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CANADIAN ARMY
TRAINING PAMPHLET
No. 13

MAP USING

1942

Prepared under the direction of
The Chief of the General Staff, Canada

OTTAWA
EDMOND CLOUTIER
PRINTER TO THE KINGS MOST EXCELLENT MAJESTY
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INTRODUCTION

The number of officers and men in the Canadian Army who can use a map properly is surprisingly small, and the reason is that it has been a tradition that map reading instruction shall be mainly given indoors, and deal with theory, whereas for good results it MUST be given mainly out of doors, the student continuously comparing the country and the representation of it on the map which he holds in his hand.

The conventional method of instruction has made the average Canadian soldier associate the words "Map-using" with complexity, unintelligibility, Boredom. He is convinced that to read a map is a scientific feat beyond his powers. But in fact, it should be simpler than A, B, C, because even a man who is hard put to it to read type can understand a map easily.

In an attempt to avoid these unfortunate impressions, this system of instruction is called "Map Using", and this is also intended to indicate that a map is a practical instrument for USE, and not a device for demonstrating applied mathematics in the classroom.

It is laid down that all soldiers in our army are to learn map reading. This means that we must find methods of instruction suited to the abilities of the majority of our men, who are incapable of really learning a subject by hearing lectures, or reading pamphlets. The average man must be taught the use of any military instrument, such as a machine-gun or a map, by having it placed in his hand, having its purpose and manner of use explained very simply, and then being made to practise it extensively over a considerable period, until he can use it without thinking "How?".

This pamphlet, or series of lessons is meant as a guide for instructors. The main part of the text in most lessons is written as if it were the instructor speaking to the student. Naturally, he need not use the words precisely as written, but they give the essential facts and principles that must be taught; and, it is hoped, indicate the simple style that teaching should follow.

The paragraphs within brackets (or italicised) are directions to the instructor.

The nine lessons of the course should suffice to teach a driver, a despatch rider, a N.C.O. or an officer in a mechanized unit what he needs to know to use a map. Once this basic skill is acquired, the N.C.O. and the officer should learn more; particularly how to get from the map the topographical information he needs for tactical operations, but for the present purpose, is has been attempted to eliminate anything complicated, or which is not of everyday practical use to the driver or D.R.

While the course is divided into nine lessons, this does not mean that only nine periods of 45 minutes each are needed to cover the work. On many of the lessons several hours may have to be spent; instruction must be continued until the student can pass the test laid down.
The first rule is that only the local map is to be used. There should be one map for each student, or as a minimum, one between two students. If there are not enough maps for this, send the surplus students to do something else—too many men round a map means bad instruction for all. The local map should be used even for the portion of the subject taught indoors—so that whenever the student looks at the map, he will be able to picture the country it represents, or go out and look at it afterwards.

The portion of a map, which accompanies these lessons, is to illustrate the method of teaching. All references to it must be translated into terms of the local map, before the lesson is given to the student. The instructor, after he has grasped what is intended to be taught, finds a place on the local map when he can teach it, and takes his class there. The teaching ground should be the nearest to the students' quarters which is suitable. In the illustrations given in the lessons, it is assumed the students are quartered in the village of GLENHOLME.

The wall-charts of the “Map-Reading” Series, issued by the Directorate of Military Training, may be used to illustrate the lessons. At the beginning of each lesson, the applicable charts are listed. The method of using them is obvious, so it is unnecessary to refer to them in the text proper. The lessons have been so written, however, that it is not necessary to use the charts, as it will often happen that instruction in map-reading must be given in units or elsewhere when the charts are not available.

Between two-thirds and three-quarters of the time should be spent outdoors. Men will never learn to read a map sitting in a class-room.

When the student has completed the course, and passed the tests, he must continue to practise—and practise—until he finds his way by map becomes second nature to him, and he can extract from the document the full value of the pains-taking labour which the topographers have put into its making.

