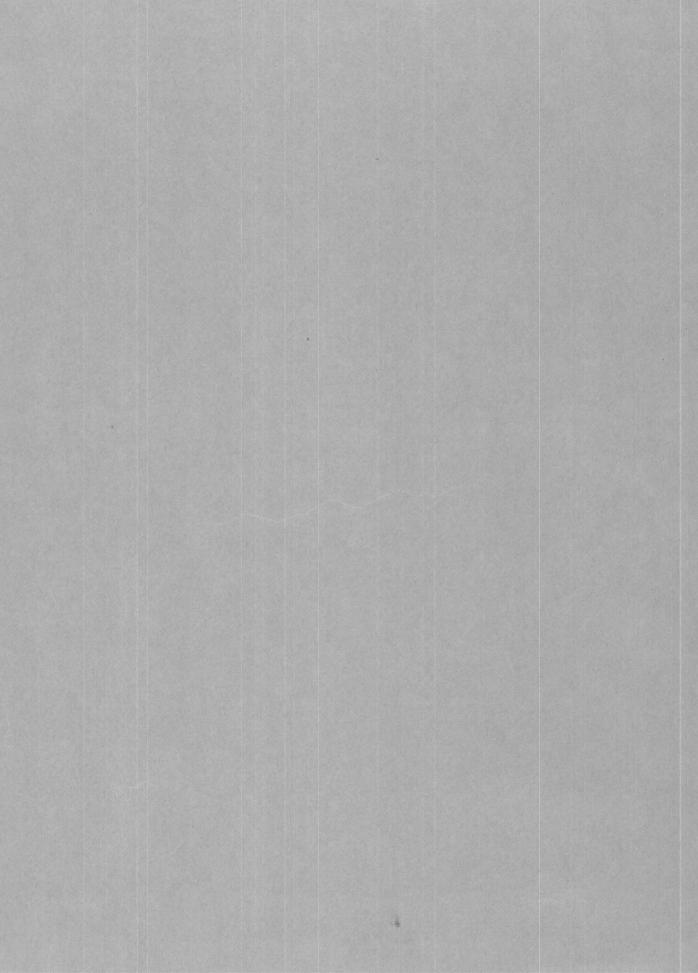
## **GEOLOGICAL SURVEY CIRCULAR 368**



# FEATURES SHOWN ON TOPOGRAPHIC MAPS





UNITED STATES DEPARTMENT OF THE INTERIOR Douglas McKay, Secretary

> GEOLOGICAL SURVEY W. E. Wrather, Director

GEOLOGICAL SURVEY CIRCULAR 368

## FEATURES SHOWN ON TOPOGRAPHIC MAPS

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## GEOLOGICAL SURVEY

#### TOPOGRAPHIC INSTRUCTIONS

## Chapter 1B3

## FEATURES SHOWN ON TOPOGRAPHIC MAPS

## Contents

## Page

Abstr	act	5
Princ	iples of map representation	5
1.	Definition of a map	5
	a. Topographic map	5
	b. Planimetric map	5
2.	Elements of map construction	5
	a. Colors and classes of features	5
	b. Lines and symbols	6
	c. Letters and numbers	6
	d. Map scale	6
З.	Problem of selecting features	6
4.	Selecting map features for a purpose	6
5.	Other factors in selecting map	
	features	7
	a. Legibility	7
	b. Cost of production	8
	c. Obsolescence	8
	d. Concept of a landmark	8
Map o	delineation of topographic relief	8
6.	Methods and objectives	8
	a. Measurement	9
	b. Interpretation	9
7.		9
	a. Choosing a contour interval	9
	b. Generalization	10
8.		10
9.		10
	a. Erosional features	10
	b. Residual features	12
	c. Depositional features	12
10.	Symbols and patterns used to show	
	relief	12
	a. Hachures	12
	b. Area patterns	12
	c. Relief shading	15
Map 1	representation of water features	15
	Periodic changes in water features .	15
	a. Classification of water features .	16
	b. "Normal" water level	16

Map r	representation of water featuresConti	inued
	Kinds of water features and map	
	symbols	16
	a. Linear watercourses	16
	b. Area water features	17
	c. Glaciers and permanent snow-	
	fields	17
	d. Springs and wells	17
	e. Coastal features	17
Mann	nade map features	18
13.	Coordinate systems, subdivisions,	
	and boundaries	18
	a. Coordinate systems	18
	b. Public-land subdivisions	18
	c. Boundaries	19
14.	Travel and transportation routes .	19
	a. Roads and trails	19
	b. Railroads	19
	c. Other route features	19
15.	Buildings and cities	19
	a. Buildings	19
	b. Building groups	20
	c. Towns and cities	20
16.	Names, notes, and numbers	20
	a. Map names	20
	b. Geodetic control marks	20
	c. Spot elevations	21
Inform	mation on map margins	21
	Identification, orientation, and	
	explanation	21
	a. Identification	21
	b. Responsibility, methods, and	
	dates	21
	c. Scale, contour interval, and	
	other data	21
	references	22
18.	Special selected list	22
19.	Other reference maps	23

Page

## Illustrations

-

	Page
Figure 1.	Pictographic map symbols 6
2.	Comparison of map scales 7
3.	Contours
4.	Two maps of identical areas in southeast New York State
5.	Contoured slopes
6.	Drumlins in northern New York 14
7.	Cedar Creek alluvial fan in Montana
8.	Depression contours and hachures 16
9.	Hydrographic features
10.	Information shown in center of lower margin
Topograph	ic map symbols facing page 22

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## Chapter 1B3<sup>1</sup>

#### FEATURES SHOWN ON TOPOGRAPHIC MAPS

#### ABSTRACT

Topographic maps represent features on the earth's surface by means of symbols and labels; separate colors distinguish the main classes of map features. The amount of information shown on a topographic map depends on the map scale, the purpose of the map, and the cost of obtaining the information. This chapter describes the three main categories of map information and the methods by which they are shown. Reference lists of published maps and a chart illustrating standard map symbols are included.

#### PRINCIPLES OF MAP REPRESENTATION

#### 1. Definition of a map

A map is a graphical representation, at an established scale, of a part of the earth's surface, showing important natural and manmade features in their correct positions relative to a coordinate reference system and to each other.

a. <u>Topographic map</u>. --A topographic map, as distinguished from other kinds, portrays by some means the shape and elevation of the terrain. Geological Survey topographic maps usually represent elevations and landforms--the shapes into which the earth's surface is sculptured by natural forces--by contour lines. Other features are shown by a variety of conventional signs, symbols, lines, and patterns, which are printed in appropriate colors and identified by names, labels, and numbers. The chart facing page 22 shows the standard symbols used on the topographic maps of the Survey.

b. <u>Planimetric map</u>. --A planimetric map is similar to a topographic map, except that it does not portray relief in a measurable form. The Survey publishes some planimetric maps for use until they can be replaced by topographic maps.

