1895

Topographical Surveying

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Butler University

Butler University Early Theses Collection

Summary

Volume of Collection

8 boxes, 154 folders

Collection Dates

1887 – 1911

Scope and Content Note

The collection contains early theses manuscripts from Butler University dating from 1887 until 1911 on subjects including Literature, Religion, Science, Greek and Latin. Until 1897 Butler required all students, including undergraduates, to write a theses statement in order to receive a degree. One year after Butler University joined the University of Indianapolis and became Butler College the theses requirement for undergraduate students was dropped. Postgraduate theses are available in this collection ending in 1911. While the majority of these manuscripts are handwritten, as early as 1908 graduate students were required to type theses statements. The documents are arranged alphabetically by author.

Topographical Surveying.

Nelson O. Brayton. '95

Topographical Surveying.

General Introduction.

Surveying, defined in its broadest sense.

Surveying is the art of determining the relative positions of prominent points and other objects on the surface of the ground, and then making a graphic delineation of the included area.

General principles.

All the different varieties of surveying, however, depend on the same general principles.

1st. Certain measures and observations are made on the ground, and then,

2nd. according to whatever scale may be deemed suitable to the occasion, these measures or observations are protracted on paper, i.e. mapped.

Now the object of this theses will be, first, to show how certain results in a certain survey were obtained and then, secondly, to present by means of a map, an exact summary of the results attained.

Topics considered under the head of surveying.
I. Different varieties of surveying.
II. Instruments used for surveying.
III. Accuracy of results.
IV. Mapping.

General land, nautical, mining, city and topographical surveying (of which this paper treats) come under the first class.

Instruments. The instruments used are varied, numerous, and some of them very rare and costly. The most common one is the transit, with which belong the chain and level, used in the survey to be later described.

Accuracy of result. The accuracy of result depends on many things, for example, the skill and experience of the surveyor, the condition of the instruments, the temperature at which the measurements have been taken, etc.

From this condition of affairs it happens that ideal surveys i.e. perfectly accurate surveys, have probably never been made; they certainly could not be proven by a resurvey.

But happily on this mundane sphere land is not and cannot be as precious as on Ceres or Vesta and small and trifling errors can be let alone.

Mapping. Mapping is the other half of surveying, as without a plot a survey would be without profit, except to the surveyor.

Topographical Surveying.

Definition.

Topographical surveying, or the art of not only determining the relative positions of prominent parts and other objects on the surface of the ground, but also of furnishing data from which the character of the surface may be delineated with respect to the relative elevations or depressions, and making a map of the same.

General methods of making a topographical survey.

I. With compass ~~and~~ or transit and chain or tape to determine geographical location, and with a level for obtaining relative elevations.

II. With planimeter and plane-table.

III. With transit and stadia rods.

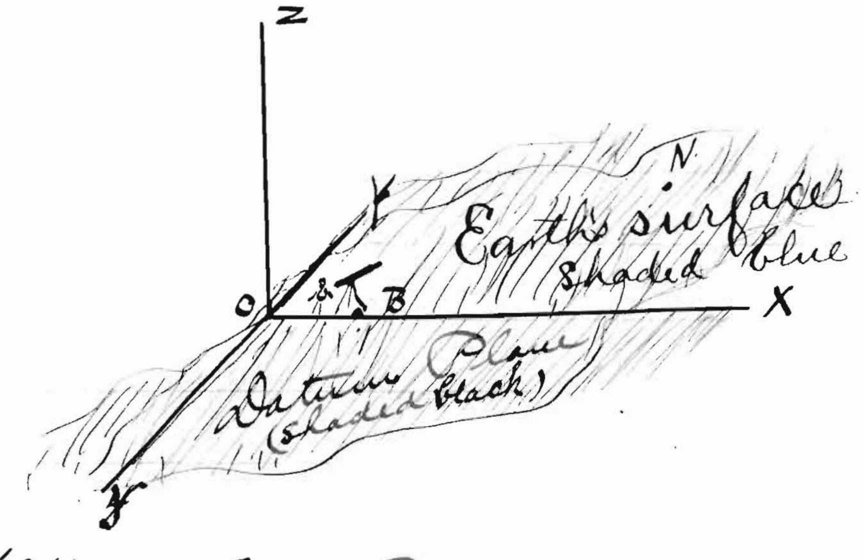
Relative merit of the three systems.

The first is laborious, expensive, and extremely slow but it embraces the only instrument with which the school is provided.

2nd. The Planimeter by which without doing any actual field work any desired area may be plotted. It is an instrument to be relied upon for great accuracy and saving of time.