Lesson 1

WHAT A MAP IS

D.M.T. Map-reading charts to use:

MR 2—Illustrating Air Photo
MR 3—Conventional Signs

A map is a picture of the ground; such as you might see if you went up very high in an aeroplane, and had very good eyesight.

Although much scientific knowledge enters into map making, anyone with ordinary sense can use a map; in fact, it is the simplest way of giving directions how to get from one place “A” to another “B”. It is just a development of the simple device of drawing a sketch to show the route “A” to “B”, when verbal directions would be too complicated.

For an example of the sketch—to get from this lecture hut to the cook-house, you go to the main road—turn right, go 100 yds—turn left—go about 150 yds—etc., etc.

(Instructor draws route on blackboard, using actual distances and directions, which he has determined beforehand.)

To guide a person in this way, three elements enter—direction, distance, landmarks. Direction. In our simple example, we took from the direction of the main road, as a reference. Distance was measured in yards, or paces, and for landmarks, we had the buildings and roads. These three elements or kinds of information are needed to solve any problem of finding the way from one place to another. And a map contains all these kinds of information, in a convenient form.

In the next few lessons we will learn how to get information about directions and distances from the map. For the present, we will see how it conveys information about landmarks—or natural and artificial features of land. These are shown by what are called conventional signs, or simplified pictures representing a feature or object. We shall leave out hills, valleys, etc., for the time being, dealing with this in a later lesson.

Conventional signs are generally shown in a legend, and differ little between various series of maps. Look at those on the bottom of the local map. You should memorize these.

(Instructor then indicates signs for roads, rivers, buildings, railways, woods, etc.; and tests class’s knowledge. A competition between two sides to see which side gets most signs correct can be held.)

(If an air photograph of nearby ground can be obtained, it will illustrate the point in the first paragraph of this lesson.)

In using a map, you generally want to know your position on it; and the first step towards doing this is to locate on the map some well-known and unmistakable feature or landmark, such as the road junction in Glenholme, where the church and cemetery are, on the attached map. From that point which you have identified on ground and map, you work along from landmark to landmark to where you are. To follow the above example, suppose you know you have come from the road junction mentioned about 400 yds East to another one, where you turned North on Highway No. 4. You are now halfway between the last houses of the village, and the little wood by the road. So you locate your position.

It is also necessary to learn how to orient a map—that is, to place so that directions between objects shown on the map are parallel to the directions between the actual objects on the ground.

The simplest way to do this is to line up the map on objects on the ground. If you are standing on the road, say at the crossroads in the top right-hand corner of the sample map (024694), you can hold the map at the level of your eye, and line the road shown on it with the actual road. Or, if you are near one of the houses on the high ground East of the FOLLY River, and can see the church in GLENHOLME, you can draw a line from your location to the church, and then sight along it to the church.

In using a map to follow a route (See lesson V) you should keep it oriented, as this makes map using much easier.

TEST: Student must be able to recognize correctly 8 out of 10 conventional signs indicated at random on the local map.
Lesson II

MAP REFERENCES BY GRID COORDINATES

A means of describing the position of objects shown on the map.

D.M.T. Map-reading chart to use—

MR 16—Grid References

If we want to describe the location of any object, we start from a reference point—something well known, and not liable to be confused with any other point. For example, if we are describing a house in a town, we may say it is on a street 3 blocks East and 2 blocks North of the City Hall.

To define a point in open country, we could say it was so many yards East and so many yards North of some reference point—say a house, or a church. Or on a map, we could draw a line running North and South, and another East and West through our reference point, and measure distance of other points East and North from those lines.

For example, we could use the church in GLENHOLME as our reference point, and measuring with a scale, find that the post office is 250 yds East and 250 yds North of it; the road junction in the village 500 yds East and 500 yds North; the iron bridge over the FOLLY River 700 yds East and 400 yds North.

