Chapter 12

Infantry

Infantry Officer Casualties
(Report No.19)

Location of Enemy Mortars
(Report No.11)

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Infantry Officer Casualties

Introduction

1. The report describes an investigation into various aspects of infantry officer casualties. The subject is dealt with under the following headings:

1. The proportion of Officer Casualties to Other Rank casualties.
2. Officer casualties by appointments.
3. Officer mortality rates.
4. Distribution and causes of Officer casualties -
    - By phase of the battle;
    - By weapons;
    - By activity at the time of becoming a casualty.
5. Reduction of Officer casualties.

2. The information has been collected from Infantry battalions and from the records of GHQ 2nd Echelon. The latter have been analysed with the help of AORG, Ministry of Supply.

3. Although most of the report is concerned specifically with officer casualties, it is likely that the conclusions on the reduction of casualties will apply in general to other ranks.

The Proportion of Officer Casualties to Other Rank Casualties

4. The proportion of officer to other rank casualty rates for the infantry of seven different divisions are given below:

Table 1

	Proportion Officer to Other Rank Casualty Rates	% by which other Divs exceed 15 and 53 divs
15 Div	1.28	0
53	1.28	0
43	1.33	4
50	1.48	16
3	1.51	18
49	1.64	28
51	1.70	33

These figures are for the period 1st August - 6th November, for which fully reliable records are available. They take into account the relative strengths of officers and other ranks in the divisions.

5. The variations between divisions are striking, but the reasons for these variations are not apparent.

Officer casualties by Appointments

6. An analysis of 2,407 Infantry casualties from the same seven divisions, suffered between 6th June and 6th November, gave the following casualty rates for different appointments, per month.

Table 2

	%
Rifle Platoon Commander	31.2
Rifle Company Commander	30.0
Second-in-command (2 i/c) Rifle Company	20.1
Commanding Officer	18.0
Intelligence Officer	16.0
Anti-Tank Platoon Commander	14.8
Carrier Platoon Commander	13.9
Mortar Platoon Commander	11.8
Pioneer Platoon Commander	9.8
Signals Officer	9.8
Adjutant	9.5
2 i/c	7.7
Support Company Commander	6.2
2 i/c Carrier Platoon	5.9
2 i/c Anti-Tank Platoon	5.9
HQ Company Commander	3.5
Transport Officer	3.0
Administration Officer	1.8

7. These figures assume the full establishment of a battalion, and take into account that various of the divisions did not arrive in the theatre for some time after D-day. In fact, casualty rates were probably higher than they appear, but it is not possible to make any allowance for this. The figures may be of value in the allocation of personnel in the training and drafting stages.

Officer Mortality Ratios

8. The percentage of officers killed out of officers killed and wounded varies in different appointments. In the majority of appointments the total number of casualties so far sustained in the seven divisions is not enough to give a firm mortality ratio but in some cases this is possible:

Table III		
	% Mortality Rates	Number of Casualties on which ratio is based
CO	38.9	59
Coy Comd	32.6	389
Pl Comd	28.9	1190
2 i/c Coy	27.1	258
IO	26.4	53
A/Tk Pl Comd	22.9	48

9. It is suggested that the very considerable variations may be connected with the immediate availability of medical services, with the different types of risk to which various officers are exposed, and the extent to which various ranks carry on when wounded.

10. The officer mortality ratios in the different divisions also show considerable variation:

Table IV	
	% Mortality Ratios
51 Div	24.2
3	27.0
49	27.3
43	28.4
15	28.9
53	32.1
50	35.0

Distribution and Causes of Casualties

11. 262 casualties, taken from 8 battalions out of 3, 15, 43, and 49 Divs were examined in as much detail as possible. The findings are tabulated and then discussed:

Table V - Distribution of officer casualties in different phases of battle (226 cases)	
	%
Attack (Forming up, attack, reorganization)	69
Defence	23
Patrols	8
Total	100

Table VI - Weapons Responsible for Officer Casualties (216 cases)	
	%
HE (shells and mortars)	57
SAA	35
Mines	6
Miscellaneous	2
Total	100

