

8927 623.4383:355.422

A. O. R. G.
 LIBRARY
 Date recd. 27.5.52.
 Cat. No. 8927(2)
 Section for copy 2 Shelf 12

Handwritten scribble

~~CONFIDENTIAL~~

~~SECRET~~

COPY NO. 57

cb
TD 11

ARMY OPERATIONAL RESEARCH GROUP

MEMORANDUM NO. G.6

RLM 724.

Some material models of
Tank Combat. H.K. Weiss.

A SURVEY OF TANK WARFARE
 IN EUROPE FROM D-DAY TO
 12TH AUGUST 1944.

"ACRG Memoranda are informal papers with restricted circulation. They are signed by the writers, and do not necessarily represent the official views of AORG."

SECRET

ARMY OPERATIONAL RESEARCH GROUP

MEMORANDUM NO. C.6.

A SURVEY OF TANK WARFARE IN EUROPE FROM D-DAY TO 12th AUGUST 1944.

Prepared by: H.G. Gee.

ABSTRACT

After Elamein, in October 1942, and with the advent of the Sherman '75' the relative performance of the British and German tank guns approached parity.

This study was undertaken in order to examine the supposition that weight of numbers was the deciding factor in tank battles after 1942. The fighting in Normandy was chosen for examination as it was considered that it would offer the greatest amount of data for conditions which were by no means adverse to the Germans.

The contents of the paper are dealt with under the following headings:-

- (a) The historical aspect of the armoured fighting in Normandy.
- (b) The analysis of tank actions.
- (c) The application of results to possible future war.

The following is the summary of the main conclusions:-

- (a) During the major offensives in Normandy in July and August 1944, the British had four times as many tanks as the Germans, though in battle it is possible that the numerical advantage did not exceed 2 or 3 : 1.
- (b) Two British tanks were successful when opposed by one enemy tank. In the cases where British tanks opposed enemy SP and towed A/tk guns the ratio was 5 : 2.
- (c) The British numerical superiority which brought success in action was greater during the Normandy fighting than in similar actions averaged over the whole of World War II.
- (d) In general it would appear that the British and enemy percentage tank losses in successful and unsuccessful actions were less during the Normandy fighting than they were averaged over World War II.
- (e) For the period under review the following mean ranges of engagement obtained for the types of country shown:-
 - (i) Open, 1200 yards.
 - (ii) Close, 400 yards.
- (f) Both British and enemy percentage tank losses were higher in open country than in close country.

- (g) To counter each major Russian front it would seem that the Allies would require more than 1200 tanks and SP guns. This presupposes the assault from a major front to be undertaken by two mechanized divisions containing 1800 tanks and 600 SP guns. These are numerical indications only and are based upon the continuance of a similarity of effectiveness as that which existed between the British and German tanks in Normandy, and without considering the advent of new weapons and tactics. Within these limitations it would further seem that the Allies would require a replacement rate of between 150 and 200 tanks and SPs for every 1000 committed in successful defence, compared with Russian losses of 800 to 1600 if unsuccessful.

~~SECRET~~

ARMY OPERATIONAL RESEARCH GROUP

MEMORANDUM NO. C.6.

A SURVEY OF TANK WARFARE IN EUROPE FROM D-DAY TO 12th AUGUST 1944.

CONTENTS

	<u>Paragraph</u>
INTRODUCTION AND OBJECT	1
METHOD	3
THE HISTORICAL ASPECT OF THE FIGHTING IN NORMANDY	
General	5
Enemy tank strength	7
The offensive to the SE of Caen	8
The offensive to the SE of Caumont	9
German tank losses in Normandy	11
THE ANALYSIS OF TANK ACTIONS	
General	13
Allied tanks versus enemy tanks and A/Tk weapons	14
Losses sustained by tanks in action	17
The average ranges at which the actions were fought	18
The success attending the side which fired first	19
The influences of terrain on tank losses	20
Conclusions	21
THE APPLICATION OF RESULTS TO POSSIBLE FUTURE WAR	
General	22
The German offensive of 1940	24
The Allied offensive in Normandy	25
Russian tactics and tank strengths	28
Synthesis	30
APPENDICES	<u>Appendix</u>
Sources of information	A
Summary of actions and general analysis	B
Estimated strengths of German formations at 23.59 hours 19th July, 1944.	C
Typical Soviet 'Front'	D

Requested by S.I./AC

86/Research/736

MEMORANDUM NO. C.6.

A SURVEY OF TANK WARFARE IN EUROPE FROM D-DAY TO 12th AUGUST 1944.

Prepared by: H.G. Gee

INTRODUCTION AND OBJECT

1. The Sherman with its 75 mm gun first made its appearance, in any large numbers on the battlefield, at Alamein. Prior to this the German tanks had outgunned those of the Allies, but the introduction of the 75 mm brought the striking power of the two contestants nearer parity. Hence, before October 1942 the history of tank encounters during World War II is mainly a succession of victories for the German Afrika Corps; after this date the success was predominantly with the Allies.
2. With the nearer parity in gun performance of the British and German tanks, it would logically seem that weight of numbers was the deciding battle factor during the latter stages of the war. This study was undertaken with a view to examining this supposition, and it was considered that the fighting in Normandy would offer the best opportunity of studying the factors which led to the Allied success under conditions which were by no means adverse to the Germans. Only the events in the British sector are dealt with in detail here, and it has not been possible to take into consideration any tactical features relating to the front held by the United States which may have affected the issues.

METHOD

3. The contents of the paper are dealt with under the following three main headings:-
 - (a) the historical aspect of the armoured fighting in Normandy;
 - (b) the analysis of tank actions;
 - (c) the application of results to possible future war.
4. Data relative to some 250 actions between D-day and 12 Aug. 1944, were extracted from the official war records as listed at Appendix A. A certain number of these actions had to be discarded due to insufficient detail, but data relevant to the remaining 112 are recorded in Appendix B.

THE HISTORICAL ASPECT OF THE FIGHTING IN NORMANDY

General

5. When we compare the recorded numbers and losses of German and British tanks involved in the Normandy fighting, the various sources of information give a conflicting picture. Even though the figures have been cross checked where possible, they should only be taken as an indication of those involved. Nevertheless they are considered adequate for the comparisons which follow.

6. During the Normandy fighting, the most important operations were those carried out to the S.E. of Caen and to the South of Caumont. For these two operations it was found that the battle dispositions of the major German and British units could be ascertained from the official records with a fair degree of accuracy. These dispositions are shown on the traces at Appendix C. For the purpose of this report, it is perhaps unfortunate that there is no record of an unsuccessful British attack on the same scale as the two offensives considered. It was thought that the Ardennes offensive might be of use in this connection, but the information available on the German strengths was not sufficiently reliable for it to be used here.