Rather than take any special building or other natural object, it is more convenient, when we want to refer to objects over a wide area covered by several maps, in such a way that there cannot be confusion between them, to select a point as origin (or reference point) which is fixed by astronomy and surveying procedures. It probably is not marked on the surface of the earth at all, yet the surveyors who make the map can find the position of every object shown, with reference to this origin, or point of reference. And in reproducing these maps, the surveyors mark grid lines on them to enable us to give the references of features conveniently. These grid lines are 1000 yds apart on Canadian maps, and 1000 meters on British or continental maps.

You will see them, with figures marked, showing how many thousand yards East, or North of the origin these lines are. The figures representing distance East (90, 91, 92) are printed on a vertical line; and those representing distance North (58, 59, 60) are printed on a horizontal line. Every point on the vertical (N & S) line marked 90 is 90,000 yds East of the origin, and every point on the horizontal (E & W) line marked 90 is 60,000 yds North of the origin. The piece of road in which they intersect is 90,000 yds East and 60,000 yds North of this origin.

If we only want to indicate position to about 1000 yds, we can say that an object—such as the bridge East of GLENHOLME is at origin 9057. We leave off the 000's, give the East coordinate first, and the North second, and join them together. The reference of the bridge over the DEBERT R., given in the same way, would be 9156.

We usually want to locate objects more closely than to 1000 yds— to 100 yds, at least. To do this, we have to divide the 1000 yd grid squares into 10—by eye, or by using a scale. Each 1-10th of the 1000 yd square is, of course, 100 yds. (The class should make scales by marking off 1000 yds in

100 yd divisions, by placing the edge of a piece of paper against the scale on the bottom of the map, and marking the divisions across.)

(DO NOT teach the use of "Rommers" at this stage. It is apt to cause confusion as to the order of figures in the reference. The use of the improvised Scale is only the first step in teaching the student to estimate to the nearest hundred yards—i.e., the last figure of the co-ordinate.)

So the East coordinate, to 100 yds, of the bridge over the FOLLY R. is 903, and the North coordinate is 573. We put them together, East first—thus 900573—to get a six-figure map reference for the bridge.

We measure the coordinates of the bridge over the DEBERT R. similarly; Note the number in the grid line to the West of it—91—measure or estimate the number of 100's of yards from that grid line to the object—9; so we get Easting 919. Note the figures on the grid line South of the Church—56, measure or estimate the hundreds—8; so we get Northing 568 the whole reference is 891568.

It is usually accurate enough to estimate the hundreds of yards by eye. The Easting (or distance East) is always given first, then the Northing. Note that a map reference is always an even number of figures, usually 6, often 4, sometimes 8, when you want to be very accurate.

(The class will now be practised in giving the map reference of objects, and in finding objects from map references. This should continue for brief periods of 10—15 minutes after subsequent lessons, until the man under training can give an accurate map reference in 30 secs or less.)

TEST

Give and read 8 out of 10 map references correctly, allowing 30 secs per reference.

Lesson III

SCALE

D.M.T. Map-reading chart to use—

MR 4—Scales

One of the things we need to know to find our way, and can discover from a map is distance. Distance on the ground is measured in miles and yards (or metres and kilometres) and on the map is measured in inches (or centimetres). In an accurate map there is a fixed relation between distance on the map and distance on the ground, which is called the scale. This may be expressed as a fraction—or ratio, as 1—25000, which is the scale of the sample map attached. It means that one inch on the map represents 25,000 inches on the ground, or about 700 yds.

It is more convenient, however, to have a direct means of measuring in yards and miles on the map—this is also called a scale. One is drawn at the
foot of the local map. You may cut it out of the paper and use it to measure, or you may use similar scales which are engraved on the protractor, or you may mark off a paper scale by laying the edge close to the scale on the map, and marking off the divisions.

