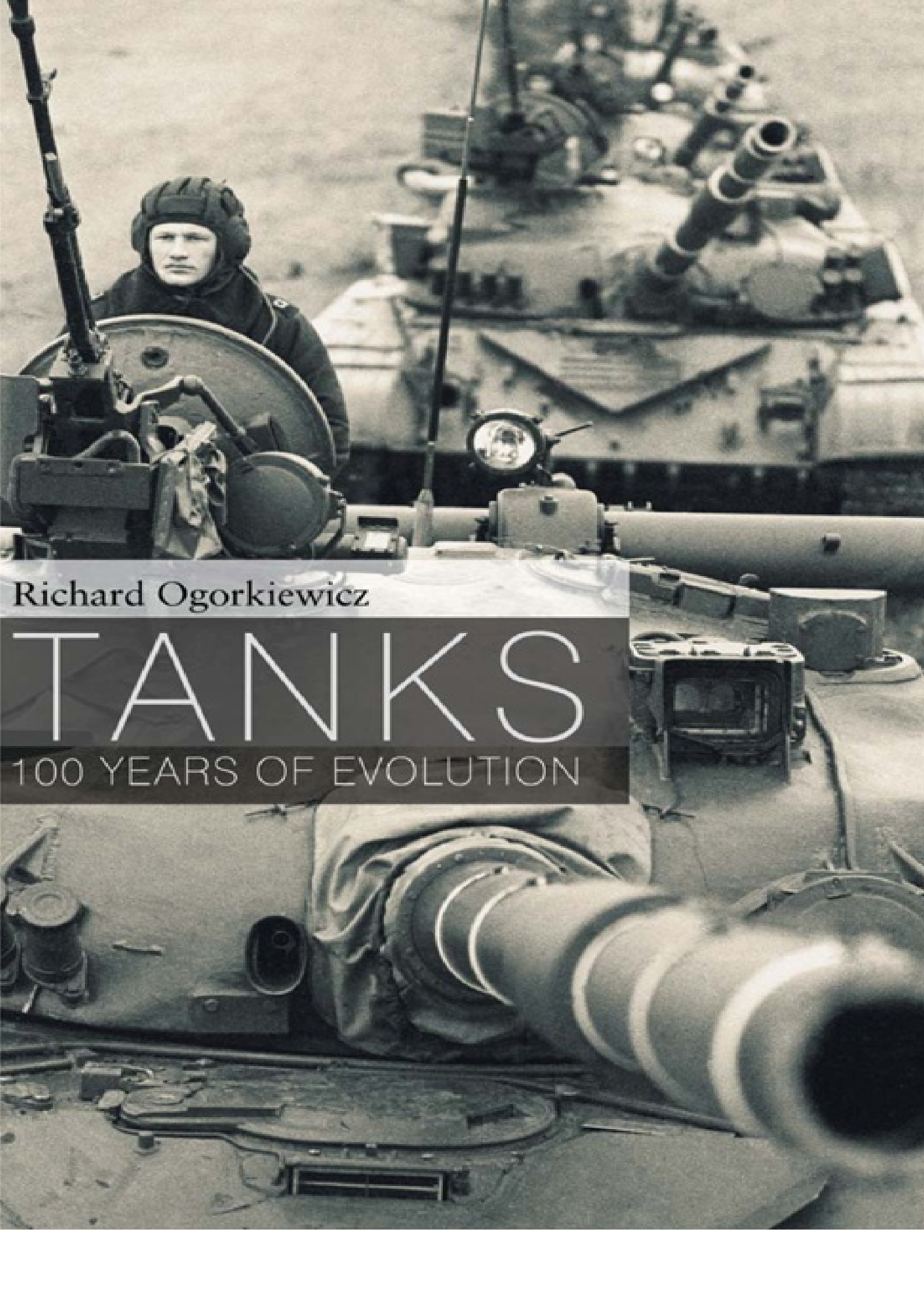


Richard Ogorkiewicz

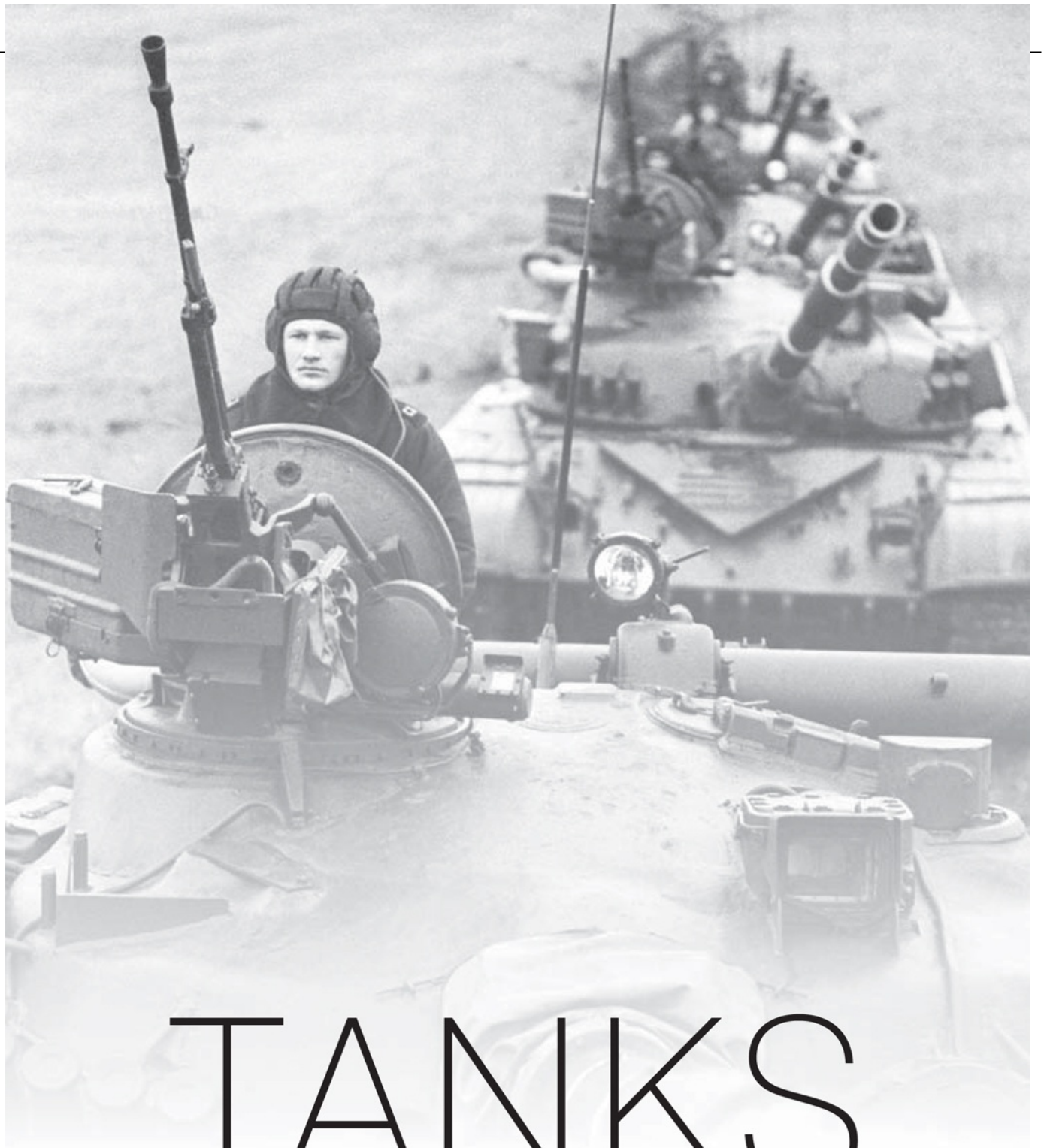
TANKS

100 YEARS OF EVOLUTION

TANKS

100 YEARS OF EVOLUTION

OSPREY
PUBLISHING



TANKS

100 YEARS OF EVOLUTION

Richard Ogorkiewicz

Contents

Introduction

The aim of this book is to present a comprehensive account of the worldwide evolution ar employment of tanks from their inception a century ago to this day.

