See note at the bottom on documant S.S. 192 referred to in this text

GHQ Machine Gun School.

Fighting

To Construct a Fighting Map.

Method 1. By actually drawing the Fighting Map on the Trench Map. (See large Fishing Map).

(a) To get direction. The position of the Directing Gun of the Battery is accurately fixed on the Trench Map, and a line is drawn on this Map representing the direction of the zero line of this gun.

Then as each gun of the Battery will have a zero line parallel to the zero line of the Directing Gun, the Battery Commander can lay all his guns in a known direction by simply giving the order "All guns on ZERO".

It is assumed that in all cases the Directing Gun will be the Left Gun of the Battery.

To complete the Fighting Map, lines are drawn on the Trench Map radiating from the point representing the position of the Directing Gun, each line making an angle of 1° with the line on each side of it. A total angle of 40° (i.e. 20° each side of the Zero Lino) will generally be found sufficient, and an angle much less than this will often suffice. The Battery Commander is now able to switch the lines fire of his Battery in the direction of any target, by noting from the map the angle that this target is to the right or left of the zero line on the Map. For example, suppose a certain target is shewn by the Fighting Map to be in the line of 10° Right of the zero line, the Battery Commander will give the order:-

"All guns on Zero".

"All guns 10° Right".

and the Battery will then be laid in the direction of the target.

(b) To get the Angle of Quadrant Elevation

(i) Take the gun position marked on the Map as being the centre of a circle. Arcs are now drawn at intervals of 100 yards commencing at the lowest range at which fire is likely to be required (say 1,000 yards) and on the left of each arc the range it represents is written. The Battery Commander is now in a position to see at a glance, the Direction and Range to any target on the Map, and from the Contours of Map he can get the vertical interval to any target and thus get the necessary angle of Quadrant Elevation to hit the target. This is the Fighting Map in its most elementary stage, where it enables the Battery Commander to obtain his necessary data without actually making any measurements with Protractor or Scale.

The Fighting Map can be completed as time permits. Below will be found various suggestions as to the manner in which time and labour can he cut down to an absolute minimum.

(ii) On the right of each arc mentioned in (b) (i) above, the Angle of Tangent Elevation for the range can be written. This will save the process of referring to a Table for the Angle of Tangent Elevation.

(iii). Method (ii) above is slow unless the range happens to be an exact multipe of a hundred yards.

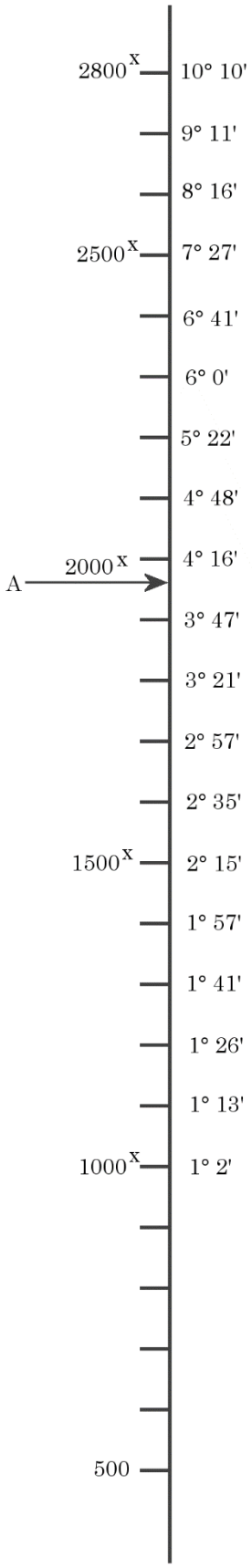


Figure 1

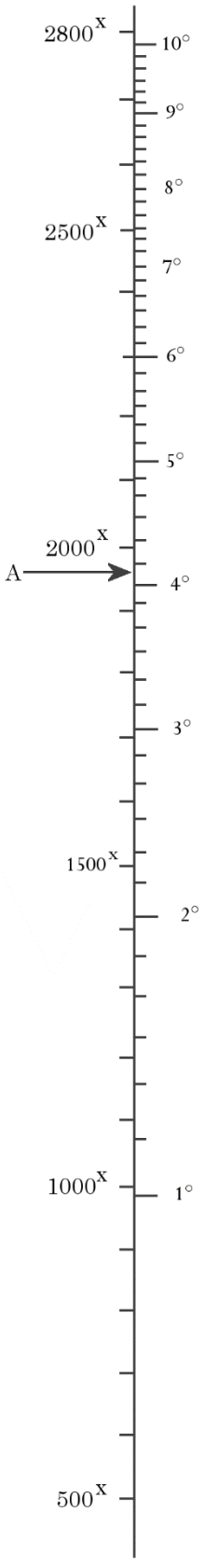


Figure 2

For example, suppose the target is at A figure (1). By method (ii) it will take several seconds to find the exact angle of Tangent Elevation to this point. The method would be to subtract 3° 47' from 4° 16' (i.e. 29'). Then noting that A is about two-thirds of the distance between the two ranges, find two-thirds of 29' (i.e. 20') and add it to 3° 47' (i.e. 4° 7')

It is clear that time would be saved if the difference between the angles of Tangent Elevation were written down by the side of the Angles of Tangent Elevation. A much better method is to draw a scale of Angles of Tangent Elevation (Figure 2), showing degrees and tens of minutes. The Angle of Tangent Elevation then be read off immediately. For example, in the case of the point A worked out above, the angle of Tangent Elevation is at once seen to be 4° 7'.