A map's scale may also be described as one inch to one mile; or as one inch to four miles. These maps are sometimes referred to as the one inch, and quarter-inch maps respectively; meaning one inch (or a quarter-inch) representing one mile. (Class then makes scale, or uses one on protractor to measure distances between objects on a map, straight lengths of roads, etc.)

(The instructor then shows how the distance along a curing road may be measured with a piece of paper and pencil—ticking off the straight lengths of road on the edge of the paper, so converting the curing line to a straight one, which is measured by a scale. The class does several examples.)

(When distances by road have been so measured, the class can work out how long it would take to cover them at the rates of 15 miles in the hour, (standard rate for wheeled convey) or 25 miles in 2 hours (standard rate for cruiser tanks on the road.)

For example—the distance over a route is measured as 17½ miles. Time required at 15 m.i.h. \( \frac{17\frac{1}{2} \times 60}{15} \approx 70 \) mins.

Time required at 25 m.i.h. \( \frac{17\frac{1}{2} \times 120}{25} = 1 \) hr. 24 mins.

TEST:

To be able to scale, within less than 5% error, distances between places 16 miles apart over a twisting route, and to be able to measure distances between objects on maps of different scales, using the protractor, and by marking pieces of paper and comparing with printed scale.

Lesson IV

MEASURING DISTANCE ON THE GROUND—PACING

Pacing is the means usually adopted to measure distance on the ground, when we only require an approximate result, or have no better means (such as a range-finder, surveyor's chain or tape, etc.) Every soldier should be practised in pacing distances.

The first rule in pacing is to walk at your natural gait—don't try to pace an even yard. You pace known distances several times, counting your paces carefully. Then you find out how many of your paces go to 100 yds, and you will be able to convert your paces into yards fairly correctly.

(Several distances of 100 yds are measured, and staked off. One should be on level ground, one uphill, one on rough ground (cross-country). Each man paces the level distance 5 or 6 times, and takes the average. Say it is 115 paces—then in 115 paces you must deduct 15 to make paces into yards—which is 15 in one pace, or \( \frac{115}{115} = 13 \) in 100 paces.

Each man should calculate how many paces in each hundred—that is, what percentage—he should deduct to turn his paces into yards.

(After calculating this for level ground, he paces the 100 yds distances laid out on rough or hilly ground, and notes how the ratio of paces to yards rises.)

(The students then pace several distances between objects, which are marked on the map; turn these paces into yards, and them compare the result with scaled distances.)

(This lesson can be fitted in with "Judging Distance" which is important in all weapon training.)

Lesson V

USING A MAP OVER A SIMPLE ROUTE ON FOOT

(Start at a well-defined landmark—such as the road junction 90572. Point out buildings. Estimate distance to them. Scale distance off map. Compare.)

(Have group march to bridge 903573. Compare distance paced with distance scaled. Note distance to fringe of woods to the South-East.)

(Continue march to road junction 908571. Ask group to show location. Then pick out houses in squares 9056, 9657. Advance to high ground 914566. Identify farms and roads.)

Group is now told to proceed to road junction 919568. One or two to act as guides. Halt every few hundred yards—identify landmarks. Note their distance, and scale. Make members of group spot their position on the map.)

(Similar lessons, following different routes are repeated until every man is able to follow his progress on a map on foot and find his position from detail. He should be able to pick out those features which will make good landmarks, and note the distance between them by road, and any changes in direction.)

TEST:

Student to identify his position to 100 yds approx. at various points along 2 miles of road he does not know.)
Lesson VI

FOLLOWING A ROUTE IN A MOTOR VEHICLE

To follow an unknown road using a map when driving in a car or lorry, one uses essentially the same methods as in following a road on foot. It is not very difficult in daylight, if one is using a 1" to 1 mile map, and pays attention to the turns in the road, landmarks, etc. But, at night, if one must drive with dim headlights, or none; and it is impossible to see any distance, and hence difficult to recognize landmarks, then following a route is much harder, and demands practice, care and attention.

