

CHAPTER EIGHT

**'THE PROPER APPLICATION OF
OVERWHELMING FORCE'****THE BATTLE OF THE FACTORIES**

Writing in his war memoirs, Churchill recalled his sense of relief when the United States was thrown into the war by the Japanese attack on Pearl Harbor on 7 December 1941. 'So we had won after all! . . . All the rest was merely the proper application of overwhelming force.' Stalin had said something similar on 6 November 1941: 'Modern war is a war of motors. The war will be won by whichever side produces the most motors.' He went on to claim that the combined American, British and Soviet production of motors was at least three times that of Germany – which, if true, seemed to leave the issue in no doubt. But in fact there was a good deal of doubt. The entry of the United States into the war was followed by one disaster after another for the Americans and British; and with the Germans advancing on Moscow, Stalin was by no means confident of victory, whatever the figures for the production of motors. Even so, the combined opinions of Churchill and Stalin carry great weight, and were justified by later events, when the economic resources of the United States, Britain and the Soviet Union were eventually translated into overwhelming power; and the side with the greater resources and heavier armaments won the war.

Yet this progression was by no means inevitable. History demonstrates that even overwhelming force does not always guarantee victory in war. In the Vietnam War of 1965–73, the Americans possessed immense material superiority over their opponents, but they eventually lost the war because they lost the will to win it. In Afghanistan between 1979 and 1988, the Soviet Union deployed superior force against their opponents but failed to crush them; and eventually the Soviets gave up the struggle and pulled out. In both these cases, morale and determination counted for more than numbers and weight of material. Moreover, quality of armaments can often

be more important than quantity – for example, in Normandy in 1944 the German Tiger tanks were so powerful that a single well-placed Tiger could halt a strong Allied attack.

So numbers of men and weight of weaponry do not by themselves bring victory. But if other conditions are roughly equal, they can go a long way towards it; and they certainly did much to decide the outcome of the Second World War. It is true that there was no single dramatic turning point in the battle of the factories, like the German victory over France in six weeks in 1940; but the broad outline of events reveals a distinct period in which the balance of war production tilted decisively in favour of the Allies. The Second World War, despite its many complications, fell into two clearly defined phases: the initial triumph of the Axis, from 1939 to late 1942; and the victory of the Grand Alliance, from late 1942 to 1945. In the first phase, Germany and Japan scored striking victories over powers that on any reckoning of resources were economically superior; and surprise, speed and fighting power carried them through to the verge of final victory. But they failed to clinch their success, and in the second phase of the war the Allies first held their own, and then brought their immense resources to bear with overwhelming effect. The turning point in the battle of production and resources is to be found at the hinge between these two great phases of the war, at the end of 1942 and the beginning of 1943. The story starts with the war economies of the individual belligerent powers, and then moves on to bring out the comparative performance of the combatants which ultimately decided the issue.

War Production: Germany and Japan

Germany was preparing for war well before the outbreak of hostilities in 1939. From the beginning of 1933 (when Hitler came to power) to the end of 1938 (the last full year of peace), the share of German industrial output devoted to arms production rose from a mere 1 per cent to 20 per cent. The aircraft industry grew at dizzying speed. Under the Treaty of Versailles of 1919, the Germans were forbidden to possess any military aircraft at all – a prohibition which they evaded, but only on a small scale, so that in 1932 the German aircraft industry produced no more than about 100 planes for military purposes. Expansion was then so rapid that by 1939 the production of military aircraft reached 8,295, and by 1940 it had reached 10,247. In a similar way, tank production started from almost nil in 1933, and reached 1,300 in 1939 and 2,200 in 1940.

To carry out the first strong push of its armaments programme, Germany possessed a strong industrial base and a skilled factory workforce. It had ample supplies of coal, and acquired more in 1940 by conquering the coalfields of Belgium and north-east France. On the minus side, the Germans lacked good-quality iron ore, and even after capturing the iron mines of Lorraine they remained heavily dependent on imports of iron ore from Sweden. Even more serious for a country preparing for war was lack of access to oil, the life-blood of modern warfare. In the 1930s Germany imported most of its oil from the Americas, sources that were at once cut off by the Allied naval blockade when war began. Germany's only secure source of oil was Rumania, which by 1940 was entirely under German control; and Germany imported between 2 and 3 million tons of oil per year from Rumania between 1940 and 1943. The Germans also seized large stocks of oil in western Europe by their conquests in 1940. In the long run, however, they relied increasingly on the production of synthetic oil by the chemical firm I.G. Farben; and in 1940 Germany produced 4 million tons of synthetic oil, rising to 6.5 million in 1943. The Germans also lacked supplies of rubber, which was mainly produced in Malaya and the Dutch East Indies; and again the Germans had to rely largely on synthetic production by I.G. Farben.