Enemy tank strength

7. On D-day there were nine Panzer Divisions in France, with a total strength of between 1000 and 1200 tanks, and slightly less assault guns (800). To these were later added the 130 tanks and 100 assault guns from the 9th and 10th Panzer Divisions which were withdrawn from Poland. By the middle of July the German High Command had become aware that the Normandy invasion was the main Allied effort. By the 16th July, of the eleven Panzer Divisions available, between 5 and 6 were opposed to the British forces, two or three were still with the 15th German Army in the Pas-de-Calais area or in reserve, and the remaining two or three were distributed along the American sectors. The strengths of the German units on 19th July are given in Appendix C, from which it will be seen that the enemy still had a little under 500 tanks and 800 assault guns to counter the mounting British armoured offensive. The distribution of enemy units along the British sectors prior to the offensive to the south east of Caen are given in Appendix C1. At this stage of the battle the British forces totalled between three and four thousand tanks. Two major allied offensives followed - one to the S.E. of Caen and a second to the S.E. of Caumont.

The offensive to the S.E. of Caen.

8. The Allied offensive to the south east of Caen was perhaps the opening move in the final breakthrough since it not only contained the enemy defences in that area but also distracted the German attention from the other sectors, thus aiding the later operations. The main Allied attack was put in by the 7th, 11th and Guards Armoured Divisions with between 700 and 800 tanks at their disposal. It will be seen from Appendix C that the enemy units opposing the Allies had available about 140 tanks and 70 assault guns. The overall numerical advantage was therefore of the order of four to one in favour of the Allies. Although it was not possible to determine the numbers actually committed to battle, it is likely that the Allies with their greater numbers held more in reserve than did the enemy. Thus the actual numerical advantage obtaining during the battle can only have been between 2 : 1 and 3 : 1, a value suggested by the analysis of data (para. 14). The thrust was successful but not without a certain loss of men and machines, mainly as a result of the well camouflaged screen of anti-tank guns deployed by the enemy.

The offensive to the S.E. of Caumont.

9. The main British armoured thrust which led to the breakthrough in Normandy took place during the latter part of July and beginning of August in the area to the south east of Caumont. Coming so soon after the Caen fighting this offensive was only made possible as a result of a rapid switch of armoured units. The disposition of the main contestants on 30th July and 2nd August are shown in Appendices C3 and C4. Nearly 1200 British tanks, attacking through the poor tank country of the Bocage, were initially opposed by a negligible number of enemy anti-tank weapons, some 50 tanks, 30 assault guns and 50 towed anti-tank guns. During the early stages of the offensive the British forces greatly outnumbered those of the enemy. By August 4th however, after considerable progress had been made on the right flank, at least another two enemy Panzer Divisions were committed against the successful 11th and Guards Armoured Divisions. By this time however the main objectives of the offensive had been realised, and the

complete defeat of the enemy forces in Normandy was at hand. During this offensive the 8th Armoured Division on the British left flank was considerably delayed by a German Infantry Division equipped with a nominal number of anti-tank guns. As regards the 11th and Guards Armoured Divisions it was not possible to determine from the records the actual numbers of tanks committed by each side. From the actions available during this period it would seem that in battle the British tanks outnumbered those of the enemy by between 3 : 1 and 4 : 1.

10. In these two major offensives it will be seen that the British tank forces had a numerical superiority over the enemy in battle of between 2 : 1 and 4 : 1. The analysis which follows of our own and enemy losses for this period should be considered with this fact in mind.

German tank losses in Normandy

11. The German tank losses increased considerably after D-day and for June and September they outstripped production (7). During these months the Panzer Divisions lost as many tanks as they had done on the Russian and African fronts during the whole of 1943. An estimate of their casualties between D-day and the 12th August is as follows (6):-

Table 1

Opposing Allied Army	Enemy tank losses between D-day and 12th August								Total KO + Dam	
	Period	Mk. III & IV KO.	Mk. V Dam.	Mk. V KO.	Mk. V Dam.	Mk. VI. KO.	Mk. VI. Dam.	Others KO.		Others Dam.
1st. Cdn.	23/7-11/8	16	2	13	5	10	2	-	-	48
2nd. Brit.	6/6-12/8	223	129	249	123	122	52	260	61	1219
1st. US.	6/6-6/8	-	82	-	34	-	27	-	52	195

NOTE:-

- (a) Destroyed tanks are included under KO.
- (b) The US Army only counted 'captured' tanks.
- (c) Destroyed tanks counted by the 2nd British Army also include those attributed to air action but these are estimated at not more than 5% of the total.

12. On the British sectors it will be seen that between 1200 and 1300 German tanks were put out of action. During this period the 2nd Army lost 1267 tanks from all causes (records of DIME Stats 2nd Army), and it is estimated that the Canadian losses were of the order of 300 tanks. It is concluded that when the campaign in Normandy was well under way the 1st and 2nd Armies had four times as many tanks at their disposal as the enemy units opposing them. It is not likely that such a high numerical advantage was maintained in battle. The total losses of Allied tanks were only a little greater than the battle losses of the enemy, namely 1600 as against 1250 - a ratio of approximately 1.3 : 1.

THE ANALYSIS OF TANK ACTIONS

General

13. The 112 actions which were extracted from the war diaries on the fighting in Normandy are given in Appendix B together with the results of

the general analysis. Where possible the figures are compared with the comparable overall values from World War II (shown in brackets) as given in MORU Report No. 33. The main results which emerge are discussed below in the sequence they appear in the Appendix.

Allied tanks versus enemy tanks and A/Tk. weapons

14. In the general analysis which was adopted the ratios of Allied to enemy tanks have been calculated for success by each side. The detailed results obtained are shown in Table 3 of Appendix B. In most of the specific actions considered however the numbers of incidents are so small, particularly for enemy successes, that only the grouped data are shown in Table 2 below.

Table 2.

Results of tank actions

Type of Engagement	Ratio of Allied to Enemy for	
	Allied success	Enemy success
1. Allied tanks v Enemy tanks	2.2 (1.6)	1.5 (1.1)
2. Allied tanks v SPs and towed A/Tk. guns	2.5 (1.8)	1.8 (0.6)

(Figures in brackets are the comparable overall values for World War II - see MORU Report 33.)

It will be seen that on the average 11 Allied tanks were successful when opposed by 5 enemy tanks, whereas 3 were not successful against 2 of the enemy. Thus it would seem that during this period two Allied tanks were required to overcome each of the enemy's.

