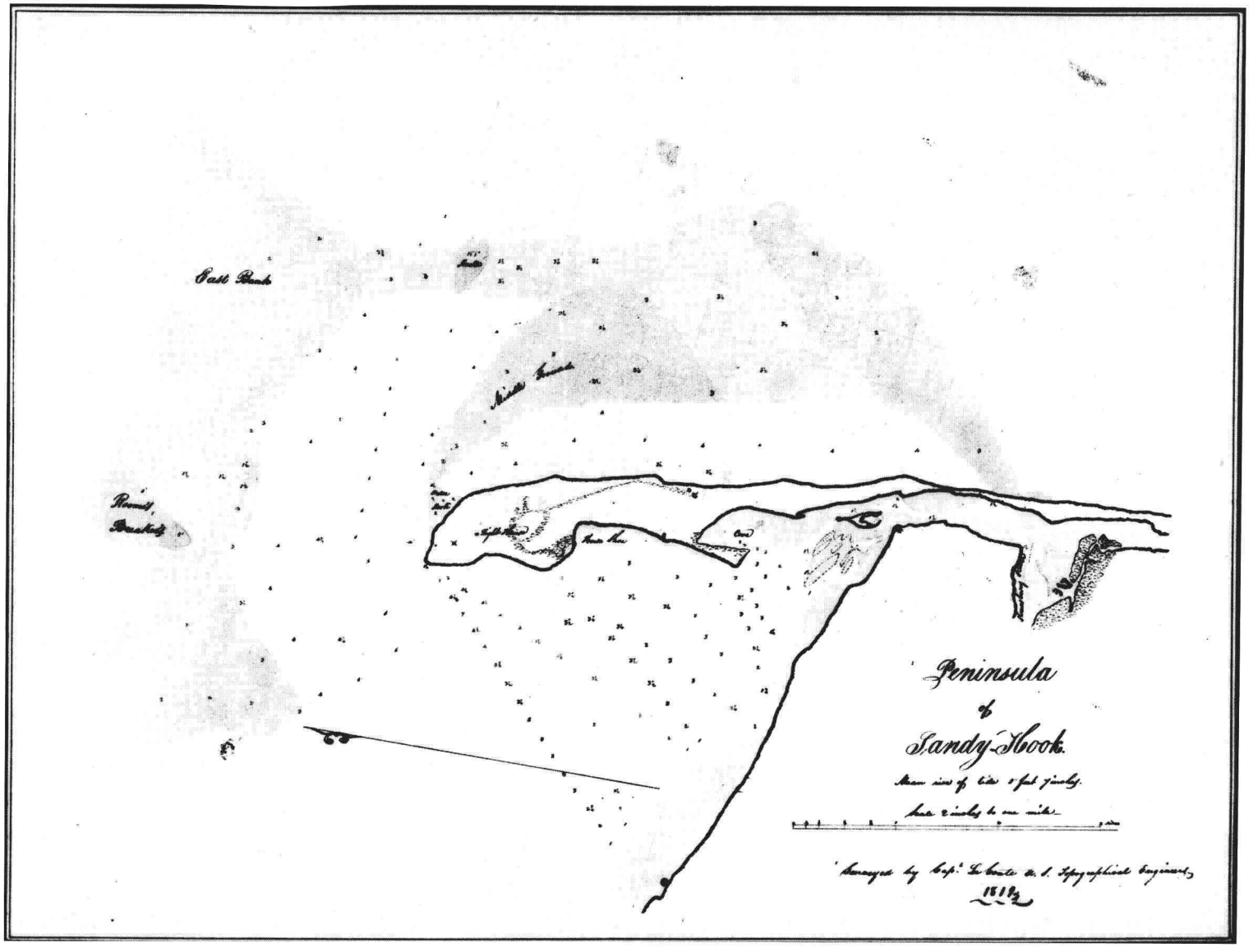
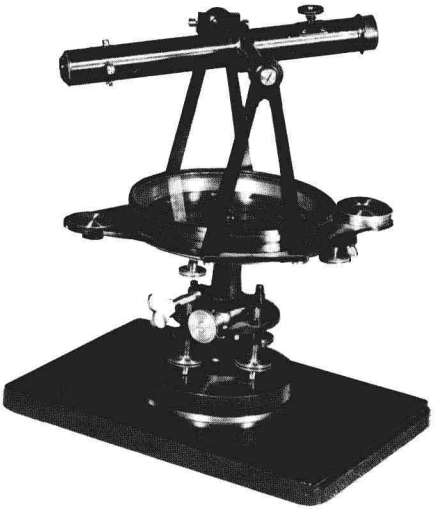


FIGURE 2. The survey work for this early map of Sandy Hook was performed during the period when Ferdinand Hassler was the Superintendent of the Survey of the Coast.