In going from one place to another by road, it is at the turns and road junctions that one may go astray. Therefore, we must pay particular attention so as to recognize these points, when we come to them. The commonest error is to go on past the road junction where one should have turned in another direction.

The best check on where to turn, is to measure the distance from the map, and then watch the speedometer, and the landmarks, so far as they can be seen. The measurement should be made beforehand, and it is often advisable to prepare a “Route Card”.

Let us work out a simple example on our sample map.

ROUTE CARD

Starting point—road junction GLENHOLME 896560.

<table>
<thead>
<tr>
<th>(A) Distance from last landmark</th>
<th>(B) Distance from start point</th>
<th>(C) Remarks and Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>.3 mile</td>
<td>.3 mile</td>
<td>Road junce—road to left continue East.</td>
</tr>
<tr>
<td>.2 &quot;</td>
<td>.5 &quot;</td>
<td>Bridge over FOOLY River. Road branching Right. Go straight on.</td>
</tr>
<tr>
<td>.2 &quot;</td>
<td>.7 &quot;</td>
<td>Rd junce—Road branching left. Go straight on.</td>
</tr>
<tr>
<td>.2 &quot;</td>
<td>.9 &quot;</td>
<td>Rd junce. Take dirt road to left.</td>
</tr>
<tr>
<td>.7 &quot;</td>
<td>1.6 miles</td>
<td>Dirt road coming in from right. Clearing begins—</td>
</tr>
<tr>
<td>.7 &quot;</td>
<td>2.3 &quot;</td>
<td>Crossroads—turn left.</td>
</tr>
<tr>
<td>.6 &quot;</td>
<td>2.9 &quot;</td>
<td>Bridge over small stream.</td>
</tr>
<tr>
<td>.4 &quot;</td>
<td>3.3 &quot;</td>
<td>Road from right. Go straight on.</td>
</tr>
<tr>
<td>.2 &quot;</td>
<td>3.5 &quot;</td>
<td>Bridge over stream, followed by sharp bend L and R.</td>
</tr>
<tr>
<td>1.1 miles</td>
<td>4.6 &quot;</td>
<td>Dirt road joins highway—turn R.</td>
</tr>
<tr>
<td>.7 mile</td>
<td>5.3 &quot;</td>
<td>Start point.</td>
</tr>
</tbody>
</table>

In this case a lot of detail has been noted. With practice the turnings and a few main landmarks would be enough as a guide.

The man sitting beside the driver keeps the route card and/or map, and tells the driver when he should come to a landmark or turning. The driver watches his speedometer, and as he is about to reach the point, lets the guide know, so they can both spot the turning.

If driving without headlights, any light in the vehicle should be kept to a minimum, and shielded from the driver’s eyes as far as possible, so as not to interfere with his accommodation to the darkness.

(The class should be taken over several routes in the way indicated, taking turns to guide. Six or seven may be trained using one station wagon. Unexpected stops should be made, and the students asked to locate themselves.)

(After the class is sufficiently practised in daylight guiding, night guiding should be practised with sidelines only, or no lights, if traffic conditions render this safe.)

TEST:

Acting as co-driver, to guide a vehicle over 15 miles of difficult road, including 4-5 turnings, at night, with sidelines only, in 1 hr. 15 mins.

Lesson VII

CONTOURS:—OR THE REPRESENTATION OF THE SHAPE OF THE GROUND

Hills, valleys and all such land forms are as important or more so than other features which are represented by conventional signs, but it is difficult to depict them simply and clearly in a map. Earlier map-makers tried to draw them by shading, or pen-strokes called hachures, but these means were all unsatisfactory.

Another device is to show, in figures, the height of points above mean sea level. This is done on military maps to a limited extent. The points usually selected are the tops of hills, and road junctions. But to tell the shape of the ground from spot heights, one would need so many of them that the rest of the detail would be obscured, and the multiplicity of numbers would be very confusing. Instead, map-makers adopt the device of drawing a line which joins all points which are the same height above sea level. Such a line is called a contour, (because it indicates the contour, or shape of the ground).

