Dip Chart

Discussion of the paper of Howland Bancroft, presented at the Salt Lake meeting, August, 1914, and printed in *Bulletin* No. 91, July, 1914, pp. 1767 to 1769.

Theodore Simons, Butte, Mont. (communication to the Secretary*).—While preparing maps and models for use in mining litigations the writer was frequently confronted with the problem referred to in Mr. Bancroft's paper. His chart gives the apparent angle of dip with which a vein should be plotted on a vertical section not at right angles to the strike of the vein. For a quick determination of this apparent angle the writer has used an exceedingly simple graphical method, which he believes may prove helpful to engineers engaged in practical work. It is submitted, not as a criticism of Mr. Bancroft's paper, but as a means of solving the same problem when no chart is available and when calculations would consume too much time.

The writer's method requires merely a few lines marked off on a piece of tracing cloth, as shown in Fig. 1: Draw line bc on any convenient scale. At b erect a perpendicular, ba. By means of a protractor cut off on ba a number of angles within the probable range of variation of dip, so that a line connecting a and c, for instance, forms an angle of 60° with bc, etc. With b as a center and bc as a radius, draw a circle through c. This completes the tool for solving the problem.

Fig. 2 represents the line of strike of the vein and db the trace of the vertical plane on which the vein is to be plotted with the apparent angle of dip. $A°$ is the angle which this plane makes with the strike.

Fig. 3 shows the application of the method: Place line cb of tracing over line db of Fig. 2 and move fore and back until line of strike becomes tangent to the circle. Connect d with the point (a) that marks the true angle of dip as found by measurement in the mine (60° in the case illustrated). The angle adb is the apparent angle of dip ($C°$) to be used in the vertical section.

Proof.—As stated in Mr. Bancroft's paper, the apparent angle of dip is:

$$\tan C° = \sin A° \tan B° \qquad (1)$$

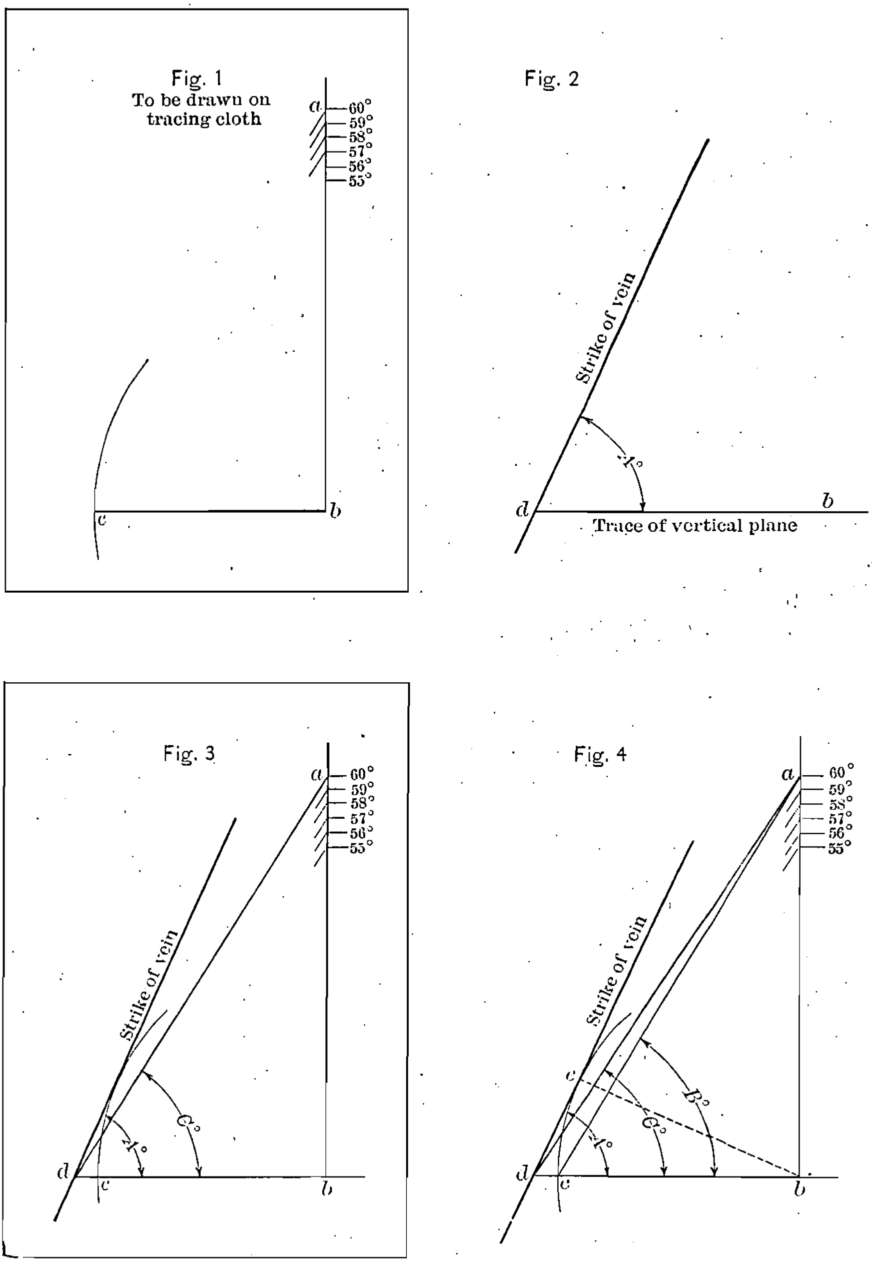
From Fig. 4, which is the same as Fig. 3 with a few lines added for sake of demonstration, we have:

$$\frac{ab}{bd} = \tan C° \text{ whence } ab = bd \tan C°;$$

also

$$\frac{ab}{bc} = \tan B° \text{ whence } ab = bc \tan B°;$$

* Received July 28, 1914.