Because of their military importance and general interest much has been written already abo tanks, including three books of which I have been the author.[1, 2, 3] However, there is much more to b said about them, not only because of the more recent developments or because of tanks' worldwi proliferation but also because of the misconceptions about their origins and other developments.

In consequence, the present account starts with a reappraisal of what led to the development tanks and how they came into being during the First World War. By the end of that conflict tanks ha gained considerable importance but this was not sustained in its immediate aftermath, and a reviv only began when the British Army started in the 1920s to experiment with a more mobile use of tank The subsequent rise in the importance of tanks was accompanied by and was partly due to th advances in their design and performance that were achieved in Europe and America before th Second World War. The enhanced capabilities that tanks consequently acquired enabled them t become the core of combined arms, mechanized formations and these provided the most effective wa of employing them, which was demonstrated by the German panzer divisions at the outset of th Second World War.

The successes of the panzer divisions were followed by a widespread expansion of the armour forces, which came to dominate ground warfare and resulted in the large scale production ar employment of tanks during the Second World War by the Soviet Union, the United States and Britai as well as Germany.

The present account goes on to describe the development of tanks during the years of Cold Wa confrontation between the Western countries and the Soviet Union that followed the Second Worl War, when large numbers of tanks were deployed in Central Europe by the opposing armies and whe

further intensive development of them took place in what were at the time the five leading ta producing countries, namely the Soviet Union, the United States, Britain, France and German Significant developments also took place in a number of other countries, in particular in Switzerlan Sweden and Israel, while others acquired tanks produced elsewhere. Important progress has also be made in the Far East, where Japan, South Korea and China have developed in recent years tanks that some respects have overtaken those built in the United States and Europe, while India and Pakista have embarked on the production, respectively, of the latest Russian and Chinese designs.

Tanks produced in the various countries may appear to differ, but much of the technology o which they are based is common to them and the principal aspects of it are summarized in thr Appendices. The first deals with the general growth in the gun power of tanks and the attempts improve on it by resorting to guided missiles, liquid propellants and electromagnetic launchers. Th second Appendix describes the universal quest for greater protection, which involves not only the us of different armour materials but also explosive reactive armour and computerized active protecti systems. The last Appendix concerns the mobility of tanks and includes, among others, th development of various types of engines as well as the interaction of tanks with the terrain on whi they operate.

Although the book covers a wide field it does not claim to be exhaustive. It does not, therefo attempt to deal with more than the most important or the most interesting of the many tanks that ha been built. Similarly, it does not attempt to do more than indicate the principal operations in whi tanks have taken part, a detailed description of the operations being beyond the scope of one volume.

Richard Ogorkiewi

Acknowledgements

This book is the outcome of several years of study of the evolution of tanks during which I receive
much help and encouragement from many individuals that I would like to acknowledge with gratitud

My early studies benefited from the help given to me by my father, Colonel M. A. Ogorkiewic
and by Colonel R. J. Icks, in his day the leading American historian of tanks, with whom
corresponded regularly over a period of more than 20 years. I also benefited from discussions with S
Basil Liddell Hart, whom I had the privilege of assisting when he was writing his history of the Roy
Tank Regiment and who encouraged me to write my first book on armoured forces.

During the course of my studies I had the good fortune to meet and subsequently be able
correspond with some of the pioneers of tank development, including Lieutenant Colonel Phil
Johnson, whose Medium D tank led the way in the development of more mobile tanks after the Fir
World War, and Leslie F. Little, who, as chief engineer of Vickers Armstrongs, was responsible fo
the design of the Valentine, the most numerous British tank of the Second World War. I also met an
corresponded for several years with Lieutenant General Tomio Hara, who as a young engineer offic
designed the first Japanese tank.

I also met some of the leaders of the more recent development of tanks and was able not only
discuss with them tank design but also to examine and to operate the tanks for which they we
responsible. In particular they included Sven Berge, who was responsible for the design of the high
original Swedish S-tank, and Major General Israel Tal, who led the development of Israel's Merkav
tanks. They also included Dr Philip W. Lett, who as vice president of Chrysler Defense directed th
development of the US Army's M1 tank. All three became close friends and I had the pleasure o
serving with them for several years on the Technical Advisory Group of General Dynamics Lan
Systems.

Others who also became close friends included Dr M. G. Bekker, who introduced me in the ear
1960s to his pioneer work in the United States on soil-vehicle mechanics, and Iwao Hayashi, who l
the Mitsubishi Heavy Industries' team that developed Japan's Type 74 tank.

More recently I was able to share ideas and information with Professor Manfred Held, the invent
of explosive reactive armour, and Dr Vernon Joynt, the South African mine expert, while lecturin
with them on armoured vehicle technology at the Royal Military College of Science over a period
more than ten years.

I have also benefited from sharing information with Rolf Hilmes, who directed studies at t
German Defence Academy in Mannhein, with Christopher F. Foss, the editor of *Jane's Armour an*
Artillery, with Rickard O. Lindstrom, of the Swedish Defence Materiel Administration, and wi
David Fletcher, the historian at the Tank Museum in Bovington, who helped to unravel sever
historical questions.

Richard Ogorkiewicz, Londo

CHAPTER 1

The Origin of the Species

For centuries wars were fought almost entirely with individual weapons wielded by hand. But wh gunpowder came into use, the relative importance of hand-carried weapons gradually diminishe while that of the heavier weapons increased until they became dominant during the 19th century. No other than Napoleon acknowledged this, reflecting on St Helena that 'artillery decides to-day t destiny of armies and peoples'.

However, siege warfare apart, the effectiveness of guns was constrained by their limited battlefie mobility, which, at best, amounted to being hauled by horses from one firing position to another.

Machine guns became an exception to this when they were developed during the latter part of t 19th century because, unlike other non-portable weapons, they were light enough to be mounted and fired from horse-drawn carriages. This offered a way of making them more mobile, which w actually adopted during the civil war that followed the Russian Revolution of 1917. Horse-drav carriages mounting machine guns, or *tachankas*, were then used during the Polish-Russian War 1920–21 by the Red Cavalry Army of Budyenny, and they were retained as standard equipment by t Polish cavalry until 1939 and by the Soviet cavalry well into the Second World War.

