SECTION 5. — THE LIGHTWEIGHT COMPASS

A. INSTRUCTOR'S NOTES

Aim

0591. *To introduce cadets to the lightweight compass, its functions and basic uses.*

Timings

0592 *Three 30 minute periods.*

Stores

0593. *One compass to each cadet.*

Preparation

0594. *Prepare a large scale drawing of a lightweight compass showing the component parts (see paragraphs 0597 – 05102 below, and Fig 133) clearly and of a compass rose showing the cardinal points (N, S, E, W) and principal intermediate points (NE, SE, SW, NW) (see Fig 134). Blackboard drawings may be used if necessary.*

Approach

0595. *To successfully navigate cross country, map and compass are complementary: it is essential that cadets are fully conversant with both.*

0596. *The compass is the most accurate, lightweight instrument in common use for navigation: it never lies and familiarity breeds confidence.*

B. CONDUCT OF THE LESSON

Description of the Compass

0597. *Explain and demonstrate:* The Compass Magnetic Unmounted Lightweight, calibrated in mils and degrees, is the current official issue lightweight compass. The two makes of lightweight compass in most common use in the Cadet Forces are the Suunto and the Silva compasses. The Silva is the compass illustrated in this chapter; the Suunto is very similar in design, but has the following differences:

a. *Housing.* The Suunto's housing is raised more, and is black in colour.

b. *Calibration.* Whereas on the Silva compass the calibration in mils is given on the circle at the top of the housing, on the Suunto it is within the housing but outermost to the calibration in degrees.

c. *Compass Needle.* The Silva needle is red (N)/white (S), the Suunto needle is red (N)/black (S).

d. *Luminosity.* The Suunto has a longer luminous strip on the north pointing end of the needle.

0598. The compass is mounted at one end of a transparent plastic plate about 126 x 60 mm (5 x 2 11/42 inches). The short end of the plate, furthest from the compass, is bevelled; a scale in millimetres is shown along one of the long sides at **'A'**, and a short scale in inches on the opposite side is shown at **'B'**.

0599. A magnifying lens is at **'C'**.

05100. Romers, which are the means of measuring the position of an exact point within a grid square more accurately than estimating the tenths explained in Section 2, for scales 1:25,000 1:50,000 and 1:63,360, are shown at **'D'**, **'E'** and **'F'**.

05101. The compass needle at **'G'** is white at the south end and red with a luminous patch at the north end. The inner circle (**'H'**) is graduated in two degree divisions from 0°–360° and the outer circle (**'J'**) in 50 mil divisions from 0–6400. The circles can be rotated by hand taking with them a series of lines parallel to the 0–3200 mils (0°–180°) axis of the graduated circles (**'K'**). An arrow (**'L'**) made from the two central parallel lines always points to 0 on the circles. It is referred to as the North Arrow.

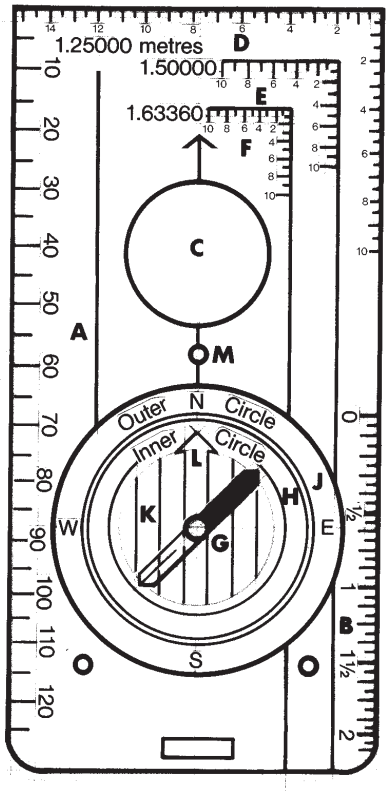


Fig 133. — The Silva Compass

05102. A line with an arrow and a luminous patch on it at M runs down the centre of the transparent plate from the edge of the outer circle towards the bevel on the short end. This is the Direction of Travel Line and bearings are read against it.

Points of the Compass

05103. *Explain:* North, South, East and West (N, S, E and W) are the four main points of the compass and are referred to as the cardinal points. The intermediate points are North East (NE), South East (SE), South West (SW) and North West (NW) (*see* Fig 134).