(iv) The next stage in completing a Fighting Map is to provide the Battery Commander with some means of obtaining the angle of sight to the target without having to make any calculation. The Maps we use are contoured in intervals of 10 metres, so a very convenient scale to have

would be one showing the angles subtended by 10 metres at various ranges.

This can be obtained by the formula given on Page 8, S.S.192, Part II.

$\frac{VI}{HE} x$ 3,400 = Angle of Sight (in minutes)

Example :- Find the angle subtended by 10 metres at 1,500 yards.

10 metres = 11 yards. 11/1,500 x 3,400 = 24·9' = 25'.

In order to get the vertical interval between gun and target without wasting time, the height of the Battery should be marked on the Map, and contour lines should be marked with reference to the Battery height.

For example, if the Battery height is 113 metres, the 120 metre contour should be changed to plus 7 metres, and the 110 metre contour to minus 3 metres. The vertical interval to any point can then be read off without reference to the Battery height.

For example, if the target is seen to be 5 metres above the gun, and at 1,500 yards range, the Angle of Quadrant Elevation is found as follows:-

The Angle of Tangent Elevation is seen to be 2° 15'

Then 10 metres at 1,500 yards subtends 25'. Therefore 5 metres subtends 12'. Thus the Angle of Quadrant Elevation is 2° 7'. Since the angle of Quadrant Elevation= Angle of Tangent Elevation plus or minus Angle of Sight.

The right half of the large Fighting Map illustrates stages (iii) and { iv) above.

(v) The Battery Commander will now be in a position to find the angle of switch to his target, and the Angle of Quadrant Elevation necessary to hit it with scarcely any calculations and without having to refer to any Tables.

The quickest method of all of obtaining the Angle of Quadrant Elevation to a target, is to draw on the map curves joining all points which need the same Angle of Quadrant Elevation. It should be noted at the outset that the preparation of such curves is neither a long nor a difficult matter, once the compiler has realised how to set about the task. For example, in the portion of the map reproduced in Fig. 3, suppose it is required to draw the 8° curve (i.e., a curve such that all points in require an Anglo of Quadrant Elevation of 8°).

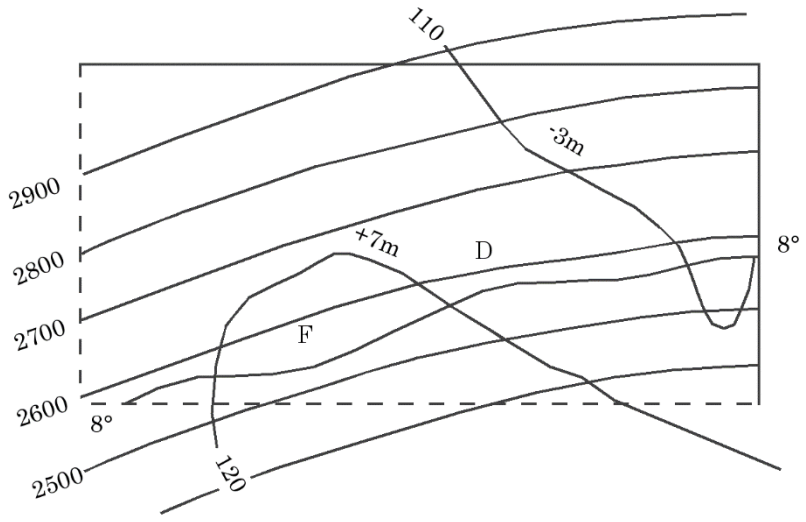


Figure 3

Suppose the Battery contour is 113 metres. Then referring to the Q.E. Graph

(S.S.192. Part II. App.V. No.1.), the 8° curve cuts the Horizontal Plane at a range of 2,575 yards.

Then in examining the Map it will be seen that the point A will, because its height is 113 metres (i.e. level with the Battery) and,2,575 yards away.

Now all points on the 110 metre contour are metres below the Battery. The Q.E. shows that the 8° curve is 3 metres below the horizontal plane at 2,580 yards, therefore B and C are points on the 8° curve, because they are 3 metres below and 2,580 yards from the Battery.

Again, all points on the 120 metre contour are 7 metres above the Battery, and the Q.E. Graph shews that the 8° curve is 7 metres above the Horizontal Plane at 2550 yards. Therefore the points D and E are on the 8° curve.

Now assume that the highest point of the spur between E and D is 122 metres (i.e. 9 metros above the battery), then the Q.E. Graph shows that the 8° curve will fall at 2540 yards (the point F).

Suppose that the point in the valley midway between B and C is 109 metres (i.e. 4 metres below the battery), then the 8° curve will fall at 2580 yards (the point G).

Now if all these fixed points are connected by a continuous curve, the 8° Q.E. Curve is completed.

In this manner curves are drawn for each degree or half degree.

