CHAPTER 8

COMPASSES AND THEIR USE

SECTION 1 - THE PRISMATIC COMPASS

801. Description

1. The Prismatic Compass is one of the principal compasses employed in the Forces. It is illustrated in Figures 8-1 and 8-2, but to understand this section fully, it should be read with a compass at hand. Figure 8-1 shows the compass opened for reading through the prism. Figure 8-2 shows the compass out flat.

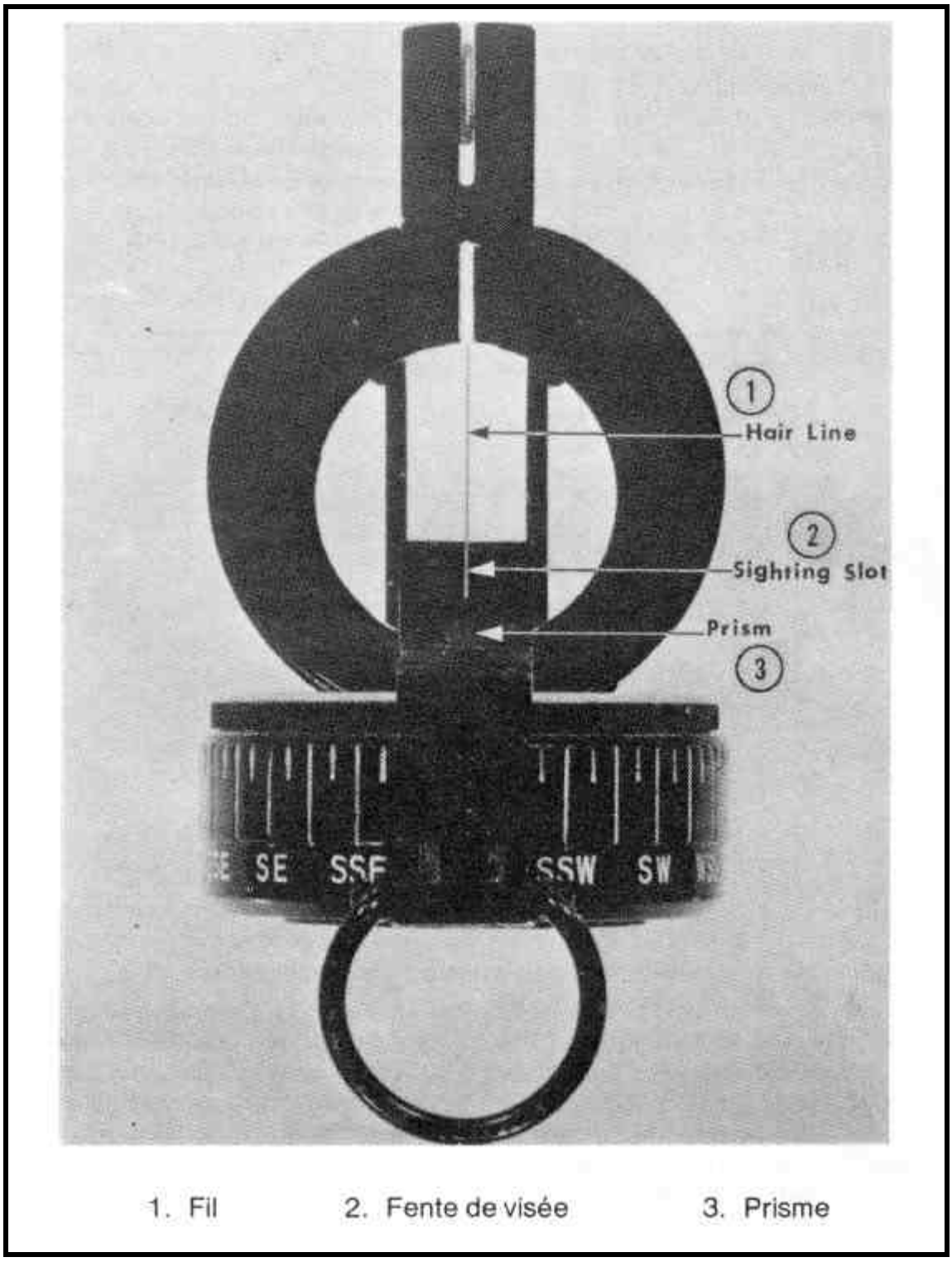

Figure 8-1 Prismatic Compass Open for Reading Through the Prism

2. The body of the compass box has a double glass cover over the compass card. The North point on the card is marked by a luminous triangle, and the card is engraved with an inner and an outer circle of mils. The inner circle reads clockwise from 0 to 6,400 mils, starting at the North point, each small division being 100 mils. The outer circle, printed for viewing through the prism, reads clockwise from 0 to 6,400 mils, starting at the South point, each small division being 20 mils. The compass needle is fixed below the card so that the two swing together. The box is filled with oil to damp the movement of the card.

3. The upper glass cover is marked with black figures 2 to 64, each division being 100 mils. The cover is held by a brass ring and can be rotated to any desired position, and clamped in that position by a screw near the lid hinge.