Table VII Distribution of officer casualties according to their exact occupation at the time (163 cases)	
	%
Close fighting (within 500 yards of enemy)	40
Moving from one position to another, visiting troops, etc.	18
In FUPs or Concentration areas	13
In Slit trenches in defensive positions	8
In command posts	8
On reconnaissance	6
Miscellaneous	7
Total	100

12. Of the 163 cases referred to in table VII, 23% could be directly attributed to things going wrong:

Table VIII	
	%
Wireless not working	3.5
Running into own mines	3.5
Bad reconnaissance or orders	3.5
Bad map reading or intelligence going into enemy lines	3
'Swanning'- unnecessary movement	2.5
Inexperience	2.5
Accidents with own weapons	2.5
Shot by own sentries	1.5
Conspicuousness	.5
Total	23

Reduction of Casualties

13. Table V shows that the defensive phase (Defence 23%, Patrols 8%) accounts for nearly one-third of all officer casualties. Casualties in defence are therefore particularly worth attention, as a reduction is most likely to be achieved in this phase, where there may be no actual fighting, or if there is, it is of a less confused nature.

14. Table VI cannot be considered completely reliable but it indicates in a general way that about two-fifths of casualties are caused by forward enemy troops and forward enemy defences (SAA 35%, Mines 6%), and about three-fifths by guns and mortars sited further back (HE 57%). The lesson to be drawn, which will be referred to again is that there is at least as much to be done in reducing casualties by improving CB and CM methods alone as by improving the infantry's tactics or training.

15. Tables VII and VIII give a more detailed idea of how and to what extent Infantry casualties might be saved. Two obvious, though minor causes of trouble are command posts and wireless. With regard to the first, the complaint is often heard that we are not as careful or thorough as the enemy in choosing or building command posts, and the 7% of casualties caused actually in command posts should certainly be eliminated by more effort in this direction. As regards the second, although only 3.5% of casualties were directly attributed to wireless breaking down, the opinion was expressed by many officers that the failure or absence of wireless communications meant more moving round by officers at a critical period. In particular, some of the 18% of casualties caused in visiting or inspecting troops or positions might have been eliminated.

16. Except for the two improvements mentioned above, it is not possible to make firm recommendations for any particular action; it is however possible to give some idea of where the responsibilities lie. The casualties occurring in close fighting can be reckoned perhaps as half the Infantry's responsibility, to be improved if possible by better tactics, etc., and half the responsibility of the supporting arms, for adequate covering fire on forward defences. Those occurring on reconnaissance may similarly be accounted as a half and half responsibility. The casualties in FUPs and concentration areas, those incurred in moving from one position to another, and those suffered in slit trenches in defensive positions, are to be reckoned as a supporting arm responsibility, while the miscellaneous casualties, and those where things went wrong are an infantry responsibility. This tentative allocation of responsibilities gives a "balance sheet" as follows:

Table IX

Infantry Responsibility		**Supporting Arm Responsibility**	
	%		%
Half of casualties in close fighting	18	Half of casualties in close fighting	18
Half of casualties on reconnaissance	3	Half of casualties on reconnaissance	3
Casualties in command posts	8	Casualties in FUPs etc.	10
Miscellaneous casualties	1	Casualties in or moving from one position to another, visiting troops, etc.	10
Casualties due to things going wrong (excepting wireless breaking down - 3%)	20	Casualties in slit trenches in defensive positions	6
Total	50	**Total**	47

Note: The casualties caused by things going wrong have been removed from the various categories above, and put in as a separate entry under infantry: hence the discrepancies as against Table VII.

17. This means, in very broad terms, that about half of the infantry casualties, if they are to be reduced at all, can only be reduced by the infantry: the other half, if they are to be reduced at all, can only be reduced by the supporting arms. This conclusion is in general agreement with that of para. 16, arrived at in a quite different way.

18. Of the casualties that could be reduced by the infantry themselves, we have already dealt with command casualties. For the rest it would seem that a higher standard of training all round is the only way to get an improvement; this should save officers exposing themselves to risks so often, and should also cut out some of the casualties due to mistakes.

