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OF THE INTERIOR UNITED STATES  
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OF TOPOGRAPHICAL METHODS**

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Topographical Methods by Henry Gannett

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**HENRY GANNETT**

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UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

MANUAL  
OF  
TOPOGRAPHIC METHODS

BY

HENRY GANNETT



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## CONTENTS.

	Page
CHAPTER I. INTRODUCTION.....	1
Object of this manual.....	1
Classes of maps.....	1
Topographic maps.....	2
Contours.....	2
Scales.....	3
Cultural features.....	3
Plan of the map of the United States.....	4
Diversity of conditions.....	4
Scale.....	4
Contour interval.....	5
Features represented.....	5
Size of sheets.....	6
CHAPTER II. METHODS AND CLASSIFICATION OF WORK.....	7
General methods.....	7
Correctness of maps.....	7
Accuracy of location.....	7
Number of locations.....	8
Distribution of locations.....	9
Quality of sketching.....	10
Classification of work.....	10
CHAPTER III. ASTRONOMIC DETERMINATION OF POSITION.....	12
Object and importance of astronomic determination.....	12
Definitions.....	12
Astronomic transit and zenith telescope.....	13
Chronograph.....	14
Field work.....	16
Observations for latitude.....	17
Reduction of latitude observations.....	18
Measurement of a division of the head of the micrometer screw.....	19
Measurement of a level division.....	22
Computation of apparent declination of stars.....	23
Observations for time.....	25
Reduction of time observations.....	25
Correction for error of level.....	26
Correction for inequality of pivots.....	26
Correction for error of collimation.....	26
Correction for deviation in azimuth.....	27
Correction for diurnal aberration.....	27
Example.....	27
Comparison of time.....	32
Observations for azimuth.....	33
Reduction of observations for azimuth.....	35

	Page
CHAPTER IV. BASE LINE, PRIMARY CONTROL, AND ELEVATIONS.....	38
Party organization.....	38
Base-line measurement.....	38
Site.....	38
Methods and instruments used.....	39
Personnel of party.....	41
Reduction of base-line measurement.....	42
Reduction to standard.....	42
Correction for inclination.....	42
Correction for temperature.....	42
Reduction to sea level.....	42
Example.....	43
Primary triangulation.....	45
Selection of stations.....	45
Signals.....	46
Heliotropes.....	47
Theodolites for triangulation.....	48
Instructions for measurement of horizontal angles.....	49
Organization of parties and prosecution of work.....	56
Reduction of primary triangulation.....	57
Reduction to center.....	57
Spherical excess.....	58
Station adjustment.....	58
Figure adjustment.....	60
Computation of distances.....	63
Computation of geodetic coordinates.....	64
Traverse lines for primary control.....	67
Precise and primary elevations.....	69
CHAPTER V. SECONDARY TRIANGULATION AND TRAVERSE AND STADIA MEASUREMENTS.....	70
Secondary triangulation.....	70
The plane table.....	70
The alidade.....	73
Measurement of altitudes.....	75
Traverse work.....	76
Traverse plane table.....	77
Measurements of altitudes in connection with traverse work.....	78
Vertical angles.....	78
The aneroid.....	79
Organization of parties and distribution of work.....	80
Stadia measurements.....	81
CHAPTER VI. SKETCHING, OFFICE WORK, AND PROJECTIONS.....	83
Sketching.....	83
Scale of field work.....	85
Office work.....	85
Projections.....	85
INDEX.....	87

## ILLUSTRATIONS.

---

	Page.
PLATE I. Astronomic transit and zenith telescope.....	12
II. Baldwin tape-stretching device for base measurement.....	40
III. Framed signal for use where observing tower is not necessary.....	45
IV. Signal combined with tower for observer and instrument.....	46
V. Eight-inch theodolite.....	48
VI. Telescopic alidade.....	70
VII. Johnson plane table and telescopic alidade.....	72
VIII. Traverse plane table and ruler alidade.....	76
FIG. 1. Chronograph.....	15
2. Johnson plane-table movement (section).....	72
3. Aneroid.....	79
4. Works of the aneroid.....	79



# MANUAL OF TOPOGRAPHIC METHODS.\*

By HENRY GANNETT.

## CHAPTER I.

### INTRODUCTION.

#### OBJECT OF THIS MANUAL.

The object of this manual is a description of the topographic work, instruments, and methods of the United States Geological Survey, primarily for the information of the men engaged in this work. It is not intended to be an elementary treatise on surveying, as it presupposes a knowledge of the application of mathematics to surveying equivalent to that obtained in our professional schools. Neither is it intended to be a general treatise on topographic work, altho it may, to a certain extent, supply the need of such a work.