3rd. The transit instrument with stadia. This is the most interesting, the most common, the most servicable method of all. It depends upon the principle of polar coördinates, that is to say that, if, we have three planes each perpendicular to the other, we can at once locate a spot through its coördinates. Thus we obtain the exact position of a station, as regards a certain specific bench-mark and datum plane, at which the elevation is read by referring it 1st. to the meridian, its angular distance being read on the horizontal limb of the transit 2nd. the distance being determined by reading the space on the stadia intercepted by certain minute cords in the telescope, this space always having a relative value with the actual distance and 3rd. the elevation being determined by reading the vertical angle which the telescopes makes with the horizontal level, i.e. a tangent to the earth.

Illustration of Stadia method.



Plane YOX is the Datum Plane tangent to the earth. Plane ZOX is a plane perpendicular to YOX. Line OX represents the meridian, the instrument being placed on the meridian at B, though not necessarily on the same level as the Datum Plane, since a back-sight is to be taken on O, the first bench-mark.

To determine the position of N, and its elevation above the point O or Datum Plane.

Direct the transit towards O and read the back-sight on O, i.e. the Datum Plane, having the instrument so arranged that the angular distance from the meridian OX may be measured when the theodlite is turned in the direction of N.

Now arrange the telescope so that the intercepted portion of the stadia, i.e. the distance on the rod between the two horizontal threads in the telescope, may be read and then the __actual__ distance is at once determined, since this actual distance __always__ has a relative value with the __intercepted portion__ of the stadia rod. Now by trigonometrical formula the coördinates of of this point can at once be determined.

There remains the determination of the elevation (or depression). This is obtained by by reading the vertical angle and reducing the angle so that the coördinates of the point (N) may be determined as before.

We thus have the position of the point in question, its distance from __O__ being measured 1st, on OX; 2nd. on OY; 3d. on OZ.

Advantages of the stadia method.

1. It does away with chain work.

2. It saves the time ~~to~~ necessary to measure distances and set up instrument.

3. Inconvenient places are readily and accurately measured and located.

Description of First Method.
With transit and level.
(Employed in survey of campus.)

A convenient base-line is laid out (Foot note 1), and upon this at equal distances (Foot note 2), stations □ are located.

The instrument having been placed at some convenient spot, so that, if possible, all the stations may be seen, a back-sight (B.S.) is taken on the first station, through which the Datum Plane (Foot note 3) should pass, and levels, i.e. fore-sights (F.S.) on all the remaining stations.

Now by reducing the F.S. levels to the level of the first station, or Bench-mark, △, (Foot note 4) as it is technically called the plus (+) or

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1. In the campus survey this line was located five feet inside of the east property line.
2. 100 feet.
3. Datum plane. The plane or level from which all depressions or elevations are registered. In the campus this ~~line~~ plane was started from the northeast corner.
4 See blue-print. Letter A at the northeast corner of the campus.

minus elevation or depression of these fore-sight stations on the base-line may be determined in feet and hundreths (as − 1.88 ⊡ E.). Thus the positions for the beginning of the contour lines (Foot note 1) are determined.

The instrument is now carried to the stations in advance of the bench-mark and from these stations at right angles (or any angle provided the same is continued throughout the course of the survey) similar but secondary base-lines are run and readings of the levels taken at regular intervals on these. (Foot note 2)

Now by reducing these levels (i.e. readings) to the + or − levels of the initial back-sight on the secondary base-line (Foot note 3), the relative position of a point or station on the secondary

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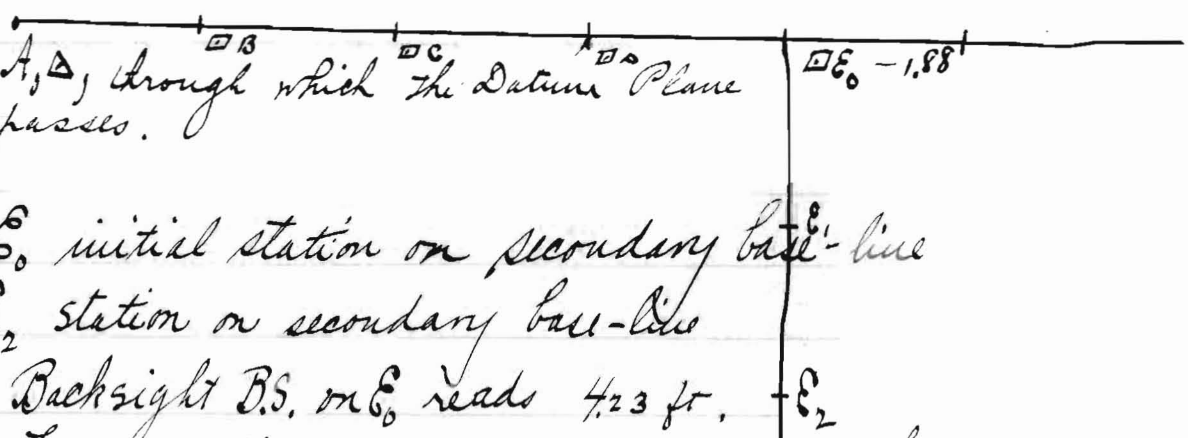
1. A contour line is the projection, of upon the plane of the paper, of the intersection of a horizontal or rather level plane, with the surface of the ground. They are the crooked irregular lines in the blue print representing a rise or fall of two feet in the elevation of the ground.
2. Eleven (11) secondary lines were run across the campus. All but one were so unfortunate as to meet with obstructions, trees or buildings around which it was necessary to trace them.
3. Fore-sight on primary base-line.

base-line is obtained with reference to its first station or initial back-sight on the primary base line.