19. Of the casualties that could be reduced by the supporting arms, the greater part are caused by enemy mortar and shellfire from behind the lines. The greatest improvement is therefore to be expected from better CM and CB.

20. Finally, it should be explained that although in the course of this work we have heard a great number of reasons put forward for the high rate of infantry officer casualties, we have not discussed them, mainly because, from their very multiplicity, it is evident that no one or two of them are outstandingly important. The arguments of the preceding paragraphs show that there are only two really important methods of improvement:

(i) A higher standard of training throughout the infantry
(ii) Better methods of CB and CM;

While there are two less important methods:

(iii) First class forward wireless equipment.
(iv) Well constructed dugouts.

Report No.11

The Location of Enemy Mortars

CONTENTS

I. THE EXTENT OF THE PROBLEM

The German army uses mortars and nebelwerfers in large numbers. These weapons are small and difficult to detect from the air; their trajectories make it possible to conceal them completely from ground observation, particularly in close country. The small noise of discharge of the mortar and the ripple fire of the nebelwerfer make sound ranging difficult, while the flash and smoke from the mortar is slight and hard to spot. In defence the casualties from mortars and nebelwerfers may be considerable, while the strain of holding a position and being mortared for days on end is intense. In attack casualties in forming up areas and on the objective may be very heavy indeed, and are often decisive in throwing back an attack. In either attack or defences, mortars can make movement in forward areas difficult.

So much has long been realised. In the present campaign, however, casualties from mortars have been particularly heavy and have contributed as much as anything else to making advances slow and costly. The enemy's mortars are as much a weapon to be defeated as his tanks. This will continue as long as fighting goes on in undulating and cultivated country. Even on the plains of Picardy and Flanders, there is enough cover to conceal mortars, and although their importance may decline, they are still likely to prove a great source of trouble.

In view of this, a short survey has been made of the position in six different divisions in order to find out what methods have given the best results, what immediate improvements, if any, can be suggested, and what new methods could be applied. The survey is only concerned with the present and immediate future, and new equipmentments under development have not, therefore, been considered.

II. THE PRESENT POSITION

1. Organisation

There is at present no official organisation for Counter Mortar work in the British Army. Within a generally agreed framework, formations have built up their own organization. At Divisional HQ RA there is a Counter Mortar Officer, usually a gunner, with sometimes a deputy, and a number of other ranks to plot and man communications. The CMO is in touch by one means or another with some or all of the following:

(a) Gunner OPs (in some cases specially deployed for mortar location)

(b) Air OPs

(c) APIS

(d) Infantry Brigades (who may have an ACMO to collect and pass on all possible information from the forward troops)

(e) Survey Regiment (who may get mortar locations in the course of normal sound ranging)

(f) Four pen recorder team

(g) GL III

(h) Counter Mortar Group (a few guns and mortars are sometimes deployed, at the call of CMOs or ACMOs for counter mortar shoots)

(i) Divisional HQ, RA (to get concentrations put down as and when required.)

Until further experience has been gained the variability of this makeshift organisation and of its communications is inevitable. There is, however, unanimous agreement in Divisions that some sort of establishment is urgently needed, at least for a CMO and staff at Divisional HQ RA, and, if possible, for Gunner Counter Mortar OPs and Infantry ACMOs at Brigades. At present the necessary personnel are taken with difficulty from many different places, in particular the LAA Regiment.

2. Relative Success of the Methods of Location

A large number of methods of mortar location have been suggested and are being tried out in the present campaign. These are:

a. Aural sound bearings.

b. Air photographs.

c. Air OP.

d. Flash spotting, visual spotting, etc.

e. Normal sound ranging.

f. Four pen recorders.

g. GL III.

Two further methods have been suggested, but have scarcely been used so far:

h. Flash - bang timings.

i. Estimation from craters.

The success of these methods is difficult to estimate. In only a very few cases is any subsequent check possible as to whether the location was accurate or even genuine at all. In general it can be assumed that air photographs and Air OP locations are the most accurate. But with every method there is the possibility that some of the locations are, for one reason or another, completely false. For purposes of comparison it can only be assumed that all locations are, in fact, genuine.