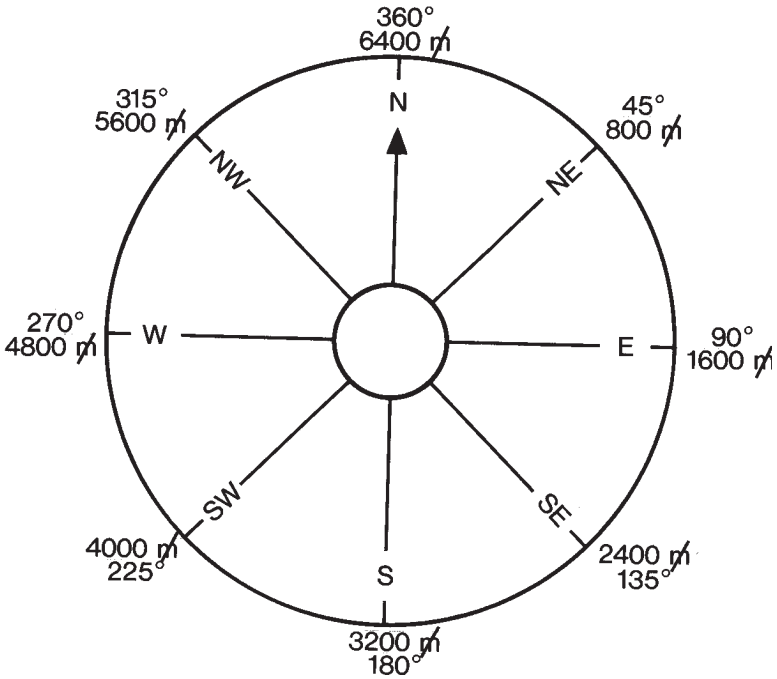


Fig 134. — Compass Points, Degrees and Mils

05104. For more precise indication of direction it is necessary to sub-divide the circle formed by the cardinal points into much smaller parts called mils or degrees. Because degrees are now being used less and less as a term of measurement, mils are used with the equivalent degrees in brackets when necessary.

The Mil System

05105. *Explain:* The standard military system is to divide the circle of the compass into 6400 mils (360°), the zero being at the North Point. The four quadrants of the circle are each 1600 mils (90°), so the East, South and West points are at 1600 mils (90°), 3200 mils (180°) and 4800 mils (270°) respectively.

a. If it should be necessary to convert from mils to degrees or vice versa, the following is a conversion table:

1°	=	17.8 mils (18 mils approximately)
1'	=	0.3 mils
1 mil	=	3.4'

b. The sign for a degree is ° (360° in a circle), a minute is ' (60 minutes in a degree) and a mil is η.

North Points

05106. *Explain:* There are three North points:

a. True North — The actual direction of the geographical North Pole.

b. Grid North — The direction of the vertical grid lines on a map. For all practical purposes True and Grid North are the same.

c. Magnetic North — The direction towards which the compass needle points which is the Magnetic North Pole.

05107. ***Angles Between North Points.*** *Explain and demonstrate:* The terms used in compass work are (*see* Fig 135).

a. *Grid Magnetic Angle.* This is the new name for what used to be called Magnetic Variation. It is still the angle between Grid North and Magnetic North and it depends on two factors:

(1) *Time.* As the position of the Magnetic North Pole moves slightly eastwards, so the Grid Magnetic Angle changes. This is called the Annual Magnetic Change and must be taken into account when converting magnetic bearings to Grid bearings and vice versa.

(2) *Place.* The Grid Magnetic Angle also varies from one part of the country to another.

These two factors are included in the margin information on the map.

b. *Magnetic Declination.* This is the angle between Magnetic and True North.

c. *Grid Convergence.* This is the angle between Grid North and True North which can, in practice, be ignored since for practical map reading purposes True and Grid North are the same.