FIGS. 1 TO 4.—METHOD OF USING DIP CHART.

whence $$bd \tan C^\circ = bc \tan B^\circ;$$

or $$\tan C = \frac{bc}{bd} \tan B^\circ \tag{2}$$

From Fig. 4, $$\frac{bc}{bd} = \frac{be}{bd} = \sin A^\circ$$

Introducing in equation (2) we get:

$$\tan C^\circ = \sin A^\circ \tan B^\circ \tag{3}$$

This is the same as equation (1) and shows that angle C° in Fig. 4 is the required angle.

Frank A. Linforth, Butte, Mont. (communication to the Secretary*).—Referring to Howland Bancroft's paper, entitled Dip Chart, and also to the various other charts and formulæ for the correction of dip in making geologic cross-sections, I would like to emphasize the importance of making these corrections and to call attention to the method used by the geological department of the Anaconda Copper Mining Co. for this work.

Cross-sections are used extensively in Butte for laying out development work in the mines, for checking the interpretation of geologic facts on the separate level maps, and to some extent in legal work. They are not generalized drawings, but accurate records based on observed facts, and great care is taken to make them geometrically as well as geologically correct. The complex structure of the Butte district with its east-west, northwest, and northeast systems of veins and faults renders necessary the corrections for dip on almost every cross-section. If a section is laid out at right angles to any one system of veins, the observed dips for that system can be platted without alteration, but, obviously, the observed dips for the other two systems must be corrected before platting if they are to appear properly on that section. There are many examples in the geologic work at Butte where it has been necessary to make accurate vein correlations between new or partly developed mine levels. In some of these cases there have been a number of veins to choose from and the correct correlations have come from the application of corrected dips on the sections. That these correlations are correct is invariably proved by later developments in the mines.

Formerly these corrections were roughly calculated. More recently D. F. Hewett's excellent chart referred to in Mr. Bancroft's paper was enlarged and used in the routine work of the office. As a wall chart, however, it was found to be less convenient than a tabulated arrangement of values in which the angles of intersection with the section appeared across the top of the sheet and the angles of observed

* Received Sept. 21, 1914.

dip were shown in the left-hand margin. The required value is found at the intersection of the vertical and horizontal columns under the proper headings. This is believed to be a better scheme than using the curves, but both are now supplanted by a small instrument devised and patented by the writer. This instrument, Fig. 5, is a symmetrically designed box 1¼ in. square, and about 8 in. long. A small square opening is cut in the top of the box near each end. One opening bears the designation, "Angle with section"; the other, "Observed dip." The observed values are made to appear in their respective openings by turning small knobs, one at each end of the box. Increments of 5° are used and this interval is found to be satisfactory for practical purposes, although in a slightly larger instrument this interval could be diminished. As soon as the observed values are set, the required value appears as a definite number of degrees in an opening cut in the top of the box. No

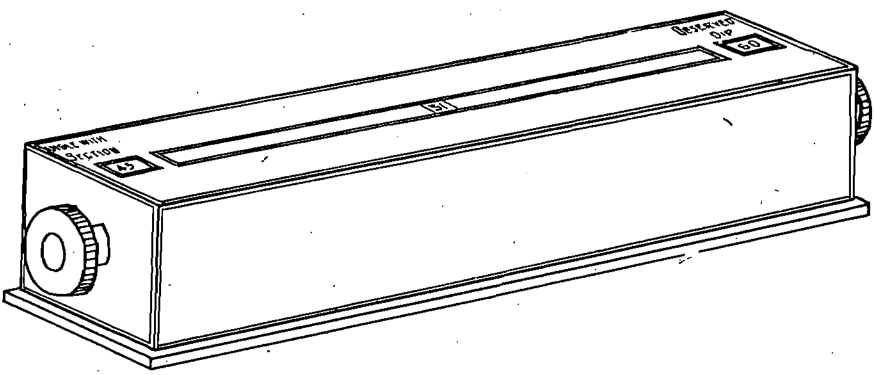


Fig. 5.—The Dipometer.

other numbers appear and no chance for error is introduced, provided that the observed data are properly set up. All confusion is removed, and the determination is made much more rapidly than by tracing out a curve on a chart or figuring from a formula.

The construction of the instrument is very simple. The values of the required angle were figured from the various dips and angles with the section and were tabulated. The sheet of figures thus obtained was mounted on a cylinder, and set in the box so that it could be easily rotated by one of the knobs. A cylindrical shell in which certain openings had been cut was placed over the first one, and its rotation about the common axis is controlled by the other knob. The indices were then adjusted so that the proper value appears for any given set of angles.

The small dimensions of the device, the ease of making the determinations, and the absence of chance for error make this method ideal.