At present, therefore, no attempt has been made to go beyond an analysis of some of the Hostile mortar lists of four divisions. this analysis is set out in Table I.

Table I - Analysis of some hostile mortar lists of four divisions (Locations shown as % of total)

Method	Division			
	1	2	3	4
Sound Bearings	30	31	32	93
Air Photographs	54	46	37	nil
Air OP	11	nil	nil	nil
Flash or Visual spotting	nil	nil	16	5
Normal SR	5	23	15	2
No. of locations on which based	85	26	67	52
	1, 2 and 3 had neither 4-pen recorder nor GL III. 4 had both GL III and 4-pen recorder for a time, but locations by these means are not included in this table.			

It is clear from this table that the methods of the four divisions differ considerably. All have made extensive use of sound bearings, Division 4 to the exclusion of almost everything else. Divisions 1,2 and 3 have used Air photographs, while Division 4 has not (this is understood to have been largely due to the fact that there was little Air Photograph coverage on this front). Only one Division has made successful use of the Air OP, and only two have used flash or visual spotting. Normal sound ranging has been used by all four with varying degrees of success.

This analysis does not give any indication of the number of locations per day. This is difficult to determine exactly, since hostile mortar lists are cumulative, and the other records kept are not usually sufficiently detailed for an accurate analysis. From what evidence could be collected, however, it appears that the number of locations on an active front does not vary much from Division to Division, and is usually about 10 per day. This was the case with Divisions 1, 2 and 3. Division 4 was on a fairly quiet front and only got about half this number per day. The percentage figures for Divisions 1, 2 and 3, therefore, must be divided by 10 and the figures for Division 4 by 20, to get the average number of locations per day by each method.

It is evident from this analysis that a more complete pooling of methods and ideas throughout the Army Group would be valuable, so that every Division should understand and use every method to the full. If each Division of the four under consideration were to do as well in every method as did the best of the four, the number of locations per day would be nearly doubled.

3. Details of the Methods of Location

(a) Aural sound bearings. When mortar fire is put down, someone is nearly always in a position to get a rough bearing on the noise of the discharge. This may not be the troops who are themselves being mortared; more probably it is the troops to one flank or a nearby Gunner OP. Such sound bearings should be passed on at once, together with the time, place and any other relevant information, to the CMO at Division, by whatever channels have been arranged. The extent to which this is actually carried out varies greatly. In some cases, sound bearings are passed back with only a delay of a few minutes, but there is no doubt that even in those Divisions most alive to Counter Mortar work far from all instances of mortaring are in fact reported.

A large number of sound bearings arrive singly and cannot, therefore, be satisfactorily correlated to give locations. Even single bearings, however, may help to determine which of previously located mortars is actually firing, may help to confirm a suspect position or may serve as a search bearing for the Air OP. But a certain number of bearings do come in from different places, referring to some mortaring, and in the course of time a series of double, treble, or even quadruple intersections are obtained.

Whenever possible, locations obtained from sound bearings are cross-checked with other methods. In particular, a careful scrutiny of Air photographs in the light of sound bearing locations has often given exact fixes. Air OP's have also been used to examine a particular bearing or suspect location.

The accuracy of a sound bearing is uncertain. Some claim to be accurate within 2 degrees, others within 5 degrees. From a few estimates made in battle, it seems likely that both these figures are optimistic. This point is being examined further, and its effect on the accuracy of intersection and the degree of dispersal of fire for best effect, is being considered.

(b) Air Photographs. High level air photographs seldom, if ever, show 8 or 12 cm mortars, unless they are dug in and their positions poorly camouflaged. Nebelwerfers, on the other hand, usually do show up, and a considerable number may be spotted by APIS. As mentioned earlier, a careful re-scrutiny of a particular suspect area will sometimes show slight evidence that had been previously overlooked.

In some Divisions this method of spotting has been conspicuously successful. Of 46 locations (54%) obtained from air photographs by Division I (Table I) 27 were got by a re-examination after sound bearings. In others it has not been used, either because of a lack of photographic cover, or a failure to realise its possibilities.