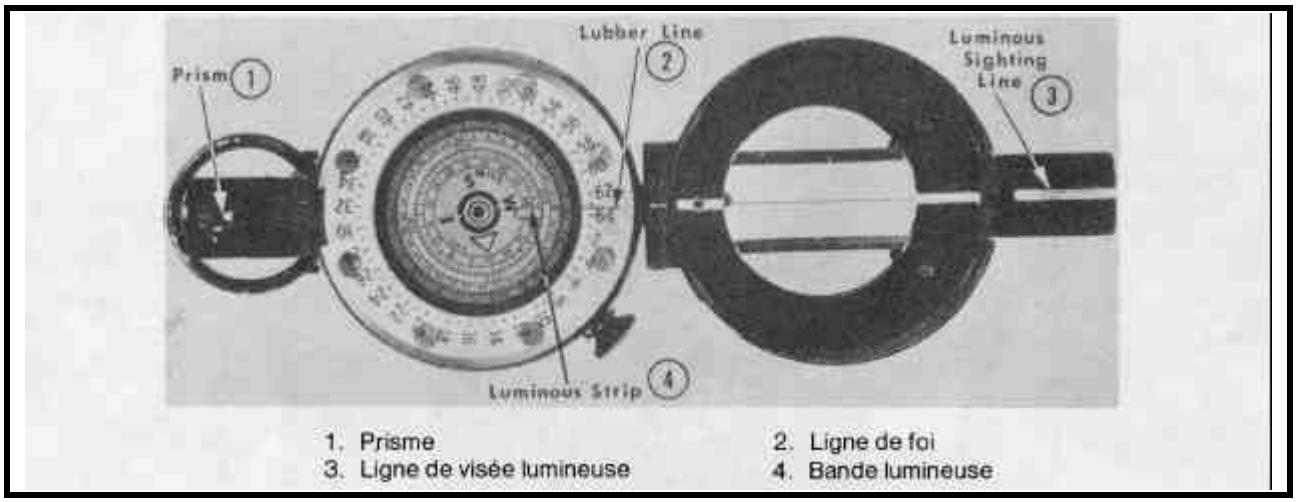

Figure 8-2 Prismatic Compass Opened Out

4. On the white ring below the black figures of the upper glass cover there is a black li ne on a luminous patch opposite the centre of the lid hinge. It is extended by a hair line on the lower glass cover reaching to the inner circle on the compass card. This is called the lubber line. Inside the lid the lubber line is further extended by the hair line on the glass of the lid, and by a luminous line reaching to the end of the tongue where there is a notch. On the outside of the ring attached to the box, and by which it may be held, is another luminous notch. When the compass is opened out flat as in Figure 8-2, all these lines and notches are in a straight line passing through the centre of the compass card; this line marks the axis of the compass.

5. At each end of the engraved hair line on the lid there is a small hole to allow a hair or thread to be fixed as a temporary substitute should the glass get broken.

6. Opposite the hinge and covered by the tongue on the lid when the box is closed is a small triangular block which contains the magnifying prism. When the box is open, it can be turned over the glass into the reading position shown in Figure 8-1. This figure also reveals the eyehole and the sighting slit above it. When one looks through the eyehole one sees the magnified figures of the outer circle of the compass card. The prism may be raised or lowered on its slides to get the best focus. On the bottom of the box inside, directly below the prism, is a luminous patch against which markings on the compass card can be read it night.

802. Observing with the Prismatic Compass

1. Hold the compass steady in both hands with a thumb through the ring. The lid must be vertical and the prism turned over in the reading position (see Figure 8-1). The compass must be held level so that it can swing freely.

2. To take a bearing, look through the sighting slot on top of the prism and line up the hairline on the lid with the object on which the bearing is to be taken. At the same time, observe through the eyehole the readings on the card. When the card comes to rest, read off the bearing against the hairline. A bearing to the nearest 20 mils can be read without difficulty. Readings increase from right to left as seen through the prism. See Figure 8-3. It helps if the hand or elbows can be rested on a firm object, but avoid any metallic object that would attract the compass (see art 808).

3. To find the direction of a given bearing, look through the eyehole and turn the compass until the hairline cuts the required bearing. Any object which is then in line with the hairline is on the required bearing.

4. To set out a bearing, send a man with a long pole to a distance of about 100 metres, and direct him to move to left or right until he is on the required bearing. Then mark both the position of the pole and the position from which the observation was made.

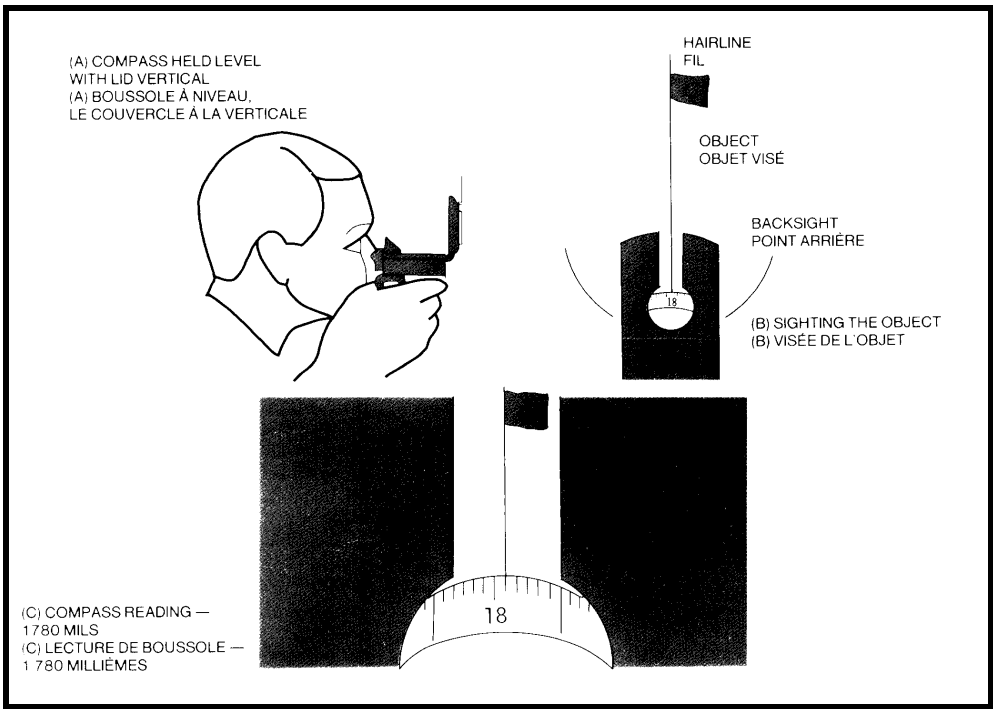

Figure 8-3 Compass Reading

5. The compass can he used without the prism but with much less accuracy. The bearing is then read from the inner circle against the lubber line. One must be careful to read with the eye vertically over the lubber line.

6. All bearings observed are magnetic bearings and must he converted to grid bearings for plotting on a map. See Chap 7, Sect 3.

803. Setting the Prismatic Compass for Marching on a Bearing

1. Convert all bearings to magnetic. Turn the outer glass cover with the brass ring until the reading of the graduations against the lubber line shows the required magnetic bearing, corrected of course, for compass error. Clamp the cover in this position. The axis of the compass through the lubber line will then be on the required bearing when the north point on the card coincides with the luminous strip on the glass cover.