Then if firing on parallel lines of fire is all that is required, the Battery Commander can read his Orders from the Map without having to make even the most elementary calculation.

The left half of the large Fighting Map exemplifies the above method.

(vi) In order to ensure the safety of our own troops, it is advisable to draw on the map a. "Safety Limit Curve" which is such a curve that it joins all the points on the ground which when engaged, give only the minimum clearance over our own troops.

The form and position of such a curve depends primarily on the range to the Friendly Troops, and on the vertical interval between the Friendly Troops and Gun. For example, suppose that the position of the safety limit curve is desired when firing over the Trench Sector N.21.7.

Battery Contour = 113 metres. Friendly Troops contour = 116 metres.

Range to F.T. = 1350 yards.

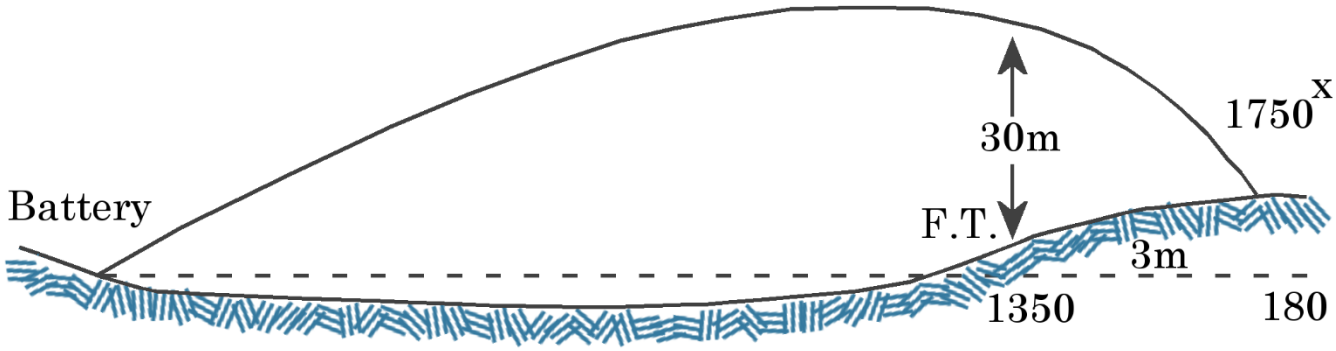


Figure 4.

Then the F.T. are 3 metres above the Battery. Now the Minimum Clearance at 1350 yards is 30 metres, therefore the centre shot of the cone of fire must pass 30 metres above the heads of the F.T., or in other words, 33 metres above the horizontal plane through the gun position. On reference to the Q.E. Graph it will be seen that the 3° 25' trajectory is the lowest trajectory that fulfils the above condition, and also, that this trajectory will cross the horizontal plane at a range of 1800 yards. Now find the point in the line of fire on the map which is 1800 yards from the battery (i.e. N.2l.a.18.72).

It will be seen that the ground there is 121 metres (i.e. 8 metres above the battery), and therefore the trajectory will never reach 1800 yards because it will hit the ground at a point 8 metres above the horizontal plane through the battery position (i.e. at a range of 1750 yards from the battery, and this is the nearest point on which the battery can fire with safety.

By fixing the positions of several such points along the front covered by the battery, a continuous curve can be made by joining the points.

(vii) If there is any portion of the ground on which that particular battery cannot fire, say owing to an obstruction, or any other cause, the area should be shaded or coloured so that fire will not be wasted in trying to engage an impossible target.

Method II. Method I above, in which the whole of the Fighting Map is actually drawn on the Trench Map, has several disadvantages. Firstly, it assumes that a skilful draughtsman is available, and that he possesses accurate instruments, because it is a very difficult task to draw such a map with great accuracy, and unless the map is

accurate it is almost worse than useless.

Secondly, unless all the lines are drawn very thinly there is such a network of lines on the map that it is difficult to read the details of the original Trench Map.

These disadvantages have been fully appreciated, and in order to overcome them, and also in order to save time, a Fighting Map Tracing has been designed.

As in Method I above, the position of the directing gun is accurately fixed on the map, and a line showing the zero line of this gun is drawn on the map. The Trench Map is attached to a board and the tracing is then pinned securely on it, so that the zero lino on the tracing coincides with the zero line on the map, and the origin of the tracing coincides with the position of the directing gun on the map. Then in order to prevent the edges of the tracing from tearing they might be gummed to the Trench Map, or strips of cardboard might be pinned round the tracing.

Once the tracing is in its correct position it will at once give the direction to any target, and any of the methods of obtaining the Angle of Quadrant Elevation described in Method I can be employed.

Method III. The radian arc and cursor already given to Class illustrates another method of obtaining the direction and range to any target without the use of any other instrument. Such a device would be specially useful if the Trench Map was only faintly printed, because then it would be very difficult to locate a target owing to the density of the lines involved in Methods I or II.

The arc and cursor are cut out from the cardboard, and the arc is pinned to the Trench Map as per the instructions on it, and the cursor is pivoted at the gun position.

Again, any of the aids for getting the Angle of Quadrant Elevation already mentioned, can be employed.

This design is printed by the Field Survey Company., R.E., attached XV Corps.