#### 2. Elements of map construction

A topographic quadrangle map is the product of both engineering and the graphic arts. Surveys made on the ground and from photographs are organized in a coherent form and reproduced graphically according to a plan. To be useful the map must present information legibly. The graphic accuracy must be consistent with the accuracy of the source surveys and with the publication scale. The map must include the information essential to its purpose and must exclude nonessentials. The main elements of quadrangle map construction have been formulated to attain these objectives.

a. <u>Colors and classes of features</u>. --The information shown on the quadrangle map is divided into three general classes, each printed in a different color. Information about the shape of the land surface--hypsographic or topographic information--is printed in brown. Water features--hydrographic information--are shown in blue. Cultural features--manmade objects-are shown in black. The system of division is not precise. Some manmade features--for example, levees and earth dams--are also topographic features and are printed in brown, not black.

5

<sup>&</sup>lt;sup>1</sup>The number 1B3 signifies Book 1, Part B, Chapter 3 of the Geological Survey looseleaf manual of Topographic Instructions. For a table of contents, see Chapter 1A2 (Circular 92).

Besides the colors used for the three main classes of features, green is used to show woodland--timber, brush, vineyards, and orchards-and red is used to show public-land subdivisions (cultural features) and the classification of the more important roads.

b. Lines and symbols. --Linear features are represented by lines of various weights and styles (solid, dashed, dotted, or some combinations). Structures, or individual features, are portrayed by a system of pictographs or symbols. The symbols originated as plan views of the objects they represent, and they retain something of this character although they are now formalized. The building symbol, for example, is a solid or open square. The railroad symbol is a line with evenly spaced crossties. The dam and levee symbols look approximately like dams or levees as seen from the air. (See fig. 1.)

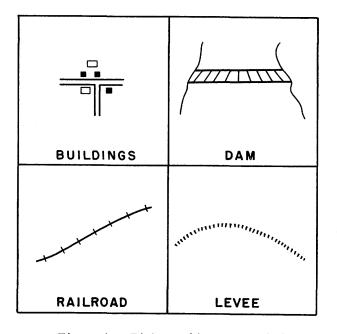


Figure 1. -- Pictographic map symbols.

c. Letters and numbers. --Because lines and symbols cannot represent map information completely, they must be supplemented by the names of places and objects. Notes must be added to explain some features that cannot be depicted clearly by symbols alone. In mapping topographic features the information portrayed by contour lines must be supplemented by elevation figures. Letters and numbers are essential to map interpretation, but they tend to obscure other map information. Therefore, they must be selected and positioned carefully on the map so that interference with other detail is kept to a minimum.

d. <u>Map scale</u>. --Map scale is the relationship of the size of the map to the size of the ground area it represents. The relationship may be expressed as a linear equivalent, such as 1 inch equals 1 mile--meaning that 1 inch measured on the map represents 1 mile on the ground--or it may be expressed in many other ways. The scale of Survey maps is given in the form of a ratio or fraction, without dimensions; the numerator is the distance on the map, and the denominator is the corresponding distance on the ground. For example, 1:24,000 means that one unit of length on the map represents 24,000 similar units on the ground.

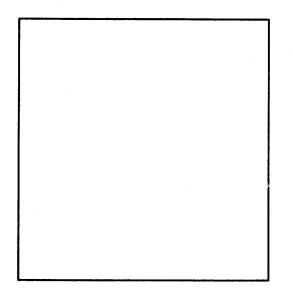
#### 3. Problem of selecting features

The amount of information that can be depicted legibly on a map is limited by the scale of the map. The effect of scale on map content is emphasized if the scale is considered as a ratio of areas rather than a ratio of distances. Figure 2 illustrates the actual paper areas representing 1 square mile at 2 standard scales for topographic mapping.

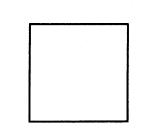
The major problem in map compilation is to make the best use of the available map space. The space cannot be crowded with lines and symbols beyond a definite limit without making the map unreadable, yet the amount of information that might be useful or desirable is almost unlimited. The cartographer must select the features that are the most valuable to the map user. The smaller the map scale, the more critical and difficult the problem of selection becomes.

#### 4. Selecting map features for a purpose

Topographic maps are often made for a particular purpose. For example, a map made



l sq mi at 1:24 000



1 sq mi at 1:62 500

Figure 2. -- Comparison of map scales.

for the purpose of designing a new highway would show the type of woodland cover and the classification of soil and rock along the route. Information about drainage, property lines, and buildings would be shown in detail as required. The map would be in the shape of a strip and would cover a relatively small ground area. This type of map is called a special-purpose map because it has limited value for other uses.

Unlike special-purpose maps, the quadrangle maps produced by the Geological Survey have been designed to be used for many purposes. Scales, contour intervals, accuracy specifications, and features that are shown on the maps have been developed gradually over a period of years to satisfy the requirements of governmental agencies, industry, and the general public. Because these maps serve a wide variety of uses--scientific, engineering, military, and administrative--they are called general-purpose maps.

Changes in symbolization and in features to be shown are adopted only after careful consideration of their effect on the various map users, as well as the operational problems and costs involved in making the changes. Changes in symbolization usually are submitted to a governmental interagency Committee on Map Symbols for review and approval.

5. Other factors in selecting map features

The functions the map is intended to serve determine the features that it is desirable to map, but other factors must be taken into account before it is decided what features actually can be shown. Among the most important considerations are legibility, the cost of compiling the information, and the permanence of the mapped features.

a. Legibility. --The requirement that map information be legible and easily read means that small map features must be represented by symbols larger than the true scale size of the features. Roads, for example, are shown 90 feet wide on 1:62,500-scale maps despite the fact that most roads are not actually this wide. Buildings and other structures also are shown by minimum-size symbols that may be larger than the actual scale size of the buildings. On aerial photographs at the same scale as the map, which show all features are not visible without magnification. Symbols larger than scale size take up extra map space; therefore, where small features are close together, all of them cannot be shown. Generally, the less important features are omitted in congested areas.

b. <u>Cost of production</u>. --The extent to which some kinds of map features are shown is determined partly by the cost of compiling the information. Aerial photographs are the source of most map information, but features that cannot be identified on mapping photographs must be obtained by field methods, a procedure that is relatively more expensive. As an example, not all section corners are mapped; they are too small to be seen on aerial photographs, and the cost of mapping all of them by field surveys would be excessive.

c. <u>Obsolescence</u>. --Not only the original cost but also the cost of keeping the map up to date is considered in deciding what features to map. Generally, the more features depicted, the more quickly the map becomes out of date. Cultural features are especially subject to change. If the maps are to have a reasonably long useful life, the features portrayed must be restricted, to some extent, to relatively permanent objects.

d. <u>Concept of a landmark</u>. --Many kinds of features are shown on some maps, although omitted from others, because of the landmark character of the features. In this sense, a landmark is an object of sufficient interest in relation to its surroundings to make it outstanding. For example, buildings may be considered landmarks when they are used as schools or churches or when they have some other public function. They may be landmarks also because of their outstanding size, height, or design; or they may be landmarks because of their history, such as old forts or the birthplaces of famous men.