2. The compass can be set most accurately by laying it on a table on the required bearing, using the prism, and then turning the cover until the luminous strip coincides with the north point on the card. Check the bearing before clamping the cover.

3. The prismatic compass can be set in the dark, as the bearings can be read through the prism against the luminous patch in the bottom of the box, but this is not easy and should not be attempted unless it is absolutely necessary.

4. To employ such a pre-set compass by night, open it out flat as illustrated in Figure 8-2, and turn it until the north point on the card coincides with the luminous strip on the glass cover. (The brilliance of these luminous points may be increased by exposure to light.) The axis is then on the required bearing. Sight along the axis and select an object to march on. It need not be directly on the bearing, you can estimate how much right or left of it to move.

SECTION 2 - THE SILVA COMPASS

804. Description

1. The Silva Ranger Model Compass, type 15 TD, Canadian modified, is calibrated in mils. It is in many respects easier and more convenient to use than a prismatic compass and when used correctly it will serve with good accuracy. Figure 8-4 shows the compass opened out flat.

2. The compass is mounted on a transparent plastic plate at one end of which there is a hinged cover containing a sighting mirror and sight. The plate also includes romers at 1:25,000 and 1:50,000 scales in metres.

3. The compass needle is white at the south end, and red with a luminous patch at the north end. The dial is graduated in 50 mil divisions from 0 to 6,400 mils. It can be rotated by hand, taking with it on a baseplate below the compass a series of meridian lines parallel to the 0-3200 mils axis of the graduated circle. An arrow on the central meridian always points to 0 on the dial. The dial may be set to any desired bearing, the reading being taken at the index pointer.

4. The sighting arrow, index pointer, sighting mirror and line, and the sight are used to align the compass on the "Objective". This line marks the axis of the compass or line of travel.

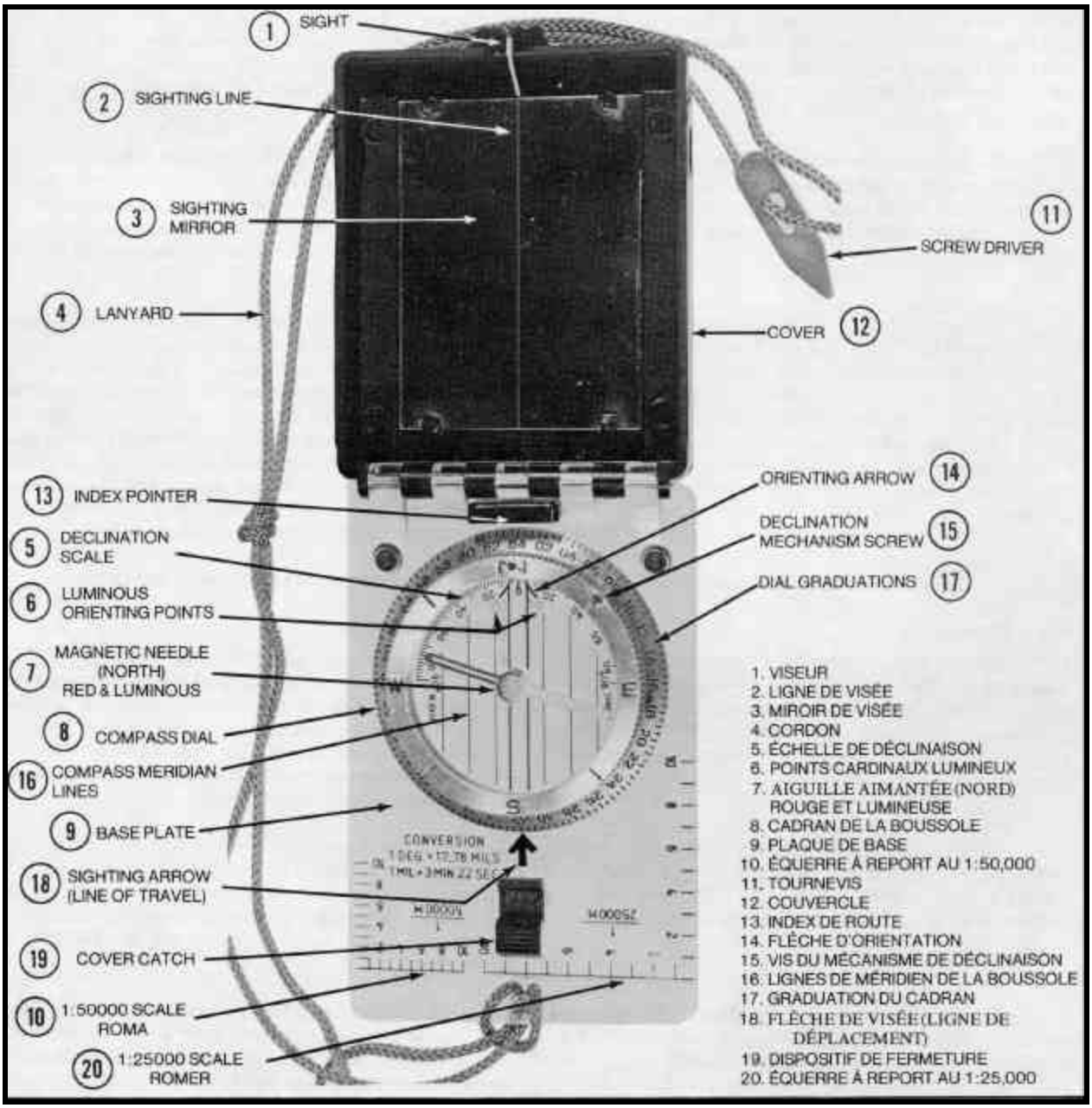

Figure 8-4 The Silva Ranger Model Compass

805. Magnetic Declination Mechanism

1. The Silva Compass is equipped with a declination offsetting mechanism which can be used to make permanent allowance for the magnetic variance in your area. To apply this to the compass the following steps are to be taken:

   a. Determine magnetic variance in your area from a local map. Ensure magnetic variance is computed in degrees.

b. Move the orienting arrow to the desired setting on the declination scale by means of turning the adjusting screw located on the compass dial. See Figure 8-5.