The heads of the Coast Survey who followed Hassler gave form and direction to his plan. As the country grew, the task of coastal mapping expanded tremendously; for example, when Alaska was purchased in 1867, the length of our tidal shoreline increased by 33,904 mi (54,563 km), nearly doubling the total survey job. To meet the growing need, geodetic control, topographic mapping, and hydrographic surveys were stepped up in all coastal areas. Innumerable technical improvements were implemented to keep pace with the explosion in mapping demand. The fleet of sailing vessels (fig. 5) used at first for hydrographic surveys was augmented with steam-powered survey ships. New kinds of bottom samplers, deep-sea thermometers, and depth lines were introduced. A new automatic recording tide gage was placed in operation. A new method of determining latitude with the zenith telescope produced greater accuracy. The newly invented telegraph permitted the determination of longitude differences by flashing time signals between distant points. These are but a few of the many technical changes that marked the growth of the Coast Survey.

FIGURE 3. William Young's transit, the first to be made in the United States, Philadelphia, 1831.



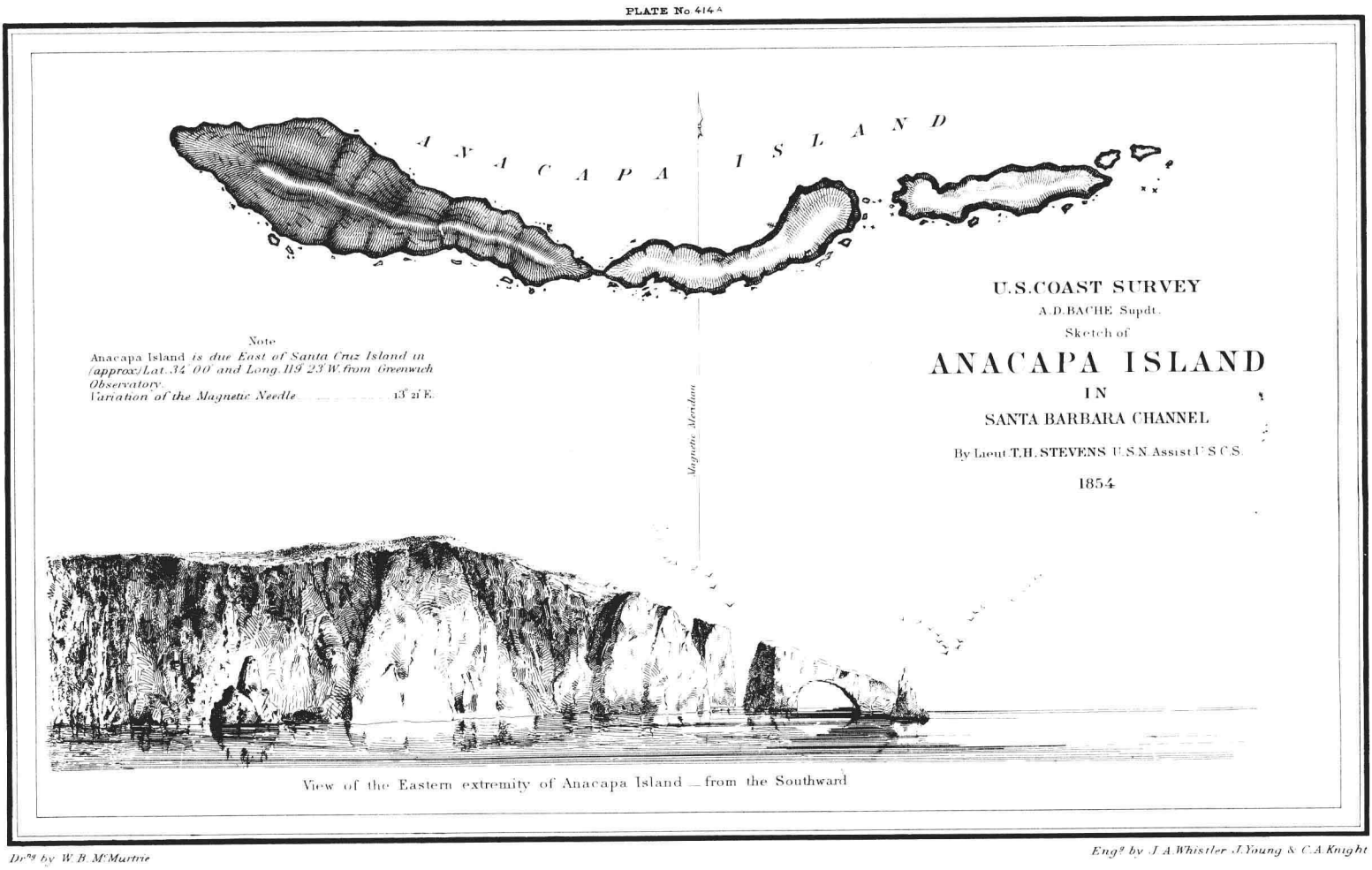
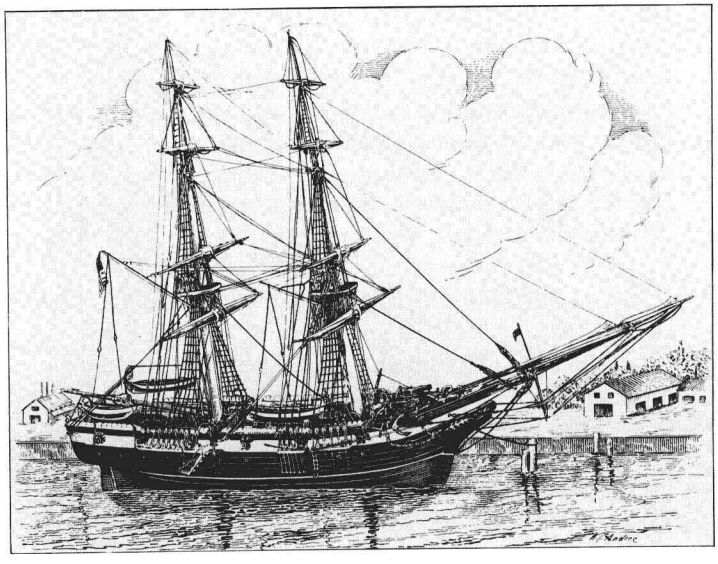


