Chapter 6*

THE GEOLOGICAL COMPASS AND ITS FIELD USES

6.1 THE GEOLOGICAL COMPASS

The attitudes of geological structures are measured with the help of a compass. The parts of a geological compass are described in Figure 6.1. The **Brunton Compass** is taken here as an example of the geological compass. Note that the compass circle is numbered from 0-360° increasing counter clockwise rather than clockwise. This allows the user to point the sighting arm at the object of interest and to read the bearing directly with the north seeking (white) tip.

6.2 MAGNETIC DECLINATION

6.2.1 *Definition*

The needle of the compass points to the **Magnetic North Pole**, located in Hudson Bay, Canada. This changes slightly every year. The **True North Pole** is located geographically and all maps and directions are based on it. **Magnetic declination** is the angle between Magnetic and True North and varies from location to location. For example, the grid lines on a topographic map locate True North, but the compass needle points towards Magnetic North.

6.2.2 *Adjustment For Declination*

By adjusting declination, all compass readings can be taken directly as True North directions. The declination angle is given on the margins of the topographic maps. To adjust for declination, use the circle adjusting screw and turn it as shown in Figure 6.2. After declination is adjusted, all compass readings are based on True North.

6.3 FIELD MEASUREMENTS

The compass can be used for measuring:

1. bearings of objects,
2. attitudes of geological structures: strike and dip of planes, plunge, and trend of lines, and
3. slope orientations.

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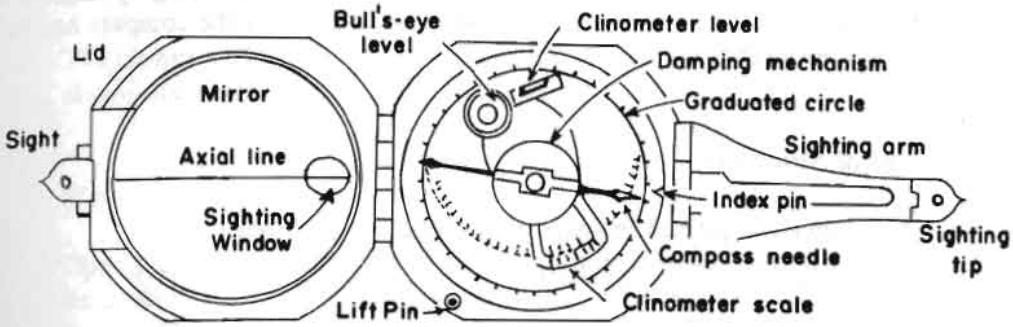
* Figures and Tables without credit lines in this Chapter are compiled by the author.



Source: Modified from the Instruction Book of the Brunton Company, 1980

Fig. 6.1 **View directly down on a geological (Brunton) compass with lid and sighting arm fully open**

6.3.1 *Bearing (or Azimuth)*

A bearing is the angle in degrees, between True North and the object, measured in a horizontal plane from the position of the observer. Note that nearby magnetic materials (watches, hammers, belt buckles, etc) can adversely affect the reading. There are two methods for taking a bearing with a Brunton Compass.

a. *Nearby objects* (Fig. 6.3)

1. Hold compass horizontally at waist level with mirror lid opened at 45° towards you.

2. Open front sight, while looking down into the mirror lid, until you can line up the black centre line of the mirror with the front sight and the object.

3. Centre bubble in circular level.

4. Take bearing (azimuth) by reading north-seeking end of needle.

b. *Far Away Objects; for Greater Accuracy, or Objects Below or Above Operator* (Fig. 6.4)

1. Open front sight vertically, or slightly inclined away from eye, and turn its tip up.

2. Hold compass at eye level with front sight close to you, and align the object and front sight with top of lid; or bottom of front sight with mirror opening, with the object aligned.