When we see such a line on the map, usually with a figure against it, we know that every point on that line is so many feet above the seal level. There will be other contour lines, higher and lower than the one we are considering, and we can tell which are the hills and which are the valleys by the shape and relation of each other of these lines.

Let us now take the map, and go on the ground, say to 896560, where the 50 ft. contour crosses the road. Note the other points of detail which lie on the 50 ft. contour—buildings, and roads, and try to imagine a line along the ground joining these points of equal elevation, as the contour is drawn on the map.
Suppose now we go to the road junction 908576. If we look West—we see that the ground falls—and the contours in that direction bear a lower number. If we look to the North-East, we see that the ground rises to the hill with the houses on it—and the contours bear higher numbers. Contours on Canadian Military Maps usually differ by 25 ft. This is called the vertical interval. On any map, it is a fixed number of feet or meters and this is usually stated with the scale and other information at the bottom of the map.

We now find we have a means of telling which is uphill and which is downhill on a map. Uphill is when you go from a low numbered to a higher numbered contour, and downhill is the reverse.

(Students will now be asked which is uphill and which is downhill on various pieces of road shown on the map.)

If we go to 907591 we see that to the North-East there is a little valley, with a stream in it. Note the way the 75' and 100' contours run in relation to the stream; roughly parallel to it for some distance, then closing in, and crossing the stream. If you follow the POLLY RIVER North, you will see that the contours do the same thing—the contours are higher ones as we go upstream. If you remember this shape of the contours, you will be able to recognize a valley, which usually has a watercourse at its lowest point. Observe also the way the contours run along the DEBERT River.

We should be able to recognize a valley by the shape and relative position of the contours.

We can also recognize knolls, or little isolated hills, such as those at 903561, and 912578. We can also note the high ground in square 9035—how the 50' and 75' contours come close to the river.

(The students should now walk or drive along a route, picking out in advance, and verifying, the high and low spots along it; where there are valleys, or knolls, and which stretches are uphill and which downhill.)

The next point is to recognize the steepness of a hill—or its gradient. The hill is steep when contours are close together; because obviously a steep hill is one where you rise rapidly in relation to horizontal distance travelled, and close contours mean a big change in height in a short distance. (Scale distance between two close contours; the class should then select the steepest gradient over a certain route, and check on the ground.)

The calculation of gradients—as 1 in 20, or 5% and so on—is of little practical value. Military transport can move along any gradient likely to be met on a made road, and if places are impassable it will generally be due to bad surface, rather than excessive gradient. And when moving cross-country, it is usually possible to avoid steep gradients.

TEST:

Student should recognize valleys, knolls, high ground; and be able to pick out high, low and steep places on a given route.

Lesson VIII

USING A PROTRACTOR TO TAKE A BEARING FROM A MAP

D.M.T. Map-reading charts to use:

MR 6—North Points
MR 7—Bearings
MR 21—Practical Application of Prismatic Compass

One of the three sorts of information we need, in order to find our way from one place to another, is about direction. Direction is commonly described by the points of the compass—North, South, North-West; North-North-West, etc. This is all right for general purposes, but in navigation, or in crossing a tract of land with no unmistakable landmarks, it is not precise enough to guide one to a definite destination, (such as a village, cross-roads, defended locality, etc.).

To be more accurate, we describe directions in terms of degrees and call them "Bearings". Degrees are subdivisions of a circle, similar to the subdivision of the face of a watch into hours, or minutes. There are 360 degrees in the complete circle; 180 degrees in a semi-circle; 90 degrees in a right angle.

A protractor is an instrument for measuring angles, in terms of degrees. By measuring angles on a map, we find directions—or bearings—on which we move over the ground, with the assistance of a compass.

The bearing of Object "B" from Object "A" in the sketch is 60 degrees.