15. The numerical superiority suggested in Table 2 for success in tank versus tank actions was adequately covered, since we have already seen that the Allies had four times as many tanks in the Normandy fighting as did the enemy (para. 10). It is quite possible that the relatively greater numbers of Allied tanks with the correspondingly increased exposure to risk had a bearing on the ratios which are given in Table 2. There would appear to be some support for this supposition in the marked differences in the values for Normandy and the average values for the whole war. No attempt could be made to take this into account in the present paper, but the problem recommends itself for further study.

16. In like manner it will be seen that about 5 Allied tanks were successful against two enemy SP and towed anti-tank guns. It is the values in this case which show the greatest variation from the overall war figures. It is felt that these discrepancies are due either to the samples or to the relatively high numbers of tanks we had available and are not an indication of a deterioration in the quality of Allied armour during this phase. It is possible too that the enemy SPs contained a higher proportion of 88s than on previous occasions.

Losses sustained by tanks in action

17. Details of the percentage losses for tanks in various actions are given in Table 4 Appendix B. It will be seen that there is a fair degree

of agreement between the figures for Normandy and the overall values for the war. The greatest discrepancies are to be found in the values for percentage losses in unsuccessful attacks. This might well denote a difference in the tactical handling of the tanks. In general it would appear that both the Allied and enemy losses were less during the Normandy fighting than they were during the remainder of the war.

The average ranges at which the actions were fought

18. The extent of the information under this heading is very limited as will be seen from the summary of actions. From that which is available the following results were extracted for tank v tank actions:-

- (a) Open country average 1200 yards
- (b) Close country " 400 yards

The figures are taken to the nearest ten yards. Comparable values are not available for the war as a whole.

The success attending the side which fired first

19. Here too the details of the 44 actions in which this information was given are shown in Appendix B. The values in Table 5 Appendix B give further emphasis to the fact that the side having the numerical superiority which fired first was invariably successful. In the cases where the sides were evenly matched the first shot appears to have had a significant bearing upon the outcome.

The influence of terrain on tank losses

20. Table 6, Appendix B shows the detailed results. The most significant fact which appears to emerge from the results is that tank losses were generally higher in open than in close country. Comparison of the numerical superiority and percentage losses is of interest. The Allied superiority was less in open country and their percentage casualties were nearly double those in close country. Either the Allies used less tanks or the enemy more in open country with the result that the latter had higher percentage casualties than in close country. It is also possible that engagements in open country tended to be more prolonged than those in close country but there are little or no data available on which to attempt a justification of such a supposition.

Conclusions

21. It is concluded that:-

- (a) Two Allied tanks were successful when opposed by one enemy tank. In the case of Allied tanks versus enemy SFs and towed A/Tk. guns the ratio was 5 : 2.
- (b) The Allied numerical superiority which resulted in successful actions was greater during the Normandy fighting than in similar actions averaged over the whole war. This, to some extent, may be due to the relatively greater numbers of Allied tanks in the field during this particular period.
- (c) In general it would seem that the Allied and enemy percentage tank losses in successful and unsuccessful actions were less during the fighting in Normandy than they averaged over the full war years.
- (d) For this period the following mean ranges of engagement obtained for the type of country shown:-

- (i) Open 1200 yards.
 - (ii) Close 400 "
- (e) Both Allied and enemy percentage tank losses were higher in open country than they were in close country.

THE APPLICATION OF RESULTS TO POSSIBLE FUTURE WAR

General

22. It will be apparent that the foregoing results cannot be directly applied to future tank warfare and any comparisons which utilise them must be made with the greatest caution. In many respects, however, in the initial stages of a future war in Europe the Allies will find themselves in a similar position with regard to numbers and tactical dispositions as were the Germans in 1944. A certain resemblance in the general conditions would undoubtedly be overshadowed by the types of weapons used, the quantity and quality of supporting troops and the tactics employed. From a purely numerical standpoint, however, and this is stressed, a probable Russian offensive would appear to have much in common not only with the conditions which prevailed in Normandy, but also with those in France and Belgium in 1940. Even within the limitations imposed by a different enemy and different weapons and tactics it is possible to give some indication of the quantity of armour and replacements required to contain a Russian offensive in the near future.

23. Before drawing the general conclusions it is thought that a brief historical survey should be made of the main features of the campaign in 1940 and 1944.

The German offensive of 1940.

24. In May 1940 the Germans deployed between 106 and 122 Divisions between Holland and Switzerland. The central thrust was made with some 60 divisions of which 10 were armoured and contained roughly 3000 tanks. Opposed to this thrust the Allies had some 30 divisions and probably at the most about 1000 tanks. Many of these divisions came into contact with the enemy piecemeal or too late and many troops surrendered with little or no fight. The Germans had a superiority of men and machines of at least 5 : 1, and probably in many engagements as much as 6 : 1. In the air over the front the Germans outnumbered the Allies by at least 3 : 1, and over the main thrust this ratio must have been at least twice as much. Despite this great superiority, the confusion of a split command, and the blunders which followed, the battle was very much in the balance on more than one occasion.

The Allied offensive in Normandy

25. We have already seen that the Allies had a numerical superiority of tanks available of about 4 : 1. The 14 to 15 divisions which the British had in the field were opposed by, at the most, 12 German divisions of which 5 were armoured (Appendix C) with the elements of two armoured divisions in reserve. The Allied supremacy in the air during this period is unquestioned.

26. That the British and Americans were contained in a relatively small beach head with limited venues for tactical exploitation would seem to be a factor in favour of the enemy. Despite this, the most significant feature which appears is that the most effective British attack took place in the region where it was least expected, namely through the Bocage which was considered to be unsuitable for large scale tank manoeuvres. Four years previously the Germans had also pushed their main armour through the region in which they were least expected, and again this surprise exploitation was tried just after the Xmas of 1944.

27. With the main features of these two campaigns in mind it is now advantageous to review what is known of Russian strategy. The information available is sufficiently reliable to give a general indication of the numbers of tanks and SP guns likely to be employed by the Russians in a major offensive against unduly strong opposition. The overall Russian strengths have been used for what is taken to be a typical major front, and no allowance has been made for mechanical availability or tactical use of reserves.

Russian tactics and tank strengths.

28. The Russian tactics are briefly detailed here and in Appendix D only as concerns the import of this paper. Table 8 Appendix D therefore only contains those formations which are equipped with tanks or SP guns. Further it is emphasized that two or more of these major fronts could be expected in any possible conflict in Europe.