3. Adjust mirror of lid so that compass needle and level bubble can be seen.

4. Centre the bubble and, when the needle has come to rest, take the bearing by reading the **black end** of the needle. This is because the sighting direction of the compass has been reversed by this method.

6.3.2 *Measuring Geological Structures*

Geological structures can be completely defined in space either by planes or lines.

a. *Planes*

A planar structure can be bedding, foliation, joint, cleavage, axial plane, or fault, and is completely defined by its **strike** and **dip** (Fig. 6.5), or **dip** and **dip direction** (Fig. 6.6). The **strike** is the horizontal direction of a slope, and the **dip** is the inclination of the line of maximum slope angle of the plane and is perpendicular to the strike. Several conventions for expressing dip direction, strike, and dip exist, e.g., 110/45° NE denotes a plane with a strike of 110° and a dip of 45° in the northeast compass quadrant; 200/30° is another convention denoting a dip angle of 30° towards azimuth 200°.

To measure the dip direction of a plane (Fig. 6.6):

1. Open the Brunton Compass and place it with mirror side on the plane.
2. Level the **Bull's-eye level** (Fig. 6.1) and steady the needle with the lift pin.
3. The dip direction is the azimuth on the dial indicated by the needle.

Note that for irregular surfaces an average reading may be required and can be obtained by laying a flat surface, such as a clipboard, on the plane to be measured and then taking the azimuth of that surface.

To measure the dip amount of a plane:

1. After measuring the dip direction, lay the compass with its long side on the plane to be measured.
2. Suspend the compass in the dip direction.
3. Level the clinometer level with the lever at the back of the compass.
4. Take the reading on the inside dial in degrees.

b. *Lines*

A linear structure can be a fold axis, mineral lineation, or foliation/plane intersection. The attitude of a line is expressed by its trend and plunge. This completely defines the line in space, for example, a fold axis can be said to plunge at 20° towards 45°.

To measure the attitude of a line:

1. Align a non-magnetic object, such as a pen or pencil, parallel to the linear structure.

2. Holding the compass level, align the long sight with the pencil in the plunge direction, and take the reading with the white end of the needle when the Bull's-eye level bubble is steady. This gives the **trend** which is the direction of the **plunge** of the line.

3. The plunge is obtained by determining the inclination of the pencil or any other object (described above) for measuring the dip of a plane.

c. *Slopes*

1. Open the compass with the mirror at approximately 45° and the front sight all the way open with its tip up.

2. With the front sight towards you, and the mirror to the left, the compass is held vertically in the right hand.

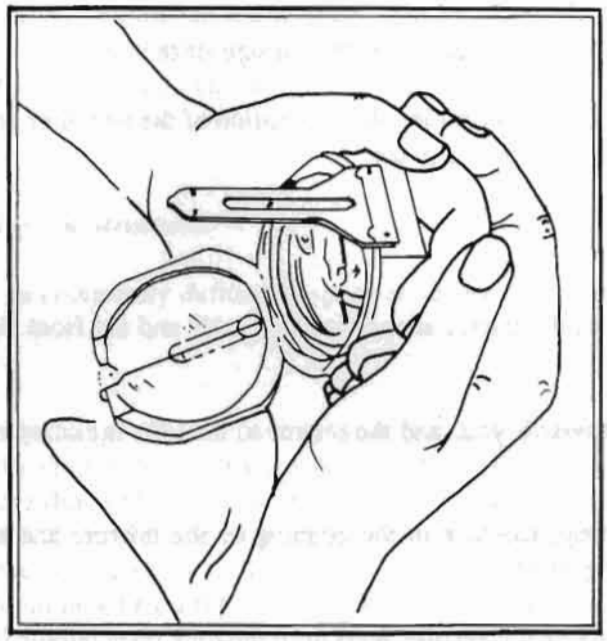
3. Align the front sight tip, the hair in the opening of the mirror, and an object up or down the slope at eye level (Fig. 6.7).