(The class will now be practised in reading a number of bearings between 0° and 180°.)

Note that 0° and 360° are the same direction—that is, North
Three sides of one face of the rectangular protractor are marked off in degrees. The outer set of figures runs, clock-wise, from 10 to 170° (the top and bottom corners representing 0 and 180°) 0° is the same as North; 90° East; and 180° South.

If we want to measure the bearing between two objects or of a road, railway or other linear feature, and it is to the East of the North and South line (meridian). We use this outer set of figures. First rule a line between the two objects, whose bearing from one another you want to discover. Lay the protractor down so the side with no degrees marked on it is to the left, with the little arrow on the one object, or on the line of bearing. The edge of the protractor must be on, or exactly parallel to the North-South grid line. Then read the number of degrees on the outer set of figures on the protractor.

If we want to measure a bearing to the West of the North-South line, we turn the protractor round so that the edge with the arrow centre mark, is to the right, and read the bearing marked on the inner line of figures, which run from 180° to 360°.

(The class will now practise taking off bearings in from 180° to 360°.)

Note.—by measuring bearings—that if the bearing of “B” from “A” is 60°; the bearing of “A” from “B” is 240°—or 180° greater in each case. A bearing taken in a reverse direction is sometimes called a “back bearing”, and will always be 180° greater or less than the “forward” bearing.

All the bearings measured so far are “grid bearings”, because the bearing or angle is measured with reference to the North and South “grid line”; which is not the true North and South line, or meridian. (Some maps have meridians marked on them, and on these it is possible to read a true bearing, by keeping the edge of the protractor parallel with the meridian. But nearly all military maps have grids on them, and so it is usual to read grid bearings.)

Note:—Do not confuse students at this stage by dwelling too much on the difference between “True” and “Grid” North. Say that they are for practical purposes, the same, and that we shall deal only with “Grid” and “Magnetic” North.

To find our way, over country with no land-marks, such as desert, prairie, or through woods, we have first to find from the map the direction of the route we want to travel; and this is done as just described. Then we have to use a compass, so as to be able to go in that direction on the ground. But the bearings we read in our compass (we will describe how the compass is used in a later lesson), are not exactly the same as the grid bearings; and this is because the magnetic needle does not point to the true north pole, but to the magnetic pole, and the two poles are separated by some distance. So that at different points on the earth’s surface, the direction of grid North, and that of magnetic north differ from one another by varying amounts. The amount can be measured by the surveyors for any point. It is called the magnetic variation, or declination, and is shown on military maps, either by means of a diagram—(see below) or by words, as for example, “Magnetic North is 24° 07’ West of Grid North at centre of sheet.”

In magnetic (or compass) bearings, the Magnetic North is our reference direction, instead of grid North. We will have to convert the grid bearing, measured off the map, to the magnetic bearing which we want to march on, when using the compass. The best way to do this correctly is to make a little sketch.

We see here that the angle between our position O, the place “A” we are going to (or object we are looking at) and grid North is 60°—i.e., that is, the grid bearing which we measure on the map from O to “A” is 60°; the magnetic variation or declination is 24° West, and so the magnetic bearing is 84°.

In the second sketch the grid bearing is 220°, the Magnetic declination 24°, and the magnetic bearing 244°.
Suppose now we have a declination of the compass of 15° East—which means the direction of magnetic North is 15° East of grid North. Using the same grid bearings as before we get:

The grid bearing is 60°, and the magnetic bearing 45°.

Maps that are printed for use by the Air Force have “Compass roses” shown on them for convenience in plotting true and magnetic bearings in navigation. Examine it and you will note that the True North differs slightly from grid North. Neglect this difference, however, and note how magnetic bearings and true bearings may be read off; and how the magnetic bearing is always greater by the amount of the magnetic variations.