29. The present Russian doctrine aims at a superiority of armour of at least 4 : 1 at the points chosen for breakthrough (5). This figure is comparable with that which was obtained for the Allies during the Normandy fighting. In addition, the average length of front upon which the Russians make their advances is probably in the region of 20 to 25 miles. When stiff opposition is encountered by the advancing rifle army, the latter take on a containing role whilst the two mechanized armies, totalling about 2400 tanks and SP guns prepare for a concentrated assault on one or more limited fronts of about 4500 yards extent. These latter are chosen where it would seem that the opponents are the weakest. Thus the main tank effort, which is highly concentrated at one or more points, constitutes about 1800 tanks and 600 SP guns. There has been no comparable example in tank warfare so far of an offensive on such a scale.

Synthesis

30. On the figures we have extracted from the analysis in Appendix B about two British tanks were successful against each German tank in Normandy at a time when the latter were defending. Further, the British had about 2400 tanks to about 600 held by the enemy in mid-July, though it is possible that the actual numerical advantage in battle was only of the order of 2 or 3 : 1. If it is permissible to reverse these numerical relationships in the case of a possible Russian offensive, then it would seem that the Allies would require more than 1200 tanks and SP guns to meet each major front of 1800 Russian tanks and 600 SP guns.

31. We have seen, Appendix B Table 4, that in unsuccessful attacks the losses in tanks of the side carrying out the offensive (the Allies during most of World War II) varied from about 34% to 60%. Thus it might be assumed that the Russians, if unsuccessful, would suffer losses of between 800 and 1600 tanks and SP guns on each major front. In like manner the enemy losses in Normandy when successful were of the order of 15% to 20%. Thus a successful Allied defence against each major Russian front might be associated with battle losses of 150 to 200 tanks and SP guns for each 1000 involved.

32. The numbers of tanks deduced in paras. 30 and 31 are based upon the assumption that the relative effectiveness of the Allied to Russian tanks would be in like degree to that which existed between the British and German tanks in 1944. In any possible future war certain other factors are likely to influence tank versus tank combat. Of these, in addition to tank effectiveness, the more important concern the tactics employed by either side, the morale and strengths of supporting arms, tank and A/Tk armaments, and the advent of new weapons such as the atomic bomb or the use made of B and C warfare. These limitations cannot be too strongly emphasized, but in spite of the restrictions it is felt that the comparisons made in the previous paragraphs are of importance in so far as they give some indication of the minimum effort required to counter a major Russian front under the conditions which prevailed during World War II. Unfortunately

~~SECRET~~

it is not possible at the moment to compare the Allied and Russian industrial potentials for the production of tanks by types and so balance the relative endurance of the contestants in the light of the losses which each might sustain. Such an economic approach does however recommend itself for further study.

33. In the numbers of tanks and SP guns involved the weight of a major Russian front is very similar to the British effort in Normandy. In the latter instance the four to five enemy Panzer divisions with their 600 to 800 armoured vehicles were insufficient to withstand the British armour which outnumbered them in battle by from 2 to 3 : 1. For this reason the study of the tank warfare in Normandy attains an appreciable significance.

May, 1952.

EH

Serial	Type of action	Allied tanks		Enemy tanks		Range (Yds.)	Who fired first (Allies or Enemy)	Terrain {Open, close or built up}
		Nos. engaged	Cas.	Nos. engaged	Cas.			
BRITISH 75 MM & 17 PDR VERSUS ENEMY SP GUNS								
(a) Allied success								
68		15	0	6	6	-	-	-
69		1	0	1	1	-	-	-
70		12	0	2	2	-	-	O
71		1	0	1	1	900	A	C
72		4	0	1	1	-	-	C
73		4	2	1	1	-	E	C
(b) Enemy success								
74		1	1	1	0	-	E	-
75		4	1	4	0	-	E	C
76		9	9	4	2	-	-	-
77		3	2	1	1	-	A	C
ALLIED 75 MM & 17 PDR TANKS VERSUS ENEMY A/TK GUNS								
(a) Allied success								
78		18	1	3	1	-	-	O
79		3	0	1	1	50	A	-
80		6	1	1	1	-	E	-
81		3	0	1	1	2500	A	O
82		10	0	5	5	-	A	O
83		10	2	4	2	-	E	C
84		14	2	4	4	-	-	C
85		12	0	4	2	-	E	C
86		14	0	3	3	-	-	-
87		3	0	2	2	-	-	-
88		3	0	1	1	-	-	-
89		3	0	2	2	-	-	-
90		8	5	2	2	-	-	-

Serial	Type of action	Allied tanks Nos. Cas. engaged	Enemy tanks Nos. Cas. engaged	Range (Yds.)	Who fired first (Allies or Enemy)	Terrain (Open, close or built up)
ALLIED 75-MM & 17 PDR TANKS VERSUS ENEMY A/TK GUNS						
(a) Allied success						
91		4 1	6 2	-	-	-
92		3 0	1 1	-	-	-
93		3 0	2 2	-	-	-
94		1 0	1 1	-	-	-
95		4 0	6 3	-	-	-
96		9 3	5 3	-	-	-
97		10 1	4 2	-	-	-
98		4 0	3 2	-	-	-
99		3 0	1 1	-	-	-
(b) Enemy success						
100		9 5	2 1	-	-	-
101		14 4	8 2	-	-	-
102		6 1	1 0	-	-	-
103		12 3	20 4	-	-	-
104		10 4	8 0	-	E	C
105		15 2	1 0	-	A	-
106		18 2	6 0	700	E	C
107		14 2	8 0	800	E	C
108		17 3	6 0	-	E	C
109		1 1	1 0	100	E	-
110		1 1	1 0	100	E	C
111		2 2	1 0	2700	E	O
112		12 7	6 0	-	E	O

SECRET

General Analysis

General

The data listed in the summary of actions were extracted from the war diaries of tank units serving in N.W. Europe. It is not possible to cross check the incidents with the corresponding German accounts. As a result it should be appreciated that the incidents are subject to a bias in favour of the British tanks. Thus numerous reports occur of Allied successes and engagements in which large numbers of Allied tanks were encountered by smaller numbers of the enemy. These conditions are rarely reversed, and the numbers of reported enemy successes are very limited. Unfortunately it is not possible to overcome the inherent bias of the data without considerably reducing the numbers of incidents under the various headings, a process which would naturally detract from the results obtained. For example, by varying the ratios of the two contesting sides and thus eliminating such cases as 31 tanks versus 8 we could obtain comparative values for success which would differ considerably. A general analysis has, therefore, been adopted which compares directly the numbers of contestants which were engaged in the various actions.

The actions have been listed according to which side was considered the victors in the war diaries. In cases of doubt, success has been attributed to the side which suffered the least percentage casualties. This criterion is, however, suspect in such instances as serial 7, where both sides lost an equal number of tanks though the enemy suffered the greater percentage loss. Equality of numerical losses has been taken as the limit where such anomalies occurred.