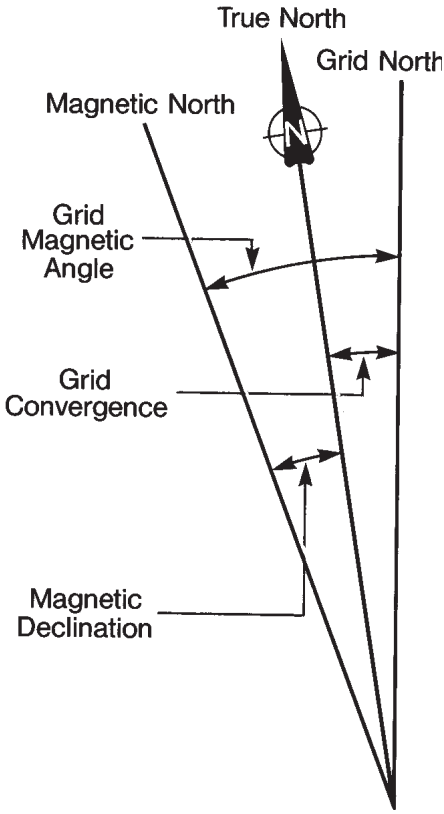
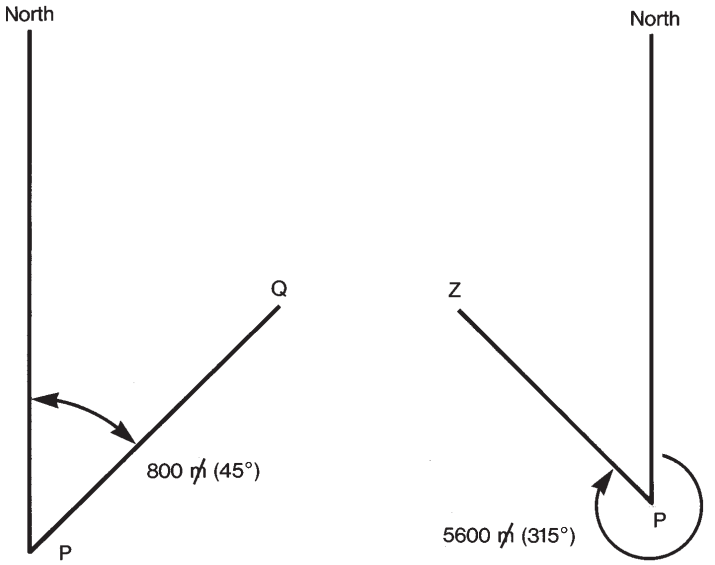


Fig 135. — Angle Between North Points

Bearings

05108. *Explain:* A bearing is a method of indicating direction (*see* Fig 136). It is the angle, measured in a clockwise direction, between North and a line joining two known points, so in **Example A** the bearing from **'P'** to **'Q'** is 800 mils (45°), whilst in **Example B** the bearing from **'P'** to **'Z'** is 5600 mils (315°).



Example A **Example B**

Fig 136. — Bearings

05109. *Explain:* As there are three different kinds of north points, there are three kinds of bearings, according to the north point from which they have been measured:

a. A magnetic bearing is one taken with a compass. (An accurate compass needle always points to magnetic north.)

b. A grid bearing is one measured on the map with the compass used as a protractor.

c. A true bearing cannot be measured direct, but must be calculated from one of the other two. However, this can be ignored for practical map reading purposes.

Measuring a Magnetic Bearing

05110. *Explain and demonstrate:* To take a magnetic bearing hold the compass horizontally and point the direction of travel arrow at the objective. Then, while keep-

ing the compass in this position, turn the graduated circles so that the north arrow corresponds with the north (red) end of the compass needle. The magnetic bearing is then read off at the direction of travel line (*see* Fig 137).

05111. Remember to avoid nearby iron and steel objects, such as vehicles, power lines, wire fences and weapons which can influence the compass reading.