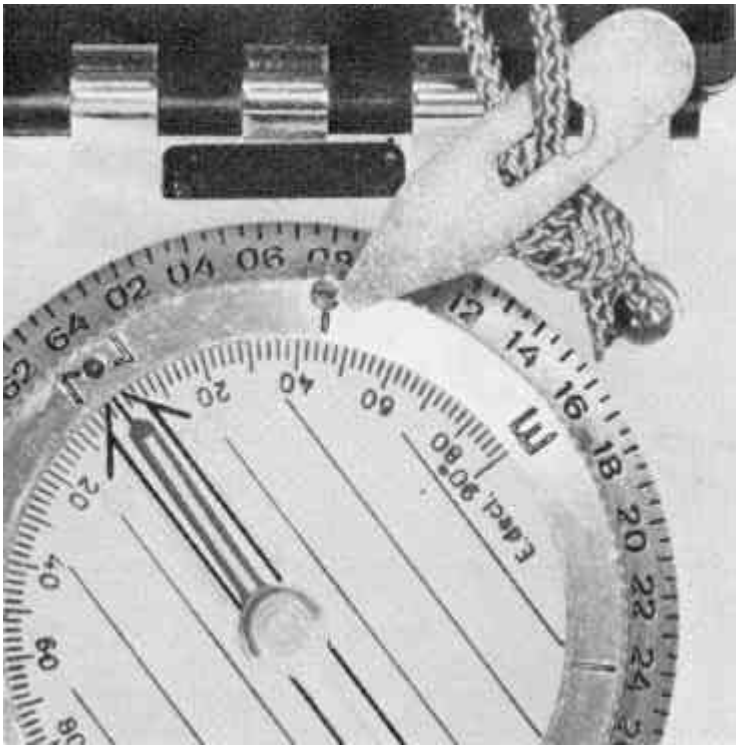

Figure 8-5 Declination Mechanism

c. If the declination in your area is 10° west, turn the adjusting screw clockwise so the orienting arrow points to 10° on the west side of the scale as shown in Figure 8-6. If the declination in your area is 10° east, turn the adjusting screw anti-clockwise so the orienting arrow points to 10° on the east side of the scale as shown in Figure 8-7.

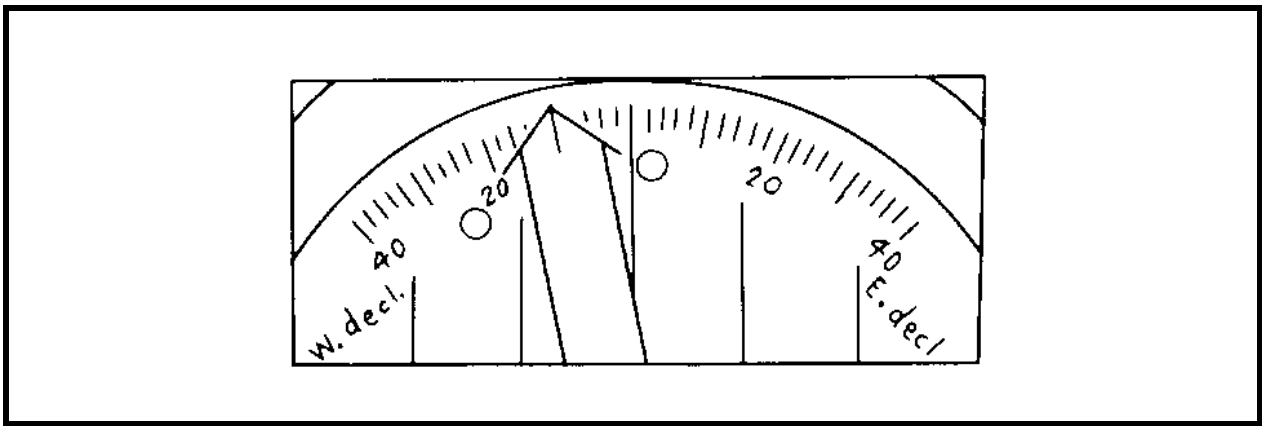

Figure 8-6 Declination West

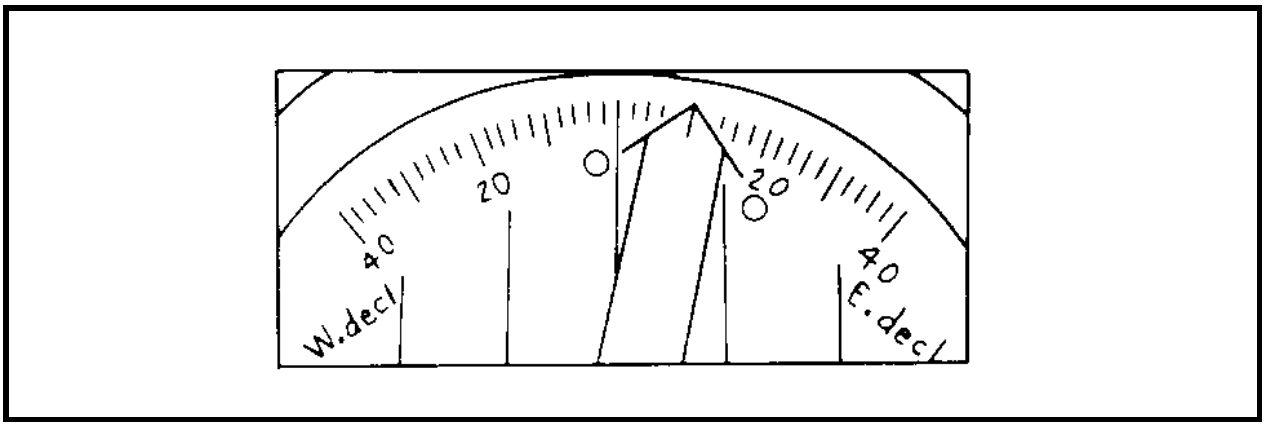

Figure 8-7 Declination East

806. Observing with the Silva Compass

1. The following steps are taken to obtain a bearing or direction to an object which is visible:

a. Open the compass cover wide and hold it level and waist high in front of you.
b. Pivot yourself and your compass around until the sighting line points straight to the object on which you are taking the bearing. See Figure 8-8.