In addition to the main results, the following values have also been extracted:-

- (a) Losses sustained by tanks in action.
- (b) Average ranges of engagement.
- (c) Success attending the side which fired first.
- (d) The influence of terrain on tank losses.

Results of tank actions

In the 15 actions listed for Allied success (serials 1 to 15) it will be seen that a total of 96 British 75 mm and 17 pr tanks were opposed to 50 German Mk. VI tanks. Thus, on the average 1.9 Allied tanks of the types shown were successful when in action with one German Mk. VI. In the small number of cases where the enemy were successful (serials 16 to 19) one Mk. VI was sufficient to overcome 1.4 of the Allied 75 mm and 17 pr tanks. The small number of actions upon which this latter figure is based is typical of all the samples of enemy success.

The results of this general analysis are given in the table below:-

Table 3

Results of general Analysis

Type of Action	No. of incidents	Ratio of Allied to Enemy for (i) Allied success	(ii) Enemy success	No. of incidents
1. Allied 75 mm & 17 pr. v Mk. VI	15	1.9	1.4	4
2. do v Mk. V	16	2.7	1.5	2
3. do v mixed	6	2.1	1.7	6
4. Allied mixed v All types	51	2.2	1.5	16
5. Allied 75 mm & 17 pr. tanks v SPs.	6	3.1	1.6	3
6. do v a/Tk.	23	2.4	1.9	13
7. do v SPs & a/Tk. guns	29	2.5	1.8	16

NOTE: (a) the rough proportion of 75 mm to 17 pr. tanks was 3 : 1
 (b) only about 20% of the actions listed here are contained in MORU Report No. 33.

In general it will be seen that on the average more than 2 Allied tanks were required for success against each enemy tank, and that when the latter were successful they were outnumbered by about 3 : 2. In the cases where the Allied tanks encountered enemy SP and towed anti-tank guns, the numerical advantage required for success was greater, being of the order of 3 : 1 and 5 : 2 respectively.

Losses sustained by tanks in action

A further analysis of the data gives the following percentage losses for tanks in the various actions. The figures in brackets are the averages for the whole of World War II.

Table 4

Attackers	Successful actions	Unsuccessful actions
	(1) <u>Tank versus tank</u>	
Allies	8.7% (10%)	34% (64%)
Enemy	15% (20%)	60% (66%)
	(2) <u>Tank versus enemy SP and towed a/tk. gun</u>	
Allies	10% (12%)	33% (54%)
Enemy	13% (13%)	74% (100%)

A fair amount of agreement will be noticed between the two sets of figures, and in general it would appear that during the fighting in Normandy both the Allied and enemy losses were lower in both successful and unsuccessful actions.

Ranges at which actions were fought

The average ranges at which the actions were fought were calculated for open and close country, and the following results were obtained:-

Open country. Range 1204 yards. (Standard deviation 735)
 Close country. " 405 " (" " 380)

Success of side which fired first

The results from the 44 actions in which this information was given are as follows:-

Table 5

Ratio of numbers of tanks engaged on each side	Success of side which fired first	Failure of side which fired first
1 : 5	-	1
1 : 4	-	1
1 : 3	1	3
1 : 2	4	1
2 : 3	1	2
1 : 1	17	1
3 : 2	1	1
2 : 1	3	1
3 : 1	4	-
4 : 1 and greater	3	-
Totals	34	11

Thus on 77% of occasions success attended the side which fired first; this figure accords well with the 70% found in MORU Report No. 33.

The influence of terrain on tank losses

The actions are listed for three types of country, namely Open, Close and Built up. For each type of terrain the percentage losses incurred by each side were determined with the following results. Because of the very few incidents in built up areas, these have been included in the figures for close country.

Table 6

Type of terrain	No. of actions	Allied numerical advantage	Allied Percentage losses	Enemy Percentage losses
Close	35	2.8 : 1	9.7	43
Open	20	2.3 : 1	17.7	49

Appendix C

Estimated strengths of German formations
at 2359 hours 19th July, 1944.

Table 7

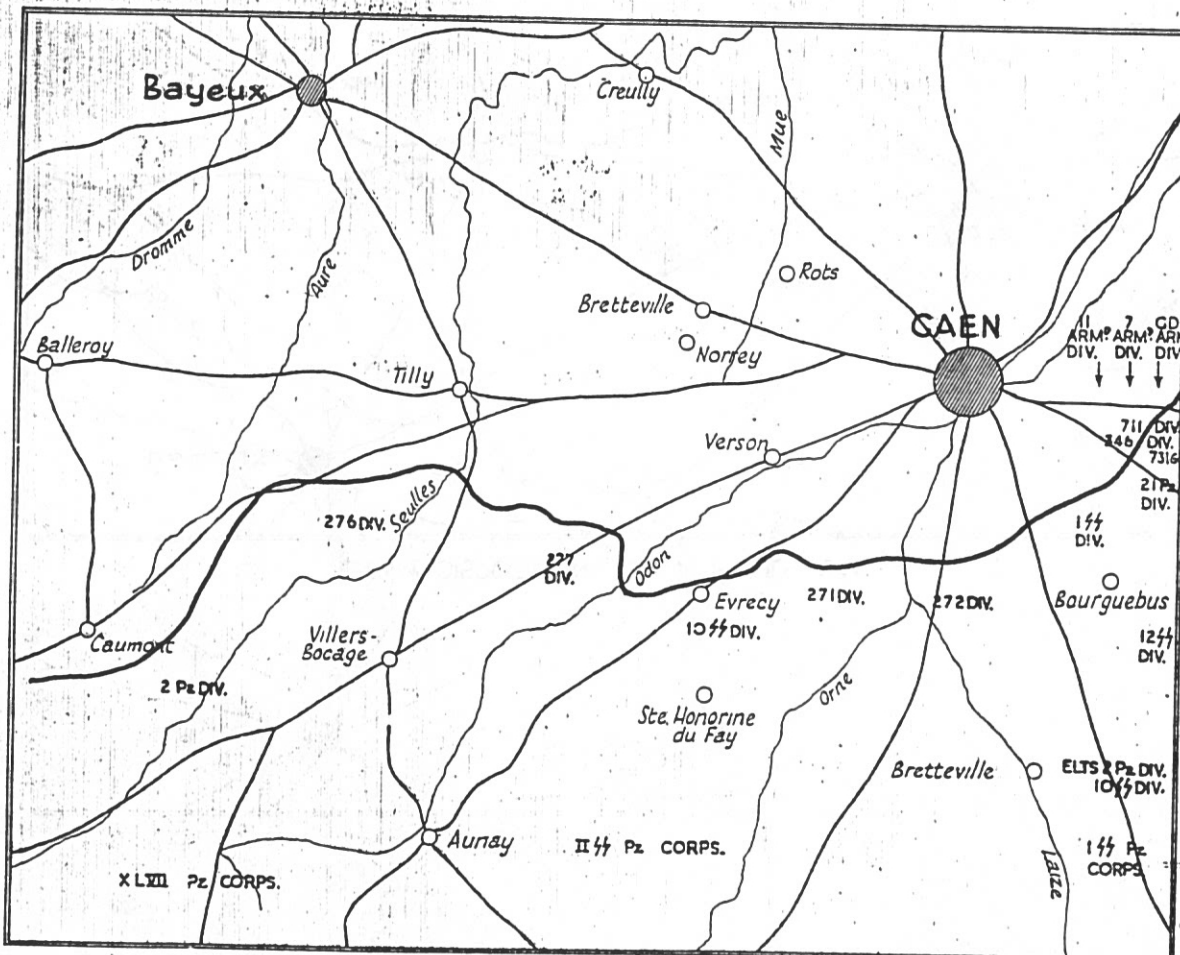
	Pz IV	Pz V	Pz VI	Asslt. Guns	A/tk (over 50 mm)
1 44 Pz Div.	60	20	-	35	70
9 44 Pz Div.	20	50	-	20	68
10 44 Pz Div.	25	25	-	30	65
12 44 Pz Div.	45	35	-	30	55
2 44 Pz Div.	30	20	-	37	65
21 44 Pz Div.	60	-	-	30	42
16 G.A.F.				8	30
271 Inf.				9	27
272 Inf.				9	27
276 Inf.				9	25
277 Inf.				9	20
346 Inf.				6	27
711 Inf.				9	27
101 Tiger Bn			25	-	-
102 Tiger Bn			30	-	-
503 Tiger Bn			30	-	-
Totals	240	150	85	241	610 [#]