4. With the right hand, move the **vernier level** until the long level bubble (as reflected in the mirror) is centred and read the **vernier scale**. The reading is either in degrees or percentages on the vernier scale.

5. Measure the direction of the slope by treating it as a plane and getting the azimuth of the dip direction.

Source: Instruction Book of the Brunton Company, 1980

Fig. 6.2 Declination adjustment



Source: Instruction Book of the Brunton Company, 1980

Fig. 6.3 Taking azimuths of nearby objects

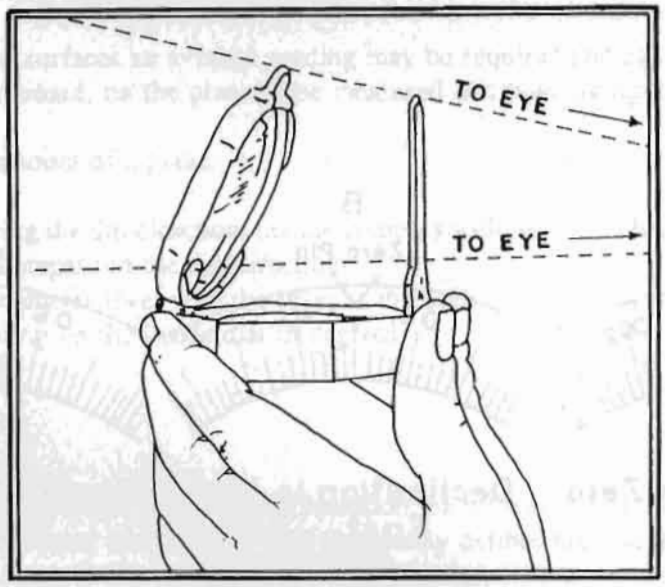


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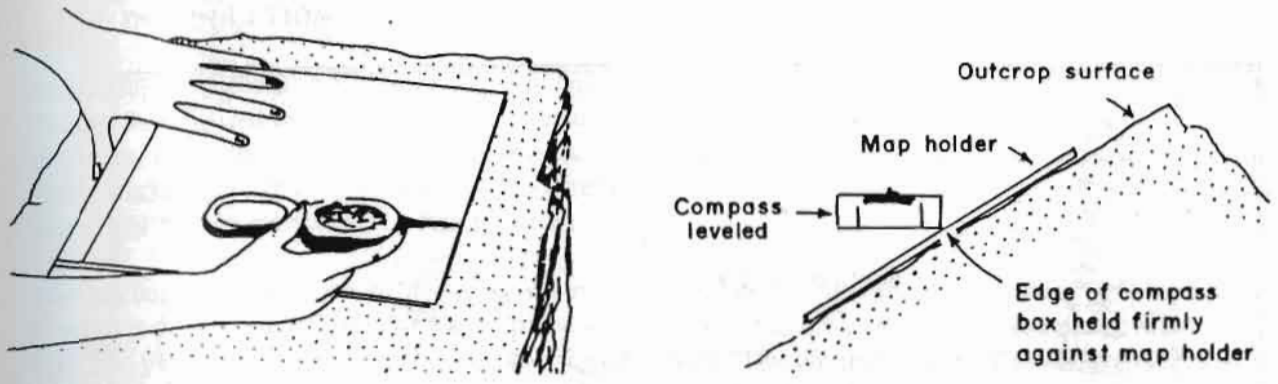
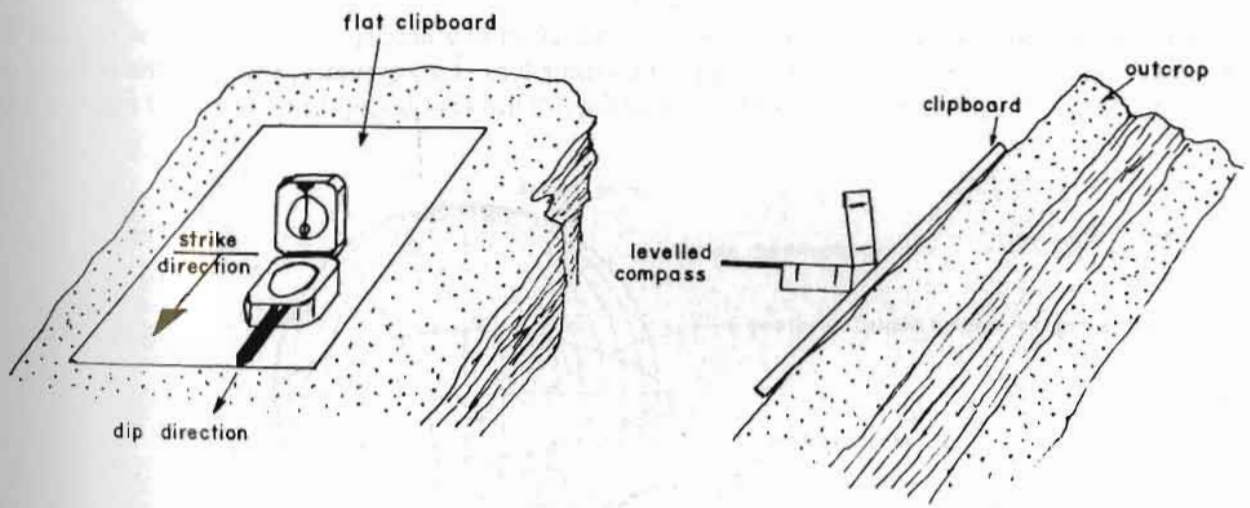
Fig. 6.4 Taking azimuth of far-away objects