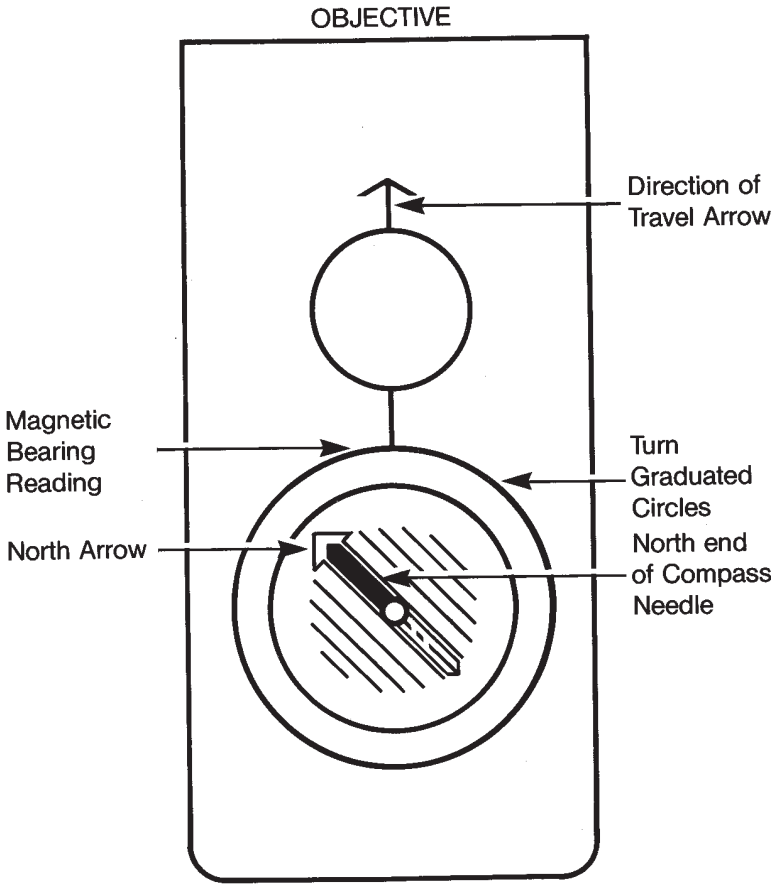


Fig 137. — Taking a Magnetic Bearing

Conclusion

05112. ***End of Lesson Drill.***

a. *Questions to from the squad.*

b. *Sum up.*

c. *Look forward to next lesson.*

05113 – 05120. *Reserved.*

SECTION 6. — MAP AND COMPASS

A. INSTRUCTOR'S NOTES

Aim

05121. *To teach cadets the basic function of map and compass together.*

Timings

05122. *Four 30 minute periods.*

Stores

05123. *One compass and map between two cadets, and pencils.*

Approach

05124. *Reiterate that the map and compass are complementary particularly for cross-country navigation and position finding. Therefore cadets must be fully conversant with both and have confidence in their use.*

B. CONDUCT OF THE LESSON

05125. ***Setting a Map by Compass.*** *Explain and demonstrate (see Fig 138):*

a. Find the Magnetic North Arrow (**'A'**), normally in the top margin of the map. With a ruler or the edge of the compass, extend the line.

b. Lay the compass on the map so the Direction of Travel Arrow line (**'B'**) on the compass coincides with the magnetic North Arrow line on the map.

c. Now turn both map and compass so that the Magnetic Needle in the compass (**'C'**) coincides with the Direction of Travel Arrow line and also the magnetic North Arrow line on the map.

d. The map is now set.

05126. To avoid removing the map from its protective cover during inclement weather, it is possible to set the map sufficiently accurately for all practical purposes by laying the edge of the compass along any Easting grid line. Then turn the map and compass until the Magnetic Needle in the compass coincides with the Direction of Travel Line.

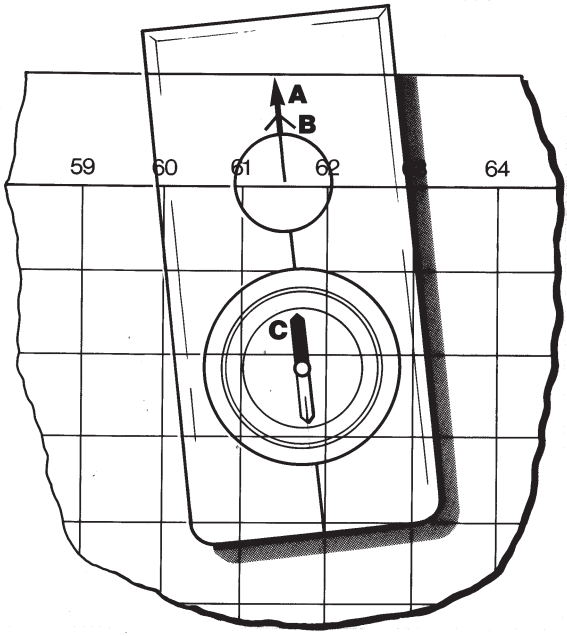


Fig 138. — Setting a Map by Compass

Calculating a Magnetic Bearing from the Map and its Use

05127. ***Use.*** *Explain:* When the objective cannot be seen a grid bearing must be measured off the map in the first place. and then converted to a magnetic bearing. The compass is then set at this latter bearing and followed to the objective.