How to use a Fighting Map. (See large Fighting Map).

(i) If the target is small it will be sufficient to switch the battery on its parallel lines of fire, so that the target will be in the centre of the fire produced.

Knowing the map co-ordinate of the target, the battery can at once be read from the Fighting Map.

Example.

Task.	8 gun battery on a frontage of 70 yards.
Order.	Concentrate on N.14.c.75.00
	All guns on zero.
	All guns 14° 30' Left.
	Load.
	Elevation 5° 15'.
	Rapid.
	Fire.

Note 1. The battery is switched an extra 30' Left in order to place the target in the centre of the fire produced.

Note 2. If the Battery Commander considers it necessary, he can order a small traverse.

(ii) It is not generally appreciated that with the aid of a Fighting Map, any kind of Machine Gun Target can be engaged, thus any kind of barrage can be worked out from a Fighting Map far more quickly than by any other means.

Take the case of a frontal or oblique barrage. Let AB represent the target, and G the point on of the Directing Gun on the Fighting Map. Suppose D is the position of the Right Gun of the Battery. Then draw DE parallel to AG, and join DB and DA.

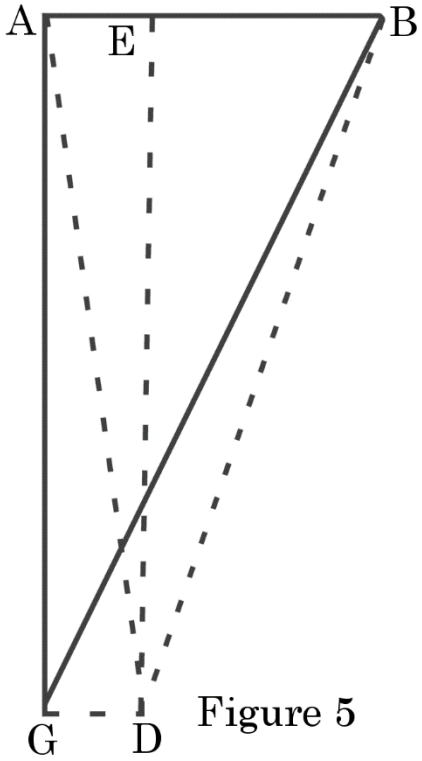


Figure 5

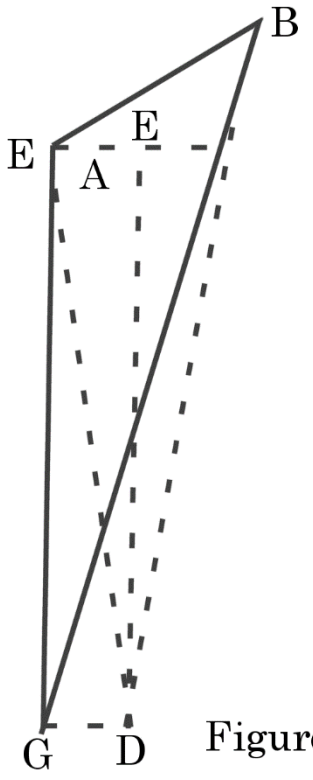


Figure 6

Now in comparing these figures with Figure VII on page 63, and Fig. VIII on p,64, (S.S,192, Part II) it will be seen the angle EDB is the total angle which has to be distributed.

But as GD is very small compared with the distance GA, the angle, the angle ADB is practically equal to the angle AGB. Again GD = AE.

Therefore the angle ADE= the angle subtended by the battery frontage at the range of the target .

Then the angle to be distributed = EDB
= ADB - ADE
= AGB - ADE.

Now the angle AGB can be read off at once from the Fighting Map, because it is the angle subtended by the target at the position of the directing gun. The method of obtaining the angle AD, i.e. the angle subtended by the battery frontage, will be explained later.

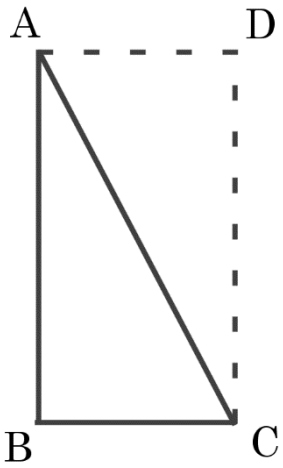
The rule then is:-

Angle to be distributed = Angle subtended by the target minus the angle subtended by the battery.

and the angle of distribution = Angle to be distributed/ Number of gun intervals.

It will be seen that the above rule is equally applicable to the Oblique as to the Frontal Barrage.

(iii) If the task in hand is an Enfilade Barrage, it will be necessary to concentrate the lines of fire of the guns of the battery.



Suppose BC is the Battery and A the target, the angle to be concentrated is the angle ACD, i.e. the angle subtended by the battery at the range to the target.

The angle of Concentration = Angle to be Concentrated/Number of gun intervals.

(iv) Thus in order to complete paras (ii) and (iii) above, we require some quick method of obtaining the angle subtended by the battery at various angle. It is only necessary however, to know this angle to the nearest 30 minutes, because, whether the tsk is one of distribution or concentration this angle is divided by the number of gun intervals eventually and the error per gun is very small especially when one considers that angles of distribution are only taken to the nearest 10 minutes.