The same principle is applied to features other than buildings, but the adjacent area always is considered in relation to the object. Where map features are few, objects that would not be shown in more congested districts may be mapped as landmarks.

#### MAP DELINEATION OF TOPOGRAPHIC RELIEF

#### 6. Methods and objectives

Contour lines are the principal means used to show the shape and elevation of the land surface. Other means are spot elevations and hachures and pattern symbols for special kinds of relief features that are not suited to contouring. Relief information is printed in brown on topographic maps.

Contours are lines connecting points of equal elevation. They always are continuous lines, and, if the map is large enough, they return to the points of beginning to form closed loops. A contour may be variously defined as--

- An imaginary line on the ground, every point of which is at the same elevation above a specified datum surface (mean sea level for topographic maps of the Survey).
- A level or grade line.
- A line of constant elevation.
- A coastline or shoreline of level water.
- An assumed shoreline resulting from the assumed rising of a body of level water.

However it is defined, a contour is the line traced by the intersection of a level surface with the ground. A series of contours is traced by a series of level surfaces, a different contour for each elevation. Contours are illustrated in figure 3. Each contour line on the map represents a definite ground elevation measured from mean sea level, and the contour interval is the difference in elevation between adjacent contours. The contour interval, together with the spacing of the contour lines on the map, indicates the slope of the ground. On steep slopes the lines are more closely spaced than on gentle slopes. To make maps more readable, contours are classified and the classes distinguished by different weights and styles of lines. Index contours--every fourth or fifth contour, depending on the basic interval--are accentuated by making the line wider than the other contours. Supplementary contours, used on the flatter areas of some maps, are shown as dashed or dotted lines. Elevation figures are shown on the contour lines at frequent intervals to facilitate their identification, as well as to assist in determining the values of adjacent contours.

The two main reasons for showing relief information on maps are to furnish coordinated data for engineering calculations or other scientific mensuration and to present a graphic picture of the ground surface. The two objectives are related but distinct, and sometimes they may be conflicting.

a. <u>Measurement.</u> --For engineers or scientists who are interested in exact measurement, topographic maps furnish dimensional information about elevations, areas, grades, and volumes. The approximate elevation of any point can be read directly or interpolated from contours. A series of elevations on a line determines the grade or profile of the line, and areas and volumes can be computed by combining line profiles in various ways. The relief information shown by contours is sufficient for calculating the storage capacity of a reservoir, the area of a watershed, or the volume of earth to be moved in a large road cut or fill.

b. <u>Interpretation</u>. --On the other hand, many persons who use maps are not concerned with exact ground elevations but are more interested in the general appearance and shape of the land. For them, contours are the graphic means of visualizing the terrain and an aid in locating positions on the map.

#### 7. Selection in mapping relief features

The amount of relief information that can be shown on a map depends largely upon the scale of the map and the contour interval used to portray the relief. If a great amount of relief detail is required, the scale must be enlarged and the contour interval made smaller; but regardless of the scale

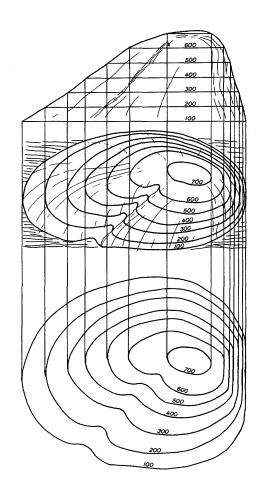


Figure 3. -- Contours.

and contour interval all information concerning the ground surface cannot be shown on maps. The mapmaker must always make a judicious selection of the features that it is desirable to portray.

a. <u>Choosing a contour interval</u>.<sup>2</sup>--A satisfactory contour interval is one that shows the important topographic features adequately, yet does not result in closely spaced contour lines that are difficult to read. For a given scale and contour interval, the slope of the ground determines the spacing of contours on the map. Therefore, the most appropriate contour interval is selected according to the scale and the average ground slope in the quadrangle. Most quadrangles in continental United States are mapped with intervals of 5, 10, 20, 40, or 80 feet.

<sup>2</sup> See Chapter 1 B2, Contour intervals.

Where slopes vary considerably within a quadrangle, the interval chosen may not give enough information in flatter areas because the contours are too far apart. Where this occurs, supplementary contours--at one-half or onefourth of the basic interval--are added in the flat areas. If the interval based on average slope causes too much congestion of contours in the steeper areas, intermediate contours may be dropped for short distances to avoid coalescence in printing. This treatment in drafting or scribing is called "feathering."

The contour interval used determines not only the amount of relief information that can be shown but also the allowable tolerances in the vertical accuracy of the map. The two are directly related. <sup>3</sup>

b. Generalization. --Small irregularities of the ground surface are omitted from the map by drawing the contours as smooth lines through these areas. The technique of ignoring the very small features and drawing the contour lines so that the larger features are emphasized is called generalization.

Generalization is used to some extent in contouring at any map scale, because it is obviously impossible, even at the largest scale, to show every irregularity of the ground surface. The amount of detail omitted varies inversely with the map scale; some of the relief detail mapped at the scale of 1:24,000 may be omitted at the scale of 1:62,500. Figure 4 illustrates an area contoured at the scales of 1:24,000 and 1:62,500; the greater amount of detail shown at the larger scale is plainly evident.

#### 8. Topographic expression

The drawing of contour lines on a map is both an art and a science. It is a science in the sense that the lines must be positioned within certain limitations of accuracy; it is an art in that within this limitation the mapmaker has a limited choice in the way the lines are drawn. When the contour lines are drawn so that they represent the typical characteristics of the ground surface, the map is said to have good topographic expression. On the other hand, the

3 See Chapter 1B4, Accuracy specifications for topographic mapping.

contours could be drawn to meet accuracy specifications and yet have such poor topographic expression that the map might give a misleading picture of the landscape. Good topographic expression makes the map easier to interpret-that is, the relief features are easily identified.

For example, the contours depicting a smooth, rolling hill, without abrupt breaks or sharp ridges, are drawn as a series of gently curved lines, with no acute angles. On the other hand, the contours portraying a rugged, kniferidged hill, with many cliffs, are jagged and bent sharply to indicate these characteristics. The amount of generalization and the accuracy may be the same for both features; the difference is in the detailed delineation of the contours.