FIGURE 4. U.S. Coast Survey chart of Anacapa Island, 1854.



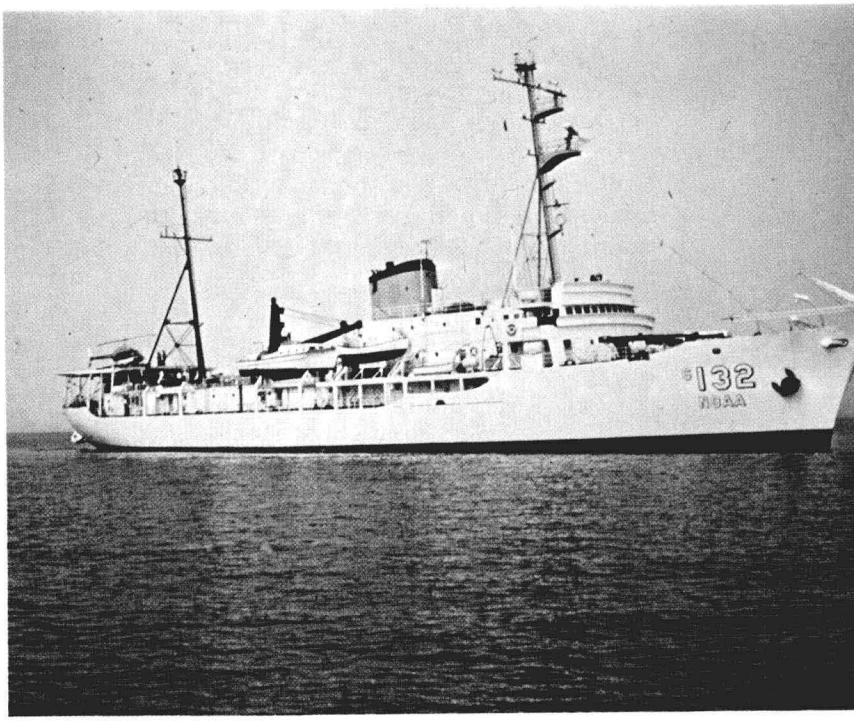


FIGURE 5. Brig *Washington*, the U.S. Coast Survey's first hydrographic survey vessel, 1840 (*above*); and the National Oceanic and Atmospheric Administration Ship *Surveyor*, 1977 (*right*).

During the Civil War, unprecedented demands for maps and charts strained the resources of the Coast Survey. Annual chart production grew from a pre-war count of less than 10,000 copies to 66,000 copies by 1863. The Coast Survey performed defense surveys of the areas around Washington, Baltimore, St. Louis, Philadelphia, and other cities. Coast Survey maps played important roles in such operations as Grant's running of the batteries at Vicksburg and Sherman's march to the sea.