The following methods of obtaining the angle subtended by the battery are suggested:-

(a) Knowing the frontage of the battery, say to be 70 yards, it is not difficult to visualise this length on the map at the range of the target, and thus read off at once the angle subtended.

(b) From the Traverse Graph in S.S.192, Part II., one on quickly see what 70 yards subtend at various ranges, and another column can be written on the right of the Fighting Map. (See App. I.)

Note It will not be found necessary to allow for the smaller angle subtended by the battery, when the target is to the right or left of the zero lino.

(c) If a very thin line is drawn parallel to the zero line on the Fighting Map, and at a distance of 70 yards (to scale) from the, zero line, the angle subtended by the battery can be read off the Fighting Map at once.

(v) There is yet another aid which will be found useful and will do away with the necessity of any mental calculation. Once the angle to be distributed has been found, it has to be divided by the number of gun intervals in order to get the angle of distribution to the nearest 10 minutes. Or in the case of an oblique or enfilade target, once the difference between the quadrant elevation to hit the near end, and the quadrant elevation to hit the far end has been found, this angle has to be divided by the number of gun intervals in order to get the differences in elevation to the nearest 5 minutes. It is a simple matter to work these out before hand and thus save time, and then paste the Table thus made in one corner of the Fighting Map. On large Fighting Map such a Table has been worked out for an 8 gun battery.

Examples from Appendix I.

1. Task. Concentrate N.15.d.04.20
Order. All guns on zero.
All guns 16° Right
Load.
Elevation 4° 18'
Rapid.
Fire.

Note 1. The Battery is intended to fire on parallel lines.
A switch of 16° Right will bring the centre of the Battery opposite the target.

Note 2. The Q.E. is found as follows:-
The Tangent Elevation is found to be 4° 2'
The target is 8 metres above the gun and the angle of sight is =8/10 x 20=16'.
Therefore the angle of Quadrant Elevation is 4° 18'.

2. Task. Barrage the road from N.14.c.80.00 to N.14.d.30.25
Order. All guns on zero.
All guns 13° 30' Left.
Distribute 40'.
Load.
Elevation 5° 15'.
Medium Rate.
Fire.

Note 1. 13° 30' Left will bring No.8 gun on the left end of the target.
Note 2. The angle to be distributed= angle subtended by the target minus the angle subtended by the battery 7°-2°=5°
Note 3. Angle of Distribution = 5°/7= 40' (by the table)
Note 4. The Angle of Quadrant Elevation is read straight off the map

3. Task. Barrage from N.15.c.35.75 to N.15.a.65.45

Order. All guns on zero.
All guns 8° 30' Right.
Distribute 30'.
Load.
Elevation 6° - ADD 15'
Medium Rate.
Fire.

Note 1. 8° 30' Right will bring the line of the directing gun on the left edge of the target.
Note 2. Angle to be distributed = 4° 30' – 1° 30' = 3°
Note 3. Angle of distribution = 3°/7 =30' (from table)
Note 4. Elevation for near end.
Angle of Tangent Elevation for near end = 5° 45'
Angle of Sight for near end = 9/10 x 16 =14'
∴ Angle of Q.E. = 5° 45' + 14' = 5° 59' = 6°
Note 5. Elevation for far end.
T.E. for far end = 8° 6'
Angle of sight for far end= -3/10 x 14' = -4'
Q.E. for far end = 8° 2'
Note 6. Difference in elevation= 2° 2'
Difference per gun =2° 2'/7 = 15'
Note 7. It is assumed that the battery is trained to carry out the order "Elevation 6° - ADD 15', " as follows:-
No. 8 gun puts 6°
No. 7 gun says "Elevation 6° 15' – ADD 15' " and puts on 6° 15'
No. 6 gun says "Elevation 6° 30' – ADD 15' " and puts on 6° 30' and so on.
The necessity for this order instead of "Elevation 6° - 15 Differences will be seen in Example 4 below.

4. Task. Barrage from N.14.c.60.10 to N.20.b.20.80
Order. All guns on Zero.
All guns 15° Left.
No. 8 gun directs.
Distribute 30'.
Load.
Elevation 6° - LESS 15'
Medium Rate.
Fire.

Note 1. 15° Left will bring the line of the directing gun on the left edge of the target.
Note 2. Angle of Distribution= (5° -2°)/7 = 3°/7 = 30'
Note 3. Q.E. for far end = 6
Q.E. for near end = 4
Difference per gun =(6°-4°)/7 =2°/7 =15'
Note 4. It is assumed that the Battery is trained to carry out the order "Elevation 6 - Less 15'," as follows:-
No. 1 of No. 8 gun says "Elevation 6° – Less 15' and puts on 6°.

No. 1 of No. 7 gun says "Elevation 5° 45' – Less 15' and puts on 5° 45'.
No. 1 of No. 6 gun says "Elevation 5° 30' – Less 15' and puts on 5° 30' and so on.

Note 5. The great advantage of this new fire order is that No. 8 gun can in <u>all</u> cause direct fire, and it becomes really unnecessary to include "No. 8 gun directs" in any fire order.