Germany's war economy thus showed a rough balance of strengths and weaknesses. Germany was basically a medium economic power, heavily reliant on its chemical industry and on imports of oil from Rumania and iron ore from Sweden. If the Germans became involved in war against the Soviet Union and the United States – which is what happened by the end of 1941 – then the balance of economic power would be heavily against them.

After the dramatic victories in 1940, Germany slowed down in some aspects of war production. Aircraft production rose only slowly from 10,247 in 1940 to 11,776 in 1941; and U-boat production actually declined in mid-1940. Tank production, on the other hand, more than doubled from 2,200 in 1940 to 5,200 in 1941, in preparation for the invasion of the Soviet Union. This slackening of pace in armaments production was mainly due to the euphoria created by the astonishing victory over France in 1940, and a natural though mistaken belief that the war was effectively over. Even the attack on the Soviet Union in 1941 was expected to bring another easy victory. For a time, even Hitler let industry take its foot off the accelerator. Moreover the Nazi regime, despite all its machinery of dictatorship and repression, sought to conciliate German

public opinion by protecting workers' hours of work and standard of living. A German historian writes of 'an almost paranoid sensitivity to popular sentiment', which may be going too far; but it was certainly true that the Nazi government remained cautious in its treatment of German industrial workers until well into 1942. It is striking that in 1941 nearly all German war factories were working only one shift per day.

This slackening of German industrial effort came to an end in 1942, when war production put on a new spurt. On 22 January 1942, facing setbacks on the Eastern Front, Hitler issued a directive mobilising all possible resources for the armed forces and the arms industries. In February he appointed Albert Speer (his chief architectural adviser and a close political confidant) as Armaments Minister, with orders to increase arms production. Speer quickly improved economic organisation by setting up a Central Planning Committee to coordinate the work of the different bodies concerned with war production. But it was the disastrous defeat at Stalingrad in the winter of 1942–43 that led to more drastic measures. On 22 January 1943 Speer announced the Adolf Hitler Panzer Programme, launched with a great propaganda fanfare, which aimed to boost the production of tanks and self-propelled guns. On 18 February 1943 Goebbels made a striking effort to stimulate sentiment on the home front by a dramatic speech at the *Sportpalast* in Berlin, calling for total war and universal sacrifices.

There was a difficulty in this call for total war. The German workforce was already at full stretch. It has sometimes been argued that there was slack to be taken up, in that the Germans made less effective use of women in the war economy than the British and Americans, because Nazi ideology stressed the role of women in the home and family. But in fact as early as 1939 the level of participation of women in the German workforce was already higher than it was to be in Britain and the United States *even at the end of the war*. It was true that the majority of women workers were in agriculture rather than industry, but farm work and food production made a vital contribution to the war effort. In 1943 the German Ministry of Labour undertook a registration of women aged between 16 and 45 for total war, but found a potential of only an extra 1.5 million women workers, of whom 700,000 could only work part-time. The Ministry compared German figures for women workers with those in Britain and the USA, and found that the share of women in war work was 34 per cent in Germany, 33.1 per cent in Britain, and only 25.4 per cent in the United States. So there was some slack to be taken up by recruiting more women,

but not much. Meanwhile, the numbers of German men in the war economy was declining, as more had to be called up into the Army to make up for casualties on the Russian Front. The only remaining resources were the use of foreign labour from the countries of occupied Europe, and employing Jews as forced labour before extermination.

Despite these difficulties, the Germans made a great spurt in war production in 1943–44. Aircraft production rose at a remarkable rate, from about 15,000 in 1942 to nearly 25,000 in 1943, and nearly 40,000 in 1944 – though some of this increase was achieved at the cost of quality, by building types that had slipped behind their enemies in performance. (The Me109, for example, was still a good aircraft, but by 1944 was inferior to the long-range Mustang fighters which were escorting American daylight bombing raids.) Tank production also increased: from 9,200 in 1942 to 17,300 in 1943, and 22,100 in 1944 – and many of these were powerful Tigers and Panthers. The production of guns more than trebled, from 12,000 in 1943 to 41,000 in 1944. There is some dispute as to how much of this achievement was due to the efforts of Speer himself. Certainly much of the 1943 production was the result of changes that were under way before Speer took charge; and Speer was undoubtedly adept at securing propaganda coverage for his efforts. In any case, whatever the role of Speer in person, the achievement itself was real. The trouble was that it was nothing like enough to meet Germany's needs. The Germans pushed their aircraft production up to nearly 40,000 in 1944; but the USA alone built 96,000 in the same year, to which the USSR added 40,000 and Britain 26,000, making 162,000 in all, or *four times* the German production. Moreover, the annual figures disguised the fact that the German effort peaked in the course of 1944. The production of aircraft began to decline in the summer; ammunition production fell away in September; and tank production dropped later in the year. Allied bombing, transport difficulties, and pressure on manpower all took their toll. The Germans also suffered from a growing shortage of oil, and there was little point in building aircraft if they were to be grounded for lack of fuel. The revived German war effort was not enough.