This total includes the A/tk guns of Werfer Regts, which are not actually shown on the chart.

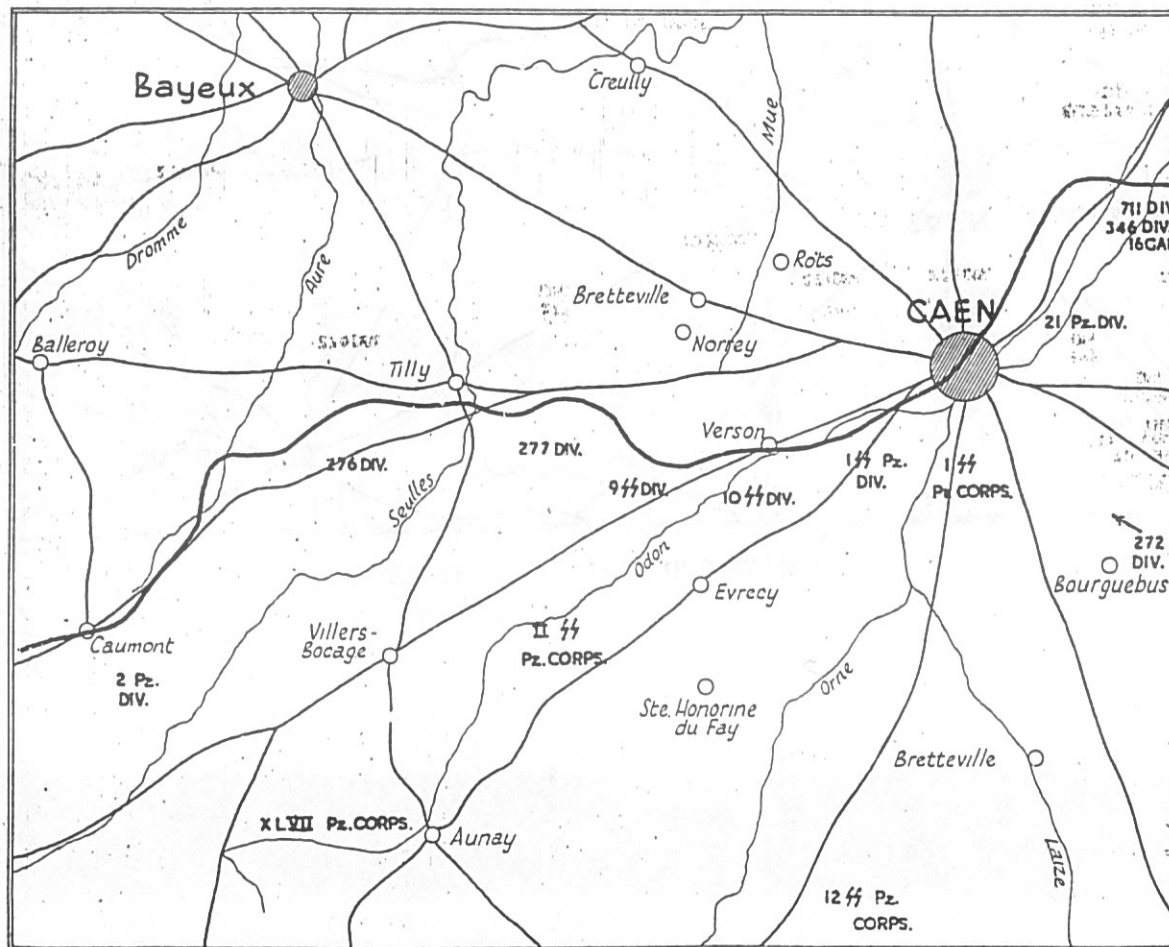
NOTE: (1) The anti-tank gun states in the Panzer Divisions and ~~44~~ Panzer Divisions seem, judging from the German strength returns, to be far too high. Halving the figures would possibly give a truer picture.

(2) A further 70-100 8.8 cm Flak Guns could be drawn from the Flak Bns. on 2 Army Front for use in an anti-tank role.

ALLIED FRONT AS AT 20th. JULY, 1944.



ENEMY DISPOSITIONS ON 16th. JULY, 1944.