But, whatever mobility they provided, horse-drawn machine gun carriages were very vulnerable enemy fire and their utility was to a very large extent confined to engagements between formations cavalry. Moreover, by the time they came into use, far better means of making machine guns, as we as other guns, more mobile already existed in the form of self-propelled vehicles. Guns mounted them could not only be moved more rapidly and fired more readily, but they could also be fitted wi armour protection, which allowed the guns to be deployed more freely under enemy fire.

The first step in the development of self-propelled vehicles was taken by N. J. Cugnot, a Fren military engineer who in 1769 built a three-wheeled, steam-powered vehicle that can still be seen the Musée des Arts et Métiers in Paris. Cugnot's venture was supported by General J. B. Gribeauval, the inspector general of French artillery, who laid the foundations of that arm th Napoleon later used so effectively. A second vehicle was built for further trials but no progress wa made beyond this.[1]

The prospect of developing self-propelled vehicles for military purposes revived in the second ha of the 19th century with the construction of steam-powered traction engines. It has been widely b wrongly believed that a traction engine fitted with Boydell footed wheels was already used by t British Army for towing guns during the Crimean War of 1854–56, the erroneous belief arising out the confusion between Boydell's traction engine and some horse-drawn carts with Boydell's foote wheels that were used in the Crimea. In fact, the first steam-powered engine with Boydell's whee was only demonstrated at an agricultural show in England in 1855 and it was a Garrett-Boydell engin which appeared a year later, which was first tried for pulling a siege gun at the Woolwich Arsenal. T Burrell-Boydell engine, which is generally believed to have been used in the Crimea, was n completed until 1857 when two were ordered for gun-towing trials, again at the Woolwich Arsenal.[2]

Steam traction engines were also used to tow guns on other occasions during the second half of t 19th century. In the meantime, prompted probably by the Crimean War, J. Cowan proposed anothe use of steam traction for military purposes in 1855 in Britain by taking out patent No.747 for 'Locomotive Battery for Field of Battle with a Steam Engine' – a wheeled vehicle with a turtle-lik iron carapace out of which protruded several guns and at the side of which were scythes for mowi

down any troops that might attack it.

Cowan's vehicle was never built, but during the South African War of 1899–1902 the Britis Army used about 50 traction engines for towing supply trucks and guns. In 1900 two of the engin built for use in South Africa by John Fowler and Co. of Leeds were armoured, as were the trucks the towed, to protect them against Boer attacks when they were used for carrying supplies. Eventually th number of the armoured Fowler engines sent to South Africa rose to four.[3] The armour of the Fowl engines and of the trucks was provided with loopholes through which rifles could be fired, and a fie gun could be hauled onto a truck instead of being towed. In principle, there was only a small step fro this to a steam-powered, gun-armed armoured fighting vehicle. Such a vehicle had in fact already bee envisaged by Cowan and was depicted in 1883 by A. Robida in a French journal *La Caricature*.[4]

The ideas of Robida, like those of Cowan, were never implemented, but 20 years later steam powered armoured vehicles were the subject of a story by H. G. Wells, the science fiction write which was published in the *Strand Magazine* in December 1903 under the title 'The Land Ironclads This story is often presented as a prophetic vision of future armoured vehicles and as havi influenced, albeit indirectly, the development of the first British tanks several years later.[5] In fac Wells' 'ironclads' did not represent an advance on Fowler's armoured steam engines built three year earlier so far as their means of propulsion were concerned, and this was equally true of the armament, which still consisted of rifles. Nor did they foreshadow future armoured fighting vehicl in other respects, except for being envisaged to operate off the roads over broken ground. Howeve what was to make this possible was not very practicable, as it was based on the use by the 'ironclad of Pedrails – another type of footed wheel devised around 1899 by B. J. Diplock. This wheel has bee confused with the Pedrail track, which was not brought out by Diplock until 1910, and has led to th erroneous belief that Wells foresaw tracked armoured vehicles.

By the time Wells' story was published a far more effective alternative to steam engines ha already emerged in the form of the internal combustion engine, and the motor cars that they powere became a more practical basis of making guns more mobile. The first to recognize this appears to hav been E. J. Pennington, a fraudulent American vehicle designer who came to England in 1895. Within year of his arrival Pennington produced pictures of four-wheeled motor cars with low, boat-lik armoured hulls above which protruded two Maxim machine guns with shields. What is more, he let be known that such vehicles were being built in Coventry, which was becoming the birthplace of th British motor industry. There is no evidence of what inspired Pennington but, as one of his picture showed armoured vehicles on a beach attacking a naval landing party, it could well have been th threat of cross-Channel invasion, which was seriously considered in Britain in the 1890s.

Pennington's activities led the *Naval and Military Record* to declare in 1896 that 'there is a gre future for the military motor car' and news of them was published in Austrian and French as well a British journals.[6] However, in 1897 a French journal, *La France Automobile*, expressed regret th Pennington's inventions only existed in the form of watercolours.[7] In fact, Pennington never built a armoured vehicle, but the belief he created persisted and more than 60 years later he was still bein credited with building one.[8]

While Pennington never put his armoured vehicle ideas into practice, a vehicle very simila externally at least, to those he depicted was built by F. R. Simms, a German-born British engineer an entrepreneur who was involved with the same motor syndicate as Pennington. After producing th design of a 'motor war car' Simms persuaded the armament firm of Vickers, Sons & Maxim to put u the money for its construction, which they did, and paid him £750 for it, according to the copy of a order dated 20th July 1898 in the writer's possession. A year later Simms exhibited detailed drawing of the vehicle he was building at a motor show in Richmond, Surrey. On the same occasion Simm also demonstrated a powered quadricycle fitted with a Maxim machine gun, which became one of th

first self-propelled vehicles ever to be armed.[9]

Simms' 'motor war car' was completed in 1902, when it was exhibited at the Crystal Palace London. It weighed about 5.5 tonnes with an open-top hull of 6mm Vickers steel and was armed wi two Maxim machine guns and a 'pom-pom' automatic cannon. Powered by a 16 horsepower Daiml engine, it was reported to be capable of moving at up to 9 miles per hour, but its steel-tyred woode wheels restricted it to operating on paved roads. This was accepted as part of its proposed use for coa defence, which formed another link between Simms' vehicle and Pennington's ideas.[10]

The mobility of Simms' vehicle was obviously limited, but it was the first self-propelled vehic that was both armed and armoured, and even if it was not very practical the potential of vehicles of i kind was recognized by the technical press that reported on it. On the other hand no military officia came to see it, which provoked some very sarcastic comments on the attitude of the War Office in or of the motoring journals reporting on it.[11]

The evident lack of official interest in Simms' 'war car' led to it being abandoned, and furth efforts to make heavy weapons more mobile followed the more gradual process of mounting machi guns on motor cars and armouring the latter. The consequences of this process were foreseen by som when only one or two motor cars had been actually fitted with machine guns. One of them was A. G Hales, a correspondent of *The Times*, who from the basis of his observations of the South African Wa wrote in May 1901 that armoured motor cars 'were going to revolutionise affairs both in peace an war'. A similar if more measured opinion was expressed by Brigadier J. H. A. Macdonald who wro in 1902 that 'high speed motor vehicles, with bullet proof sides, would be of great value'.[12]

