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Technology Development in Coalition: The Case of the First World War Tank

PERHAPS BECAUSE THE tank was the only weapon of war to be designed, developed, and deployed entirely between 1914 and 1918, it is often credited with achieving far more than it did. This article ignores the merits and defects of the tank as a new weapon in order to examine the opportunities for co-operation it gave to the allies who developed it, France and Great Britain. The tank's history illustrates both the way the relationship between the partners evolved, and their ambivalent attitude to their eventual associate, the United States.

With the tank, opportunities for allied co-operation were there for the taking. There was no reason to build incompatibilities which might impede interoperability (differing calibres, or metric versus imperial measurements) into a new weapon; nor a history of production to prevent joint development. The infrastructure of France's munitions industry and its world leadership in automobile- and aero-engines, and the pre-eminence of its premier 75mm field gun, complemented Britain's command of world resources of coal and steel, and of shipping for their transport. Despite France's loss of its coal- and steel-producing areas to Germany in 1914, its munitions capability complemented Britain's pre-eminence in light engineering. Lastly, the wish of both the tank's French and British sponsors to deploy it en masse would be more easily fulfilled with the savings in time and cost that joint production and deployment might bring.

The record of allied co-operation is tracked here through three phases of production and deployment. The first covers the tank's genesis to the deployment of fifty on the Somme in 1916; the second covers its deployment in 1916 and 1917, the tactical lessons learned, and the improvements in design to which they led; and the third covers the attempts to increase production and to exchange tanks in 1918.

* * *

The idea of using an armoured vehicle to end the stalemate at the end of 1914 arose independently in France and Britain. Such a vehicle was needed to restore mobility to the battlefield by crushing enemy wire and crossing

trenches, and to enable the accompanying infantry to cross the no man's land between the opposing lines of trenches with some protection from machine-gun fire.

In Britain, a colonel of the Royal Engineers, E. D. Swinton, conceived as early as October 1914 of a motorized machine-gun destroyer able to cross trenches and belts of barbed wire. When he put his idea to the cabinet secretary, Maurice Hankey, and to army headquarters in France (GHQ), little resulted, except, typically, for a memorandum from Hankey. At the admiralty, however, the first lord, Winston Churchill, had set in train experiments with armoured cars to protect the Royal Navy Air Service's aerodromes along the French coast. Churchill set up a Landships Committee, which met on 22 February 1915 to consider the production of an armoured vehicle to cross trenches and crush barbed wire. Between March and June, substantial engineering work was carried out on its design.

Only after the commander-in-chief in France, General Sir John French, showed an interest was real progress made towards the deployment of the new weapon. The war office, with good reason, dismissed a machine fitted with Holt caterpillar tracks that had not performed well in tests in February 1915. After Swinton convinced French and GHQ (who were probably open to persuasion on account of the repeated failure of British offensives) of the tactical value of such a vehicle, French persuaded the war office in June 1915 to draw up precise specifications which took account of the admiralty's experiments, and to set up a joint committee with the admiralty to develop a prototype. After it passed its tests on 2 February 1916, Churchill's order a year earlier for a handful of experimental machines costing £70,000 became a war office order for one hundred. The new ministry of munitions headed by David Lloyd George was made responsible for production. He appointed Major Albert Stern, formerly secretary to the admiralty's Landships Committee, as chairman of a tank supply committee.¹

Meanwhile, in France, after a deputy, Jules Louis Breton, wrote to the minister for war, Alexandre Millerand, in December 1914 suggesting the need for an armoured vehicle to cross and destroy wire, the commander of the engineers immediately ordered a prototype. At the same time, Colonel J. B. E. Estienne, an artillery officer with several inventions to his name, and who played a role in the development of military aviation for the registration of artillery, had seen, like Swinton, the need for an 'armoured

¹ For recent work on British tanks, see R. J. Q. Adams, *Arms and the Wizard: Lloyd George and the Ministry of Munitions, 1915-16* (College Station, 1978), pp. 154-62; D. Fletcher, *Landships: British Tanks in the First World War* (London, 1984), pp. 3-19; J. P. Harris, *Men, Ideas, and Tanks: British Military Thought and Armoured Forces, 1903-39* (Manchester, 1995), pp. 4-39; R. Prior, *Churchill's 'World Crisis' as History* (London, 1983), pp. 231-8.