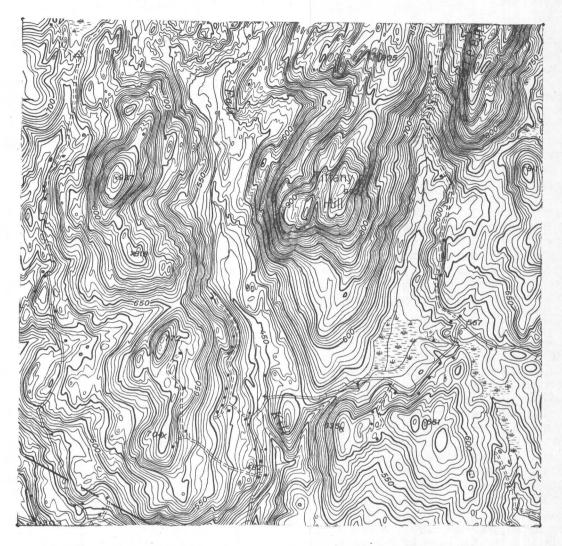
The contrast in contour treatment for two different kinds of terrain can be seen by comparing the smooth hills of New York in the Ticonderoga quadrangle with the rough, broken mountains of Wyoming in the Maverick Springs quadrangle. Both are  $7\frac{1}{2}$ -minute maps at the scale of 1:24,000, with 20-foot contour intervals.

#### 9. Kinds of relief features

To illustrate the contoured appearance of different kinds of topographic features, examples from three general classes have been selected.

a. Erosional features. -- These features are formed by the erosive action of wind, waves, glaciers, and streams. Features formed by stream courses are the most common and include valleys, gullies, washes, and gorges. The typical contour characteristic of stream courses is the shape of the contour reentrant. the part of the contour that curves or bends toward and away from the drainage channel. In a series of contours outlining a hill, reentrants show the courses of streams too small to be shown on the map with blue lines. The spacing between the reentrants along a stream shows the grade or slope of the watercourse. The shape of the reentrants sometimes suggests the steepness of the banks of the drain, or the kind of soil or rock formation through which the water flows. In flat areas the width of a stream channel often must be exaggerated to avoid running the contour lines together.

FEATURES SHOWN ON TOPOGRAPHIC MAPS



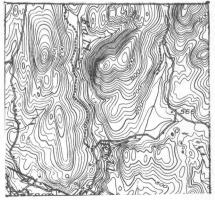


Figure 4. --Two maps of identical areas in southeast New York State. Each map covers 4 square miles. The upper one (1945) is at the scale of 1:24,000, with a contour interval of 10 feet; the lower one (1902) is at the scale of 1:62,500, with a contour interval of 20 feet. b. <u>Residual features</u>. --Features of this kind are the parts of the earth's crust that have resisted erosion effectively and have remained somewhat in their original state. Plateaus, benches, mesas, escarpments, cliffs, and terraces are typical residual features. Important characteristics of this class of features shown by contours are the slope and the breaks or changes in the slope.

A slope may be uniform, concave, or convex. A uniform slope is indicated by even spacing of contours. On a concave slope, the contours are closely spaced near the top, gradually widening toward the bottom. On a convex slope, the arrangement is reversed; the contours are closely spaced near the bottom, and the spacing increases toward the top. Land slopes are seldom of a single type and may be found in all possible combinations.

Rock escarpments, which usually border high flat plateaus, are characterized by closely spaced contours near the top, which bend sharply at the crest and meander across the plateau. The slope below the crest is usually concave, with the spacing between contours gradually increasing toward the base of the hill. Figure 5 illustrates contoured slopes; the Juanita Arch, Colo.,  $7\frac{1}{2}$ -minute quadrangle is a good example of contoured cliffs, escarpments, mesas, and other residual features.

c. <u>Depositional features</u>. --As the class name indicates, these features are deposits of soil, rock, and other material built up by such carrying agents as glaciers, streams, winds, and volcanoes.

Drumlins, illustrated in figure 6, are elliptical hills of unstratified glacial debris, larger and steeper at the north end and tapering toward the south. Their contoured shape is typical and recognizable. Groups of drumlins occur in Wisconsin, New York, and Massachusetts.

Eskers are another form of glacial debris, deposited in long, narrow bands by streams beneath glaciers. They vary in length from a few hundred yards to several miles; within an area they frequently occur in series. Alluvial fans develop in valleys at the base of block mountains, being formed from rock and gravel washed out of canyon mouths. They may be almost any size from a few feet to several miles in diameter. Usually, they slope evenly from the center to the outer edge, and their contoured appearance is that of a fan--hence the name. Figure 7 illustrates a typical alluvial fan in Montana.

10. Symbols and patterns used to show relief

Although contours are the best method of showing most topographic features, symbols must be used to represent features that cannot be shown clearly or economically by contours. Hachures and patterns are frequently used to depict relief in areas having a predominance of distinctive ground features that are either too intricate or too small to be individually or accurately shown at the scale or contour interval selected for the map.

a. <u>Hachures</u>. --Hachures, short lines drawn in the direction of the ground slope, are used to show gravel or borrow pits too small to contour; piles of waste material, such as mine dumps (see fig. 8); small banks or escarpments that are prominent but not high enough to be shown by the selected contour interval; and similar relief features.

A slightly different form of hachures is used to depict small earth dams, small levees, spoil banks, and cuts and fills along roads or railroads. Contoured depressions are distinguished from hills by short ticks at right angles to the contours, pointing toward the center of the depression.

b. <u>Area patterns.</u> --Intricate surface areas too irregular to contour except in a very generalized manner, such as lava beds, sand dunes, and open strip mines, are shown by a variety of symbol patterns. The patterns are made up of dots, hachures, or form lines that indicate the typical appearance of the area. Where symbol patterns are used, no attempt is made to represent the topography in detail. The Medicine Lake, Calif., 15-minute quadrangle shows a volcanic area with many craters and lava beds. The lava beds are represented by a surface pattern and generalized contours. FEATURES SHOWN ON TOPOGRAPHIC MAPS