05128. ***Measuring a Grid Bearing.*** *Explain and demonstrate* (*see* Fig 139): To take a grid bearing from a map the compass can be used as a protractor, ignoring the compass needle. To read a grid bearing from **'A'** to **'B'** place the compass with a long side on the line **'AB'** and with the direction of travel arrow pointing towards **'B'**. Then turn the graduated circles so that the north arrow points towards grid north and is parallel to the north-south grid lines. The grid bearing of **'B'** from **'A'** is then read off at the point where the tail of the line of travel arrows cuts the graduations on the circle.

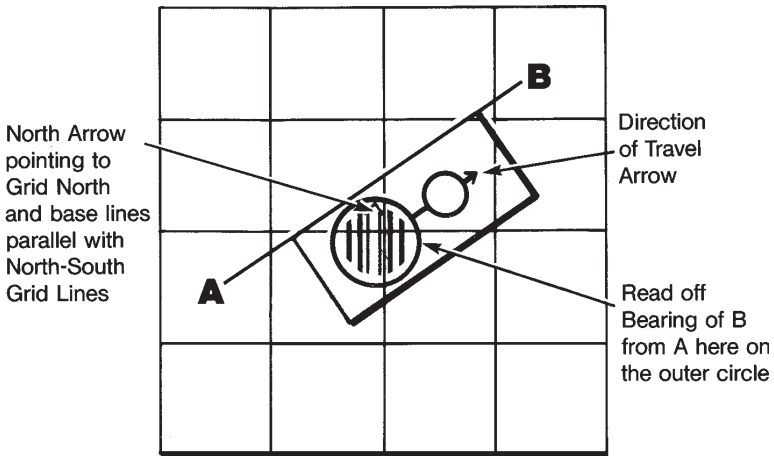


Fig 139. — Measuring a Grid Bearing with a Lightweight Compass

Conversion of Grid to Magnetic Bearing

05129. The bearing, (*see* Fig 140) measured with the compass used as a protractor, of a windmill from point **'X'** is found to be 2100 mils (118°). To convert this grid bearing to a magnetic bearing, a diagram is drawn as shown. From the marginal information on the map the magnetic bearing is known to be larger than the grid bearing by 140 mils (8°), and is therefore 2240 mils (126°). In converting bearings it is always wise to draw a diagram to see whether the magnetic variation should be added or subtracted — it is a less fallible method than remembering sets of rules. For those who like an aide-mémoire, however, the following rhyme may be of assistance:

"Mag to Grid — Get rid
Grid to Mag — Add"

Marching on a Bearing

05130. *Explain and demonstrate:* To march on a required bearing, convert the grid bearing to a magnetic bearing. Set the graduated circle to read this magnetic bearing at the direction of travel line. Then turn the whole compass until the north end of the needle coincides with the north arrow and, holding the compass in front of you, march in the direction of the line of travel arrow. So long as the compass needle and

the north arrow are kept coincident, the direction of travel arrow will remain on the required bearing (*see* Fig 141).

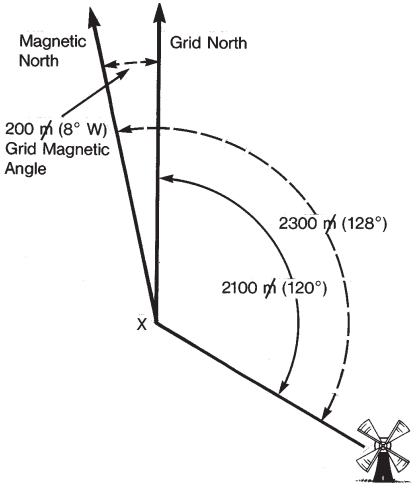


Fig 140. — Conversion of a Bearing

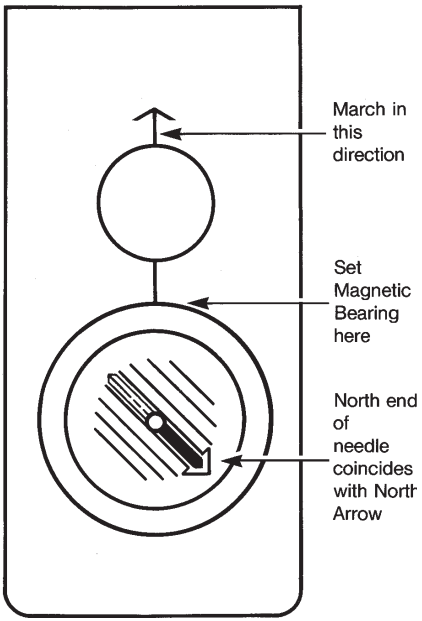


Fig 141. — Marching on a Bearing

Moving Round Obstacles

05131. *Explain:* Obstacles often lie in the direct route and in order to keep a really accurate direction they should be bypassed by going round them at right angles (*see* Fig 142).