landship' able to manoeuvre over heavy ground. On 1 December 1915, he sent to French headquarters, Grand Quartier Général (GQG), a design for what became the first units of the *artillerie d'assaut*, as the French called tanks. Two weeks later, the commander-in-chief, General Joseph Joffre, authorized Estienne to 'pursue its creation with all the required speed and secrecy'.¹

In France, as in Britain, 1915 was spent in research and development, in secret in both countries. Although the French escaped the rivalries among the admiralty, war office, ministry of munitions, and GHQ that beset the British, they were handicapped by the lack of a suitable caterpillar. Although Estienne had seen American Holt caterpillar tractors being used for haulage behind the British front, he was unable to obtain supplies and had to rely on wheel-driven tractors. The prototype, which was demonstrated to Millerand in July 1915, performed well enough nonetheless that he ordered ten to be built. After spending the rest of the year developing caterpillar traction, in December the war ministry ordered ten more tanks with caterpillars, to be made by the firm of Schneider, for delivery in April 1916.²

Schneider & Co., France's largest iron- and steel-making firm with headquarters at Le Creusot,³ had already a 'completed project' for a vehicle carrying six men and armed with one 37mm gun and two machine-guns. It guaranteed to supply between three hundred and four hundred similar vehicles within seven months, powered by Holt tractors, of whose superiority Estienne was convinced, thanks to the 'kindness' of the British artillery officers who had allowed him to try some out on the banks of the Somme. Despite the appearance of Anglo-French co-operation, Estienne, perceiving a need for 'absolute secrecy', had not told the British why he wanted to try out the tractors.⁴

Thus far, both countries had proceeded independently. Nonetheless, the winter of 1915/16 saw attempts by each to keep the other informed. Although Raoul Mortier claims that 'several British officers' accompanied Estienne to the French trials in December 1915, none of the British accounts mentions them. No Frenchman appears on the guest list of the trial

¹ 'Historique général de l'AS' [Vincennes, Service historique de l'armée de terre, Grand Quartier Général, État-Major, Artillerie d'Assaut, file 1: 'Documents annexes, 1915-16'], 16N 2121.

² R. Mortier, *Chars d'assaut: comment ils furent réalisés* (Paris, 1918), passim. See also, Capitaine Dutil, *Chars d'assaut* (Paris, 1919); J.-G. Jeudy, *Chars de France* (Boulogne, 1997); Col. E.-G. Ramspacher, *Le général Estienne 'père des chars'* (Paris, 1983).

³ See D. Stevenson, *Armaments and the Coming of War: Europe, 1904-14* (Oxford, 1996), pp. 29-39, passim; J.-A. Roy, *Histoire de la famille Schneider et du Creusot* (Paris, 1962); and the exhibition catalogue, *'Les Schneider, Le Creusot'. Une famille, une entreprise, une ville*, ed. C. Matthieu and D. Schneider (Paris, 1995).

⁴ Estienne to Joffre, 28 Dec. 1915, 16N 2121.

of the British prototype at Hatfield Park on 29 January 1916, nor on the list of those unable to attend. As the prototype was kept at Hatfield for a few days after the tests, Swinton invited the French military attaché, who could not come.¹ Thus, there had been opportunities for the exchange of ideas, if not for anything more practical.

During 1916, the pace of production speeded up. In February, the French under-secretary for artillery and munitions, Albert Thomas, whose department had taken over responsibility for the development of the tank in February, increased the order from ten to four hundred, and doubled the number in June. Although the British were reluctant to manufacture such large numbers of an untried weapon, in March 1916 they formed a unit of the Machine Gun Corps, known as the Heavy Section, to man them. The day after the tanks' appearance on the Somme in September, the army council asked the ministry of munitions to build one thousand tanks by the beginning of the next March.²

Despite the parallel course followed independently in the two countries, by mid-1916 developments in both had reached the stage in which secrecy was no longer possible, even desirable. On 13 June, Breton advised Millerand's successor, General Pierre Auguste Roques, to tell the British, but nobody else, of France's success, because neither Russia nor Italy had the industrial capability to manufacture a similar weapon.³ The same June, Swinton met Estienne for the first time at the secret training area at Elveden in Norfolk set aside for the trials. The initiative came from the British, rather than Breton. After GHQ told GQG of the British experiments, on 23 June Joffre ordered Estienne, who was commanding 3 Corps artillery at Verdun, to visit England to examine the British models 'of which high command and he heard speak for the first time'.⁴ Swinton wrote of the visit: 'I had never heard of Colonel Estienne until a few days before I met him at Elveden, nor had I any knowledge of what the French had been doing, nor how much they had been told of our progress.' After the demonstration, Estienne made what Swinton described as an 'earnest and reiterated request' that the British should not reveal the existence of the tank to the Germans until the French were ready to deploy theirs.⁵ Like many British officers, he hoped to obtain maximum effect from a surprise,

¹ Mortier, *Chars d'assaut*, p. 21; E. D. Swinton, *Eyewitness: Being the Personal Reminiscences of Certain Phases of the Great War, Including the Genesis of the Tank* (London, 1932), p. 254. List of invitees in [Kew, Public Record Office], [Ministry of] Mun[itions Records] 4/4979.