Moreover, it was too late, because Germany had passed the point of decision in 1942. At the beginning of that year, Hitler still hoped he could conquer the Caucasus in the next few months, and so secure enough oil to wage a long war. But if not, the economic resources ranged against Germany by the Russians, the Americans and the British would be overwhelming. Speer himself told the Central Planning Committee on 30 October 1942 that unless the war in the east was won that winter, by 1944

Germany would face what he euphemistically called 'a different situation'. In fact, Germany had lost the war of production by the end of 1942.

For much of the war, Germany was in the awkward position of having to carry a passenger, in the shape of Italy, which became an extra drain on German resources. Italy produced no oil, though ironically there were vast undiscovered deposits in Tripoli, then an Italian colony. By the end of 1942 Italian oil stocks were exhausted, and warships were unable to put to sea because they were out of fuel. The Italian aircraft industry was modest in output – 10,500 planes between January 1940 and April 1943 – and most of these aircraft were no match for their opponents. Tank production was low, and the tanks themselves were poorly armed and armoured. Italy thus proved to be a liability rather than an asset to the Axis war effort.

At first sight, the position of Japan was very different. The Japanese economy was partially on a war footing as early as 1937, to sustain the campaign in China. Then at the end of 1941 and early in 1942 the Japanese conquered the whole of South-East Asia, capturing ample resources of oil, rubber, tin and foodstuffs, and achieving something close to self-sufficiency. But in the event the Japanese were unable to make the most of these early triumphs. In the home base of Japan, Korea and Manchuria together, production of steel and coal remained steady between 1941 and 1944. Steel production (the basis for most armaments) reached a high point of 6.3 million tons in 1943, but fell to only 4.6 million in 1944. Coal production remained stuck at about 54 to 55 million tons in 1941–43, and fell to 49.3 million in 1944.

In land armaments, tank production was low. Its high point was 1,191 in 1942, falling away to a mere 401 in 1944. The tanks themselves were mostly light and poorly armed. Aircraft production did better, rising from 5,088 in 1941 to a peak of 28,180 in 1944. But these figures were much lower than American production, which reached 96,000 planes in 1944 – *over three times* the Japanese production, though of course many of the American aircraft were used against Germany. In naval production, Japan built only 438 major warships between 1942 and 1944, against 6,755 American. The cumulative effect of this disparity was overwhelming.

As the war went on, the whole Japanese effort was crippled at sea. There was little point in the Japanese controlling the oil and rubber resources of the Dutch East Indies and Malaya if they could not transport these materials by sea to Japan. The Americans began a submarine campaign against Japanese sea communications as early as 1942, at first with only modest success. But in 1943 the American submarines became more numerous,

and in that year sank a total of 1.3 million tons of Japanese shipping. In 1944 sinkings rose to 2.7 million tons, which was far more than the Japanese could replace. The Americans increasingly concentrated their attacks on Japanese oil tankers, so that by the end of 1944 the total available tonnage of tankers was only 200,000 tons. The result was a near-strangulation of Japanese oil supplies, with disastrous effects on the whole war effort. The Japanese attempt at self-sufficiency, which was the object of all their early conquests, failed under an assault by American submarines which has been rather overshadowed by the more dramatic aspects of the defeat of Japan. What the German U-boats tried to do in the North Atlantic, the Americans actually achieved in Far Eastern waters.

War Production: The Allied Powers

Of the three principal powers making up the Grand Alliance, Britain was the smallest in size and material power but had the distinction of fighting the war from start to finish, from 1939 to 1945. As the war went on, the British achieved a remarkable degree of mobilisation of manpower. From December 1941 onwards, all men between the ages of 18 and 50, and women aged between 20 and 40, were called up for national service. By 1944, out of a total active population of 32,250,000, no fewer than 23,500,000 men and women were taking part in the war effort, either in the war economy or in the armed forces – 4.5 million of them in the Army. In this mobilisation, women played a vital role. The figures tell an important part of the story. Late in 1943, about 2 million women were employed in war industries – engineering, metal industries, explosives, chemicals and shipbuilding. In addition, 470,000 were in the ranks of the women's services or in the nursing corps, and 80,000 in the Land Army. Behind these statistics lay an immense change in the role of women in society, the effects of which were felt long after the war was over.