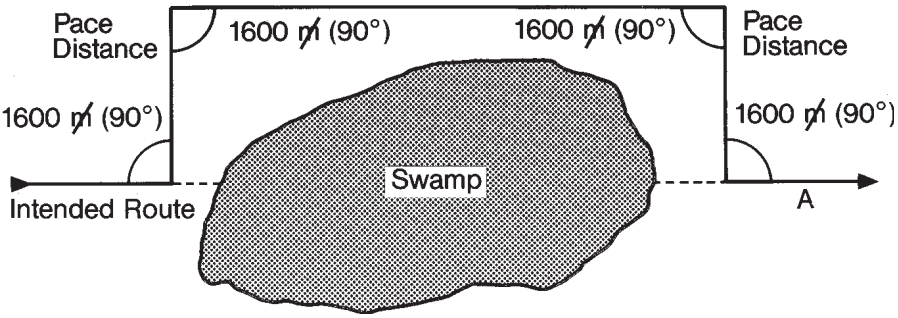


Fig 142. — Moving Round Obstacles

Position Finding by Resection

05132. *Explain:* There may be times when you need to check your position with more accuracy than is possible using the method discussed earlier. Resection is the alternative and more precise method to be used.

05133. *Explain and demonstrate:* With the map correctly set, look at the ground and select two objects on the ground which can be unmistakably identified on the map. They should be approximately 1000 metres distant and separated by approximately 1200–1600 mils 65–90 degrees) (*see* Fig 143).

a. Mark the objects, e.g., **'A'** and **'B'**.

b. From your position, e.g., at **'C'**, take a compass bearing on to each object in turn. Ideally, take three bearings to each and work out the average bearing to be used.

Example:

The average bearing from **'C'** to **'A'** is 5800 mils magnetic or 334° magnetic.

The average bearing from **'C'** to **'B'** is 1050 mils magnetic or 59° magnetic.

05134. These two bearings have to be plotted on the map, but must first be converted to grid bearings.

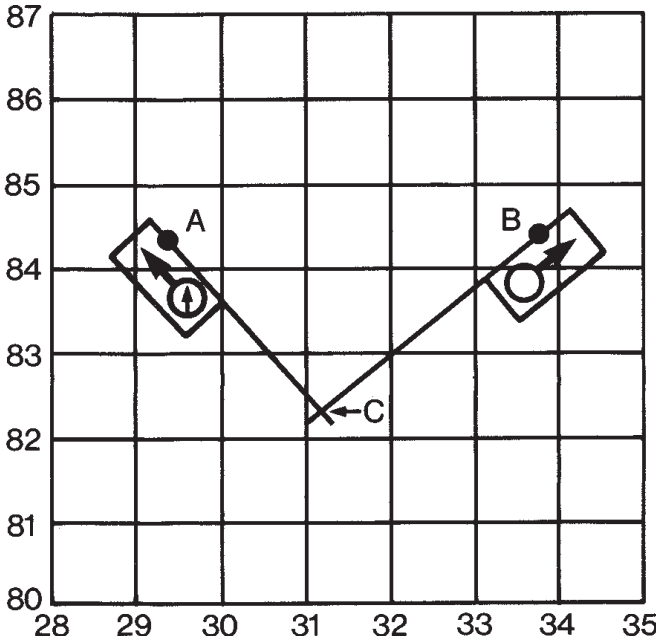


Fig 143. — Plotting Position

a. The grid/magnetic angle on the map in use is 116 mils or 7°. Therefore the converted bearings will be:

To point **'A'** 5800 mils (334°) less 116 mils (7°) = 5684 mils (327°).