² *H[istory of the] M[inistry of] M[unitions]* (London, 1921-7), xii, pt. 3. 37.

³ Mortier, *Chars d'assaut*, pp. 32-3.

⁴ See the entry on 'Tanks' written by a former general staff officer of Tank Corps HQ in France, 1916-18, Major G. le Q. Martel, in *Encyclopedia Britannica*, 12th ed. See also Ramspacher, *Estienne*, pp. 42, 119; Dutil, *Chars d'assaut*, p. 13.

⁵ Swinton, *Eyewitness*, p. 254.

massed attack. The deployment of a few tanks would surrender the element of surprise for little return.

On returning from his two-day visit to England, Estienne reported to Joffre, who gave him 'an excellent welcome' when they met on the 27th.¹ Estienne explained that the British prototype was much heavier, at thirty tons, than either of the French prototypes: the Schneider, of twelve tons, and the St Chamond, of twenty. The British technique of encompassing the entire vehicle with tracks Estienne considered 'a very good idea', although the French had rejected it on account of the weight. Estienne reported that the British, keen to make rapid progress, had the means in their naval yards, where they were already building twenty-five tanks per week: France's rate of production was slower. The heavier British tank was 'significant' because it complemented the 'less powerful but more supple' French one: it could play 'a useful role associated with ours', Estienne reported, just as heavy artillery was deployed in tandem with field artillery.

Estienne claimed that as the British had shown a 'great desire' for 'intimate collaboration', France should seize the opportunity to harness Britain's industrial power to its own 'more sophisticated systems'. He ended a report which stressed the advantages to be gained from co-operation by asking for authority to co-ordinate production with the British by putting French and British manufacturers in touch with one another.

Despite the demands of the battle for Verdun and the imminent offensive on the Somme, Joffre took time to write to Thomas on the 29th summarizing Estienne's report. Owing to Britain's great industrial resources, he explained:²

There would be a certain interest in both nations combining their efforts in this area, and each profiting from the other's experience.

In particular, the British government appears to have undertaken the construction of more powerful tractors than ours, although ours provide greater suppleness and manoeuvrability. It would therefore be advantageous to have both kinds of landship tractors in the divisions. This is one of the questions that makes an exchange of views with the British government highly desirable.

Although Joffre was trying to ensure that allied co-operation led to the supply to both armies of both types of tank, the French did not know what the British were planning to do. General Ferdinand Foch's Northern Army Group, designated to fight alongside the British in the forthcoming battle on the Somme, appeared not to know how French's successor as commander-in-chief, General Sir Douglas Haig, planned to use the new

¹ Estienne, 'Compte-rendu d'une mission en Angleterre les 25 et 26 Juin 1916', 26 June 1916, 16N 2121; brief summary in Ramspacher, *Estienne*, p. 42.

² Joffre to Thomas, 29 June 1916, 16N 2121.

weapon. The first report to GQG came from the head of the French military mission to the British army, General Pierre des Vallières, as late as 1 August, who said that Haig hoped to deploy sixty of the 'new machines' called 'modern landships'.¹ The same day, Haig noted that 'Foch did not seem to know about these machines, but he is to press for them.' And the British ambassador at Paris, Lord Bertie, discounted his military attaché, Colonel Herman Leroy-Lewis's, assertion that the French high command knew in advance that the tanks were coming.² Only at the end of August, when the battle of the Somme had been in progress for two months, did Haig invite Joffre to view a joint exercise between infantry and tanks on 3 September. According to Haig, the exercise left Joffre 'much impressed' with the tank's possibilities: he 'ran about on his little feet till he ran with perspiration'. Joffre's account of the event reveals no excitement whatsoever. His published memoirs state merely that Haig had shown him the British tanks; his war diary notes that Haig planned to deploy fifty of them on the Somme.³

Thus, by the time Haig was ready to deploy tanks for the first time on 15 September, the independent lines of development in France and Britain had yet to converge, although each now knew what the other was doing. National self-interest alone had not dictated secrecy. As Joffre warned the government, if the secret leaked out the Germans could widen their trenches 'in a night', parrying the tanks before they had the opportunity to act.⁴ Nonetheless, the imminent first use of the new weapon under battle-field conditions did not prompt Haig to reveal his plans to the French: he would use the new weapon in a joint battle without consulting his allies at any level below general headquarters.