This degree of mobilisation was achieved by a remarkable feat of government organisation, drawing on the experience of the 1914–18 war, and enjoying the active support of the vast majority of the population. In 1941 Churchill streamlined the system of committees that ran the domestic war effort, reducing the number to only three: the Lord President's Committee on the home economy; the Production Executive, under Ernest Bevin, the Minister of Labour; and the Import Executive, which dealt with imports and shipping. In all this administrative work, the role of Bevin, a resolute patriot and the most formidable trade-union leader of his day, was pre-eminent; and he was largely responsible for the impressive fact that, whereas

in 1915–18 an average of 4.2 million working days per year were lost in strikes, in 1940–45 the figure was only 1.8 million per year. The government also maintained a system of food rationing which grew more severe as the war went on, but was widely accepted as being necessary and fair, and which kept the British people well fed and in good health.

British war production kept up at very steady rates throughout the war, despite German air attacks. Steel production totalled between 12.3 and 13 million tons per year, from 1940 to 1944 inclusive. This was only about half German steel production, but the British also had access to American production, whereas the Germans were on their own. Aircraft production rose from 15,049 in 1940 to 20,094 in 1941, and then to 23,672 in 1942 and 26,263 in 1943, levelling off at 26,461 in 1944. From 1940 to 1943, the British out-built the Germans in aircraft, falling behind only in 1944, when the Germans turned out nearly 40,000 – too late. In many cases the British also produced better aircraft than their opponents – the Spitfire fighter, the rocket-firing Typhoon, the Mosquito light bomber and the Lancaster heavy bomber all outmatched anything the Germans produced. (Indeed, the Germans did not develop a heavy bomber at all.) Tanks were another matter. British tank production increased in the early years of the war: from 1,399 in 1940 to 4,841 in 1941, and 8,661 in 1942; but then fell away to 7,476 in 1943 and only 5,000 in 1944. Moreover, the British never produced a first-rate tank of their own, so that the Army became reliant on American tanks, especially the Sherman – though the Shermans themselves were no match for the German Tigers and Panthers.

The story of British war production was one of steady and unremitting effort, with no apparent turning points. But in reality the turning points were there, though they were not obvious at the time. The first was the introduction of the American Lend-Lease programme in 1941, which allowed the British to import vast quantities of materials of all kinds from the United States, even when they were unable to pay for them. The second was the victory over the U-boats in May 1943, which ensured that these imports from America could in fact get across the Atlantic. It was indeed the support of the United States, in the form of foodstuffs, raw materials, shipping, aircraft and military hardware of all kinds, that enabled the British to hold their own against Germany in the contest between the war economies of the two countries.

The Soviet Union was thrown into the war in June 1941, when the country was invaded by the Germans. In some ways, the Soviet economy

was already on a war footing. In 1938–39 the military budget made up about 26 per cent of the total budget, a proportion that increased to nearly 33 per cent in 1940. The Soviet Union had the advantages of a vast territory, important natural resources (notably oil and minerals), and a high degree of self-sufficiency. But in comparison with Germany, Soviet industry was relatively backward in sophisticated technology and production methods. Moreover, under economic agreements signed in February and April 1941, the Soviet Union actually provided the Germans with large quantities of cereals, oil and raw materials, which only strengthened the German war economy. The Soviets faithfully carried out these agreements up to the very eve of the German invasion, and Soviet goods trains were still rolling westwards during the night of 21–22 June 1941, passing through German forces massed for Operation BARBAROSSA. It was an extraordinary scene, which still beggars belief even after so many years.

When the German blow fell, it crippled the Soviet war economy. Between June 1941 and August 1942, the Germans captured the most productive areas of the USSR, including about 55 per cent of Soviet agricultural production, 65 per cent of its coal, and 60 per cent of steel and aluminium production. The Soviet government made prodigious efforts to save something from the wreck. As early as 24 June, only two days after the German invasion began, an Evacuation Council was set up to organise the transfer of men, machinery and materials to the east. According to Russian estimates in the 1990s, something like 2,500 factories, with perhaps 25 million workers and their families, were moved to destinations in the Ural Mountains, Siberia, the Volga district and Kazakhstan. Sometimes these human cargoes were discharged into open countryside in the middle of winter, and had to improvise dugouts and huts to live in while they rebuilt the dismantled factories. The suffering was appalling, and in August and September 1941 there was very little war production at all, because many factories were being transported across the country. But the final result was a striking recovery in arms production in 1942.

Everyone and everything were mobilised for the war effort. By the end of 1941 about 11 million men had been drafted into the army from employment in industry and agriculture, which in turn suffered grievous shortages of manpower. Women were drafted into factories and farms, and by the end of the war they made up 55 per cent of the total workforce. On the collective farms, four out of every five workers were women,



24 Russian women workers making shells. They were vital in taking the place of men drafted into the army.

often working by hand because tractors and horses were requisitioned for the Army or for industry. Agricultural production fell drastically, and by 1945 Soviet farms were producing only some 60 per cent of their output in 1940. There were severe shortages of food, and even the Spartan provisions allocated under the rationing system were not always delivered.