But by simply adding the elevation of this point or station to the + or − elevation of the initial station of the secondary base-line, (Footnote 1) with reference to the latter's bench-mark, or the <u>Datum Plane</u>, we have the elevation or depression of this point as regards the <u>Datum</u> <u>Plane</u>.



A, Δ, through which the Datum Plane passes.

E_0 initial station on secondary base-line

E_2 station on secondary base-line

Backsight B.S. on E_0 reads 4.23 ft.
Fore sight FS on E_2 " 3.96 ".
Difference of elevation +.27 ".

Fig 2

+.27 ft elevation of E_2 over E_0
−1.88 " " of E_0 " A, Δ, or Datum Plane.
−1.61 ft = depression of E_2 below Datum Plane.

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1. This station would be on the Primary base-line.

Contour lines.

These have been spoken of before. They are the irregular, crooked lines in the map which illustrate the vertical distances in elevations. Every point in them has the same elevation. Figure 3 represents the delineation of contour lines and is self-explanatory.

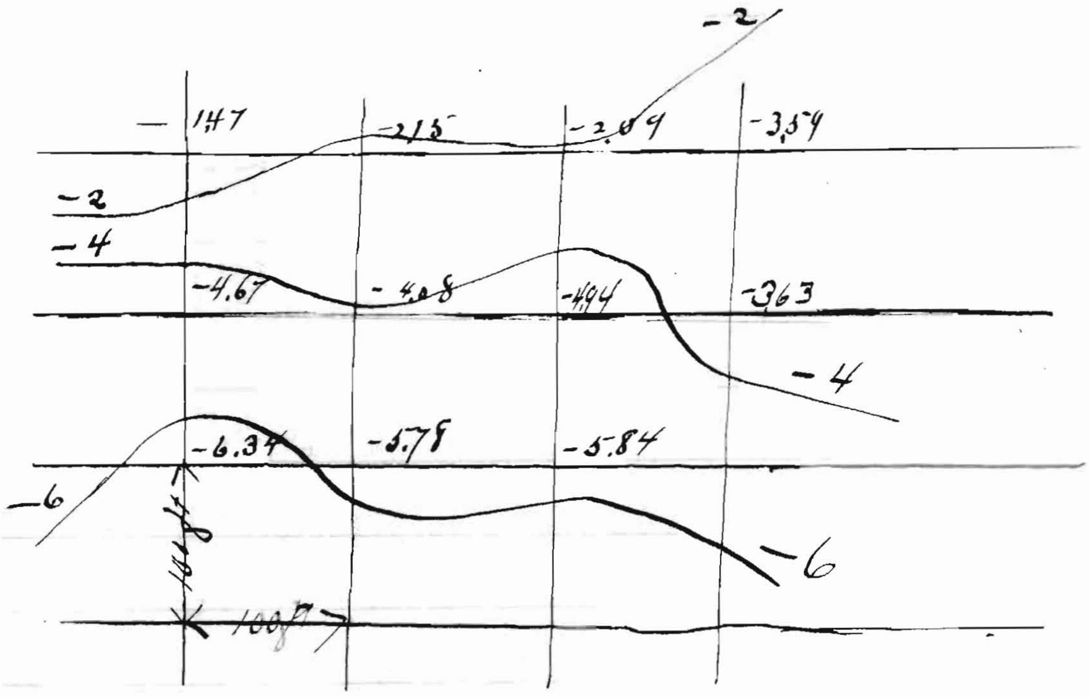

Fig. 3.

Datum Plane.

In the map the datum plane is marked by the capital letters A. & B. But two small areas surpass it in height — the one on which the observatory is located; the other being the tract of ground in front of Burgess Hall.

General Remarks about the Campus.

Size and shape.

In general outline the campus is a rhomboid with its longest edge on the east side.

Lengths.

East side, 1134 feet.
West " , 786 " .
North " , 975 " .
South " , 1008 " .

Mean east and west distance 955 feet.

Angles.

Northeast, 86° 10′.
Southeast, 73° 36′.
Southwest, 106° 33′.
Northwest, 93° 39′.

Area.

Twenty-one + acres.

Slope of ground.

Towards the southwest and west being sixteen feet lower there than ~~at~~ the north-eastern corner or portion.

Locations for new Buildings.

As the blue-print indicates, most of the higher parts of the campus have already been monop-olized for buildings. There still remains however an admirable site east of Burgess Hall, while the author would suggest that a small hillock in the southwest quarter be made the future habitation of the janitor.