LEVELING: BAROMETRIC, TRIGONOMETRIC AND SPIRIT

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PREFACE.

The following pages were prepared as a part of the author's lectures on Geodesy, given to succeeding classes in the University of Illinois, and are now published for the greater convenience of his students, and with the hope that they may be useful to others. The author does not claim that there is anything new or original in this volume; he has simply condensed into a single book what heretofore could only be found scattered through many. The object was to give all that was necessary for a thorough comprehension of the principles involved and an intelligent understanding of the method of applying them. Acknowledgments have been made as far as the scource of information was known, but as the lectures were prepared during odds and ends of time, and modified

from year to year, it is possible that proper credit has not been given in all cases. The demonstrations of the formula are original, but the resulting formula is left in that form which the best authorities consider most desirable; the authority for the formula is always given. The attempt has been made to point out all the sources of error, and to give data showing the degree of accuracy attainable by each method.

The author trusts that this little volume will be found to contain all of the essential principles and facts respecting those subjects of which it treats, and hopes that it may be serviceable to those who desire an understanding of those subjects.

UNIVERSITY OF ILLINOIS,
Nov. 8, 1886.

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§ 1. Hypsometry is that branch of geodesy which treats of the measurement of heights, either absolute when referred to the sea level, or relative between any two points on the earth's surface. There are three principal and independent methods in use.

The first depends upon the law of the decrease of pressure of the atmosphere with an increase of altitude; this method employs the barometer, and may be called barometric leveling. The second depends upon the measurement of the vertical angle and the horizontal distance. It employs an angle instrument, the horizontal distance usually being given by triangulation; the elevation is then determined from the known parts of a triangle, hence the name trigonometric leveling. The third consists in

measuring the distance of two points above or below a horizontal line; this is ordinary leveling, in which a leveling instrument gives a visual horizontal line. Notice that the second is the only one applicable when one or both stations is inaccessible. These three methods will be treated separately in succeeding chapters.

§ 2. In a geodesic survey conducted to determine the size and figure of the earth, the vertical element is required, although it is not nearly as important as the horizontal. For example, the profile of the base must be determined so that the measurement may be reduced to a level line, and its elevation above the sea-level must be known, that the measurement may be reduced to the level of the sea; in planning the triangulation, at least the approximate difference of level of the vertices of the triangles is required to determine the height to which the signals must be elevated that they may be visible from the other stations.

When the object of the survey is a map, the vertical element is more important; if the map is to serve as a basis of a geological or topographical survey, the vertical element is equally as important as the horizontal element, or perhaps more so. If the map is to be useful in the preliminary examination for railroads, canals, river improvements, etc., the vertical element becomes the most important.

§ 3. Of the three co-ordinates necessary to completely determine a point—1, vertical distance; 2, horizontal distance, and 3, direction—there is the greatest uncertainty in the results for the vertical distance. It is only very recently that leveling has been done with an accuracy that would compare favorably with other geodesic operations. This is partly due to the fact that early geodesic operations were carried on for scientific objects which did not involve the vertical element, and partly to the natural difficulties, which will be discussed presently.