The result of this mobilisation, despite all the hardships and difficulties, was a success. By the end of 1942 there was a remarkable spurt in armaments manufacture. Figures for six-month periods in 1941–42 tell their own story.

	July–December 1941	January–June 1942	July–December 1942
Aircraft	8,200	8,300	13,400
Tanks	4,800	11,200	13,300
Mortars	19,100	55,400	70,100

But what these figures do not reveal by themselves was more extraordinary still. In 1942 the Soviets were far outbuilding the Germans. That year, the USSR built nearly 25,000 tanks, but Germany only 9,200; the Soviets produced 21,700 aircraft, but the Germans only 15,400. It was a remarkable achievement.

In this way, Soviet war production passed a crucial turning point by the end of 1942. This success was then consolidated in 1943, when the Soviets continued to outbuild the Germans in all the main forms of weaponry: 35,000 aircraft as against 25,000; 24,000 tanks against 17,000; 130,000 guns against 27,000. Moreover, the Soviets went ahead or at least stayed level in quality. Their new light bomber, the Sturmovic, was a better plane than the Ju-87 Stuka, which had been in service since before the war. In tanks, the Soviets and Germans were evenly matched. The Russians produced improved models of the T-34 medium tank in 1943, and introduced a new heavy tank, the Josef Stalin, in 1944. The Germans introduced the powerful Tiger I in 1942, and the manoeuvrable Panther in 1943. Even in 1944, which was a year of almost constant Soviet victories, the Germans destroyed about 17,000 Soviet tanks; so the Red Army needed all the tanks its factories could build.

Soviet war production was supplemented by aid from Britain, Canada and above all the United States, at first in only small quantities but making a substantial contribution by 1943. American lorries were particularly important – Stalin said that he needed trucks more than tanks. Aircraft too arrived in large numbers from the Western powers, equivalent to about one-fifth of Soviet production in 1943–44.

This turning point in Soviet war production and increasing Allied help came at the turn of the years 1942 and 1943, coinciding with the long drawn-



25 Soviet T-34 tanks being assembled in a railway marshalling-yard for shipment to the army. The T-34, sturdy and reliable, was the main battle tank used by the Red Army.

out battle of Stalingrad. Soviet industry provided the material for victory on the battlefield, and established a material superiority which was never lost.

Of all the belligerent powers, the United States proved to be the greatest industrial giant, and American war production exceeded that of any other country. This was achieved despite the Americans starting virtually from nothing. In 1940 the United States possessed immense resources of raw materials and oil, and advanced factories and industrial methods; but these vast resources were hardly used at all for military purposes. The entire American armed forces comprised only 700,000 men in 1940. Tank production for the year was a mere 400. The air forces, military and naval, were made up of only 1,700 aircraft, many of them obsolescent, though the aircraft industry was beginning to expand under the impulse of orders from France and Britain – production was 5,856 in 1939, rising to 12,804 in 1940. The navy was strong, but in need of modernisation. Perhaps even more important, the Americans were not a militarised people, and saw no reason to fear for their own safety.

This situation began to change in 1940, when the fall of France and the apparently imminent defeat of Britain put the security of the United States in jeopardy. In March 1941 Roosevelt steered the Lend-Lease legislation through Congress, and began providing supplies to Britain, and later to Russia. When the United States was suddenly plunged into war with the Japanese attack on Pearl Harbor of 7 December 1941, the Americans responded with extraordinary speed. In January 1942 Roosevelt set out an ambitious programme for arms production, aiming for 60,000 aircraft and 45,000 tanks per year. Astonishingly, the aircraft industry far outstripped its target within two years, reaching nearly 86,000 planes in 1943. Tank production fell short of Roosevelt's aim, reaching just over 29,000 in 1943, but this was still a great achievement for an industry that was virtually starting from scratch. Meanwhile the Americans also produced over 72,000 guns in 1942, and over 67,000 in 1943.

These remarkable feats of production were achieved by a mixture of government direction, private enterprise and sheer improvisation. In January 1942 the head of the Office of Production Management, a government agency, called a meeting of businessmen, read out a list of military products, and 'simply asked for volunteers to produce them'. This was free-wheeling American-style planning, and it worked. Henry Ford set an example on the largest possible scale by establishing a completely new aircraft factory south of Detroit, to build heavy bombers (B-24 Liberators) on mass-production



26 B-24 Liberators under construction. Henry Ford, the car manufacturer, set out to build a bomber every hour in his new factory near Detroit. Using mass-production methods, he achieved his aim by 1944.

lines. He undertook to build a bomber every hour, and at one point in 1944 this extraordinary aim was achieved, with the plant producing planes at an average of one every 63 minutes! This success was sometimes achieved *despite*, as well as by means of, Ford's highly individual approach – at one point he insisted on shifting part of the factory to avoid including a county that voted Democrat. Chrysler made a similar effort, starting with a cornfield near Detroit and building a factory that produced 100 medium tanks per week.