5. Task. Barrage from N.15.a.30.00 to N.15.a.20.80.
Order. All guns on Zero.
All guns 8° 30' Right
Concentrate 10'
Load.
Elevation 7° – ADD 30'
Traverse 30' Right & Left
Medium Rate
Fire.

Note 1. Angle of concentration = (angle subtended by battery) /7
= 1° 30' = 10'.

Note 2. Q>E> to hit the near end :-
Angle of T.E. = 6° 41'
Angle of Sight = 8°/10 x 16 = 12'
Q.E.= 6° 41 + 12' = 6° 53' = (7° Approx.).

Note 3. Q.E. to hit the far end:-
Angle of T.E. = 10° 10'.
Angle of Sight = -3°/10 x 13 = -4
Angle of Q.E. 10° 10 -4' = 10° 6'

Note 4. Difference per gun =(10° 6' – 6° 53')/7 = 3° 15'/7 =30'

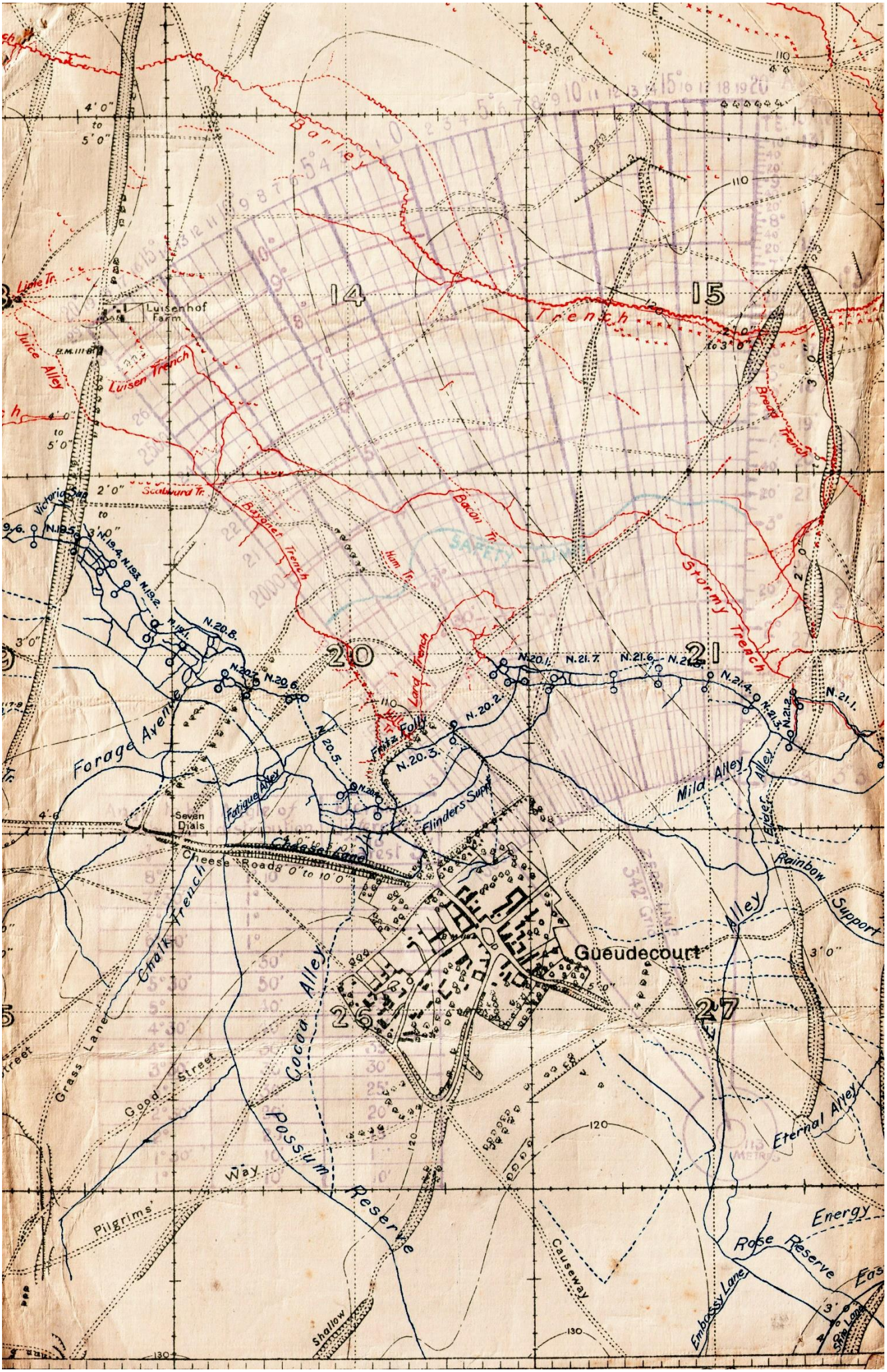
Conclusion. It is obvious from the above examples that any Machine Gun Task can be worked out from a Fighting Map with far greater speed than by any other means. For no measurements or calculations have to be made, nor is any reference necessary to any other tables or Text Book.

It must again be emphasised however, that intensive training is necessary in order to get the best value from a Fighting Map.