It was envisaged in both cases that the motor vehicles would be armed with machine guns, and a unarmoured motor car had already been fitted with one in the United States in 1898, a few month ahead of the appearance of Simms' quadricycle. The vehicle was a Duryea three-wheeled passeng car on which Major R. P. Davidson of the Illinois National Guard mounted a Colt machine gun with small shield.[13] This vehicle was followed by a four-wheeled version, and according to a contempora report it was being built 'for city use against mobs', which suggests that it may have been inspired b the disorders which afflicted US cities in the 1890s.[14]

A further step forward took place in 1902 when the Charron, Giradot et Voigt company exhibite at the Salon de l'Automobile in Paris a car with a circular shield of armour plate instead of the re seats and within it a pedestal mounting for a Hotchkiss machine gun. A French Army commissio carried out firing trials with it in 1903 but saw no need for such a vehicle.[15]

Nevertheless, Charron, Giradot et Voigt continued to work on the development of an armoured ca in collaboration with the Hotchkiss company and Major Guye of the French Artillery, whose patente turret it incorporated. The resulting vehicle was still based on a passenger car chassis but it had a ful armoured body surmounted by a turret with a Hotchkiss machine gun. It came to weigh about 3 tonn and was capable of a road speed of 45km per hour.

The new vehicle was ready by the beginning of 1906 when it was inspected by the French minist of war. This was followed by tests during the autumn manoeuvres of the French Army, but commission that reviewed reports on the vehicle as well as other new developments concluded in Ma 1909 that armoured cars should not be considered further because they could not move over all typ of terrain and because of their high production cost. Moreover, the French cavalry preferre unarmoured machine gun cars.[16]

In the meantime the activities of Charron, Giradot et Voigt attracted the attention of the Russia authorities, who are claimed to have considered ordering 36 vehicles but ultimately settled for on which was delivered in 1906. Subsequently they ordered a series of ten, the last of which was still France when the First World War broke out in 1914. It was immediately requisitioned by the Frenc authorities and sent into battle but only to be quickly lost.[17]

While Charron, Giradot et Voigt were developing their armoured car in France, another armoure car was built in Austria by the Österreichishen Daimler Motoren company. It was designed by i technical director, P. Daimler, the son of Gottlieb Daimler the motor car pioneer, who started workin on it in 1903, and it was completed in 1905. In the following year it took part in the manoeuvres of th Austro-Hungarian Army but the latter showed little further interest in it.[18] By the end of the same ye its constructors obtained permission to sell it to France, and at the beginning of 1907 it was tested the Mont Valerien fort outside Paris. Its performance was described as 'spectacular' but this did n alter the negative opinion of armoured cars formed by the 1909 French Army commission.[19]

Like the Charron armoured car, the Austro-Daimler had a fully armoured body that wa surmounted by a hemispherical turret with one or two Maxim machine guns. It was somewhat lighte weighing less than 3 tonnes, and had a lower maximum speed of 24km per hour. But, unlike the othe it had four-wheel drive, which only a few armoured cars were to have until the 1930s. Although the differed in detail, the Charron and the Austro-Daimler cars had a similar general configuration, whic foreshadowed the design of most armoured cars built during the next three decades. However, the example was not followed until 1912. The intervening years did not provide any incentives for th further development of armoured cars and armies did not foresee their future potential.

It took the Italo-Turkish War of 1911–12 to prompt the building of two more armoured cars. Bot were built at the Arsenal in Turin and were presented to the Italian Army for use in Libya by th Automobile Club of Milan.[20] One of them was based on a Fiat motor car fitted with an armoured boc surmounted by a small cylindrical turret with a machine gun. The other, which was generally simila was based on a Bianchi or Isotta-Fraschini car chassis. The two armoured cars were shipped to Liby in the autumn of 1912, but by then fighting had almost ceased and their use was limited mainly escorting columns of other motor vehicles.[21] Nevertheless, they became the first armoured cars to b used in military operations.

Two more armoured cars are reputed to have been built in Italy in 1913 and they, together with th two earlier Italian armoured cars and the ten produced in France for Russia, were the only additions the number of armoured cars constructed before the outbreak of the First World War.

Yet motor cars were already being used in large numbers. In Britain, for instance, their annu production rose from 10,500 in 1908 to 34,000 in 1913 and in the United States the number of ca built in 1914 was no fewer than 573,000. Nevertheless, armies continued to rely on horses. The approach to motor vehicles was cautious, to say the least, and it was only under the pressure of even that they took up motor vehicles in earnest. For example, before the outbreak of the war in Augu 1914 the French Army possessed only 220 motor vehicles. The British Army had even fewer of them its total of mechanical transport vehicles amounting to 100. But by the end of 1914 the French Arm acquired 13,000, mainly by requisitioning civilian vehicles, and by the end of the war in 1918 ha 95,000 motor vehicles.

Similarly, it was only after the outbreak of the war that armoured cars came into use. Th happened almost spontaneously as a result of the use of motor cars for reconnoitring and for harassin enemy forces in the opening stages of the war.

One of the countries in which this happened was Belgium, where within the first month of th outbreak of the war armoured cars began to be improvised on Minerva car chassis and used to hara the invading German forces. Almost simultaneously improvised armoured cars also began to be use in France. Recognizing their potential, the French minister of war ordered 136 armoured cars August 1914, and a month later the first unit of them was attached to a cavalry corps to provid mobile fire support. The original French armoured cars were based on a variety of motor cars, b their construction was followed by another order to the Renault company for 100, this time all built o the same standard 18 horsepower car chassis, and they became operational before the end of 1914.[22]

At the time Russia had virtually no motor industry but its one car company, the Russo-Balt located in Riga, Latvia, built an armoured car soon after the war started, and subsequently produced few more so that a unit could be formed that was sent into action in October 1914.[23] More armoure cars were ordered by the Russian authorities from abroad and especially from Britain. The mo numerous of the British cars were produced by the Austin company to a Russian design, whic incorporated a very peculiar arrangement of two side-by-side machine gun turrets. Their tota including armoured cars built in Russia on Austin chassis, rose eventually to more than 200. Mo armoured cars were procured from other companies and some were also built in Russia using importe chassis, bringing the total acquired by the Russian Army to more than 600 in 1917.[24]

Improvised armoured cars also began to be used after the outbreak of the war by the British force However, in a bizarre twist of events, their use was taken up not by the Army but by the Royal Nav Air Service (RNAS). It arose out of the forward deployment in France of an air squadron of the RNA charged with the defence of south-east England against attacks by Zeppelins. As a result of thi armoured cars were improvised to support flying operations by ground reconnaissance and to provi protection. At first there were only two of them, but in September 1914 the First Lord of th Admiralty, Winston Churchill, authorized the procurement of 60 more. These were still of a fair primitive type, with open-top hulls and based on three different motor cars. But the RNAS forme with them four armoured car squadrons and proceeded to develop better vehicles. The outcome of th was an armoured car of about 4 tonnes based on the Rolls-Royce 'Silver Ghost' car chassis, which wa armed with a machine gun in a revolving turret and which was normally operated by three men. I design proved to be the most successful of those devised during the First World War and became model for other armoured cars built during the following two decades, while some of the vehicl originally based on it were still being used, albeit with modifications, by the Royal Air Force in Ira in 1941.