The government also stepped in directly when necessary. In 1942 German U-boats were sinking American oil tankers in dangerous numbers, and Harold Ickes (appointed Oil Commissioner by Roosevelt) set out to move oil overland, building an oil pipeline all the way from Texas to Phoenixville, Pennsylvania – 1,380 miles in all. The pipeline, called 'Big Inch', was in fact 24 inches in diameter, and could carry 15 million tons of oil per year across country. Inevitably, some plans went wrong. For example, the government converted locomotive factories to build tanks, only to find later that it needed more locomotives, including some to send to Russia. Naval shipbuilders naturally concentrated on building warships, only for the strategic planners to find in 1943 that they were desperately short of landing craft for amphibious operations.

But American war production was beyond doubt a success story, creating a vast war economy from a very low base within the space of a year

or two. The Americans called up 14 million men into the armed forces by 1944, and filled the factories with black workers and women. By 1944 there were over 19 million women in the American workforce, as against 14 million in 1940, and 'Rosie the Riveter' (whose slogan was 'We Can Do It') was a reality as well as a propaganda figure. As early as 1942 the United States was out-producing Germany and Japan together in the main categories of war production – aircraft, tanks and guns. The Americans also built, in vast quantities, the *workaday* vehicles that kept the armies moving – trucks, jeeps and half-track lorries. The jeep, perhaps even more than the tank, was the key vehicle of the war, and the USA built more than 650,000 of them. The Americans were more than the armourers of the Grand Alliance – they kept the armies moving as well.

In all this effort, the Americans enjoyed the immense advantage of almost total freedom from enemy attack. With the exception of a few months of U-boat successes on the east coast in the first part of 1942, the American mainland was safe from attack, and American factories suffered no aerial bombardment. With this secure base, the Americans could simply get on with producing the materials and weaponry of war, which they did in vast quantities.

War Production: The Key Contests

The separate stories of war production by each of the main belligerent powers must be set in the context of the war as a whole. The Soviet Union was unique, in that the Russians essentially had only one enemy, Germany; so that the whole weight of its massive war production could be concentrated on one front and one struggle. All the other countries had to fight more than one enemy, and on more than one front. From 1941 onwards Germany was committed to a two-front war, against the Soviets in the east and the British, and later the Americans, in the west; and German war production had to be divided accordingly. The British fought on a number of fronts – the North Atlantic, the Middle East and Mediterranean, and the Far East – and they had to make their limited resources go a long way. The Americans had to divide their efforts between two massive areas – the Atlantic and western Europe on the one hand, and the Pacific and South-East Asia on the other – and their immense productive capacity allowed them to do this.

Within this broad framework, there were three key economic and industrial contests: first, between Germany and the Soviet Union; second,

between Germany and the Western Allies (Britain and the USA); and third, between Japan and the United States.

In the contest between Germany and the Soviet Union, the production of the main categories of weaponry (aircraft, tanks and artillery) by the two powers, between 1941 and 1944, were as follows.

AIRCRAFT	1941	1942	1943	1944
Germany	11,766	15,409	24,807	39,807
Soviet Union	15,735	25,436	34,900	40,300
TANKS	1941	1942	1943	1944
Germany	5,200	9,200	17,300	22,100
Soviet Union	6,590	24,446	24,089	28,963
ARTILLERY	1941	1942	1943	1944
Germany	7,000	12,000	27,000	41,000
Soviet Union	42,300	127,000	130,000	122,400

The key point arising from these figures is that the Soviets consistently out-built the Germans in numbers of weapons. Only at one stage and in one category – aircraft production in 1944 – did the Germans approach parity; and by then most of their planes were used for home defence or could not get off the ground through lack of fuel. In the early stages of the conflict, Soviet superiority in production was more than offset by German advantages in speed, flexibility and fighting power; but as the Red Army came to match the Germans in all these respects, weight of material and numbers of weapons turned the scale decisively against Germany. This change came about over a long period, but the decisive stage was in the latter part of 1942 and early 1943, when war production provided the material means to win the battle of Stalingrad – a victory that was won on the ground, but was prepared in the factories.

In the contest of production between Germany and the Western Allies, the figures show that the British and Americans out-built the Germans, sometimes by a wide margin – in aircraft, the Germans were often out-produced by four or five to one. The exception to this was in tank production in 1944, when the Germans attained near-equal numbers as well as having outstanding tanks in the Tiger and the Panther; but, of course, the

Germans still had to face the Soviet production of tanks, which left them well behind overall.