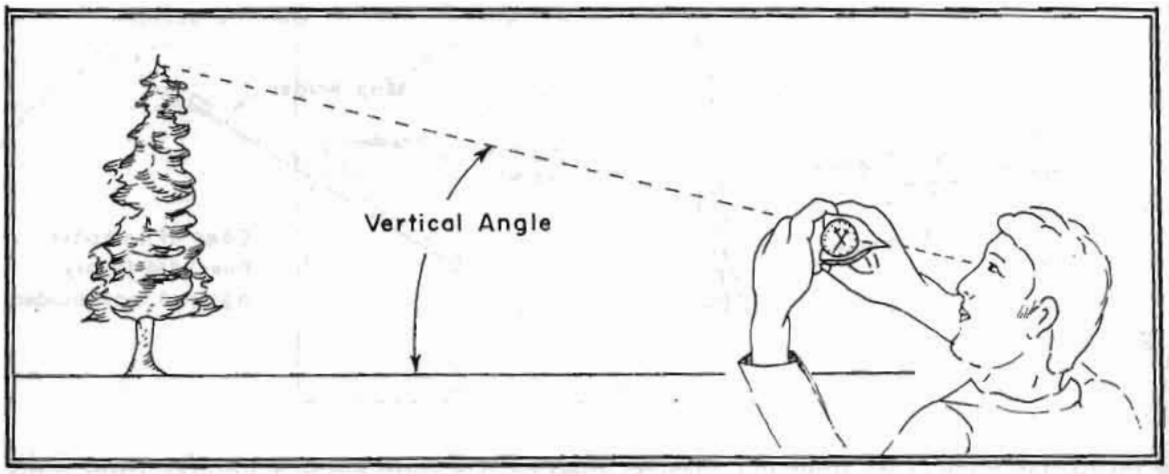
Source: Instruction Book of the Brunton Company, 1980

Fig. 6.5 **Measuring strike of a planar surface by placing the compass against a map holder that is held against the surface**
The map holder must not have iron or steel parts.



Source: Instruction Book of the Brunton Company, 1980

Fig. 6.6 Measurement of dip direction



Source: Instruction Book of the Brunton Company, 1980

Fig. 6.7 Measuring a vertical angle