The first three of the turreted Rolls-Royce armoured cars were delivered in December 1914 an soon afterwards RNAS formed a new squadron with 12 of them. The formation of five more suc squadrons followed, as did that of others equipped with different types of armoured cars, the tot number of which came to about 140, including 78 Rolls-Royce cars.[25]

Italy bypassed the use of improvised armoured cars as a result of not entering the war until Marc 1915. By then the use of the Belgian armoured cars had attracted the attention of the Italian minist of war, who ordered the armament firm Ansaldo to develop an armoured car for the Italian Army. Th outcome of this was a turreted armoured car based on the Lanzia I.Z. car chassis. Deliveries of began in June 1915, when the first Italian armoured car unit was formed.[26] Eventually about 12 Lanzia I.Z. armoured cars were deployed by the Italian Army, which used them for the rest of the wa They proved as durable as the Rolls-Royce, as some were still in use in Africa in 1941.

In 1915 the use of armoured cars spread outside Europe and in particular to India, where about 6 armoured cars were improvised to bolster the internal security forces depleted by the departure British and Indian troops for service on the different war fronts. In 1915 the first armoured car wa also built in the United States. Interestingly, it was designed by R. P. Davidson, the pioneer of th installation of machine guns on motor cars, and was based on a Cadillac car chassis. A year later th US Army deployed its first two armoured cars during the operations along the Mexican border again Pancho Villa.[27]

Thus armoured cars had come to be used in a number of countries. Most were armed with one two machine guns, but a proportion of the French cars were armed with 37mm cannon, while som British as well as French vehicles carried 47mm cannon, and a few Russian armoured cars, based o American Garford truck chassis, even mounted short-barrelled 76mm guns.

Armed with these guns, armoured cars were what would later be described as mobile weapo

platforms. As such they constituted a revolutionary advance in the employment of some of the heavi weapons by increasing their mobility well above that provided earlier by animal traction. They als provided a degree of protection for their crews, although this was an adjunct to their mobility: enabled them to operate more freely under fire but was subservient to their basic function of being mobile source of fire power.

All this meant that armoured cars had the characteristics that have come to be associated wi armoured fighting vehicles. But they could only act as such in a very restricted sense because the were generally confined to operating along roads. In fact, for much of the time they were tied to roa almost as much as armoured trains were restricted to operating along railway tracks.

This did not handicap the armoured cars greatly on the Western Front at the beginning of the Fir World War, when there was no shortage of roads along which they could operate. There was therefor no lack of opportunities for the original Belgian, French and British armoured cars to skirmish alon them. But when the opening, mobile phase of the war was followed by trench warfare, roads were c or blocked and the conditions that allowed armoured cars to operate vanished. It was only three yea later, in the final stages of the war when the fronts began to break, that they were used effectivel again on the Western Front.

This happened in March 1918 during the final German offensive, when a total of about 1 armoured cars attached in small units to French cavalry divisions fought a series of delaying actions Another opportunity occurred in August 1918, during the Battle of Amiens, when armoured cars of British battalion equipped with 16 twin-turret Austins left over from the Russian orders drove throug a breach in the enemy lines and wrought havoc behind them.[29]

In the meantime, when the opportunities for their use in France disappeared in 1915, squadrons what had by then become the Royal Naval Armoured Car Division were sent to other theatres operations where it was thought there would be greater scope for their employment. This include German South West Africa (present Namibia), German East Africa (now Tanzania) and Gallipoli, bu in the event they provided few if any opportunities. There appeared to be greater scope for th employment of armoured cars on the Eastern Front, where there was more room for manoeuvre. consequence a relatively large Royal Navy unit equipped with 20 or more Lanchester armoured car which were similar to the Rolls-Royce, was sent to Russia. It became best known after i commanding officer, Commander Locker-Lampson, and operated in 1916 in the Caucasus and then o the Romanian and Ukrainian fronts. In the course of its far-flung operations the unit overcame som very difficult terrain conditions, which spoke well for the armoured cars at this early stage of the evolution, but the military impact of its small scale actions was very limited. The same applied to th Russian armoured cars, which, although more numerous in total than all the others, were used in sma units and could only claim some local successes.[30]

In fact, armoured cars could not have achieved greater results even if they had been concentrate in larger units because they could not spread out on the roads and could, therefore, only fight alon them in ones or twos. In consequence, it was only in exceptionally favourable circumstances that the could move off the roads and act more decisively.

A rare example of this was provided by the British armoured cars sent to Egypt in 1915. In Marc 1916 a unit of nine of the Rolls-Royce armoured cars commanded by the duke of Westminster too advantage of the relatively hard, flat ground to dash at up to 40 miles per hour to surprise a larg Arab-Turkish force at Bir Aziz south of Sollum in Cyrenaica, which the armoured cars charged, in lin abreast, routing it completely.[31, 32, 33]

To act equally effectively under conditions less favourable than those of the Cyrenaican deser armoured cars would have required the ability to operate over other, more difficult types of terrai The need to provide them with this capability was in fact perceived in more than one country by 191

The consequent pursuit of it led to the use of tracks instead of wheels and hence to the next stage the evolution of armoured fighting vehicles, which was the development of tanks.

CHAPTER 2

The ‘Invention’ of the Tank

The coming into being of tanks, the first and the most important of the tracked armoured vehicles, commonly described as a unique event inspired by the ideas of one man, who is usually identified Lieutenant Colonel E. D. Swinton, an engineer officer of the British Army. Such accounts bear litt relation to what actually happened, although Swinton himself professed that it was true. He made th very clear in his memoirs, written several years after the first British tank was built, in which described himself as its ‘originator’ and included a chart showing how the ideas leading to it, ‘seeds’ as he called them, sprang from him.[1]

In fact, tanks were the outcome of the ideas and activities of several men, and any contributi that Swinton might have made to their evolution was small and indirect. Moreover, the construction the first tanks was preceded and based on developments that took place during the previous ha century.

The most important of these developments was that of the tracked running gear. Its use in stea traction engines was proposed as early as 1858 or 1859 in patents taken out in the United States. 1867 at least one steam-powered tractor was actually built there with its two rear wheels as well as t front steering wheel replaced by short tracks.[2] However, the development of tracked tractors did n begin in earnest until 1904, when B. Holt replaced the rear wheels of one of the steam traction engin produced in California by his company by tracks. Because it retained its front steering wheels, Holt original tracked tractor was what would later be called a ‘half-track’, as were other tractors produc by him until 1912.

In the meantime, in 1905, a further advance took place when Richard Hornsby built the first ful tracked tractor in Britain. It was shown in 1905 and 1906 to the Mechanical Transport Committee the War Office, which was sufficiently impressed to conduct official trials in 1907. A year later Hornsby tractor even took part in a revue at Aldershot before King Edward VII, and in 1909 the W Office ordered a somewhat smaller tractor designed by Hornsby to military requirements, which h been preserved to this day at the Tank Museum at Bovington in Dorset.[3] This tractor was tested Aldershot, but after about 1911 the British Army lost further interest in tracked tractors, although th tractor built to its requirements was exhibited in London at the beginning of 1914.

Seeing no opportunities for further business in Britain, Hornsby sold his tractor patents to the Ho Manufacturing Company in California, which started to produce tracked tractors on a regular basis 1908 and subsequently exported a few of them to Europe in addition to those sold to America farmers.