AIRCRAFT	1941	1942	1943	1944
Britain	20,094	23,672	26,263	26,461
USA	27,277	47,828	85,998	96,318
Germany	11,776	15,409	24,807	39,807
TANKS	1941	1942	1943	1944
Britain	4,841	8,611	4,746	5,000
USA	4,052	24,997	29,497	17,565
Germany	5,200	9,200	17,300	22,100
ARTILLERY	1941	1942	1943	1944
Britain	5,300	6,600	12,200	12,400
USA	29,615	72,658	67,554	33,558
Germany	7,000	12,000	27,000	41,000

When American war production really got under way in 1942 and 1943, the Germans had no chance of competing in sheer numbers, while the Allied victory over the U-boats in May 1943 ensured that the results of American output would get safely across the Atlantic. So, as with the German-Soviet contest, the turning point, or at any rate the critical stage, can be placed at the end of 1942 and the first part of 1943.

In the Pacific and East Asia, Japan fought single handedly against the USA and its British and Australian allies. In war production, this was a contest between at best a medium-weight (Japan) and a heavyweight (the USA). In the war at sea and in the air, the American superiority in ship-building and aircraft production was overwhelming. The production figures tell their own tale.

Even though the Americans had to divide their forces between Pacific and Atlantic theatres of war, their output was big enough to secure superiority in both zones. It is true that the Japanese fought with such tenacity and fanaticism that they were hard to beat, and the American Army and Marines suffered heavy casualties in individual battles, such as Iwo Jima in

MAJOR WARSHIPS	1941	1942	1943	1944
USA	544	1,854	2,247	1,513
Japan	49	68	122	248
AIRCRAFT	1941	1942	1943	1944
USA	26,227	47,826	85,998	96,318
Japan	5,008	8,861	16,693	28,180

February–March 1945; but in material terms the Pacific War was a one-sided contest, as long as the Americans did not waver. In that respect, the initial Japanese attack at Pearl Harbor in December 1941 proved to be a short-term success but a long-term disaster. The Americans never forgot Pearl Harbor, and their determination to wipe out the humiliation of ‘the day that will live in infamy’ sustained them to the end of the road. In this conflict there was no wearying or turning back.

In these various contests of war production, there was a decisive shift in the balance of power over a period between late 1942 and mid-1943. Before that time, the Germans and Japanese had used surprise, boldness and speed of movement to score dramatic victories over opponents who were even at that stage economically superior. But these victories came to an end, and the Axis advances were brought to a halt. There followed a war of attrition, in which Allied material superiority was increasingly brought to bear, on the Eastern Front, in North Africa and across the Atlantic and Pacific Oceans. The growth of Allied power behind the scenes in the hidden battle of the factories and shipyards was translated into victory on the battlefields. By 1943 the output of the three Allied powers exceeded that of Germany and Japan by an extent varying between three to one and four to one in different categories of war material. When this degree of material superiority was properly applied, victory for the Allies became as certain as anything can be among the hazards of war.

In sum, therefore, by 1943 the three powers of the Grand Alliance had established massive superiority in the output of war materials and weaponry. This meant that they were almost sure to win the war, *unless* the alliance broke down through some internal dispute; or the Anglo-American invasion of France, which was planned for 1944, failed; or in some way war weariness set in and their determination faltered. These were very real possibilities, and the story of the Second World War was therefore far from over.

- p.124 German U-boat strength, January–February 1943, Milner, *Atlantic*, p. 136; Padfield, *War Beneath the Sea*, p. 314.
- p.124 Convoy SC 121, Milner, *Atlantic*, p. 146.
- p.124 Convoys SC 122 and HX 229, *ibid.*, p. 147; Middlebrook, *Convoy*, gives a graphic account of this battle – not to be missed.
- p.124 German successes, March 1943, Milner, in Deare and Foot, *Oxford Companion*, p. 68; Padfield, *War Beneath the Sea*, p. 147; Gardner, *Decoding History*, p. 183.
- p.124 Sugar and frozen carcasses, Middlebrook, *Convoy*, pp. 183, 218.
- p.124 Naval Staff paper, quoted in S.W. Roskill, *The War at Sea, 1939–1945*, vol. II, *The Period of Balance* (London, 1956), and Roskill's own comment, pp. 367–8.
- p.125 ONS 5 losses, Padfield, *War Beneath the Sea*, pp. 330–1; 'In one action . . .', Milner, *Atlantic*, p. 152.
- p.125 Summary of British and German losses, 10–24 May, Milner, *Atlantic*, pp. 153–4.
- p.125 Dönitz's signal, 21 May, quoted in Padfield, *War Beneath the Sea*, p. 335.
- p.126 Horton's signal, quoted in Milner, *Atlantic*, p. 155.
- p.126 'I recall the joy . . .', quoted in Middlebrook, *Convoy*, p. 213; the witness was Lieutenant Gravely, USS *Upsur*.
- p.127 U-boats sunk by aircraft, Padfield, *War Beneath the Sea*, p. 335.
- p.128 U-boat successes and losses, September–October 1943, Milner, *Atlantic*, pp. 172–6; Padfield, *War Beneath the Sea*, p. 369.
- p.128 Snorkel U-boats, Padfield, *War Beneath the Sea*, p. 424.
- p.129 Average U-boat sinkings, 1944–45, Milner, *Atlantic*, p. 22.
- p.129 Last wolf-pack operation, *ibid.*, pp. 228–9.
- p.129 Merchant-ship and U-boat losses, and casualty figures, Middlebrook, *Convoy*, pp. 326–7; slightly different figures, Milner, *Atlantic*, p. 230.
- p.129 'The only thing that ever really frightened me . . .', Winston S. Churchill, *The Second World War*, vol. II, *Their Finest Hour* (London, 1949), p. 529.