The opportunity for closer co-operation had existed throughout the first half of 1916. Thomas's push for an allied munitions council as early as October 1915 led on 6 September 1916 to the Inter-Ally Bureau of Munitions, which might have arranged to pool, say, supplies of the caterpillar tracks the French lacked. This did not happen, even though Thomas did supply information on the design of the French 75mm gun for which the British had asked.⁵ In June Lloyd George, too, had spoken of the need for

¹ Vallières to Joffre, 1 Aug. 1916 [*Les Armées Françaises dans la Grande Guerre*] (Paris, 1922-38) [tome] 4/[vol.] 2, annex 2665.

² Haig diary, 1 Aug. 1916 [Kew, Public Record Office], W[ar] O[ffice Records] 256/12; Bertie diary, 20 Sept. 1916, *The Diary of Lord Bertie of Thame*, ed. Lady A. Gordon Lennox (London, 1924), ii. 31.

³ Haig diary, 3 Sept. 1916, WO 256/12; *The Memoirs of Marshal Joffre*, trans. Col. T. Bentley Mott (London, 1932), ii. 480; entry for 3 Sept. 1916, *Journal de Marche de Joffre (1916-19)*, ed. G. Pedroncini (Vincennes, 1990).

⁴ Joffre to Thomas, 7 July 1916, 16N 2121.

⁵ Thomas to Lloyd George, 26 April 1916, London, House of Lords Record Office, Lloyd George Papers, D/19/6/28.

greater co-operation. Describing the outlook to Thomas as 'ominous', he added: 'unless the Allies pull themselves together without loss of time, I fear disaster.'¹ The value of closer co-operation was also perceived by those directly involved in developing the tank. As a 'reciprocal courtesy' for Estienne's invitation to the British tank trials, GQG asked the war ministry to grant Haig's request to send three officers to examine the French tanks under construction.²

In sum, as the British tanks assembled on the Somme for the next phase of the battle – in what was essentially a gamble – Anglo-French co-operation over the development of the new weapon amounted to this: the two governments proclaimed their desire for it; each general headquarters knew what the other was doing; and experts from each country had visited the other. But the allies had not decided how the tank should make its first appearance in battle. Even though the French assumed that the two types of tank might prove complementary, their own country-wide network of state arsenals was fully stretched and could not compensate for Britain's total lack of munitions production infrastructure. After the French field commanders learned six weeks ahead of time that the British were proposing to deploy the new weapon on the Somme, Estienne, who strongly disapproved, asked Joffre to try to dissuade them.³ For everyone else, the tank remained a secret.

* * *

By the time Estienne and Swinton met again in France in September 1916, the tank was a secret no longer. On the 15th, a handful of British tanks was deployed in a vain attempt to win a great victory on the Somme. Of the fifty scheduled, forty-nine were available on the day; of those forty-nine, seventeen broke down before the start; and, of the remaining thirty-two, fourteen were put out of action almost immediately. The image portrayed in the newspapers of a British tank lumbering along what had been the main street of the village of Flers, with British infantry walking behind it cheering, was exceptional, not typical.⁴

Estienne lamented the British unwillingness to wait until the French were ready, as he had asked Swinton to do back in June. The argument over whether the British should have used tanks in such small numbers –

¹ Lloyd George to Thomas, 3 June 1916 [Paris, Archives nationales, Albert] Thomas Papers, 94/AP/162.

² GQG to Thomas, Guerre, Artillerie, no. 9724, 14 July 1916, 16N 2121; Thomas to GQG, 20 July 1916, *ibid.*

³ Ramsbacher, *Estienne*, p. 59.

⁴ For a recent comprehensive account of the engagement, see T. Pidgeon, *The Tanks at Flers: An Account of the First Use of Tanks at the Battle of Flers-Courcelette, The Somme, 15th September 1916* (Cobham, 1995).