(Ch. 1B3) 13

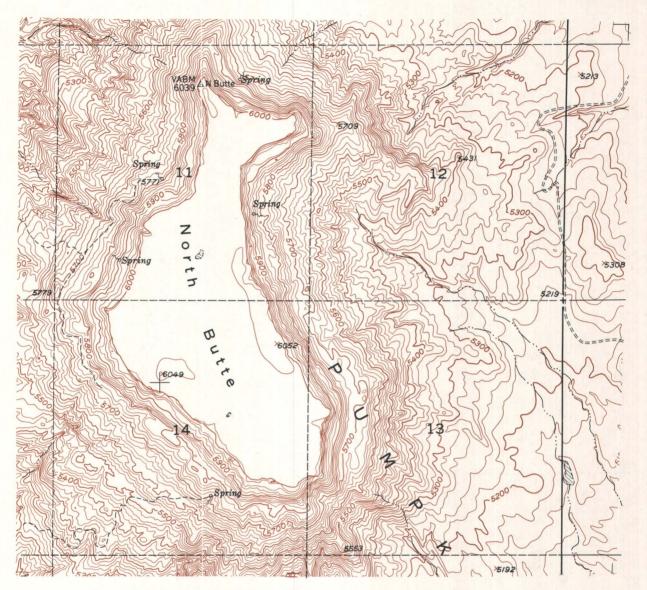


Figure 5.--Contoured slopes. A flat-topped mesa in Wyoming mapped at the scale of 1:24,000, with a 20-foot contour interval. The steep mesa rim is portrayed by closely spaced contours, which come together in places where there are vertical cliffs. Toward the foot of the hill the contour spacing is wider, indicating a generally concave slope. The outlined squares are public-land subdivisions 1 mile, more or less, between corners. Part of the North Butte, Wyo.,  $7\frac{1}{2}$ -minute quadrangle.

14 (Ch. 1B3)

TOPOGRAPHIC INSTRUCTIONS



Figure 6. --Drumlins in northern New York. The elliptical hills are oriented generally in the direction of glacial movement. Usually they are steeper at the north end. The map scale here is 1:24,000; the contour interval is 10 feet. Part of the Sodus, N. Y., 7<sup>1</sup>/<sub>2</sub>-minute quadrangle.

FEATURES SHOWN ON TOPOGRAPHIC MAPS

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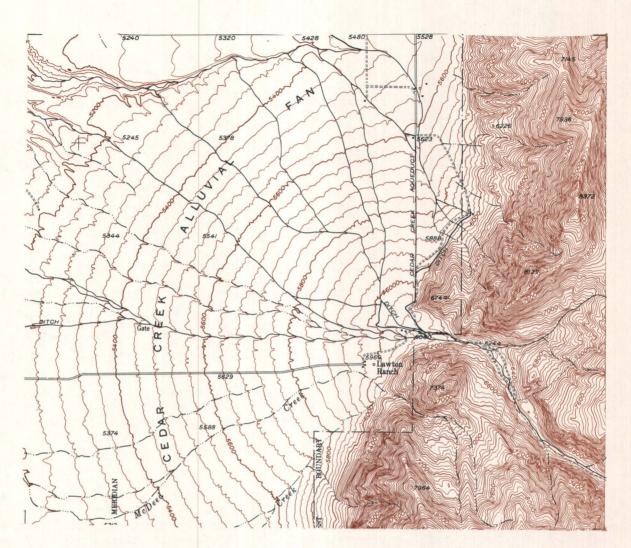


Figure 7. --Cedar Creek alluvial fan in Montana. A deposit of sand and gravel washed out of Cedar Creek canyon in the mountains at the right. It forms a semicircular cone with a radius of almost 4 miles and with a height at the center of over 800 feet. The contoured slope is exceptionally uniform. The map scale here is 1:62, 500; the contour interval is 40 feet. Part of the Ennis, Mont., 15-minute quadrangle.

c. Relief shading. -- The pictorial effect of some maps is emphasized by relief shading, a half-tone overprint that simulates the appearance of sunlight and shadows on the terrain and provides the illusion of solid, three-dimensional topography. Relief shading copy is prepared after the rest of the map has been produced in the conventional way. Of the maps listed in article 18, the Delaware, Mich., the Ironton, Mo., the Waldron, Ark., and the Ennis, Mont., which are reasonably stable, water features --

15-minute quadrangles are published in shadedrelief editions.

#### MAP REPRESENTATION OF WATER FEATURES

#### 11. Periodic changes in water features

Unlike other natural features, most of

TOPOGRAPHIC INSTRUCTIONS

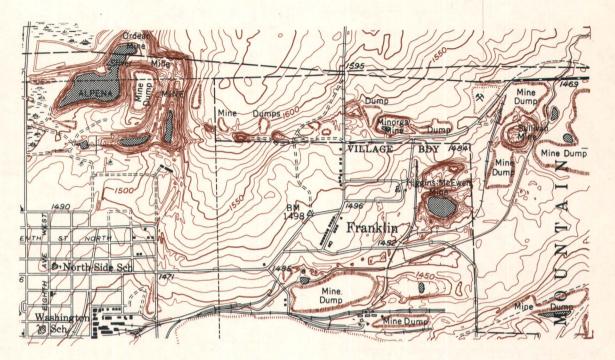


Figure 8.--Depression contours and hachures. Iron mines in the Mesabi district of Minnesota mapped at the scale of 1:24,000, with a 10-foot contour interval. Hachures show the piles of ore and waste material. Depression contours, with short right-angle ticks, show the open-pit mines. Many of the worked-out mines contain water. Part of the Virginia, Minn.,  $7\frac{1}{2}$ -minute quadrangle.

shown in blue on the map--change from time to time. The levels of rivers, lakes, and reservoirs fluctuate during the year, according to the amount of rainfall and runoff. Smaller streams and springs may be entirely dry for a part of the year. Daily or even hourly variations in streamflow and water level occur in areas where melting snowfields or glaciers feed the streams or where streams are controlled for irrigation or industrial purposes.

a. <u>Classification of water features</u>. --To give a general indication of the amount of annual variation, water features are classified for mapping purposes as either intermittent or perennial. Intermittent streams, lakes, and ponds are those that usually are dry at least 6 months of the year. All others are perennial.

b. "<u>Normal</u>" water level. -- The surface elevations and the shorelines of larger bodies of water usually undergo seasonal changes. As far as practical, the level shown on the map represents the so-called "normal" stage, defined as the one prevailing during the greater part of the year. Usually it corresponds to the line of permanent vegetation on the banks or shores. Strictly speaking, there is no normal stage; the definition is practical rather than precise.

12. Kinds of water features and map symbols

The style of lines, tints, and patterns shows the classification of water features as either intermittent or perennial.

a. Linear watercourses. --Single lines represent rivers, streams, canals, and ditches less than 40 feet wide on  $7\frac{1}{2}$ -minute maps, or less than 80 feet wide on 15-minute maps. If the features are larger than these dimensions,

#### FEATURES SHOWN ON TOPOGRAPHIC MAPS

shorelines are mapped to scale, and the spaces between the double lines are filled with blue tint (see fig. 9).

Solid lines are used for perennial watercourses, either single- or double-lined. Intermittent drains are shown by dash-dot lines (long dashes separated by three dots). Falls and rapids in large streams are shown by hachures--in small streams by crossbars. The Strasburg, Va., 15-minute quadrangle shows the falls and rapids in the South Fork of the Shenendoah River by blue hachures.