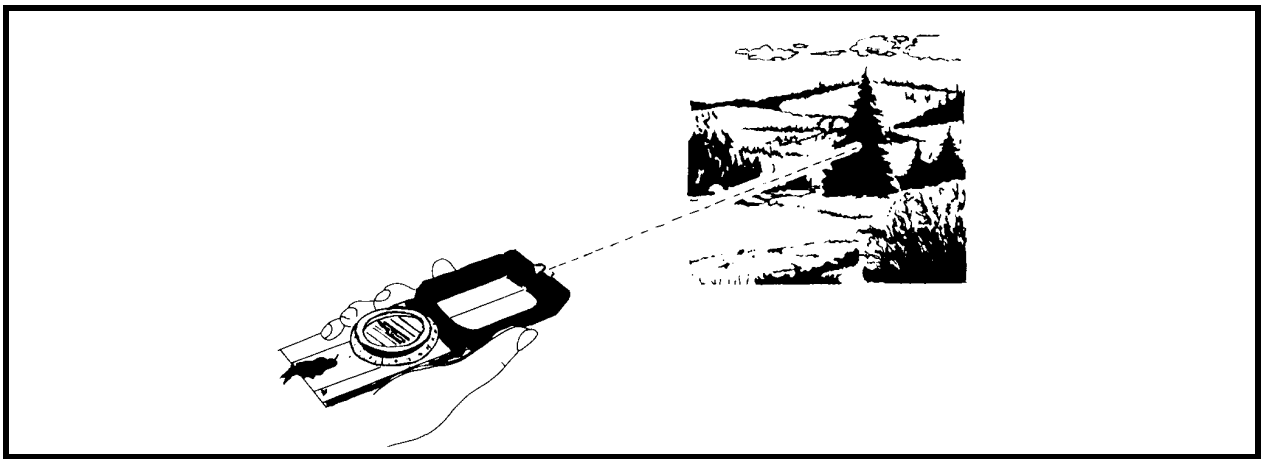

Figure 8-8 Taking a Bearing

c. Turn the dial until the orienting arrow and the magnetic needle are lined up with the red end of the needle lying between the two orienting points.

2. The bearing to your object is the mil reading indicated at the index pointer, subjected of course to any individual compass error. See art 811.

3. For greater accuracy,, bearings can be determined by, using the sighting mirror as described below:

a. Hold the compass at eye level and adjust the cover so the top of the dial is seen in the mirror. Face toward your object using the sight and align on the desired point. See figure 8-9.

b. Look in the mirror and adjust the position of the compass so the sighting line intersects the luminous points as in Figure 8-10.

Figure 8-9 Taking a Bearing - Sighting Mirror Method

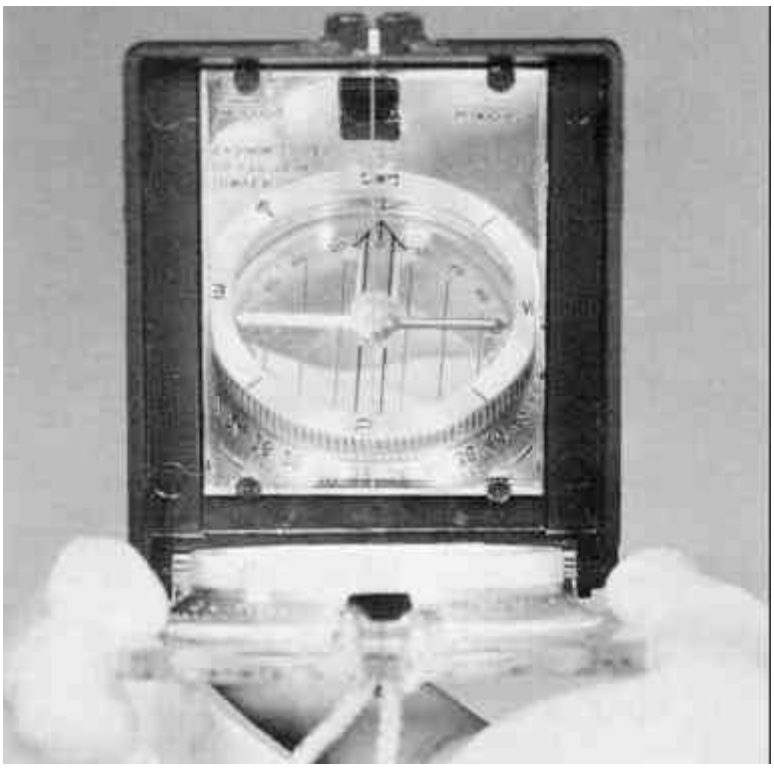

Figure 8-10 The Sighting Line Intersecting the Luminous Points

c. While sighting on your objective across the sight and continuing to ensure that the sighting line intersects the luminous points, turn the dial so the orienting arrow is lined up with the needle. its red end between the orienting points. See Figure 8-11.

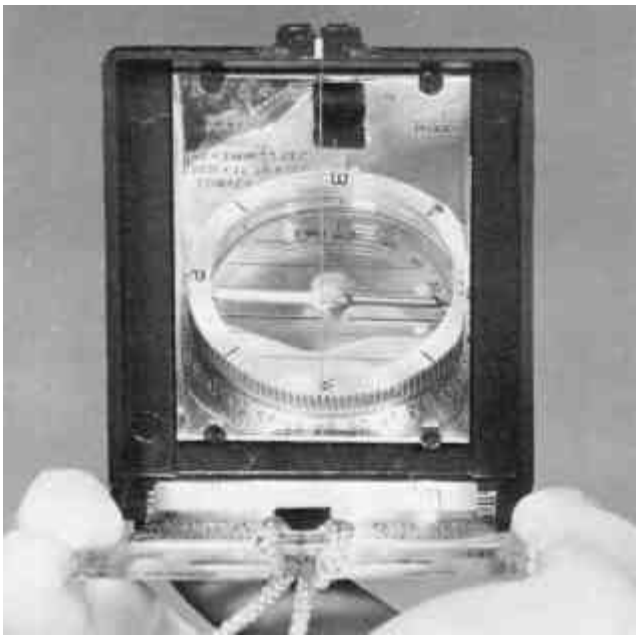

Figure 8-11 The Orienting Arrow and Needle are Lined Up

807. Taking a Grid Bearing from a Map

1. 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 i long side on the line AB and with the sighting arrow of the line of travel pointing in the direction of Travel. See Figure 8-12.