The success of high level cover has led to the suggestion of a lower level cover of small areas of enemy FDL's, with a view to detecting mortars. This is being tried out at present by one Division.

There is one serious objection to Air Photograph methods, namely that they are at best very slow and allow the nebelwerfers hours of time in which they can move positions. It is thought however, that nebelwerfers have a limited number of alternative positions prepared in advance with trenches etc. and that they do not usually move outside them. At present, therefore, the delay in Air Photographs is probably not very serious. When counter mortar methods improve, there is no doubt that the Germans will move more often and that air photographs will become less useful. The same argument applies in some degree to all methods of location.

(c) Air OP. Air OP's have seldom, if ever, spotted mortars, either directly or from flash or smoke. They have, on the other hand, occasionally seen nebelwerfers, usually by means of the flash or smoke of discharge. At the present the Air OP is unlikely to spot nebelwerfers if he is simply sent up with no indication, but if he is given an area to search, there is some chance of success.

When he has spotted a nebelwerfer, he can either report its position, and leave the artillery to do a predicted shoot, or himself direct a destructive shoot. The latter is seldom practised, but is in fact likely to be both more effective and far more economical.

There is some evidence that the Germans suspect the Air OP of being able to spot mortars and nebelwerfers, since there are various recorded cases of mortaring ceasing as soon as the Air OP went up.

The further possibilities of the Air OP are discussed later in the paper.

(d) Flash spotting, Visual spotting etc. Because of their high trajectory, mortars are easily concealed on rear slopes and behind cover. Nebelwerfers, while not employing upper register fire, have quite a high trajectory and are still fairly easy to conceal. Any form of direct visual spotting from the ground is, therefore, seldom likely to be possible. Occasionally, however, forward troops or OP's may be in a position to see flashes, particularly at night. Flash spotting from 60 ft towers in the wooded and undulating country of Normandy is not often effective, but has given a few locations. The further possibilities of flash spotting are discussed later.

(e) Normal sound ranging. SR bases are normally deployed about 4000 to 5000 yards behind our own FDL's. This ensures that they are reasonably safe, and does not appreciably affect the accuracy of gun location. It does, however, mean that the rather slight noise of discharge of a mortar is seldom picked up. While SR, deployed on normal Counter Battery work, may occasionally get mortar locations, it is not likely to get many unless deployed well forward, specifically for such a task. This is likely to be costly in equipment and trained personnel, neither of which can be spared. In general, too, CB is considered to be of primary importance.

(f) Four pen recorders. Only three four pen recorders have so far been operating with 21 Army group. Various reports have already been rendered on these equipments by those specifically concerned with them, and it is not, therefore, proposed to deal with them in any detail. In brief, they have suffered from various electrical troubles, and there has been a shortage of trained personnel to keep them in working order. There has also been difficulty in keeping the line base intact, because of shellfire and our own tracked vehicles. When, however, the sets have been working satisfactorily, they have obtained a good number of locations. In one instance, a set deployed with a Division on a quiet front, obtained 37 different locations in 14 days. Much of this time the set was not working satisfactorily, and at its best, it gave 8 locations in one day (2 'A,' 4 'B,' 1 'C,' and 1 'Area' location).

It has become apparent that the Regimental Survey Officer and a party of Gunners and Infantrymen cannot at present effectively operate the Four pen recorder. It is generally felt that 2 officers and at least a dozen other ranks, specifically trained for the job, are essential.

The accuracy of the Four pen recorder, under good conditions, is estimated as within 50 yards up to 2,250 and within 250-350 yards up to 5000 yards. This is about the maximum range against mortars.

It is understood that a Four pen recorder base is not likely to be surveyed in and working in under about 24 hours of a move forward. Once the base is working, however, the production of locations is only a matter of a minute or two from hearing the noise of discharge.

Like all SR equipments, the Four pen recorder cannot operate in strong winds or in the presence of much activity from guns, mortars or machine guns. This, and the long time into action, is likely to limit the Four pen recorder to fairly quiet, static, or semi-static fronts. It will not, however, deal with the situations where counter mortar methods are most needed, namely in the various stages of an advance and consolidation.