The Battery Commander must be so familiar with the ground in front of him that he can locate any point on the map without a moment's hesitation.

Thus is particularly difficult in an area where all landmarks have been obliterated and some Divisions employing these "Sniping Batteries" (as they have been called well behind our line with the idea of them breaking on our own ground in case of a general break-through, have even gone so far as to erect ferro-concrete posts visible to the Battery Commander to enable him to fix certain definite points on his map.

It must also be assumed that the Observer is in telephonic communication with the Battery, otherwise a fleeting target will have disappeared before the order reaches the Battery. This demands that the Machine Gunners will erect their own Observation Posts, or arrange with the Artillery to use theirs, and link them up with the Battery telephone wire.


Barley
Trench
Luisenhof Farm
Juice Alley
Luisen Trench
Scotland Tr.
Bavaria Trench
Bacon Tr.
Ham Tr.
Long Trench
Stormy Trench
Broad Trench
Forage Avenue
Fatigue Alley
Seven Dials
Cheese Road
Chalk Trench
Cocoa Alley
Possum Reserve
Way
Pilgrims'
Good Street
Grass Lane
Flinders Supt
Fritz Folly
Mild Alley
Rainbow Support
Alley
Eternal Alley
Energy
Rose Reserve
Causeway
Embassy Lane
Shallow
Gueudecourt
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15
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21
25
27
N.19.5
N.19.4
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N.21.6
N.21.5
N.21.4
N.21.3
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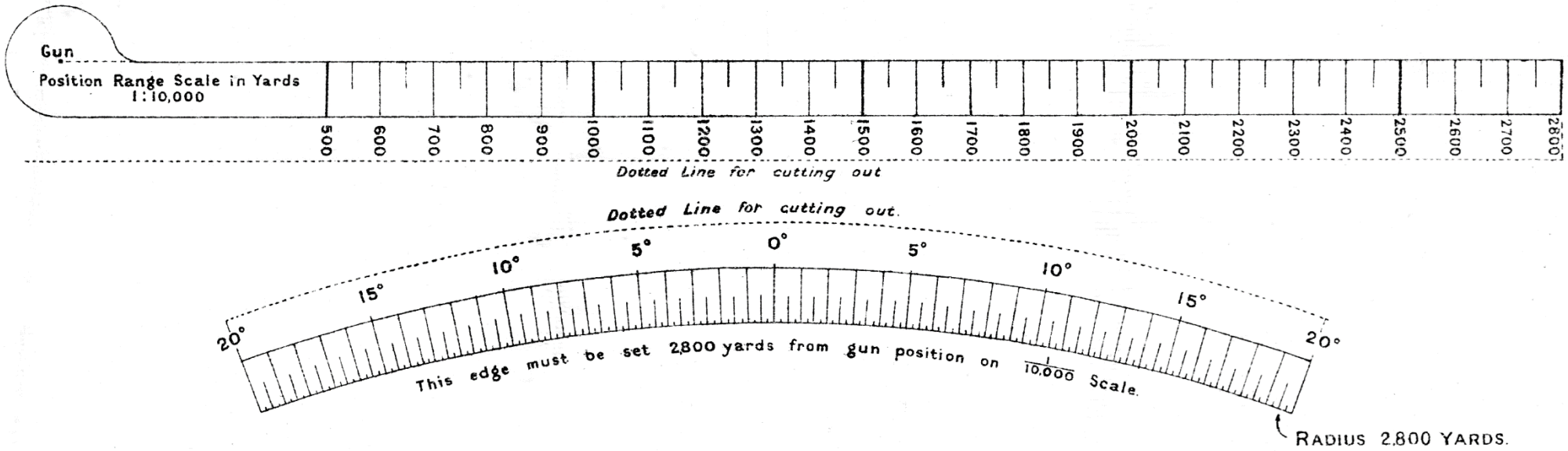
130
4'0" to 5'0"
2'0" to 3'0"
3'0"
5'0"



Field Survey Coy., R.E. (8373) 24-2-18.

The document S.S. 192 referred to in this text is The Employment of Machine Guns: Parts I and II. Appendix V is at the end of this document, the rest can be obtained here:-