The class will now convert a number of grid bearings, which they take from the map by protractor, to magnetic bearings, drawing a diagram in each case. After about 10 examples, using the actual declination marked on the map, a few more may be done, using an imaginary “East” declination. Explain that in Western Canada, the declination is East.

(Finally, the class measures on the map, the magnetic bearings of several objects from a suitable observation point nearby; and in the next lesson will go to that observation point and take bearings by compass to those objects, and compare results.)

TEST:
Students to measure four grid bearings on map and convert to magnetic bearings correctly in 10 minutes.

Lesson IX

THE PRISMATIC COMPASS

D.M.T. Map-reading charts to use:
MR 17—Prismatic Compass Mk. IX
MR 18—“ “ “
MR 19—Bearing with Prismatic Compass—Conversion
MR 20—“ “ “ “
MR 22—Marching on Magnetic Bearing

The prismatic compass consists of a compass card, attached to a needle which points to the magnetic north when left to swing freely; a sighting device (the backsight being the notch in the hinged prism casing and the foresight being the hair-line on the window), and a prism to enable the user to see the figure on the compass card at the same time as a sight is being taken.

The card is fixed when not in use, and released by the stud (stop) on the right hand side. The pin (check-spring) on the left side is used to steady the compass, and bring it to a standstill, so that a reading can be made. Both these devices should be handled gently, to avoid damage to the pivot of the card, on which the compass’ accuracy depends.

To take a sight with the compass—open the cover to a vertical position, and turn up the hinged prism. It may be necessary to adjust the prism by moving it up or down in the groove, so that the figures on the card may be distinctly seen.

Putting the left thumb through the ring, sight towards the distant object, and release the stop. The compass will usually oscillate through quite a wide
angle at first. Note the extreme figures—say 150 and 210—take the mean (180) and slow the card down with the check-spring at the left until it comes to rest about the mean reading (180). Verify the sight, and read the bearing (outer row of figures).

To fix a direction on the ground by magnetic bearing, slow the card down after release, and then turn round until the figures of the bearing in question are seen—then note the line of sight, and distinctive features or land-marks on it, upon which you can march.

*(Students should practice reading bearings, which they have previously measured on the map, using the protractor and correcting for magnetic declination. They should then move across country between points which are not intervisible by determining the bearing between point of departure and destination from the map, and using the compass as indicated above to follow that direction. The distance to be covered should be about 800-1000 yds. It may be necessary to read bearings several times on route, depending on the land-marks which will serve as guides.)*

A bearing can be followed by night, using the luminous arrow on the card, and the luminous mark (index) on the inner compass cover. The latter is set to the required bearing by releasing the milled-headed clamping screw, and rotating the cover until the indicating mark is opposite the required bearing, as marked on the outer wall of the compass. To use, the compass is held so that the luminous arrow indicating North is under the mark; when a sight can be taken, and a land-mark be picked up, as in daylight; though of course it will not usually be possible to select very distant ones; hence more frequent sights must be taken.

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**FINDING THE NORTH BY SUN AND STARS**

D.M.T. Map-reading charts to use:

MR 9—North by a Watch

MR 11—North by Stars at Night

If you haven’t a compass, the Cardinal Points (North, South, East and West) may be found approximately by the sun, more accurately by the stars.

Everyone knows the sun rises in the East and sets in the West, and that at noon it is nearly due South (when you are in northern countries, such as Canada or England). These facts may be used to find direction at any time of day, by use of a watch.

It is done as follows:—lay the watch flat, with the hour hand pointing at the sun (get the sun’s reflection on it). True South then lies midway between the hour hand, and the figure 12.
At night, the North Star (POLARIS) is very close to True North. You can find it by its position relative to the two well-marked constellations of the DIPPER (Great Bear) and CASSIOPEIA—as the sketch shows.

Every soldier should make a habit of orienting himself, wherever he is, by finding the direction of North, either from the map, or by compass, or by one of the means described above. This develops the sense of direction, and helps you to find your way around.