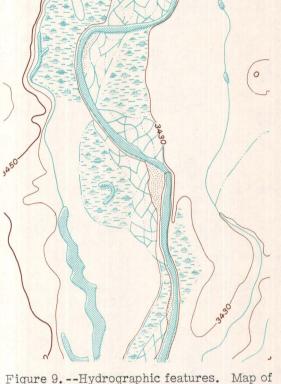
b. Area water features. --All perennial open-water features are outlined in blue and filled with blue tint or blue half tone. Intermittent lakes and ponds are shown with dashed outlines and filled with a fine diagonal hatching. Marshes and swamps are shown with a characteristic pattern symbol; permanent stream channels passing through them are represented by solid lines. The Little Creek, Del.,  $7\frac{1}{2}$ -minute quadrangle map shows a large swamp containing many permanent stream channels.

c. <u>Glaciers and permanent snowfields</u>. --These are outlined with dashed lines and treated otherwise as relief features, except that the relief is shown in blue instead of brown. The relief and extent of these features may be indicated by regular contours, approximate contours (dashed lines), or by form lines.

d. Springs and wells. --The landmark principle applies to the mapping of these water features. In arid regions where they are important, most of the springs and wells are shown; in humid areas, only the outstanding ones are mapped. A small circle with a tail pointing downstream symbolizes a spring. The well symbol is a small circle.

e. <u>Coastal features</u>. --Quadrangles that include seacoasts and tidal waters sometimes show depth curves, soundings, some obstructions to navigation, and other marine detail of general interest. These maps are not intended, however, to be used as navigation charts.

Depth curves are similar to contours, except that the interval is not necessarily constant



'igure 9. --Hydrographic features. Map of part of the Pecos River in New Mexico, showing swamps, a sand bar, lakes, single-lined and double-lined streams, and intermittent and perennial streams. Scale 1:24,000. Part of the Bottomless Lakes, N. Mex., 7<sup>1</sup>/<sub>2</sub>-minute quadrangle.

and the reference datum is different. On the Atlantic Coast the datum is mean low water; on the Pacific Coast it is mean lower low water. The curves show the average water depth below the datum, in feet; they are not shown below a depth of 600 feet. Data for depth curves and soundings are taken from official hydrographic charts.

Permanent fixed aids to navigation, such as lighthouses and beacons, are mapped, but nonfixed aids, such as lightships and buoys, are not shown. Obstacles to navigation--rocks, reefs, wrecks, and similar objects--generally are mapped if they are visible at low tide. 18 (Ch. 1B3)

The shoreline along coasts is normally shown at the mean high-water line. Where swamps and marshes border the coast, the shoreline is shown at the outer limits of vegetation. Tidal flats are outlined with a dotted line, filled with a pattern and labeled. The Petit Manan, Me.,  $7\frac{1}{2}$ -minute quadrangle is an example of coastal mapping, showing depth curves, reefs and rocks, with tidal flats portrayed by labeled surface patterns.

#### MANMADE MAP FEATURES

## 13. Coordinate systems, subdivisions, and boundaries

Except for lettering, the lines representing political boundaries, land subdivisions, and coordinate systems are the only items of map information that are not physically evident on the ground. Boundary lines may be based on surveyed ground monuments, or they may be only described by statute. The lines of coordinate systems are mathematical abstractions.

a. Coordinate systems. --Quadrangle maps show two systems of reference coordinates, the universal geodetic coordinates in terms of latitude and longitude and State plane coordinates.

Parallels of latitude and meridians of longitude form the boundaries of standard quadrangles. Maps of continental United States at the scale of 1:62,500 measure 15 minutes in latitude and 15 minutes in longitude, and maps at the scale of 1:24,000 measure  $7\frac{1}{2}$ -minutes on each side. The coordinates of the boundary lines are printed in the margins at each corner, and ticks are placed at intervals along each edge and within the body of the map--at 5-minute intervals on 15-minute maps and at  $2\frac{1}{2}$ -minute intervals on  $7\frac{1}{2}$ -minute maps.

State plane-coordinate systems permit surveyors and others to use a simple reference grid and still base their work on the national net of geodetic control. Each State has an individual system, and most State systems have two or more zones. Within zones the coordinates of any point are the distances in feet north and east of an arbitrarily chosen zero point. Quadrangle maps show the State plane coordinates by labeled grid ticks along the border lines at 10,000-foot intervals. If the mapped area lies in more than one zone, each zone is shown with a distinctive style of tick. The grid can be laid out on the map by drawing straight lines between corresponding ticks on opposite edges.

b. <u>Public-land subdivisions</u><sup>4</sup>.-The surveyed lines that divide over two-thirds of the United States into mile-square sections form a cadastral grid system. The subdivision lines are property boundaries or the references for boundaries. Frequently they form in part the boundaries of political subdivisions, and in many areas the routes of public roads follow the subdivision lines.

The subdivision lines and corners are shown on quadrangle maps to the extent that their positions can be determined from evidence recovered on the ground. "Found" subdivision corners are shown by heavy red crosses; lighter weight crosses are used for "indicated" corners. Indicated corners are those marked in some manner, but not with markers set by the original surveyors.

Subdivision lines accurately located are represented by solid red lines; dashed red lines are used where the location is uncertain. On maps published before about 1940, subdivision lines are shown by black dotted lines; on those published between about 1940 and about 1948, black solid lines were used. On modern maps dotted red lines sometimes are used to represent subdivision lines of an unofficial nature.

Map representation of public-land subdivisions is not intended to be authoritative or official; it is presented as useful information, as accurately and completely as it can be at reasonable cost. In areas where a reasonable amount of field evidence cannot be found, the section lines are sometimes omitted.

<sup>4</sup> See Chapter 3 A 4, Mapping of public-land subdivisions.

(Ch. 1B3) 19

c. <u>Boundaries</u>. --Boundaries of civil subdivisions are shown in black, using line weights and styles appropriate to the rank of the area, in the following order:

#### National

State or Territory

- County, parish, municipio, or judicial subdivision
- Civil township, town, district, precinct, barrio
- Incorporated city, village, town, borough, hamlet
- National or State reservation, park, or monument

Small park, cemetery, airport, etc.

The boundaries of less important areas are omitted where they are not well established or where they are subject to frequent change. Where the boundaries of two civil units coincide, the symbol of the higher ranking unit is used for the coincident part of the line.

14. Travel and transportation routes

Among the most important and generally useful items of map information are transportation routes. They are distinguished on the map by symbols and labels and are classified according to traffic capacity.

a. <u>Roads and trails</u>. --The road classification system considers such factors as width, number of lanes, carrying capacity, and traffic restrictions. The symbols used to show different classes of roads are illustrated on the symbol chart.