Churchill called them the 'merest makeweight'¹ – has gone on ever since. Two critics, one British and one French, sound strikingly similar. According to Lloyd George in his memoirs, 'the great secret was sold for a battered ruin of a little hamlet on the Somme, which was not worth capturing'; and according to Abel Ferry, both soldier and deputy, a former minister and a member of the chamber of deputies' army commission, 'they captured some village or other.'² The tank's first appearance aroused little enthusiasm among politicians.

Yet a field trial under battle conditions was a necessary precursor to development. Even the most severe post-war critic of the way tanks were used, J. F. C. Fuller, did not disapprove of such a trial:³ greater numbers could not be ordered without a demonstration of their utility. Despite the French official history's claim that the 'premature' deployment of the tank gave the technologically superior Germans the opportunity to develop a similar weapon, they failed to do so. Instead, the sceptical French high command was enabled to make up its mind about the tank: they were 'perhaps not sorry to see the first experiment carried out by [their] allies'.⁴

The value of the British experience on the Somme to both the French and the British is obvious from what followed. Among the British, Haig was not so disappointed with the tanks' performance that he withdrew his support. On 29 September, he appointed Colonel H. J. Elles to command what became the Heavy Branch, Machine Gun Corps (Fuller joined its staff in December). The name Tank Corps was adopted in July 1917. Three brigades (nine battalions) were formed in France and a training centre set up at Bovington, where a tank museum stands to this day.⁵

The British made a further commitment to the new weapon in September with the decision to build one thousand more and to spend the winter in rearming and training. The new tanks were not to be copies of the current Mark I, however. Owing to the experience on the Somme, Mark IIs and IIIs were developed (of which one hundred were produced) with stronger rollers; stronger armour-plate to withstand the armour-piercing bullets that the Germans were expected to develop; and without the tail which had been designed to aid steering but proved cumbersome and vulnerable. Further improvements were made to the Mark IV, the type

1 W. S. Churchill, *The World Crisis, 1916-18*, pt. 1 (London, 1927), p. 185.

2 D. Lloyd George, *War Memoirs* (London, 1933-6), ii. 646; 'Rapport sur l'AS', 10 May 1918 [Paris, Archives Nationales, Records of the Army Commission, Chambre des Députés], C7502, file 624.

3 Trevor Wilson summarizes the arguments for and against Haig's use of the tanks in *The Myriad Faces of War: Britain and the Great War, 1914-18* (Cambridge, 1986), pp. 342-4. For Fuller, see D. J. Childs, *A Peripheral Weapon? The Production and Employment of British Tanks in the First World War* (Westport, 1999), p. 48 n. 9.

4 AFGG, 4/3, p. 59; Mortier, *Chars d'assaut*, p. 33.

5 H. J. Elles et al., *A Short History of the Royal Tank Corps* (5th ed., Aldershot, 1938), pp. 6-7, 11-12.

deployed during 1917 and the first half of 1918. It carried a beam for extricating the tank from trenches, and the sponsons to which the guns were mounted were adapted to swing into the body for ease of transportation. The sponsons had hitherto been detached and reattached before and after transport by rail, a cumbersome and time-consuming operation.

The French also took great advantage of the British experience on the Somme. Even if some Frenchmen such as Estienne criticized the use of tanks as premature, others in the field quickly digested the lessons the trial had to offer. Vallières immediately wrote two reports on the action; the French artillery liaison officer with Fourth Army, Pierre Héring, copied him within a week. In assessing the lessons to be learned, Vallières emphasized the tanks' utility in attacking strongpoints, its vulnerability to counter-attack, its mechanical unreliability and inability to protect the infantry; and the effect of lack of training and noise, heat, and fumes on the crews' performance. Héring appraised the performance of the tanks' driving gear, engine, and tracks; and described the armour-plate, armament, chassis, and the tactical organization and deployment. The reports contained a wealth of information and balanced judgement.¹

With the benefit of such analysis, the French swiftly modified their prototype. Despite criticizing the British for using their tanks in the September offensive, Joffre was sufficiently interested to meet with Estienne on the 17th and to write to Thomas three days later to suggest modifications to the French design. As tanks needed rapid-firing rather than more powerful but slower guns, he suggested that the planned 120mm gun should be replaced with the 75mm gun and machine-guns.² Joffre, who expected the Germans quickly to develop a tank of their own, also asked the ministry of munitions to develop a rapid-firing or automatic 37mm gun able to pierce armour at one thousand metres. He suggested that twenty-five hundred such guns should be deployed against enemy tanks and others mounted on France's own. As he did not expect the Germans to copy the British by wasting their opportunity for a first strike, he warned Estienne to be ready for a surprise mass attack on a lightly defended sector of the front, and told him to prepare defences such as mines, 37mm guns, and ditches in advance and to use them as planned, rather than improvising them during the battle.³