Part 1= https://vickersmg.blog/wp-content/uploads/2017/07/ss192.pdf

Part 2= https://vickersmg.blog/wp-content/uploads/2017/07/ss192-ptii.pdf

Appendix V.—(

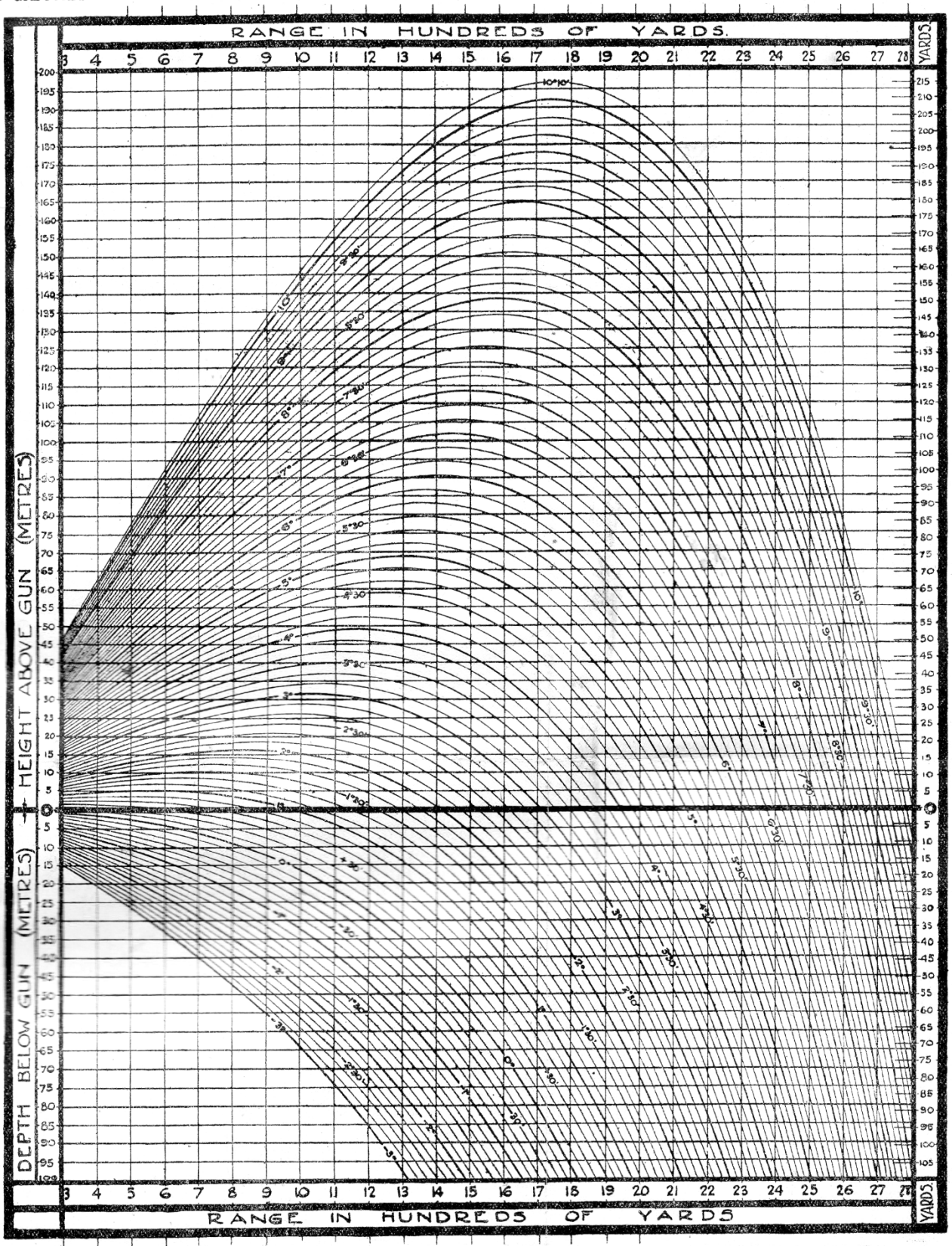
No. 1.

GRAPH FOR CALCULATING QUADRANT ELEVATION AND CLEARANCES.

(CURVES REPRESENT CENTRE SHOTS.)

DEPTH OF LOWEST SHOT BELOW CENTRE OF CONE AT VARIOUS DISTANCES FROM GUN.

IN YARDS	1·7	2·0	2·3	2·7	3·0	3·3	4·0	4·7	5·3	6·0	6·7	7·3	8·0	8·7	9·3	10	13·3	16·7	20	25	30	35	42	48
IN METRES	1·6	1·8	2·1	2·5	2·7	3·0	3·7	4·3	4·8	5·5	6·1	6·7	7·3	8·0	8·5	9·1	12·2	15·3	18·3	23	27	32	38	44



10	10	10	10	12	14	16	18	21	25	28	32	37	42	48	55	63	73	CLEARANCE IN METRES
11	11	11	11	13	15	17	20	23	27	31	35	40	46	53	60	69	80	CLEARANCE IN YARDS

MINIMUM CLEARANCES REQUIRED AT VARIOUS DISTANCES FROM GUN.

How to Use the Graph.—To Find Q.E.: Take range and run up on vertical scale to height of target above or below gun. The curve cutting this point gives required Quadrant Elevation.

To Find Clearance.—Follow this curve along, and ascertain at what height it passes vertically above a point plotted [illegible] and height (above or below gun) of own troops (or obstruction). This gives clearance in yards

No. 2.

GRAPH of TRAVERSES, etc.

(IN YARDS OR METRES AND DEGREES)

The Angle is shewn by the diagonal line nearest to the point of intersection of the required Target-Frontage line (vertical) and the (horizontal) Range line.

Note:- Both Target Frontage and Range must be taken in the same unit of measure: e.g; both in yards or both in metres.

SCALE *for the conversion of* **OBLIQUE** *to equivalent* **FRONTAL TARGETS.**

EXAMPLE:- *Target* 280" *long at an angle of* 150° *to line of fire.*
The scale gives ·45 *so equivalent frontal target* = ·45 *of* 280" = 126"