Federal highways are distinguished by shield symbols and State highways by circle symbols surrounding the route numbers. Permanent traffic restrictions are shown by notes. For important roads the distances to destinations outside the mapped area are shown in the margins. Unimproved roads and trails are mapped to the extent that the information is useful. In wilderness areas with few travel routes, most of the poorer roads and trails are shown; in more populated districts, some are omitted because they are less important and would congest the map. (See symbol chart.)

b. <u>Railroads</u>. --Railroads are shown by a line-and-crosstie symbol and labeled with the name of the operating company. The number of tracks, if more than two, is shown by a label. Dismantled railroads are shown and labeled, and the roadbeds of abandoned railroads are shown, where they are landmark features, by the trail symbol and labeled.

Railroad yards are portrayed by a conventional track pattern, similar to the true pattern of the yard; the main tracks and the outlines are shown in correct position. The principal buildings are plotted to scale. (See symbol chart.)

c. Other route features. --Other kinds of routes sometimes mapped include telephone lines, telegraph lines, powerlines, pipelines, aqueducts, and canals. Many of these, particularly powerlines and pipelines, are mapped as landmark features. The symbol is dropped as it approaches congested areas, or where it closely parallels more important linear features. Each type of route is shown by an appropriate line symbol and labeled if necessary for clarity.

15. Buildings and cities

Buildings and groups of buildings are by far the most common kind of map features. On quadrangle maps, all buildings cannot be shown legibly, and various means must be used to simplify the map representation. Some kinds of buildings are omitted, some buildings are shown larger than their true size, and in congested areas only landmark buildings are mapped.

a. <u>Buildings</u>. --Two classes of buildings are distinguished on maps by symbol. Class 1, those intended to shelter human activities, are shown by a solid or dot-filled symbol. Class 2, those intended for the protection of machinery, animals, or materials, are shown with an open-outline or a hatched symbol.

Minimum symbol dimensions are used for legibility even though the scale size of the building may be smaller. On  $7\frac{1}{2}$ -minute maps, class 1 buildings up to 40 feet square and class 2 buildings up to 60 feet square are represented by standard-size symbols. Larger buildings are mapped to scale. On 15-minute maps the minimum scale dimensions for the two kinds of symbols are 80 and 120 feet. Class 2 buildings smaller than the average dwelling, such as sheds and private garages, are not mapped.

Churches are represented by the building symbol with a cross attached; schools, by the building symbol with a pennant attached. Names of churches and schools also are given if space permits.

b. <u>Building groups.</u>--Sometimes the closely spaced buildings in a group, such as a tourist court or a college, cannot all be mapped in true position. The buildings outlining the group are shown, but some of the smaller buildings may be omitted and others displaced. Race tracks, drivein theaters, and other group structures are mapped in a similar way. The outlines are preserved, but the interior is simplified, showing only the more important parts of the feature.

c. <u>Towns and cities</u>. --In urban areas, where the numerous buildings would congest the map, only the street pattern and landmark buildings are mapped. A pink-tint overprint denotes the area in which substantially all the building sites are occupied, but its limits may not coincide with the town or city limits.

Landmark buildings that are mapped in urban areas include schools and churches; public buildings, such as post offices and railroad stations; and other buildings that are prominent because of their outstanding size, design, or historical associations. The small town of Virginia, Minn., for example, is shown on the  $7\frac{1}{2}$ -minute quadrangle of that name by a pattern tint within which only the streets, railroads, and principal buildings are mapped. 16. Names, notes, and numbers

Topographic maps present a symbolized picture of the terrain, with features represented by lines, groups of lines, or conventional symbols. To make the picture complete and usable, names, labels, and numbers must be added. The lettering and figures must be placed on the map carefully so that they will be understandable and yet not obscure other map detail.

a. <u>Map names</u>. --Names used on quadrangle maps are the names used by local people, as nearly as can be ascertained by field investigations.

The Board on Geographic Names, a Federal agency, is the legal authority on names for government maps and other publications. In general, the Board's policy gives preference to local usage; where there is disagreement, the name in current use by the majority is preferred.

Name information is obtained during field surveys from various sources, such as published maps, historical records, reference publications, and--most important of all--local residents. The information is crosschecked, and serious disagreements are referred to the Board on Geographic Names for decision.

For buildings, dams, railroads, parks, and similar features, the names applied by the controlling organizations are used on the map. For natural features the names used by the majority of local residents are accepted. The number of names published depends on the map scale and the space available. Names are selected by the map editors, generally according to the relative importance of the features in the immediate areas.

b. <u>Geodetic control marks</u>. --Although most of the permanently marked control survey stations are shown, a quadrangle map is not a control diagram because it may be necessary to omit some of the marks to avoid overcrowding the map. A complete record of the control surveys for a quadrangle area can be obtained from the Geological Survey, Map Information Office, Washington 25, D. C., or from the Director, U. S. Coast and Geodetic Survey, Washington 25, D. C.

Bench marks are symbolized by small crosses together with the letters "BM"; elevations are given to the nearest foot. Triangulation and transit traverse stations are shown with small triangles; elevations for these stations also are given if they have been determined.

c. <u>Spot elevations</u>. --Spot elevations are established, during mapping surveys, for many points on the ground. These elevations are shown on the map as useful information at road forks, water surfaces, summits of passes, mountain tops, saddles, and other points of special interest. The ground location of a spot elevation may be clear from the surroundings, as at a road fork or on a sharp peak, or its position may be indicated by a small cross. Figures for checked elevations are printed in black and usually are reliable to within one-tenth of the contour interval. Figures for unchecked elevations are printed in brown.

#### INFORMATION ON MAP MARGINS

17. Identification, orientation, and explanation

The space outside the neatline on published maps is used to identify and explain the map. The marginal information corresponds somewhat to the table of contents and introduction of a book--it tells briefly how the map was made, where it is located, what organizations are responsible for the contents, and gives other information to make the map more useful.

a. <u>Identification</u>. --In the upper right margin the quadrangle is identified by name, State, and series; the county name also is given if the area lies within one county. To locate the mapped

## JENKS QUADRANGLE OKLAHOMA-TULSA CO. 7.5 MINUTE SERIES (TOPOGRAPHIC)

area, the latitude and longitude of the quadrangle corners are given. The names of adjoining published maps are shown along each side and at each corner. On recent maps, a small diagram shows the approximate location of the quadrangle within the State.





b. <u>Responsibility, methods, and dates.</u>--The organizations responsible for the map information are listed in the lower left margin. Here also are listed the principal methods of compilation, the dates of aerial photography and field surveys, the map projection used, the horizontal datum, the State plane coordinate grid zones shown by ticks, and sometimes notes explaining the treatment of public-land subdivision or other features.