Following the Civil War, the Coast Survey embarked on an era of great expansion and continuous improvements in equipment and techniques that extends to the present day (fig. 5). In the meantime, along with continuing needs for coastal and geodetic surveys, new needs were developing for maps of the interior of the country.

Early Surveys of the West

Prior to the Civil War, the Federal Government conducted limited surveys in the vast hinterland between the coasts. The earliest surveys, usually under the sponsorship of the Army, were exploratory in nature, partly to extend geographic knowledge of the country and partly to gather information for military purposes. Early survey projects included the explorations of Lewis and Clark in the Northwest (1804–06), the Zebulon Pike expedition to the Rocky Mountains (1805–07), the Stephen H. Long expedition to the Rocky Mountains (1819–20), the geologically oriented field trips of George W. Featherstonhaugh to the Ozark Mountains (1834–35), and the examination of the mineral lands of the Upper Mississippi Valley by David Dale Owen (1839–40, 1847–49) and other geologists. In the 1840's and 1850's, the Corps of Topographical Engineers Office of Explorations and Surveys carried out surveys for wagon roads, railroad routes to the Pacific, and international boundaries.

The westward migration that followed the Civil War spawned an urgent need for detailed information about the resources and the natural features of the western portion of the country. Responding to this need, Congress authorized four Federal territorial surveys to explore various parts of the West. These surveys, known as the King, Hayden, Powell, and Wheeler Surveys, each named after its leader, operated as follows:

1. *GEOLOGICAL EXPLORATION OF THE FORTIETH PARALLEL* (*King Survey*). The Act of March 2, 1867 (14 Stat. L., 457) provided for a geologic and topographic survey of the territory between the Rocky Mountains and the Sierra Nevada Mountains, including alternate routes for the proposed Pacific Railroad. Although under the jurisdiction of the War Department, the director (Clarence King) and his scientific assistants were civilians. Results were published in 1870–80 in seven volumes, eight annual reports, and an atlas.

2. *GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES* (*Hayden Survey*). The Act of March 2, 1867 (14 Stat. L., 471, sec. 2) provided for a geologic survey of Nebraska, under the direction of the Commissioner of the General Land Office. F. V. Hayden was assigned to this work and subsequently was designated U.S. Geologist for the territories of Colorado and New Mexico; the survey's scope was extended by the Congress to include all the territories, and work was done in New Mexico, Colorado, Wyoming, Montana, and Idaho. Although primarily geological, the Hayden Survey also included topography, paleontology, ethnology, philology, botany, and allied sciences. Results were published in a series of volumes, issued from 1867 to 1883.

3. *GEOGRAPHICAL AND GEOLOGICAL SURVEY OF THE ROCKY MOUNTAIN REGION* (*Powell Survey*). In 1867, John Wesley Powell began his explorations in the West. On July 11, 1868, a joint resolution of the Congress was approved (15 Stat. L., 253), which authorized the Secretary of War to issue rations for 25 men of Powell's expedition to explore the Colorado River (fig. 6). Additional appropriations were provided in 1870–73, with the expedition coming under the control of the Smithsonian Institution. After the completion of the Colorado River expedition, Powell was authorized by the Act of June 23, 1874 (18 Stat. L., 707) to continue the survey in Utah under the direction of the Secretary of the Interior; subsequent appropriation acts extended the survey to the "Rocky Mountain region." The survey covered southern Wyoming, central and southern Utah, southeastern Nevada, and northern Arizona. Although primarily geographical, the survey established geodetic points and included work in topography, ethnology, geology, botany, paleontology, and related sciences. Results of this survey were published in reports by Powell, Gilbert, and Dutton.

4. *GEOGRAPHICAL SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN* (*Wheeler Survey*). The Act of June 10, 1872 (17 Stat. L., 367) authorized a "continuance of the military and geographical surveys and explorations west of the one hundredth meridian of longitude," under the War Department's jurisdiction, with Lt. George M. Wheeler of the Engineer Corps in charge. This survey included the western parts of the Dakotas, Nebraska, Kansas, and Texas; the Rocky Mountain States; and California. Although mainly geographical or topographical, this survey was made to obtain:

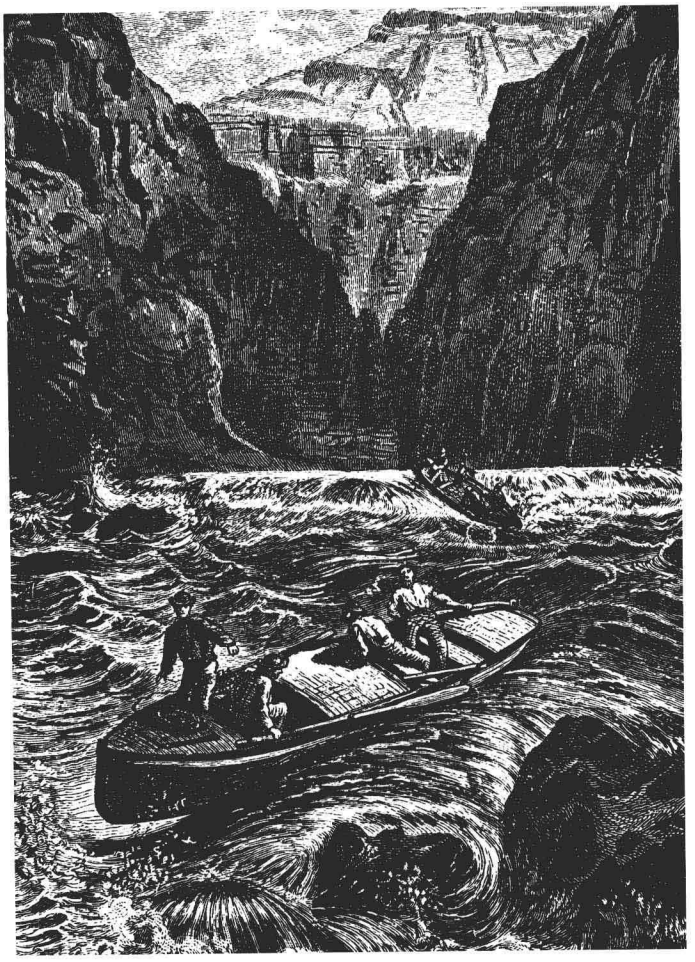


FIGURE 6. John Wesley Powell's Grand Canyon survey party negotiating Colorado River rapids, about 1870.

> . . . at the same time and as far as practicable without greatly increasing the cost, all the information necessary before the settlement of the country, concerning the branches of mineralogy and mining, geology, paleontology, zoology, botany, archeology, ethnology, philology, and ruins (Chief of Engineers, 1878).

This survey was discontinued in 1879, and its results were published in 1875-89 under varying titles.

U.S. Geological Survey

In the early 1870's a bitter rivalry arose between Hayden and Wheeler, mainly over personal prestige and appropriations. As Clarence King (1880, p. 4) later described the situation:

> . . . there remained one more step necessary to give the highest efficiency and most harmonious balance to the National geological work. It was the discontinuance of the several Geological Surveys under personal leadership, and the foundation of a permanent bureau charged with the investigation and elucidation of the geological structure and mineral resources and productions of the United States.

The Hayden-Wheeler rivalry precipitated a hearing in 1874 before the House Committee on Public Lands, focusing on the question of whether it would be most practicable to consolidate the western surveys or restrict the geographic limits of each. There followed a 5-year period of proposals, counterproposals, and acrimonious debate. In the end, President Hayes signed the bill on March 3, 1879, which discontinued the three remaining territorial surveys and gave birth to the U.S. Geological Survey.

With the establishment of the Geological Survey an accomplished fact, the controversy shifted to the appointment of a Director. After considerable political maneuvering by supporters of King and Hayden, Clarence King was appointed as the first Director.

Topographic Mapping

When Clarence King assumed his position as Director, he realized that the legislation establishing the Geological Survey did not define in detail the duties of the new organization. After discussing these functions with members of Congress, King concluded that the intention of Congress was to begin a rigid scientific classification of the lands of the national domain for the general information of the people of the country and to produce a series of land maps which would show all those features upon which the intelligent agriculturists, mining engineers, and timbermen might hereafter base their operations and which obviously would be of the highest value to all students of the political economy and resources of the United States. Accordingly, topographic mapping was included in the work of the Geological Survey. From 1879 to 1888, Survey funds were allotted for mapping surveys. Since 1889, Congress has made annual appropriations to the Survey specifically for topographic surveys.

Major John Wesley Powell, who succeeded King as Director in 1881, proposed to Congress that a 20-year mapping program be authorized and financed in order to provide a sound framework for scientific study and national resource development. Although this 20-year program did not receive specific Congressional approval, the impetus given to the topographic mapping program by King and Powell determined the eventual direction of Geological Survey mapping activities.