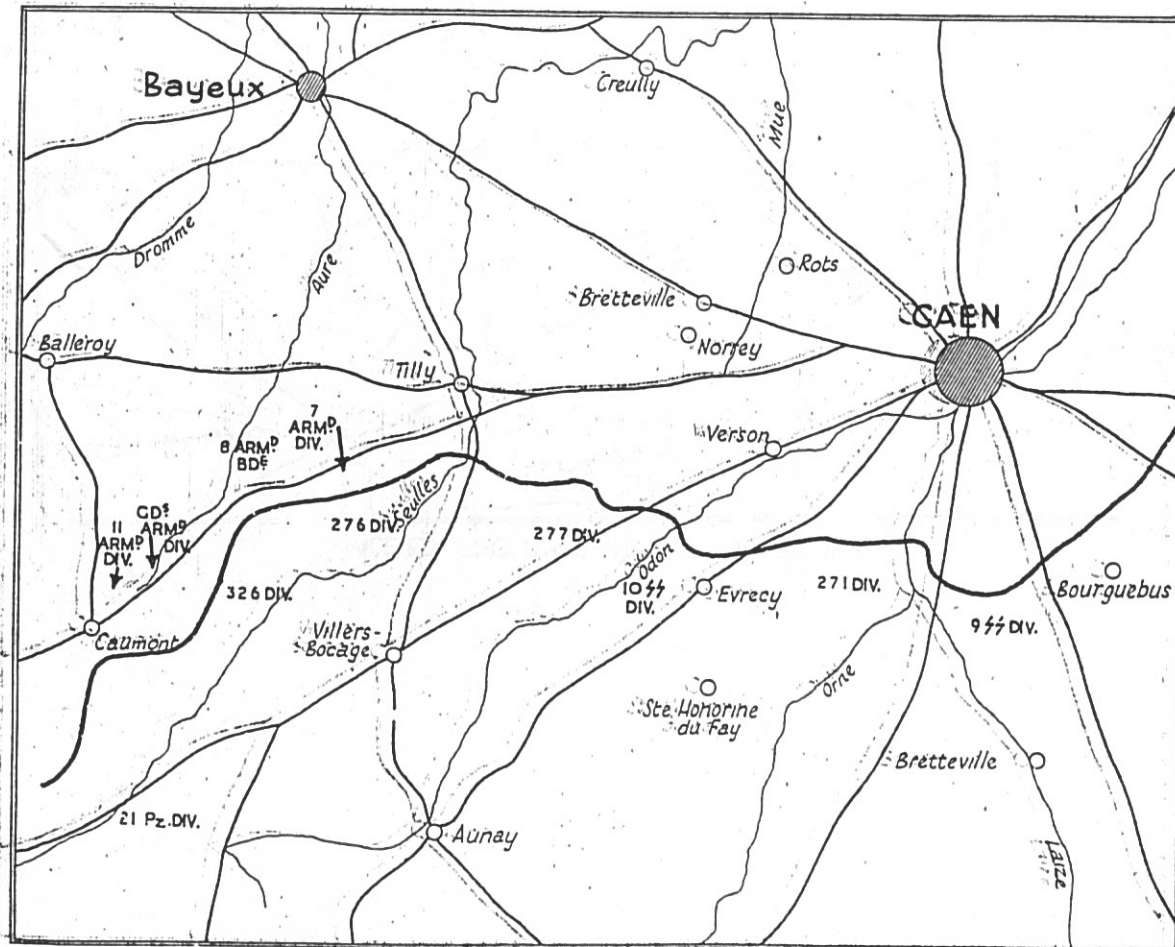


SECRET

SECRET

APP. C. I.

ALLIED FRONT AS AT 30th. JULY, 1944.

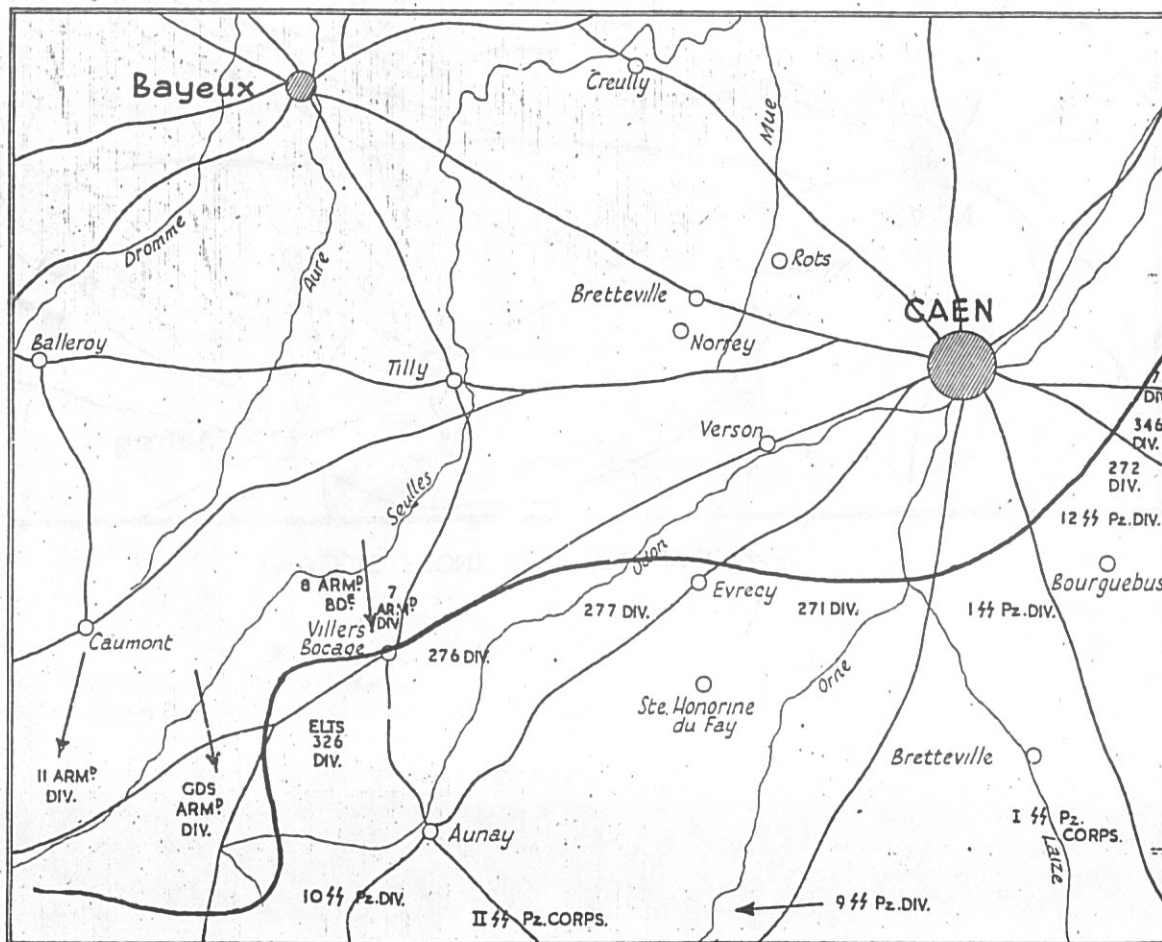


21-

SECRET

APP. C 3.