(g) GL.III An unmodified GL III was tried out in the early days of the Invasion in an operational Mortar location role. It had little success, but after a period of training for the operators and a number of modifications to the set, it has been tried again. In the space of three days on a fairly quiet front it obtained 33 locations, an average of 11 a day. It was later moved to two different sites and met with much less success. The indication of a mortar bomb on the tube is very characteristic, and it is reasonably certain that all the locations were in fact mortars, except for one which consisted of a number of breaks on the tube in rapid succession, and was probably a nebelwerfer. Shellbursts and vehicles were also picked up on the set. The details of the performances of the set are being reported by the Corps and Division in question, and are not considered further in this paper.

It is clear therefore, that GL III has considerable possibilities, but it seems likely that difficulty will be experienced in getting good sites, and that this may prove to be a limiting factor. Further GL's are to be deployed in operational roles in the near future and more definite information should soon be available.

So far, mortar bombs have been detected out to 7,000 yards, except for the nebelwerfer cluster referred to above was detected at 11,000 yards.

Once a suitable site has been selected, the GL can be quickly in action and given a good site a very accurate location can be obtained with 3 or even 2 bombs.

The conspicuousness of the GL may render its use in open country difficult, and once the enemy is aware that it is being used for mortar location, it is a relatively easy matter for him to fix its position by DF and put down a concentration on it.

(h) Timings - Sound of discharge to Burst. This method of timing can be used to get quite an accurate range. There are, however, several difficulties, in that it is necessary to know what sort of weapon is firing, which probably means examining the craters for fragments, and it is necessary also to associate a particular noise of discharge with the right explosion. Even when this has been done there are always at least two possible solutions depending on the charge that is being used, while any displacement of the observer from line of flight introduces further complications. In practice there have been very few instances of this method being used, although there is no reason why it might not sometimes be successful in the hands of intelligent Gunner OP's.

The provision of some form of simple calculating ruler for this method is being considered.

(i) Crater Examination. A means of locating mortars from various characteristics of their craters was devised by the school of artillery. This is not satisfactory for giving range, but is capable of giving a reasonably accurate bearing, on good smooth ground. The practical application of this method has several difficulties, and in fact there are very few instances in which it has been successfully used. Nevertheless, it is possible again that in the hands of trained Gunner OP's, it might sometimes be useful.

(j) Study of the Map. Study of the map is not in itself a means of locating mortars, but it is widely used to decide on likely places, to decide the most likely point in a suspect area, to rule out impossible positions, etc.

4. Casualties due to mortars

The casualties in the present campaign from mortars have been very heavy, heavier in fact than from all other weapons put together, at least as far as the infantry are concerned. This is due to a number of causes:

(a) The Germans have a large number of mortars and nebelwerfers, and use them widely, while they have relatively little artillery.

(b) Counter mortar methods are only partially developed and have not reached the degree of efficiency achieved by CB.

(c) Mortar bombs have a high charge/weight ratio and an efficient fragmentation. Their angle of descent results in a well distributed fragment pattern, while there is some evidence that it also results in a higher density of fragments near the ground, and consequently the protection given by lying down is less than with a shell. This knowledge is borne out in a rough and ready way by medical information.

Exact figures for mortar casualties are hard to get. Medical records only show the weapon causing the casualty in a few cases. A number of infantry battalion MO's, from four different divisions all agreed in placing the proportion of mortar casualties to total casualties among their own troops as above 70%. This figure is widely accepted among infantrymen and it is thought if anything to be an underestimate.

The records of "A" Branch, 2nd Army give the total casualties among Infantry battalions of 2nd British and 1st Canadian Armies up to 25th July 1944, as 35,431. 70% of this figure is approximately 25,000. It is appreciated that the estimate of 70% may be appreciably in error, and that the figure of 35,431 includes a number of captured. On the other hand there are undoubtedly a large number of casualties due to mortars among units other than infantry battalions. It is safe, therefore, to say that the casualties due to mortars and nebelwerfers among British and Canadian troops in the first seven weeks of fighting, have been over 25,000.