Chapter Eight: 'The Proper Application of Overwhelming Force'

- p.130 'So we had won after all! . . .' Winston S. Churchill, *The Second World War*, vol. III, *The Grand Alliance* (London, 1950), p. 539.
- p.130 'Modern war is a war of motors . . .', quoted in Evan Mawdsley, *Thunder in the East: The Nazi-Soviet War, 1941–1945* (London, paperback edn, 2007), pp. 185, 193.
- p.131 Share of output going to armaments, Adam Tooze, *The Wages of Destruction: The Making and Breaking of the Nazi Economy* (London, paperback edn, 2007), p. 661.
- p.131 Aircraft production, article by Richard Overy in I.C.B. Deare and M.R.D. Foot, eds, *The Oxford Companion to the Second World War* (Oxford, 1995), p. 1,060. To avoid repetition, all production figures for the main belligerent countries, unless otherwise indicated, are drawn from this article, or from the tables in Richard Overy, *Why the Allies Won* (New York, 1996), pp. 331–2.
- p.132 German oil imports, P.M.H. Bell, *The Origins of the Second World War in Europe* (London, 3rd ed., 2007), p. 177; synthetic production, Tooze, *Wages of Destruction*, p. 411.
- p.133 'an almost paranoid sensitivity . . .', Werner Abelshauser, in Martin Harrison, ed., *The Economics of World War II* (Cambridge, 1998), p. 148.
- p.133 Hitler Panzer Programme, Tooze, *Wages of Destruction*, p. 594.
- p.133 Role of women in the German war economy, *ibid.*, pp. 358–9, 515.
- p.134 Decline in production, late 1944, *ibid.*, pp. 638–9.
- p.135 Japanese steel and coal production, Akira Hara in Harrison, ed., *Economics of WWII*, pp. 230–1.
- p.136 Japanese shipping losses, Nathan Miller, *War at Sea: A Naval History of World War II* (New York, 1995), pp. 483–90.
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- p.137 Days lost in strikes, Richard Overy, in D. Reynolds, W.F. Kimball and A.O. Chubarian, eds, *Allies at War: The Soviet, American and British Experience, 1939–1945* (London, 1994), p. 136.
- p.138 Evacuation of factories and workers, Richard Overy, *Russia's War: Blood upon the Snow* (New York, 1997), pp. 211–12; Catherine Merridale, *Ivan's War: The Red Army, 1939–1945* (London, 2005), p. 103.
- p.139 Six-monthly production figures, Lydia Pozdeeva, in Merridale, *Ivan's War*, p. 154.
- p.140 Soviet tank losses, 1944, Mawdsley, *Thunder in the East*, p. 196.
- p.141 US military strength, 1940, in Overy, *Allies*, p. 190; Overy, in Deare and Foot, eds, *Oxford Companion*, p. 1,060.
- p.141 'Simply asked . . .', Overy, *Allies*, p. 192; Henry Ford and the Democrat-voting county, *ibid.*, p. 196.

Chapter Nine: The Teheran Conference, 28 November–1 December 1943

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- p.153 Allied shipments via Siberian ports, Evan Mawdsley, *Thunder in the East: The Nazi-Soviet War, 1941–1945* (London, 2007), p. 192.
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- p.156 ' . . . this meeting looks like being all over the place', David Dilks, ed., *The Diaries of Sir Alexander Cadogan, 1938–1945* (London, 1971), p. 579, entry for 27 November 1943.
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- p.165 Three-Power Declaration, quoted *ibid.*, p. 358.
- p.165 Stalin's speech on New Year's Day, quoted *ibid.*, pp. 361–2.

Chapter Ten: D-Day and the Battle of Normandy, June–July 1944

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