Figure 8-12 The Silva Used as a Protractor

2. Then, holding the compass in position on the map, turn the graduated dial so the meridian lines are parallel to the north-south grid lines (eastings) ensuring that the north (N) on your dial is towards the top of your map. The grid bearing of B from A is then read off the graduated dial at the index pointer as shown in Figure 8-13, in this case 2,600 mils.

3. By these steps, your compass has in fact been set for the mil reading to your objective. By rotating the whole compass until you line up the red end of the magnetic needle between the orienting points on the orienting arrow your compass will be pointing in the direction of your objective. Holding the compass at waist height straight in front of you, march in the direction of the line of travel arrow. As long as the compass needle and the orienting arrow are kept coincident, the line of travel arrow will remain on the bearing. For night marches, the luminous bar on the magnetic needle and the two orienting points on the orienting arrow will assist in maintaining this coincidence. The line of travel is indicated by the luminous sighting arrow, index point, and sight.

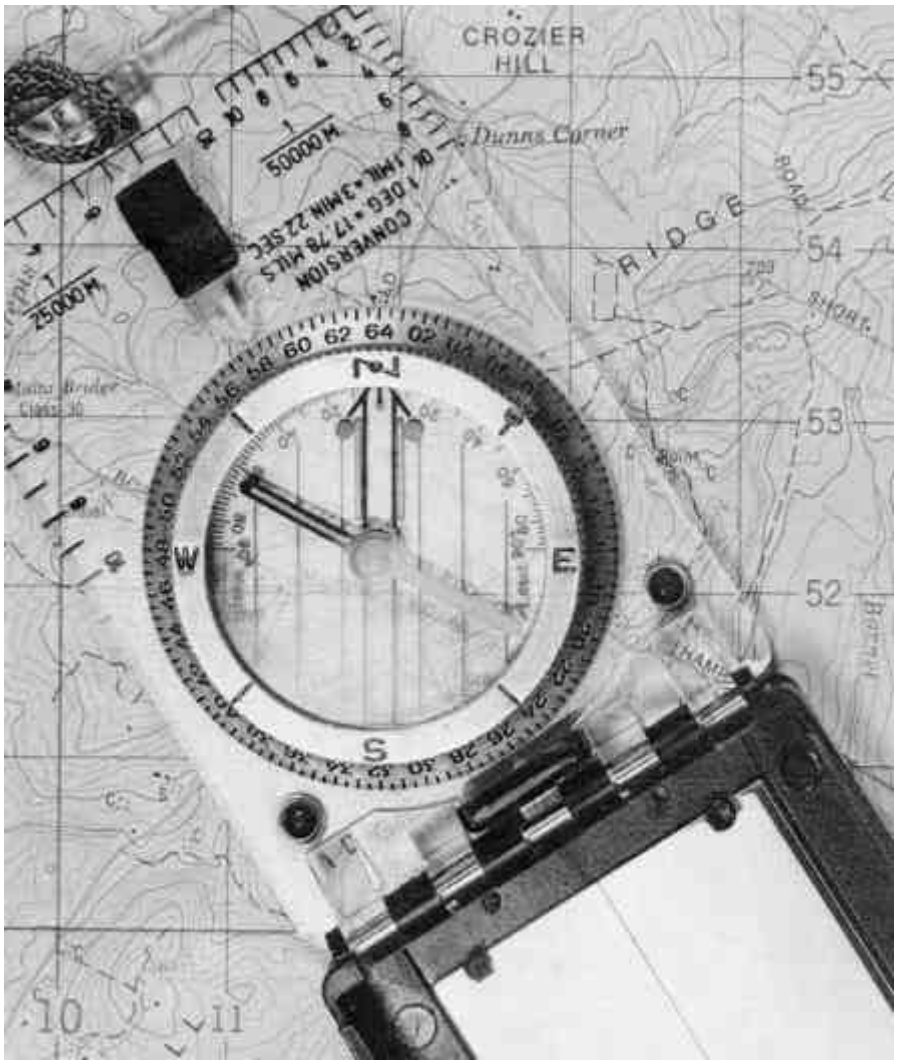

Figure 8-13 Determining the Grid Bearing

SECTION 3 - GUIDANCE FOR EFFECTIVE USAGE

808. Local Magnetic Attraction

1. A compass is sensitive to iron and steel. Even small quantities near the compass may cause a false reading. Common items which may affect the reading are overhead or buried electrical cables and pipelines, a wrist watch. helmet, or eye glass frames. Small items A,ill not affect the reading if kept in a trouser pocket. but larger articles such as a rifle or helmet should be kept at least two or three metres away. Tanks and guns may affect the reading within 50 metres, a wire fence at 10 metres.

If one is in doubt about possible local disturbances, this can be tested in one of two ways:

a. Take a bearing on a distant object, move a few metres away in various directions and take more readings. Provided the object is far enough away, all readings should be the same. If they ire not, there is a local disturbance. This test is not foolproof as there may be a general magnetic disturbance, but this is rare.

b. Select two points about 100 metres apart. Take bearings from each point on the other: The bearings should differ by 3,200 mils. If they do not, there is a disturbance at one or both points.

3. If you suspect local magnetic attraction, even if you cannot prove it. you should move to another location.

809. Effects of Temperature

1. Due to changes in temperature, a small bubble will sometimes form in the liquid. This will not affect accuracy. However, extreme cold will increase the viscosity of the liquid and slow the rotation of the compass. When taking a reading under these conditions. this must be catered for.

2. A compass should not be placed in a location where extreme changes in temperature are likely to occur. The expanding liquid may damage the capsule.

810. Damaged Pivot

Most forms of damage to a compass are obvious. A damaged pivot, however, may not be. A compass should swing freely and easily. If it does not do so, and does not return always to the same position, the pivot is probably damaged. It should be returned for repair.