III. A DISCUSSION OF THE PROBLEM

1. The number of mortars and nebelwerfers on a Divisional front

The number of mortars and nebelwerfers opposite a divisional front cannot be determined from the number of locations obtained, since there is no indication as to how complete they are. A rough estimate from what is known of the German army is however possible.

A German Infantry Division has 57 8 cm mortars, and at present a variable number, between 12 and 20, 12 cm mortars. A Panzer Division, having less Infantry, has only 28 8 cm mortars, and 12 12 cm mortars. Nebelwerfers do not form a part of Divisions, but are, on this front, usually deployed on the scale of one Regiment (54 projectors) to a Division.

Roughly speaking, one of our divisions is faced in the line by one German Division, or its equivalent, so that opposite most of our Divisional fronts, between 40 and 80 mortars are likely to be present, and about 50 nebelwerfers. Some of these will be in reserve, and some of the units will not be up to strength. As an estimate of deployed and potentially active weapons, we might take 60-80. Many of these, particularly the nebelwerfers, will fire in groups; on the other hand they will have a number of alternative positions. So that the number of Hostile mortar positions to be located on a Divisional front is likely to be at least 60-80 and possibly more.

Various other types of mortar and nebelwerfers may be encountered, but not in any numbers.

2. The requirements for effective CM
(The extent to which present methods meet these requirements)

To be fully effective, a CM organisation must be able to provide locations rapidly and in quick succession, however much activity there may be, and to bring down fire equally rapidly on the locations provided. The latter part of the requirement is already met by the highly flexible Gunner organisation for controlling fire. The provision of locations on the other hand has a long way to go.

It is uncertain what degree of success is achieved at present. By the expenditure of large quantities of ammunition on fixed and on suspected positions, mortaring can be silenced for a time, but often starts up again soon afterwards. There are a few reports from civilians of fire landing on mortar positions, and from PW's of their expecting and getting immediate retaliation. It must be remembered, however, that these reports are from relatively static fronts, where after a period of time a good proportion of sites are located, and that quite often the weight of retaliatory fire put down is so great that a few shells can hardly fail to land in the vicinity of positions.

After a period of some days in a static position, the present methods of sound bearings, air photographs, Air OP and occasional SR and Flash spotting, do locate a considerable number of mortar and nebelwerfer positions. Some fixed (reasonably certain) and some unfixed (only suspect). These are made up into a hostile mortar list which is continually amended. The size of these lists vary considerably from Division to Division, and depend on the length of time there has been to build them up and on the amount of enemy activity there has been on the front in question. It has already been mentioned that on fairly active fronts, most Divisions get on average about 10 locations per day, so that at the end of a week if there has been no change of front there may be as many as 70 locations on the Hostile mortar list. By this time the CM situation is reasonably in hand, in the sense that any mortaring can at once be met with effective counter fire, and enemy activity then usually declines. But with any move it breaks out afresh from new positions and the slow process of location has then to start again.

As indicated earlier, a more complete utilisation of these simple methods should give a great improvement, and for the first few days in a new position should nearly double the number of locations. This would mean getting enemy mortars more or less under control in perhaps half the time.

It should be noted that the figure of at least 60-80 hostile enemy mortar positions on a Divisional front tallies with the figure of about 70 locations on a hostile mortar list, required in order to get the Counter mortar position in hand. In view of this it is recommended that as a target, we should aim at being able to get 70 locations in one day. Ideally of course, we should be able to locate every mortar that fires. This, in a period of activity, is a complete impossibility, and likely to remain so. The ability to get 60-80 locations a day will, however, mean that whatever the degree of activity during the day, we shall be able to get and act on a considerable number of locations at once, and at the end of the day, will know the majority of locations on the front opposite.

3. The extent to which GL III and the Four pen recorder meet the requirements

The straightforward methods at present practised by Divisions are inherently slow. It is only with the introduction of special methods that the process can be speeded up, and result in any degree of control over the outburst of mortaring during and after an attack.

GL III and the Four pen recorder have at their best, on a fairly quiet front, produced 11 and 8 locations respectively. With more experience, and with more mortars to be located it is probable that both would do better.