The French tried to hasten production while making the necessary

¹ 'Note sur l'emploi des CT le 15 septembre', *AFGG*, 4/3, annex 463; Vallières to Joffre, 27 Sept. 1916, 16N 2121; Héring, 'Observations Concernant le Matériel et l'Armement des Tanks', 22 Sept. 1916 [Vincennes, Service historique de l'armée de terre], Duvernay Papers, 1K 91.

² Joffre to Thomas, 20 Sept. 1916, 16N 2121; Joffre journal de marche, 17 Sept. 1916 [Vincennes, Service historique de l'armée de terre], Joffre Papers, 6N 2.

³ Joffre to Estienne, 21 Nov. 1916, *AFGG*, 4/3, annex 1658.

modifications. Breton, who became more influential after his appointment on 28 October to preside over a tank commission, and who joined the government in December, presiding over a committee on tanks set up by the ministry of munitions, urged Thomas on 28 September to speed up production by fitting tanks with a Peugeot engine that had proved unsuitable for aircraft. A month later, on 20 October, after criticizing the 'distressing' British 'precipitation', he stressed the 'vital' need for armour strong enough to resist at least a 37mm shell.¹ Writing to Joffre on 1 November, he warned him that as the thicker armour-plating needed to resist German armour-piercing shells would add 600 kg to the weight of a St Chamond tank, such a heavy vehicle would get bogged down, especially in 'very wet terrain' – as Haig learned in Flanders in 1917.²

Not only mechanical and bureaucratic changes followed from the British experience on the Somme. Vallières' second report analysed the British administrative system. It described how British tanks, built entirely under the control of the ministry of munitions, left the factory fully equipped and armed. They then passed under the control of the war office, which put them through their field tests, and only then were they transported, in full working order, to Haig, who grouped them into units designated to support each British army. Britain aimed, he reported, to provide a three-battalion tank brigade for every army corps in the five armies. Each brigade would contain three companies (one for each division in the corps), each company having twenty-four tanks.³

On 9 October, Estienne, now promoted to general and drawing on both the British experience and Vallières' and Héring's reports, explained to Joffre that the new weapon should be used to precede infantry, opening up its way forward and covering its advance. The tank's greatest value lay in its ability to progress, not in the machine-guns or other weapons it carried; its armament should be designed to destroy enemy machine-guns. The ideal tactical unit was the 'group', consisting of four batteries of four tanks each (sixteen in all). Between eight and ten groups should be attached to each attacking regiment, each of them responsible for a front eight hundred metres wide, and each battery assigned a 'support company' of infantry, which would follow it and which it would rally when necessary and help across otherwise impassable obstacles.⁴ In short, serious thought was being given to the deployment of the new weapon. Estienne's views concurred with GHQ's insofar as the tanks' role of accompanying infantry was

¹ Both letters cited in full in Mortier, *Chars d'assaut*, pp. 34-6.

² Estienne to Joffre, 1 Nov. 1916, 16N 2121.

³ Vallières to Joffre, no. 1142, 27 Sept. 1916, *ibid*.

⁴ Estienne, 'Bases Générales de l'Organisation et de la Tactique de l'Artillerie d'Assaut (AS)', 9 Oct. 1916, *ibid*.

concerned, but differed in that he proposed allocating greater numbers of tanks to attacking formations. He also gave control of their deployment to a lower command level than the British, hence allowing greater independence and flexibility.

As the lessons from the Somme were learned on both sides of the Channel, the idea surfaced again that the best qualities of the British and French machines might profitably complement one another. When Swinton met Estienne in France in September, the performance of the French tanks he saw confirmed the latter's claim that they were more 'supple' or manoeuvrable than the British tanks, but less powerful at climbing and across country.¹ A report to the French ministry of munitions on the British 'tortoises', which stressed the tanks' different capabilities, drew the logical conclusion that both would be more effective if each could be deployed by both armies.²