ALLIED FRONT AS AT 2nd. AUGUST, 1944.



SECRET

-22-

RESTRICTED

SECRET

~~SECRET~~

Appx A

Appendix A

Sources of information

1. The War Diaries of 42 RAC units in BLA 1944.
2. The War Diaries of 6 Canadian armoured units in BLA 1944.
3. MORU Report No. 33.
4. The Six Weeks War, Draper.
5. Military Intelligence Reports.
6. 21 Army Group Liaison Letter No. 2.
7. German documents held by the Historical Section.

Appendix B

Summary of Actions

Serial	Type of Action	Allied tanks Nos. Cas. engaged	Enemy tanks Nos. Cas. engaged	Range (Yds.)	Who fired first (Allies or Enemy)	Terrain [Open, close] [or built up]
BRITISH 75 MM & 17 PDR VERSUS ENEMY MK. VI						
(a) Allied success						
1		3 0	3 2	-	-	C
2		18 0	3 2	1250	A	O
3		4 0	5 1	600	A	C
4		4 0	4 3	-	-	C
5		8 0	5 2	-	-	-
6		1 0	1 1	100	A	BU
7		14 2	3 2	-	A	C
8		3 0	2 1	-	A	C
9		1 0	6 3	-	-	C
10		20 2	4 2	200	-	C
11		3 0	4 1	-	A	O
12		10 0	6 1	900	E	C
13		1 0	2 2	-	A	C
14		3 0	1 1	-	-	-
15		3 1	1 1	-	-	-
(b) Enemy success						
16		1 1	1 0	100	E	C
17		1 1	1 0	500	E	C
18		3 2	2 0	-	E	C
19		12 3	8 0	200	E	C
BRITISH 75 MM & 17 PDR VERSUS ENEMY MK. V						
(a) Allied success						
20		1 0	1 1	30	A	C
21		1 0	3 1	200	A	C

SECRET

Serial	Type of action	Allied tanks Nos. Cas. engaged	Enemy tanks Nos. Cas. engaged	Range (Yds.)	Who fired first (Allies or Enemy)	Terrain [Open, close or built up]
BRITISH 75 MM & 17 PDR VERSUS ENEMY MK. V						
(a) Allied success						
22		9 1	3 1	800	E	C
23		1 0	1 1	25	A	C
24		15 3	6 6	800	A	O
25		1 0	1 1	800	A	O
26		1 0	1 1	850	A	C
27		2 0	1 1	-	A	-
28		3 0	5 2	1800	A	O
29		31 2	8 5	400	-	O
30		14 0	3 3	-	-	C
31		1 0	1 1	60	E	C
32		12 0	4 2	-	-	C
33		13 0	3 2	1100	E	C
34		12 0	2 1	1200	E	C
35		9 0	3 2	-	A	O
(b) Enemy success						
36		2 2	1 0	500	E	C
37		1 1	1 0	3000	E	O
ALLIED 75 MM & 17 PDR VERSUS ENEMY MIXED TANKS						
(a) Allied success						
38		12 0	4 3	-	A	O
39		18 1	3 3	-	-	C
40		13 0	13 5	-	A	C
41		12 0	9 1	-	-	C
42		12 1	4 3	-	-	C
43		14 0	5 4	-	A	C

SECRET

SECRET

Serial	Type of action	Allied tanks Nos. Cas. engaged	Enemy tanks Nos. Cas. engaged	Range (Yds.)	Who fired first (Allies or Enemy)	Terrain [Open, close] [or built up]
(b) Enemy success						
44		18 6	3 0	1200		O
45		6 1	1 0	-		-
46		1 1	2 0	250	E	-
47		4 2	2 0	900	E	O
48		10 9	13 2	1500	E	O
49		5 2	4 0	-	E	O
ALLIED MIXED TANKS. (SHERMAN, STUART, GROMWELL, CHURCHILL, CHALLENGER) VERSUS ENEMY MIXED						
(a) Allied success						
50		4 0	1 1	1000	A	O
51		4 2	3 3	-	A	O
52		14 0	7 3	-	-	C
53		6 1	5 3	400	-	BU
54		10 0	5 2	2850	A	C
55		12 1	5 3	1600	E	O
56		4 0	2 2	-	-	C
57		1 0	1 1	-	A	-
58		3 1	1 1	1000	E	-
59		3 0	2 2	180	-	C
60		3 1	1 1	60	E	C
61		13 1	9 3	-	E	O
62		19 6	4 4	-	E	O
63		20 2	9 5	-	A	O
(b) Enemy success						
64		1 1	1 0	200	A	O
65		18 8	12 1	-	E	C
66		3 2	5 2	200	-	BU
67		30 21	18 5	-	-	-

Appendix DA possible Soviet 'Front'.

Based on types of Formation in Eastern Germany
(information supplied by M. I. 3 April 1952).

Table 8

	Tanks		SP Guns		
	Heavy	Medium	152 mm.	100 mm.	76 mm.
<u>One Rifle Army (including)</u>					
Heavy Tk. - SP Regt.	23	-	-	42	-
Corps medium Tk. Bns.	-	70	-	-	-
4 Rifle Divs.	-	208	-	64	72
2 Mechanised Divs.	46	370	42	84	-
<u>Two Mechanised Armies (including)</u>					
2 Armies each of:-					
2 Mechanised Divs.	92	740	84	168	-
2 Tank Divs.	176	840	252	84	-
Totals involved	337	2228	378	442	72

- NOTE: 1) Only units with a complement of tanks and SP guns are shown in the Table.
- 2) The composition of this 'Front' is as it might be in N.W. Europe. It is an ad hoc grouping and is not the normal standard composition of a 'Front' in the Soviet Army. An alternative composition to the one taken here is two rifle armies and one mechanised Army.

The above table shows the numbers of tanks and SP guns likely to be used by the Russians on a possible major front. Such a front would extend a distance of 20 to 25 miles, the vanguard consisting of the rifle army with its complement of armour. When stiff opposition is encountered the advance is halted, and possibly two or more smaller break-through fronts of roughly 4500 yards are chosen across which the mechanised armies attack. Thus, after the usual preliminary bombardment two forces totalling about 1800 tanks and 600 SP guns (the two mechanised armies) may be involved in an attempt at a penetration in depth.

Distribution

SA/AC	12
DMO	1
DML	1
DGMT	2
RAC Centre	1
DWD	1
DRAC	1
Ministry of Supply	
DGFV	1
TPA 3/TIB	3
Defence Research Liaison Canada	6
Australian Army Staff	4
New Zealand Military H.Q.	4
BJSM	6
ORO Representative. Officer Group One, U.S. Army	8
ORS BAOR	2
ORS FARELF	2