Since a full SR base considers 15 locations a day good work, it is unlikely that a Four pen recorder will do any better than this, particularly in view of its line base deployed far forward. And under conditions of considerable activity it will probably not do as well. It does not record nebelwerfers.

The GL is not likely to be upset by great activity, so that given a good site there is no reason why it should not do very much better than 11 locations a day.

These estimates are only tentative, but they do indicate that even three Four pen recorders on a Divisional front, in addition to the straightforward methods, will only just reach the target figure of 60-80 locations a day. GLs, provided the difficulty of siting can be overcome, may do better.

Neither GL nor the Four pen recorder can move forward and set themselves up in less than about a day, so that the critical phase of a battle will still be without effective Counter mortar fire. To a certain extent this situation can be, and is being overcome, by putting down CM fire on locations obtained previously. This may be successful for the early stages of a battle, but the enemy mortars are likely to move as soon as the attack progresses any distance, so that the problem remains.

4. Other possible Counter mortar methods

There are a very large number of ways in which, theoretically, mortars might be located. All the obvious ones have been or are being tried: most of the rest are not immediate practical possibilities.

With the exception of Air photographs, almost all the attention has been given so far to methods of location from the ground. The majority of these methods are slow and cumbersome, and nearly all are indirect. The air however, has the advantage of being able to overlook the enemy, from such a height as to see even his mortars. (Although in theory, mortars - but not nebelwerfers - can be concealed from an angle of depression of less than 45 degrees, in fact for reasons of convenience of siting, they seldom are concealed from an angle of depression of less than about 15 degrees, and often only 5 or 10).

Two possibilities are therefore suggested:-

a. Spotting from the Air OP. This is normally impossible with mortars and difficult with nebelwerfers. However, even with the 8 cm mortar, the flash is visible in daylight up to about 400 yds. A spectral analysis of the flash of the various weapons as well as of the background of grass, may indicate a suitable filter to increase the intensity contrast, or probably the colour contrast, and so make the flash visible enough to be spotted more easily by the Air OP. It is not very likely that this method will give enough improvement to spot mortars, though it may make the difference as regards to nebelwerfers.

In addition to this possible method (which, if it were successful at all would involve no more than a pair of goggles) there is a chance that another type of special equipment might be useful. The use of this equipment is being investigated.

b. Flash spotting from balloons at night. A small balloon, flown at night 1000-3000 ft. with an automatic camera, and ground markers, could readily obtain the bearing and range of any flash in its field of view. No new equipment and no new principles are involved.

Flash spotting from balloons is neither rapid nor particularly suited for the critical phases of the attack and consolidation. It might, however, be a useful adjunct on a semi-static front. Spotting from Air OPs on the other hand is almost the only hope for these phases, and it is recommended that this and any other method of enabling the Air OP to spot mortars and nebelwerfers, is worth every attention.

IV. CONCLUSIONS

The following conclusions on the problem of enemy mortar location are put forward for consideration:

1. No single method at present in use, or shortly coming into use, is likely to prove a complete solution to the problem. For the time being, all methods must be used.

2. In order effectively to use and co-ordinate all these methods a proper Counter Mortar staff is needed.

3. As a target figure, we should aim at being able to get 60-80 locations per day. Ability to do this would mean that we should know the majority of Hostile mortar positions and be able to bring accurate fire on to them at the end of one day, whatever amount of activity there was at the time.

4. The average number of locations by the straightforward methods at present in use is 10 per day. This might be doubled by a complete pooling between Divisions of all methods and ideas.

5. Further GL IIIs and Four pen recorders are needed for trial in operational roles before firm conclusions can be drawn. It is unlikely however, that the target figure could be reached by less than 3 Four pen recorders on a Divisional front operating together with existing methods. GL III may possibly do better than this.

6. Neither the straightforward methods, nor the GL and Four pen recorder, will ever be able to operate effectively during the latter stages of an attack and consolidation. It is therefore, suggested that every possible means be tried to enable the Air OP to spot mortars and nebelwerfers, and that as a start the possibility of using special filters be considered.