The difference between the two types of tank matched the allies' different circumstances. The delay in developing the Schneider and St Chamond tanks was attributable to the constraints on French industry. Owing to the lack of the trained manpower drafted into the army and the coal and iron seized by the Germans, French industry was not capable of matching the British in output. But it *was* capable of producing a smaller, cheaper tank. A chance meeting between Estienne and the French car maker Louis Renault in Paris in July led to the production in October in record time of a mock-up of a *char mitrailleur*, or machine-gun tank, with its gun mounted in a turret which turned through 360 degrees. On 27 November, Estienne asked Joffre to recommend production. That such a light tank (the final version weighed seven tons) could not cross a wide trench no longer mattered once the new weapon's existence had been disclosed to the enemy. Although Thomas authorized the production of a prototype on 12 December, but turned down Joffre's request for an order of one thousand,³ Breton's committee were so impressed with the prototype that the ministry ordered one hundred, increasing the number to 150 in February 1917. By the end of May, the war ministry had taken delivery of one thousand Renault FT tanks.⁴

Contrast the flexibility of the French, and its practical outcome, with this report by M. Heseltine of the British ministry of munitions upon a visit to Paris to see the French tanks at the end of 1916:

¹ Swinton, *Eyewitness*, p. 290; A. G. Stern, *Tanks, 1914-18: The Log-Book of a Pioneer* (London, 1919), p. 97.

² Note 'Pour M. Simiand', 1 Oct. 1916, Thomas Papers, 94/AP/16, Chars d'assaut, liasse 1.

³ Estienne to Joffre, 26 Nov., Thomas to Joffre, 13 Dec. 1916, 16N 2121.

⁴ On the Renault tank, see F. L. Picard, *L'épopée de Renault* (Paris, 1976), pp. 30-3; Ramspacher, *Estienne*, pp. 46-8; S. J. Zaloga, *The Renault FT Light Tank* (London, 1988).

Both the 'large' and the 'small' ones were exhibited. The trials were in the Presidents' Coverts at Marly where they disturbed the pheasants considerably. The ground was a heavy clay, very wet, and they went up and down steep slopes, broke down trees (young ashes of nine inches diameter), and negotiated ditches (six feet) in as good a style as ours. I doubt, however, whether they could compete with tanks like ours can, though on the other hand they are undoubtedly faster, especially the little one which I couldn't at all keep up with.¹

The report, while trying to make a fair comparison, draws no conclusions about the advantages to be gained from manufacturing complementary types: it merely evaluates the ally's achievement. Similarly, a memorandum of 9 November 1916 from Churchill to the cabinet mentions (as the fifteenth out of twenty-six points) the need for co-operation between the designer and the army, but makes no mention of co-operation with the French.² Even the meeting at the war office which decided to build one thousand tanks took its expressed wish to co-operate in design with the French no further than the minutes. 'Little appears to have come of this,' writes J. P. Harris.³ To be fair to the British, not all of them were ignoring the French. Stern, who was in touch with the French designers, was given copies of the plans of the St Chamond and Schneider tanks, in return for promising to keep them secret.⁴

The French had already had the opportunity to study the two versions of the British Mark I model. GHQ had offered to supply them once the fighting season was over and, when GQG accepted the offer at the beginning of November, sent over two fully armed and equipped vehicles.⁵ The examination, as well as the decision to produce the Renault tank, led the French in November 1916 to suggest an exchange. The French, who could produce far fewer heavy tanks than Britain's twenty-five a week, hoped that an exchange would solve their production problems. In November 1916, Schneider was only producing one tank a day: twenty-six of them had been completed, fourteen delivered, and twenty-three more were being assembled. Even fewer of the St Chamond tank had been built. Although the French decided in December 1916 to build all of the eight hundred heavy tanks already ordered, French firms were better suited to building the lighter tank that Estienne proposed. He told Joffre that France should acquire 'heavy landships' by exchange: 'in case of need, we could obtain the large dimension tank by way of exchange with the British.'⁶

¹ Report by Heseltine, 18 Nov. 1916, MUN 4/4979.

² 'Mechanical Power in the Offensive', MUN 4/4979; repr. in Churchill, *World Crisis*, app. V, pp. 562.

³ Harris, *Men, Ideas, and Tanks*, p. 67.

⁴ Secret 'note', 2 Nov. 1916, Thomas Papers, 94/AP/16.

⁵ Haig to Vallières, 3 Nov., Vallières to Joffre, 4 Nov. 1916, 16N 2121.