To point **'B'** 1050 mils (59°) less 116 mils (7°) = 934 mils (52°).

b. Next examine the readings in mils, e.g., 5684 and 934; remembering that the smallest setting that can be applied to the compass is in increments of 25 mils; these two figures must now be corrected to the nearest 25 mils e.g.:

5684 mils — corrected to 5675 mils grid.

934 mils — corrected to 925 mils grid.

c. The corrected bearings are now to be plotted on the map.

05135. ***To Plot the Bearings.*** *Explain and demonstrate:*

a. Set the grid bearing to **'A'** on the compass.

b. With a fine pencil point put the pencil on **'A'** and hold it vertically; place a long edge of the compass against the pencil with the direction of travel arrow pointed in the general direction of **'A'** (*see* diagram), with the North arrow pointing approximately towards the top of the map.

c. Without moving the dial, pivot the compass about the pencil point until the North arrow points precisely towards the top of the map with its sides or any one of the lines on either side of it parallel to the nearest grid line.

d. Hold the compass firmly and lightly draw a line along the long side.

e. Set the grid bearing to **'B'** on the compass and repeat the procedure from point **'B'**.

f. Where the lines from **'A'** and **'B'** meet, is your position at **'C'**. Take the grid reference.

Conclusion

05136. ***End of Lesson Drill.***

a. *Confirm by questions and another problem if time permits.*

b. *Sum up.*

c. *Look forward to map reading exercises.*

05137 – 05140. *Reserved.*

SECTION 7. — BASIC NIGHT NAVIGATION

A. INSTRUCTOR'S NOTES

Aim

05141. *To teach cadets to set a compass for night marching and to find north by the Pole Star method.*

Timings

05142. *Two 30 minute periods.*

Stores

05143. *One compass between two cadets.*

Miscellaneous

05144. *The first part of this lesson should be taken in the classroom followed by a practical period after dark on a clear night.*

Preparation

05145. *The following preparations should be carried out:*

a. *Set out a number of short legs to practise marching by compass at night.*

b. *Make a chalkboard drawing or 'drop' of the Great Bear and Pole Star (see Fig 144).*

c. *Study the sky beforehand and make sure that you can not only pick out the Pole Star but that you can indicate it to the cadets.*

B. CONDUCT OF THE LESSON

Introduction

05146. *Explain:*

a. The importance of being able to march with confidence on a compass bearing at night as a lot of movement in the military environment is done under cover of darkness.

b. On occasions when a compass is not available you must be able to find the direction of north (and therefore the other cardinal points).

Setting a Compass for Night Marching

05147. *Explain and demonstrate:* The method is the same as that explained earlier, that is to take a magnetic bearing by daylight, or a grid bearing from the map, and convert it to a magnetic bearing. Now set the graduated circle to the appropriate bearing at the Line of Travel and turn the whole compass until the north end of the compass needle coincides with the letter N. Hold the compass in front of you and march in the direction of the Line of Travel Arrow. So long as the needle and the North Arrow coincide the Direction of Travel Arrow will remain on the required bearing.

05148. *Practise this in daylight so as to gain confidence in the skill before doing it after dark*.

Pole Star Method

05149. *Explain, using the drawing:* In the northern hemisphere the North Star (Polaris) indicates the position of True North to within 2°. It is a bright star and can be found by producing a line from the two end stars, or 'pointers' of the Plough or Great Bear. The North Star will be found slightly off this line on the side furthest from the remaining stars of the Great Bear and at about five times the distance between the two pointers (*see* Fig 144).