Mapped, edited, and published by the Geological Survey Control by USGS, USC&GS, USCE, and Oklahoma Geodetic Survey Culture and drainage in part compiled from aerial photographs taken 1950. Topography by plane-table surveys 1951–1952 and in part by U. S. Corps of Engineers

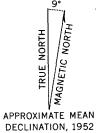
Polyconic projection. 1927 North American datum 10,000-foot grid based on Oklahoma coordinate system, north zone

Red tint indicates area in which only landmark buildings are shown

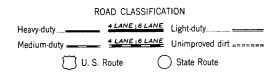
c. Scale, contour interval, and other data. --The map scale is given in the center of the lower margin, both as a numerical ratio and as graphical bar scales in miles, feet, and kilometers. Below the bar scales are listed the contour interval and the vertical datum from which elevations are measured; for most maps the vertical datum is mean sea level.

A map believed to be of standard accuracy carries a statement, printed near the bottom of the lower margin, that the map complies with the National Map Accuracy Standards. If the map was published after 1948, absence of the accuracy statement means that in some respects the map probably does not comply with accuracy standards. Before 1948, accuracy statements were not printed on the maps. Below the accuracy statement are given the addresses of the two main distribution centers of the Geological Survey from which topographic maps may be purchased. Figure 10 illustrates the information shown in the center of the lower margin.

In the left lower margin an arrow symbol shows the approximate mean magnetic declination,



east or west of true north, in the area for the year indicated. This information is taken from isogonic charts of the Coast and Geodetic Survey; it should be used with discretion because local magnetic attraction and annual variation affect the compass declination appreciably. In the lower right margin is a road classification legend. For the more important roads, destinations outside the mapped area with distances in miles from the map boundaries, are printed in the margins where the routes leave the map. Below the road legend, the names of the quadrangle and the State are repeated. Also given here are the coordinates of the southeast corner and the map series, an abbreviated form of identification. The date of the map information is shown at the bottom of the right margin.

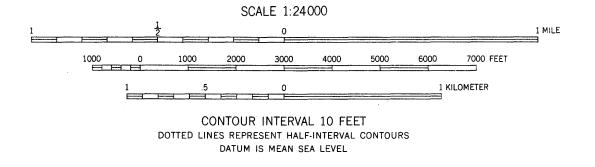


JENKS, OKLA. N3600–W9552.5/7.5 1952

#### MAP REFERENCES

18. Special selected list

The quadrangle maps listed below have been selected to illustrate the characteristic topography of the five major physiographic regions of the United States. Those marked with an asterisk (\*) are mentioned in this chapter as examples of particular kinds of map features.



THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS FOR SALE BY U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C. A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

Figure 10. --Information shown in the center of the lower margin.

## TOPOGRAPHIC MAP SYMBOLS

VARIATIONS WILL BE FOUND ON OLDER MAPS

Hard surface, heavy duty road, four or more lanes	Boundary: national	
Hard surface, heavy duty road, two or three lanes		
Hard surface, medium duty road, four or more lanes		
Hard surface, medium duty road, two or three lanes		
mproved light duty road		
Jnimproved dirt road—Trail=		
Dual highway, dividing strip 25 feet or less		
Dual highway, dividing strip exceeding 25 feet		
	Township or range line, approximate location	
Railroad: single track—multiple track		
Railroads in juxtaposition		
Narrow gage: single track—multiple track		
Railroad in street—Carline		
Bridge: road—railroad=		
Drawbridge: road—railroad	Boundary monument: land grant—other	
Footbridge		
Funnel: road—railroad		
)verpass—Underpass		. The
mportant small masonry or earth dam	Supplementary contour.	$\sim$
Dam with lock	X	
Dam with road=	- "	sector and the sector sector and
Canal with lock	→ → Mine dump Wash	
•	Tailings Tailings pond	
Buildings (dwelling, place of employment, etc.)	Ourp mino	
School—Church—Cemeteries	Gravel beach	
Buildings (barn, warehouse, etc.)		and the second
Power transmission line	Perennial streams	s
Felephone line, pipeline, etc. (labeled as to type)	Elevated aqueduct Aqueduct tunnel	
Nells other than water (labeled as to type)		
Fanks; oil, water, etc. (labeled as to type)		
_ocated or landmark object—Windmill		
Open pit, mine, or quarry—Prospect		( To the total to the total to the total t
Shaft—Tunnel entrance		
· · · ·	Sounding—Depth curve 10 Piling or dolphin	
Horizontal and vertical control station:	Exposed wreck	
tablet, spirit level elevation		
other recoverable mark, spirit level elevation		
Horizontal control station: tablet, vertical angle elevation	/ABM Δ2914	alle alle
any recoverable mark, vertical angle or checked elevation	Δ5675 Marsh (swamp) Submerged marsh	金花之外生
Vertical control station: tablet, spirit level elevation	BM X 945 Wooded marsh Mangrove	
other recoverable mark, spirit level elevation	× 890 Woods or brushwood Orchard	100000000
Checked spot elevation	×5923 Vineyard Scrub	

Inundation area.

Checked spot elevation. Unchecked spot elevation-Water elevation... 

House omission area.

#### FEATURES SHOWN ON TOPOGRAPHIC MAPS

#### Quadrangle

Scale

Ashby, Nebr.,	1:62,500
Bright Angel, Ariz.,	1:48,000
Crater Lake National Park, Oreg.,	1:62,500
Delaware, Mich., (shaded relief)	1:24,000
	•
*Ennis, Mont., (shaded relief)	1:62,500
Holy Cross, Colo.,	1:62,500
Ironton, Mo., (shaded relief)	1:62,500
Jackson, Mich.,	1:62,500
*Juanita Arch, Colo.,	1:24,000
Kingston, R. I.,	1:62,500
Lake McBride, Kans.,	1:24,000
Mammoth Cave, Ky.,	1:62,500
*Maverick Spring, Wyo.,	1:24,000
Menan Buttes, Idaho	1:24,000
Mobile, Ala.,	1:62,500
Monadock, N. H.,	1:62,500
Mt. Tom, Calif.,	1:62,500
Point Reyes, Calif.,	1:62,500
Renova West, Pa.,	1:62,500
Sonoma Range, Nev.,	1:250,000
*Strasburg, Va.,	1:62,500
*Ticonderoga, N. YVt.,	1:24,000
Voltaire, N. Dak.,	1:24,000
*Waldron, Ark., (shaded relief)	1:62,500
Warm Springs, Ga.,	1:62,500
warm opringo, da.,	1.02,000

19. Other reference maps

The following quadrangle maps are mentioned in the text as illustrating some particular types of features.

#### Quadrangle Scale 1:24,000 Bottomless Lakes, N. Mex., Central City, Colo., 1:31,680 and 1:62,500 Little Creek, Del., 1:24,000 Medicine Lake, Calif., 1:62,500 North Butte, Wyo., 1:24,000 1:62,500 Palmyra, N. Y., Petit Manan, Maine 1:24,000 1:24,000 Sodus, N. Y.,