While it lasted, the interest of the War Office in the Hornsby tractors was prompted by the possible use for hauling guns. But in 1908 a member of the Mechanical Transport Committee, Maj W. E. Donohue, suggested that instead of being towed a gun be mounted on a tractor and provide with some form of protection. This amounted to a proposal for a tracked self-propelled gun, b Donohue’s suggestion was not pursued.[4]

Remarkable as it was, Donohue’s proposal was not the first of its kind. Five years earlier a Fren artillery officer, Captain Levavasseur, put forward a scheme for a self-propelled 75mm gun on a armoured tracked chassis. The scheme was considered by the French Artillery Technical Committe but the latter came to the conclusion that animal traction was preferable for guns and finally reject the scheme in 1908.[5]

Other proposals made before the outbreak of the First World War in 1914 did not fare any bette
The most interesting of them was made by Captain G. Burstyn, an Austrian officer who apparent
saw a Holt tractor in 1911 and this inspired him to design a '*motorgeschutz*', a tracked armour
vehicle with a turret mounting a cannon and with rollers on extended arms to assist the crossing
trenches. Burstyn offered his design to the Austro-Hungarian War Ministry but the latter rejected it.[6]

In Russia, V. Mendeleev, the son of the famous scientist, is reputed to have started working i
1911 on the design of a tracked armoured vehicle armed with a 120mm naval gun, but his work did n
advance beyond drawings.[7] Another design originated in Australia, where L. E. de Mole, a civ
engineer, produced drawings of a tracked armoured vehicle. He submitted his design to the Britis
War Office in 1912 but the latter showed no interest in it.[8]

The idea of a tracked armoured vehicle had clearly emerged in more than one country before th
outbreak of the First World War in 1914, but failed to arouse the interest of the military authorities i
any of them. To be fair, few tracked tractors from which tracked armoured vehicles were to be derive
had been built and their characteristics or even existence were not widely known. What is mor
armies did not fully appreciate the growing importance of heavy weapons and the extent to which the
effectiveness was constrained by their limited mobility, based as it generally was on horse traction.
consequence they were less receptive than they might have been to the idea of tracked armour
vehicles, which offered to make heavy weapons more mobile and to a far greater extent than armour
cars had done already.

Once the war began, heavy weapons and in particular machine guns and field guns, until the
regarded as only an adjunct to the rifle armed infantry that constituted the bulk of the armies, prove
dominant. At the same time horse traction failed to provide them with the mobility necessary f
offensive action. All this favoured static defence in which heavy weapons needed little, if an
mobility and in which they could be used to full effect. The effectiveness of static defence was furth
increased by the use of entrenchments and barbed wire.

The outcome was deadlock, particularly on the Western Front in France, with neither side beir
able to break through the other's defences by the traditional massed infantry attacks. The immedia
problem became that of finding a way that would enable the infantry to continue to attack in the fa
of machine guns and barbed wire. In response to this came proposals for armoured assault vehicl
that would pave the way for the infantry by attacking enemy machine guns and by crushing the barb
wire.

The first in Britain to think of using tracked vehicles to solve the problems created by the onset
trench warfare appears to have been Swinton, and to this extent he deserves credit for originality. B
what his thoughts were is not very clear and, whatever they were, any influence they might have ha
on the development of the first British tanks was indirect and limited.

According to his own account written several years after the event, the idea of a tracked armour
vehicle came to Swinton suddenly in October 1914 when he recalled the description of a Holt tract
sent to him four months earlier. This occurred while he was travelling to England from France whe
he was acting as the sole official correspondent with the British Expeditionary Force (BEF). On arriv
in London he discussed his views with Lieutenant Colonel M. Hankey, the secretary of the influenti
Committee of Imperial Defence.[9] There is no record of what was actually discussed but it seems
have included the possibility of converting tracked tractors into some kind of assault vehicle, and suc
a vehicle is alluded to in a letter written a month later by Swinton to Hankey.[10]

A clearer outcome of the contacts is a device described in a memorandum written by Hankey
December 1914 and this, according to Swinton, embodied what he had put to Hankey.[11] But wh
Hankey proposed was only a large heavy roller pushed by a single, engine-driven track and provide
with an armoured cab for a driver and a machine gun. As Hankey explained, the object of this devic

would be ‘to roll down the barbed wire by sheer weight’.[12] What he was proposing was therefore specialized wire crusher and not an armoured fighting vehicle.

A copy of Hankey’s memorandum was sent, among others, to the First Lord of the Admiralty Winston Churchill, who after receiving it wrote to the Prime Minister, H. H. Asquith, saying that h agreed with Hankey about the use of ‘special mechanical devices for taking trenches’. However, h saw them in a different form from that envisaged by Hankey, namely that of steam tractors that we armoured and fitted with machine guns as well as tracks. The prime minister then took the matter u with the Secretary of State for War, Lord Kitchener, and this led to the formation of a War Offic committee that was to consider the possible adaptation of tracked tractors to the role of assau vehicles. As part of its activities the Committee arranged tests of a Holt tractor over an obstac course made up of trenches and barbed wire entanglements in February 1915. The tractor, handicappe by being made to pull a heavy trailer, failed to cross some of the trenches, which led the Committee t conclude that what was proposed was impracticable and to abandon further consideration of it.

Prior to the test the Committee received a memorandum written by Captain T. G. Tulloch, a artillery officer recommended by Swinton, which more clearly than hitherto envisaged armoure vehicles armed with machine guns that could move across country and over barbed wire to attac enemy trenches. The vehicles were to be based on Holt tractors but coupled in pairs to for articulated vehicles – which Tulloch appears to have been the first to propose in 1911 in sketches of large articulated armoured vehicle.[13] However, the ideas contained in Tulloch’s memorandum wer not taken up. But its title, which was ‘Land Ship’, became the designation of the first British tracke armoured vehicles and also reflected the influence of naval ideas on contemporary thinking.

In the meantime Churchill had Hankey’s idea of using large rollers to crush barbed wire put to te by the Royal Naval Air Service, which he controlled. The test was carried out using steam roller which proved incapable of climbing the slightest slope, and the whole idea was abandoned. As a resu Churchill turned his attention to other ideas. These were put to him by officers of the RNAS who we seeking vehicles more capable than their armoured cars, which were becoming ineffective with th onset of trench warfare.

The earliest of these ideas came from Flight Lieutenant T. G. Hetherington, who in Novemb 1914 proposed to Commodore M. Sueter, the director of the Admiralty Air Department who was i charge of the RNAS, the construction of a giant three-wheel armoured vehicle armed with 12i (309.8mm) naval guns. Sueter realized that this was not a practical proposition but was prepared pursue the idea of a scaled down version, which he submitted to Churchill in January 1915.