Conclusion

05150. ***End of Lesson Drill.***

a. *Questions to and from the squad.*

b. *Sum up.*

c. *Look forward to next lesson.*

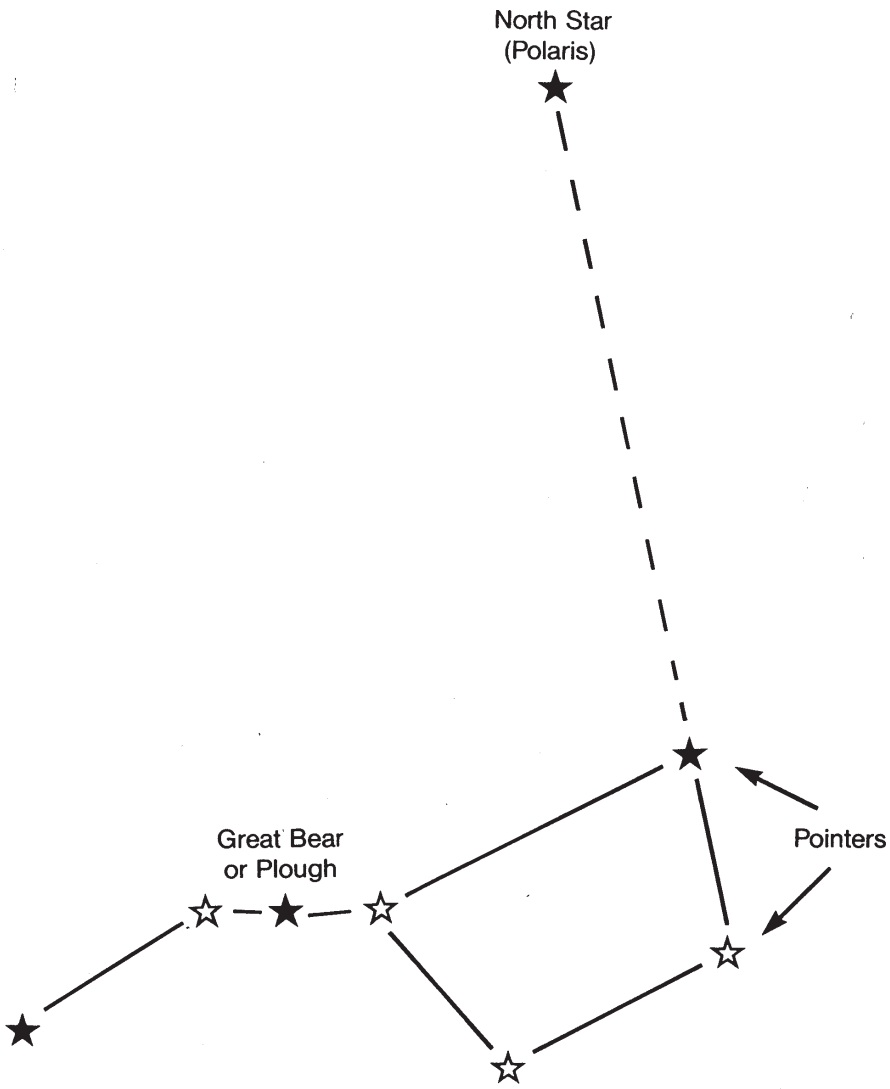


Fig 144. — Finding North from the Pole Star

SECTION 8. — PREPARATION OF A ROUTE CARD

A. INSTRUCTOR'S NOTES

Aim

05151. *To teach cadets how to prepare a route card and use it.*

Timings

05152. *Two 30 minute periods.*

Stores

05153. *One map and one compass between two cadets.*

Miscellaneous

05154. *Ensure that cadets have pencils and paper.*

Preparation

05155. *Draw a large scale route card on the chalkboard or prepare a drop for demonstration purposes.*

Approach

05156. *Explain: The construction of a route card is not only a necessity for patrol training and adventurous training but, at the same time, is a method of putting into practice the measurement of distances and bearings which have already been taught.*

B. CONDUCT OF THE LESSON

Preparation of a Route Card

05157. The purpose of a route card is to assist in navigation when moving across country. A route card should be used for map reading exercises, patrol exercises and Adventurous Training expeditions, and a copy should always be given to the adult in charge so that he knows the route selected by cadets if he is not moving with them.

05158. Routes must be divided into 'legs'. A 'leg' is a route between two landmarks easily identifiable on the map and ground.

05159. The example of a route card proforma (*see* Fig 145) shows all the information which must be included for a long expedition across difficult country. Headings marked with an asterisk may be omitted on short exercises and expeditions across easy country at the discretion of the adult responsible.

ROUTE CARD

Commander ..... **Start Point GR .....** **ETD (Estimated time of departure) .....**

Date ..... **Finishing Point GR .....** **ETA (Estimated time of arrival) .....**

Leg	From		To		Bearing		Distance	Remarks Landmarks Hazards
	Location	Grid Ref	Location	Grid Ref	Grid	Mag		
1								
2								
3								
4								
5								

Fig 145. — Route Card Proforma

Conclusion

05160. ***End of Lesson Drill.***

a. *Questions to and from the squad.*

b. *Sum up.*

c. *Look forward to next lesson.*

Figs 146 — 149. *Reserved*