811. Compass Errors

1. Almost every compass has an individual error and does not, therefore, point exactly to Magnetic North. This can be the result of the compass needle not being quite true with the markings on the card, or there may be slight divergences for other reasons. The error may be negligible or comparatively large. Before use, every compass should be checked against a known bearing or against another compass of known error. Of course, errors may be due to in individual's variation in reading and allowance should be made for this. Checks should be made from time to time by the individual, and initially by a LORE specialist.

2. When taking bearings, the compass error must be applied, plus or minus "x" mils, before reporting or plotting the bearing.

SECTION 4 - NIGHT MARCHING

812. General

1. The normal way to maintain direction on a night march across country is to use the compass. Before any night march, the bearings should be worked out and the compass set, by day. As much as possible of the route should be reconnoitred by day, even if only from a distance, and the ground should be studied on air photographs. Conspicuous features which would be visible at night, and roads, hedges, etc, which have to be crossed, should be carefully noted as a check on distance and directions.

2. It is not easy, tinder any circumstances, to hold to a constant course in the dark. Plenty of practice is needed before it can he done consistently and with confidence.

3. If more than one compass bearing is needed for a march, it is best to have a separate compass set for each bearing. Mark the compasses unmistakably to ensure that they are used in the right order.

813. Marching on Distant Objects

Even at night, it is often possible to distinguish objects at some distance, especially against a skyline. On moonlight nights they can be seen from a considerable way off. When things can be seen in this way, the best method is to pick out an object on the required bearing, as far distant as can clearly be seen, and to march to it. Then select another object, march on that, and so on.

814. Marching on Stars

1. If no suitable object exists on which to march, you may choose a star. The following precautions must, however, be taken:

    a. Choose a star that is conspicuous and easily identified. You cannot march far without taking your eyes off it. You must be able to pick out the right star easily and quickly each time you look up to it.

    b. Choose a star not too high in the sky, nor too low. It is difficult to march on a star at an elevation of more than about 30° above the horizon; on the other hand, stars lose their brighness when near the horizon and are more difficult to pick up. Choose one so that as far as possible, you can keep it and the ground in your vision at the same time.

    c. Stars move. A star fairly low in the sky may move about 100 mils sideways in 20 minutes. An error of 100 mils is a 100 metres in one kilometre of march. It is advisable to choose a new star every 15 minutes.

815. Dark Night with No Stars

1. When the night is dark and cloudy so that no stars or distant objects can be seen, send a man ahead on the required bearing as far as you can see him, close up to him, and send him ahead again.

2. When there is no need for silence the man can be called to halt when he has gone as far as you can see him. When silence is essential, determine how far he can go and still be seen and count the number of paces (say 20). Use a stick to give the man a good direction and tell him to go forward 20 paces each time, keeping as straight as he can, and then halt. Judge how far he has gone to the right or left, and move up into the correct position.

3. The man can be seen at a greater distance if he wears a square of white paper or cloth on his back. If longer bounds can be made, progress will be quicker.

816. Distance

1. On a night march, the tendency is to imagine one has gone further than one has. There is a tendency to think that the objective has been missed when in fact one may be well short of it. Unless there are frequent landmarks, it is always advisable to arrange a check on distance, pacing is frequently not accurate enough.

2. Detail two men to carry a rope or tape of a specified length, say 50 metres . The front man moves off and when the rope tightens, he halts and signals to the rear man to come forward by jerking an agreed signal on the rope. The same procedure is repeated as often as necessary. The essential point is to keep an accurate tally of the number of tape lengths measured. If there is much rough ground, it may be necessary to have a third man to help with the rope and to keep it clear of snags.

817. Training

1. It is not enough to know how a night march should be made. To carry out even a simple night march successfully, the drill must be perfect. Everyone must know exactly what he has to do and must have confidence in the rest of the party. If the enemy is near, nervous tension increases the chance of an error, and also may intensify its consequences. Training is essential.

2. An officer, warrant officer, or non-commissioned officer (NCO) should know at what speed he can expect to move over different sorts of country, under various conditions, and with what accuracy he should expect to reach his destination.

(818 not allocated)

SECTION 5 - SUN COMPASSES

819. Introduction

A magnetic compass is affected by the metal in a vehicle, and a bearing cannot be taken accurately except by stopping the vehicle, getting out, and moving far enough away from the vehicle to eliminate its magnetic disturbance. For cross-country travel in open areas such frequent stopping is unsatisfactory, and it is normal in such cases to mount on the vehicle a sun compass which operates on the movement of the sun and is not affected by magnetic disturbance; it is of course dependent on fairly constant sunlight and is principally used in desert areas.

820. Principle of Operation

1. The bearing of the sun from true north is known and recorded for all times of the day in any latitude or longitude. The direction of the shadow of a vertical rod in the sun is known as the shadow angle, and is equal and opposite to the true bearing of the sun, ic, plus or minus 3,200 mils.

2. If the sun time is known, true north can be found from the shadow angle, and hence true bearings can be determined. Special tables are provided to give the true bearings of the shadow angles at different times at curious latitudes.

821. The Standard Sun Compass

1. A standard sun compass consists of a thin vertical rod (gnomon) mounted centrally in a circular bearing plate on the edge of which is engraved a scale in mils reading anti-clockwise from 0 to 6,400 mils. This plate is fixed on the vehicle so that the direction of travel is along the 0-3200 axis with 0 to the front. A circular time, plate is mounted oil the centre of the bearing plate, on which it is free to revolve; a radial line on the time plate is marked as an index line. A slotted ruler which is free to revolve over the time plate acts as a shadow guide ind can be set at the appropriate time on the time plate. See Figure 8-14.

2. A sundial clock face is drawn by lines on the time plate radiating from the centre in such a way that each hour and half hour makes an angle at the centre of the plate with the index lines. The angles must be drawn to suit the sun's position (taken from tables) for the particular latitude and date on which it is to be used. The angles must be correct for the latitude but will hold good for a number of days on either side of the date chosen. The lines are marked according to the hours of the day which they represent.