The vehicle that was now being proposed was still very large, the front two of its three whee having a diameter of 40 feet (12m). Moreover, it was to have three turrets, each with two 4in. gun while its weight was estimated to be 300 tonnes. In its proposal it was described as ‘a cross-countr armoured car of high offensive power’, which showed that the aspirations of the RNAS officers we sound. But their judgement of what was practicable was not. It is not surprising therefore that whe Churchill referred the proposal to the Admiralty it was turned down by one of its experts, Admiral S Percy Scott.[14]

However, Hetherington’s idea of a large three-wheeled vehicle was not entirely irrational. Such vehicle with two driving wheels with a diameter of 10m, or almost as large as those of Hetherington proposed vehicle, was actually being built in Russia in 1915. Its construction was promoted by M Lebdenko, the head of the experimental laboratory of the Russian War Ministry, and was allegedl supported by the tsar. But it was abandoned as impracticable without being completed.[15]

Although it was not practicable and in spite of its rejection by Admiral Scott, Hetherington did n abandon his idea of a large-wheeled vehicle and got a chance to put it directly to Churchill at a dinn on 14 February 1915. This time Churchill showed greater interest in it and referred it to the Direct

of Naval Construction, E. H. T. d'Eyncourt. The latter concluded that the proposed vehicle wou weigh 1,000 tonnes and was not therefore practicable. But he did not reject the concept of a larg wheeled armoured vehicle, and suggested that Hetherington's vehicle be replaced by a smaller one Churchill agreed and ordered the formation of a committee chaired by d'Eyncourt to pursue the ide put to him. This came into being on 20 February 1915 under the title of 'Landships Committee'.[17]

While these events were taking place, Sueter was pursuing his interest in the use of track originally for mobile armoured shields to be pushed by infantrymen in front of them lik wheelbarrows. Then, having apparently turned against big wheel vehicles, he began in February 191 to consider the design of a tracked 25-tonne armoured vehicle armed with a turret-mounted 1 pounder gun. The design was produced in collaboration with B. J. Diplock and incorporated th latter's Pedrails, which were the only tracks made at the time in Britain.[18]

By the time the Sueter-Diplock design was drawn, the Landships Committee had come in existence and shortly afterwards was informed about it. In consequence, the committee had tw different designs to consider, one being that of a wheeled vehicle derived from Hetherington proposals but with wheels having a diameter of 16 feet (4.9m) instead of 40 feet, and the other being tracked vehicle with Pedrails. The committee reported on them to Churchill, who, relying on th advice of d'Eyncourt that the two proposed designs were viable, took it upon himself to authorize o 26 March 1915 the construction of six-wheeled and 12-tracked vehicles.[19]

The order for the wheeled vehicles went to the William Foster Company in Lincoln. Their wor suffered a series of false starts and the order issued to them was cancelled in June 1915 without vehicle being built.[20] Work on the tracked vehicles produced more tangible results. It was directe initially by Colonel R. E. Crompton, an experienced engineer who pioneered the use of steam tractio engines in India in the 1870s and was then involved with their use in the South African War, who wa appointed a consultant to the Landships Committee.

Working with another engineer, L. A. Legros, Crompton produced a design similar to tha conceived by Sueter and Diplock. But, instead of having a turret with a 12-pounder gun, Crompton vehicle was to be an armoured carrier capable of carrying as many as 50 or even 70 men, which can to be considered at that stage the tactical purpose of what were beginning to be called 'landships Otherwise it was to have the same peculiar configuration as that adopted by Sueter and Diplock, whic consisted of a long rigid chassis resting on two wide Pedrail tracks arranged in tandem, each driven b a separate engine. The vehicle was to be steered by turning the track assemblies in relation to th chassis, which meant that its turning circle was impractically large. Crompton realized this eve before the vehicle was built, which it eventually was in a reduced form by the Stothert and Pi company in Bath, and proved unsatisfactory.[21]

The failings of the original design became clear to Crompton after a visit to France on 21 Apr 1915 when he concluded that the vehicle he was designing would not be able to negotiate the bends roads and village streets. In consequence, he decided to abandon the original design in favour of a articulated vehicle that would have a smaller turning circle and therefore be more manoeuvrable. Th idea of an articulated tracked vehicle was not entirely new, as one had already been proposed b Tulloch, and it was actually implemented by Diplock who exhibited an articulated tracked truck i London in 1913.[22] But no other articulated tracked vehicle had been built and it was going to tak more than 40 years before one was successfully developed.[23]

Each section of Crompton's second articulated vehicle was still to have only one Pedrail track. Bu by May 1915 he recognized the shortcomings of the complicated and heavy Pedrail tracks, which ha not been used successfully in any vehicle, and recommended the purchase of American tractors wi lighter and proven tracks. As all the available Holt tractors had been earmarked already for the Britis Army for gun towing, the Landships Committee ordered two similar 'Creeping Grip' tractors from th

Bullock Tractor Company of Chicago.[24] Following this Crompton started working on his third desig which was similar to the second design but with each section of the articulated carrier having tw Bullock tracks.

In addition to recommending the purchase of the two Bullock tractors, Crompton also arranged th purchase of a lighter American tractor produced by the Killen Strait company. This tractor was almo unique in having a short track instead of the steering wheel that almost all contemporary tractors sti had. This was not of any mechanical merit, but the two main tracks of the Killen Strait tractor we very effective for their day. As a result the Killen Strait tractor was used very successfully in Jun 1915 to demonstrate for the first time the ability of tracked vehicles to negotiate barbed wi entanglements and other obstacles in front of the Minister of Munitions, Lloyd George, Churchill an others whose support was essential for the development of landships.[25] The Killen Strait tractor wa subsequently fitted with the hull of an RNAS Delaunay-Belleville armoured car, and this combinatio became in July 1915 the first, albeit only experimental, tracked armoured vehicle.

When the two Bullock tractors arrived in England they were coupled to test Crompton's concept o an articulated vehicle. Tests of the coupled tractors were carried out in July 1915 and showed that a articulated vehicle would be difficult to develop.[26] In consequence, the Landships Committee decide to abandon further work on it and at the same time terminated the appointment of Crompton as i consulting engineer. Instead of the large articulated troop carrier that was aimed at until then, th Landships Committee decided to develop a smaller vehicle with a rigid, one-piece hull and a turre mounted cannon. An order for such a vehicle was issued on 29 July to the William Foster Compan which had worked previously on the wheeled landships. It proceeded with remarkable speed and ha the vehicle built and running by 6 September 1915.

The vehicle built by Fosters, which came to be known after its managing director W. A. Tritton corresponded to one half of Crompton's third design, that is the articulated carrier with lengthene Bullock tracks. In the interest of speed Tritton used the engine, gearbox and differential of a heav wheeled artillery tractor that his company was producing. He also copied the method of steering use by the Bullock as well as other contemporary tractors, which involved a pair of steering wheels b mounted behind instead of in front of the vehicle. However, the vehicle could also be steered b braking one of the output shafts of the differential – a method first used by Hornsby 10 years earlier.

Tritton's vehicle was only an experimental machine with a box hull of boiler plate and a fixe dummy turret. But it provided, at last, a sound basis for the mechanical development of landship When it began to be tested its Bullock tracks proved unsatisfactory and it was rebuilt with a long and stronger type of track. The new type of track was designed by Tritton, whose prior experience track development was confined to a single half-track tractor called 'Centipede' built by his compan in 1913. Nevertheless, the track proved successful and its performance was crucial to the furth development of landships.