Surveys are made for two widely different purposes. One consists in laying down upon the ground certain geometric figures, such as a town plat or the alignment of a railroad or an aqueduct. The other purpose is the making of maps, or miniature representations of the country. While the instruments and operations are to some extent the same in both, the purpose and the results are very different.

Most books on surveying have in view mainly, if not entirely, the first of these two purposes, operations incident to the making of maps being more or less slighted. Herein the author will attempt to describe the most approved methods of surveying as applied to the production of topographic maps, whether on large or small scales and whether of a high or a low degree of accuracy, including rough reconnaissance as well as accurate and detailed surveys.

#### CLASSES OF MAPS.

A map is a representation, in plan, of a part of the earth's surface. The variety of maps is legion, depending upon the class of features or phenomena which they represent or which is made prominent on them. Thus there are geologic maps, zoologic maps, botanic maps,

\* This manual was first published in 1884 as Monograph XXII of the United States Geological Survey.

cadastral maps (which represent, primarily, property lines), political maps, etc. For all these it is essential that there be a base upon which the specific phenomena can be represented. This base should show certain topographic features, as streams and other bodies of water, railroads, towns, and cities; while some sort of convention to represent the relief of the ground is usually a valuable adjunct.

From the point of view of scale, those maps which show only topographic features may be grouped in two classes: First, those on small scales, say 10 or more miles to an inch, which may be properly called geographic maps and which are usually compiled from other maps on larger scales; and, second, those on large scales, which may properly be called topographic maps. Maps of the latter class are often made directly from surveys, and being the first product of these surveys, are known as mother maps, because they constitute the source from which other maps are compiled. In this work are described the methods of surveying and the preparation of maps on large scales—maps which can be conveniently made directly from surveys.

#### TOPOGRAPHIC MAPS.

A topographic map should represent rivers, creeks, lakes, ponds, and all other bodies of water, together with coast lines; all artificial features that are of sufficient prominence to be represented on a scale, such as roads, boundary lines, cities, towns, villages, houses, and, in case of large-scale maps, fences and other such objects, bridges, fords, dams, canals, aqueducts, etc., and the relief of the ground—its hills, valleys, mountains, canyons, etc.

The relief of features can be shown by different methods, which may be classed as qualitative and quantitative. Qualitative methods show relief by shading, either by means of crayon or color or by means of hachure lines—lines which are drawn in the direction of the slope and which by their relative heaviness and closeness produce the effect of shading. These methods merely show the degree of slope; they give no information regarding the absolute amount of relief, or elevation above sea level. They have been in extensive use thruout the world, but their use is now rapidly diminishing.

#### CONTOURS.

The method of expressing relief now commonly in use, which has largely replaced the methods described above, is that known as the contour method. Contours are lines drawn at equal elevations above sea level, every point upon a contour being, or being supposed to be, at the elevation indicated by that line. These contours would become shore lines if the level of the sea were raised successively to the heights indicated by them. This method is con-

fessedly not so graphic as the others, but it has this great advantage, that it expresses absolute elevations; the height above the datum (usually sea level) of any portion of the area represented can be read directly from the contours. Moreover, it expresses the slopes, since where they are steep the contours must necessarily be close together, and where they are gentle the contours must be far apart. Modern maps, as a rule, are contour maps.

The contour interval is the vertical scale of the map. This should be proportioned to the horizontal scale and to the degree of relief of the country. With the same horizontal scale the contour interval would naturally be large for a country of bold relief and small for one of slight relief, since in the former case the same difference of altitude is of much less importance than in the latter case.

#### SCALES.

The scale of a map is the proportion which exists between the dimensions of the map and those of the area which it represents. It is designated in several ways:

By the number of miles or of feet represented by an inch on the map.

By what is called a fractional scale, the numerator representing a linear unit of the map and the denominator expressing the number of such units in a corresponding distance on the ground, as  $\frac{1}{100000}$ .

By a bar scale, wherein a measure on a map is marked with its corresponding measure on the ground.

On many maps all of these forms of designating the scale are given.

The scale of a map should be chosen so as to represent as much detail and as great accuracy as are needed for the purpose for which the map is made. It should be neither larger nor smaller than is required to suit this purpose. For a small amount of detail a large scale is unnecessary, while too small a scale does not allow the legible representation of the detail required. Thus the statement of the scale of a map should afford an idea of its accuracy and detail.

#### CULTURAL FEATURES.

The list of cultural features, or works of man, which should be represented on a map depends upon the scale of the map and the purposes for which it is made. A general topographic map, which is designed for use for many years without revision, should contain comparatively few of these features—only those which are likely to be permanent and which are of importance to the community rather than to individuals. These features change with considerable rapidity, and keeping the map revised involves the expenditure of much labor and money if many such features are represented. For these reasons their introduction should be restricted so far as is compatible