822. Local Apparent Time

When using a sun compass, the user's watch must be set to the "Local Apparent Time", ie, the sun time. The "Local Mean Time" must first be calculated from the difference in longitude between the meridian of the local standard time and the longitude of the area of operation. To this, add four minutes for each degree of longitude east of the local standard time meridian or subtract four minutes for each degree west. Next, add or subtract the "Equation of Time" given in the tables. The result is the local apparent time.

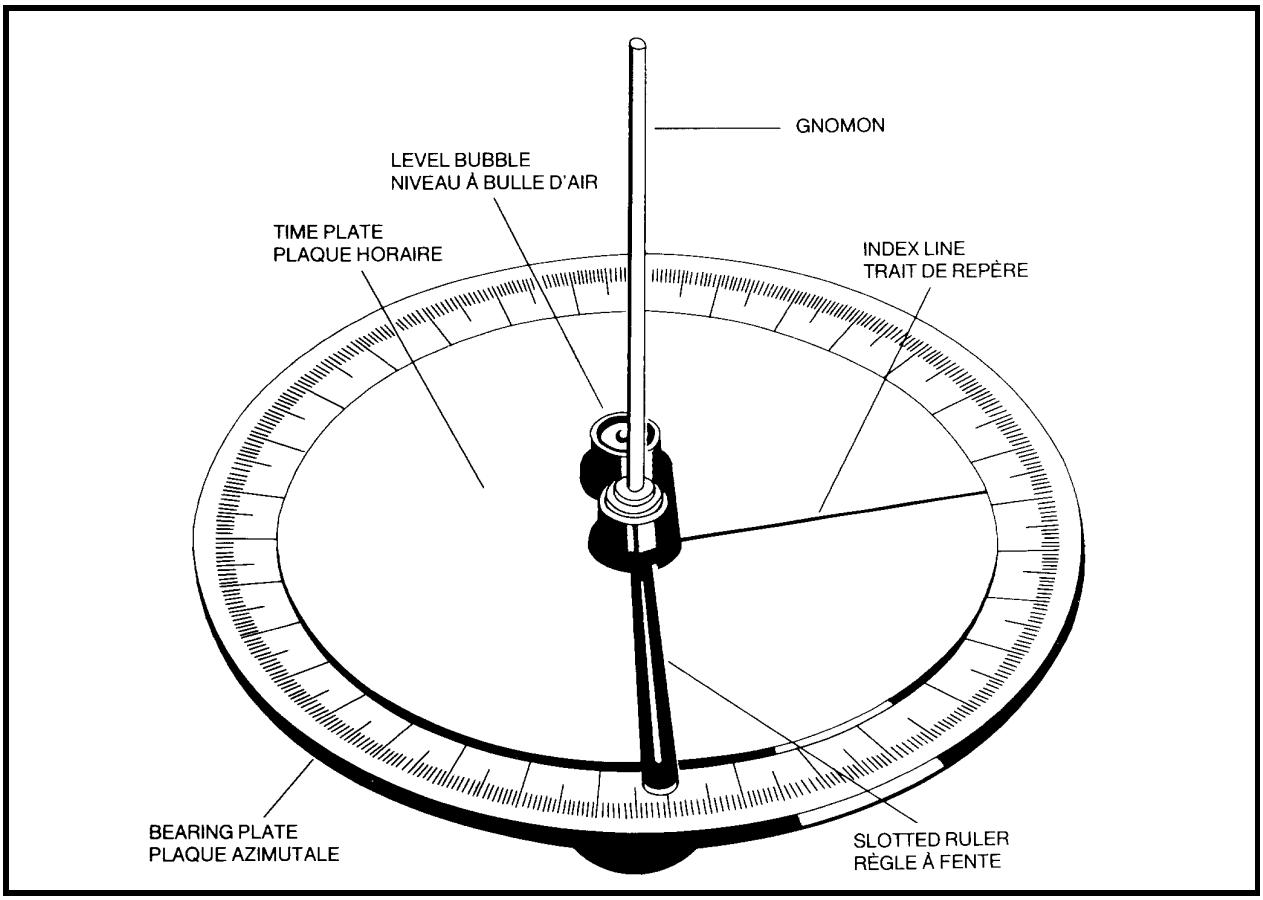

Figure 8-14 Standard Sun Compass

823. Setting a Course

To set a course, set the index line on the time plate to the required true bearing on the bearing plate, and clamp; this is called "Index on Course". Turn the vehicle until the shadow from the gnomon on the time plate coincides with the local apparent time as recorded on the user's watch: this is called "Shadow on Time". When both of these settings are complete, the vehicle is now pointed on the required bearing, and will remain so as long as the "Shadow on Time" setting is maintained with the time on the watch.

824. Steering a Course

1. To steer a course, set the vehicle on the correct bearing as instructed in art 823, pick up a steering mark dead ahead, and drive on it without paying attention to the compass. On arrival at the mark, re-align as in art 823, and carry on.

2. In featureless country, if it is not possible to pick up steering marks, an attempt must be made to maintain a straight course by continual reference to the compass. This requires keeping the shadow from the gnomon on or near the shadow guide which is set to the correct sun time on the time plate. To avoid continuous movement of the shadow guide, it is best to set it at quarter hour intervals as follows:

a. for the first quarter hour: 7 1/2 minutes ahead of starting time;
b. for the second quarter hour: 2 2/2 minutes ahead of starting time;
c. for the third quarter hour: 37 1/2 minutes ahead of starting time; and
d. for the fourth quarter hour: 52 1/2 minutes ahead of starting time.

During each quarter hour period, the shadow will then be "Fast" during the first 7 1/2 minutes and "Slow" during the second 7 1/2, the error will thus cancel out and the correct mean course will be maintained.

3. Care must be taken to have the bearing plate horizontal and the gnomon vertical when observations are made. A spirit level on the shadow guide assists this.

825. Change of Course

To change course, halt the vehicle and reset the index line of the time plate to the new bearing. Then turn the vehicle until the shadow of the gnomon comes on to the correct sun time.

826. Other Sun Compasses and Further Details

The above paras give only a bare outline description of a basic sun compass and its use. There are other types of sun compass (such as the Universal Compass), and if regular use of a sun compass is required it will be necessary to obtain more detailed instructions, especially on the use of the shadow angle tables.

(827 to 899 not allocated)