When it was modified and fitted with the new type of track, Tritton's vehicle became known a 'Little Willie' and in that form has been preserved at the Tank Museum at Bovington. It wa successfully demonstrated in December 1915, and because of its longer tracks could cross wid trenches than in its original version, whose 4ft trench crossing capabilities proved inadequate when was first tested in September 1915.[27]

In the meantime the Landships Committee had established contact with the War Office and on 2 August 1915 received from it a set of requirements to be met by landships. These requirements we derived from three memoranda submitted by Swinton to the General Headquarters of the Britis Forces in France between 1 and 15 June and sent on to the War Office on 22 June.[28] In the memoran Swinton set out his ideas concerning 'machine gun destroyers built on the caterpillar principle th would lead infantry assaults on enemy trenches' and suggested, among others, that they should be ab

to cross trenches 5ft wide. This was subsequently incorporated in the War Office requirements whic
the Landships Committee received on 26 August.[29]

However, on 29 June Swinton wrote again to the General Headquarters tentatively suggesting th
the trench crossing requirement be increased from 5 to 8ft.[30] This suggestion obviously arrived to
late to be included in what was sent to the War Office seven days earlier and was not part of th
requirements received by the Landships Committee.

Whether Swinton's 8ft trench crossing requirement was ever made known to the designers of th
landships is an open question. If it was it could only have been after they received the War Offic
requirement for a 5ft trench crossing capability on 26 August, by which time they were bound to hav
started thinking of improving on the design of the first landship since a full size wooden mock-up
the second landship was already built by 19 September, when Swinton first saw it.[31]

Nevertheless, after seeing the mock-up of the second landship Swinton declared that it was 'th
actual embodiment of my ideas and the fulfilment of my specification'. In fact, the only feature of th
second landship that might have provided some justification for such a claim was its ability to cro
wide trenches. But, although this was similar to what Swinton had belatedly suggested to the Gener
Headquarters, the second landship was designed without reference to him and the general ideas
represented were already embodied in the first landship, which, as Swinton himself acknowledge
was not built to his specification.[32]

As to Swinton's more general claim, quoted earlier, to have been the 'originator' of the tan
Churchill, who was closely connected with its development, rightly observed 'there was never
person about whom it could be said "this man invented the tank"' and added, with some justificatio
that the tank was a child of the RNAS.[33] But when Sueter quoted this in a book in which he tried to p
on record the achievements of the RNAS, Swinton wrote on the margin of his copy of the book now
the possession of the present writer 'It was not. EDS', refusing to let go of the claim that h
assiduously fostered for many years.[34, 35]

The second landship was actually designed by Tritton and Lieutenant W. G. Wilson, an enginee
seconded from RNAS to Fosters who was to become well known for his designs of epicycl
transmissions. Its salient feature was the novel layout of the tracks, devised by Wilson.[36] Th
provided the tracks with a high, upturned nose and a high return run so that they went around the boo
of the vehicle instead of being below it. The upturned nose was inspired by the high parapets of enem
trenches, and together with the long length of the tracks provided the second landship an exception
trench crossing capability that greatly exceeded the War Office requirements. It also gave the secon
landship its characteristic rhomboidal silhouette.

The configuration of the vehicle did not lend itself to the installation of a turret and the origin
idea of arming it with a turret-mounted gun was therefore discarded. Instead the vehicle was arme
with two guns mounted in sponsons projecting out of its sides – a contemporary mode of mounting th
secondary armament of the larger warships. As the Army was short of suitable guns, the vehicle wa
armed with 57mm 6-pounder naval guns that the Director of Naval Ordnance promised to supply
sufficient quantity. In addition to the two 57mm guns the vehicle was also armed with three machin
guns.

In other respects the second landship followed Tritton's machine. In particular, it was powered b
the same 105 horsepower Daimler engine and had the same Foster wheeled tractor transmission
well as a pair of steering wheels at the rear. It also ran on the same type of unsprung plate track as i
forerunner. The thickness of its armour, which was simulated by soft steel plates, varied from 6
12mm and fully laden it weighed 28 tonnes.

Development of the vehicle proceeded with remarkable speed: a mock-up of it was built
September 1915, its design was completed in October and the vehicle itself was completed by

January 1916. It was at first referred to as the 'Wilson machine' but later as 'Big Willie' and 'He Majesty's Land Ship Centipede', and eventually as 'Mother' as it became the progenitor of the Britis heavy tanks of the First World War.

By February 1916 the Army finally decided that it wanted what by then had began to be calle tanks rather than landships for reasons of secrecy. However, its decision was only taken after trials o Mother at Hatfield in January and February 1916 during which it successfully negotiated all obstacle This included trenches 9 feet wide, while the official requirement was still that it should cro trenches 5ft wide and not what Swinton ultimately suggested.[37] Its performance convinced most of th military and civilian officials who attended the trials of its potential value, although Lord Kitchen dubbed the tank 'a pretty mechanical toy'.

However, the decision to go ahead with the production of tanks similar to Mother was, curiousl left to the General Headquarters of the British Forces in France. Its representatives attended the tria at Hatfield and recommended the acquisition of tanks, although only 40 were subsequently asked fo On hearing of this ridiculously small number Swinton, who had returned to an influential governme post in England in August, persuaded the War Office to raise the number of tanks to be produced t 100 and on 12 February 1916 the Ministry of Munitions authorized their production.

Thus the evolution of tanks in Britain reached the end of its experimental phase and entered that production and use in the field.

Concurrent with the development of the tank in Britain and with no knowledge of it, the tank wa also developed in France. That this should have happened is not entirely surprising since the tw countries faced the same military problems and possessed or had access to similar technologic resources. Nevertheless, it is remarkable that some of the steps in the development were taken in th two countries at almost the same time. This applied, among others, to the decisions to produce tank which were taken in Britain and in France within days of each other.

The French decision was bolder as it called for the production of 400 tanks. However, no prototyp of the French tank had yet been built and the French production order took several more months implement than the British.

As in Britain, the development of the tank in France was preceded by proposals for the use special devices to overcome the problems created in 1914 by the onset of trench warfare and particular that of attacking trenches protected by barbed wire. The first of them appears to have been proposal made in November 1914 to convert a road roller into an armoured vehicle that would crus barbed wire. The proposal was actually implemented and the resulting Flot-Laffly roller was teste but only to be rejected as being impractical, like the rollers considered in Britain by Hankey and b Churchill. Another proposed barbed wire crusher consisted of the Boirault apparatus – a bizarre devic consisting of six large, 4 metre by 3 metre linked skeleton panels engine-driven by chains to mov forward as if it were a hexagonal wheel or six-link track. On the advice of the French commander-i chief a ministerial commission rejected this device outright, but it took a demonstration carried out months later to make another commission, representing the technical services of the Army, reach th inevitable negative conclusion.

A different method of breaching barbed wire entanglements, which amounted to the use of a larg wire cutter mounted on a wheeled agricultural tractor, was proposed in November 1914 by J. L Breton, an influential deputy to the National Assembly. This method was tested in July 1915 and, i spite of the inadequate performance of the tractor over broken ground, the Ministry of War ordere the construction of ten Breton-Prétot wire cutters.[38]

Much more practical results followed the development of an armoured car on which the Schneid armament company of Le Creusot embarked towards the end of 1914. By mid-January 1915 its desig had been drawn, and later that month a Schneider engineer involved with the project, E. Brilli