⁶ Estienne to Joffre, 27 Nov. 1916; first mtg. of the 'Comité consultatif de l'AS', 21 Dec. 1916, *ibid.*

Estienne was not alone in seeing the advantages of an exchange. Thomas had made a similar suggestion to Lloyd George on 7 October,¹ but having had no reply by January 1917, he decided to go ahead with building heavy French tanks of forty tons weight and faster and more heavily armed than the British. Lloyd George makes no mention of the proposed exchange in his memoirs, nor does 'France' figure, save as the arena for British tank operations, in the index to the chapter on the tank in the *History of the Ministry of Munitions*.

During the three months after the tank's first appearance on the battlefield, technical and tactical modifications had been made to both the British and French models and doctrine. In addition, the French had suggested that they should build a lighter and more manoeuvrable machine, the British a heavier and more powerful one. The British, however, who had refused to wait until the French were ready before using their own tank in battle, were not even thinking about co-operation.

The French were more interested in co-operation because their need was the greater: their heavy tanks never performed well. Even though British firms could not fill the orders the ministry of munitions placed with them, it never considered the expedient of allowing French firms to build British tanks under licence in order to take advantage of France's system of armaments factories staffed with mobilized personnel working under military discipline, even though the development of the Renault tank had shown how effectively the French factories could work.

* * *

The replacement in Britain in December 1916 of Herbert Asquith by Lloyd George as prime minister, and in France of Joffre by General Robert Nivelle as commander-in-chief on the western front, led to closer inter-allied discussion of tanks. In order to place Haig under French control for the forthcoming year's operations, Lloyd George had to impose French tactics on GHQ. When the war cabinet discussed the tactical use of tanks at the end of January 1917, therefore, it decided to invite both French manufacturers and French high command to a conference at the war office.² The invitation owed more to Lloyd George's wish to 'mobilize Britain's allies against the advice of his general staff' than to any interest in reciprocating the French offer of collaboration.³

A large party arrived from France to attend the tank trials held at

¹ Thomas to Joffre, 23 Jan. 1917, 16N 2130.

² Minutes of war cabinet, no. 44, 25 Jan. 1917 [Kew, Public Record Office], Cab[inet Records] 23/1. See also, Harris, *Men, Ideas, and Tanks*, pp. 91-5, on this cabinet mtg.

³ Quotation from D. R. Woodward, *Lloyd George and the Generals* (Newark, 1983), p. 136, who does not discuss the tank question.

Oldbury in Birmingham on 3 March and the conference the next day. The trials' purpose was to test various new steering devices for which the experience at the Somme had revealed the need. The choice lay between a British epicyclic drive and a petrol-electric drive train, of which there were both French and British versions. Although the St Chamond tank that was to demonstrate the French version did not appear because it was not ready,¹ the trials nonetheless allowed the experts to talk to one another.

The following day, seven British and eight French representatives met at the war office, when Estienne set forth his views on the tactical value of tanks, their concentration and deployment, and their armament. Although he 'appears to have dominated' the meeting, he dissented from its 'Report on the Tactical Employment of Tanks'.² He explained to the ministry of munitions that he proposed to allocate tank units to each division, whereas British generals preferred to allocate them to each corps.³ He added that tanks would be used most effectively in a surprise mass attack (Harris suggests that the idea for Cambrai may have been implanted by a Frenchman), rather than as substitute cavalry (Stern's suggestion) or separately from infantry.

At the end of the meeting, Estienne proposed an exchange of light for heavy tanks. Although Thomas thanked his British counterpart, Christopher Addison, for the invitation and for pointing out 'certain directions in which researches in common might be made ... [from which] I anticipate the happiest results', nothing came of the proposed exchange. A month later, Thomas had given up hope of obtaining British tanks owing to the delays in production, and counted instead on an exchange of divisions (personnel and munitions as well as tanks).⁴

Nor did anything come of Thomas's idea for an Inter-Ally Bureau, set up in June.⁵ On 10 April, he had proposed the bureau to Addison 'with the aim of ensuring permanent collaboration between the British and French services that research and build the tanks'. As Addison waited several weeks, until 24 May, before agreeing,⁶ the French military attaché, Colonel vicomte de la Panouse, may have been right to assume a lack of interest:

¹ See Fletcher, *Landships*, p. 22; Stern, *Tanks*, pp. 256-7.

² Harris, *Men, Ideas, and Tanks*, p. 93.

³ Minutes of conf. in Thomas Papers, 94/AP/17, Chars d'assaut, liasse 2, and WO 32/5154; W[ar] O[ffice] to M[inistry of] M[unitions], enclosing 'Report on the Tactical Employment of Tanks', 26 March 1917; same to same, enclosing Estienne's letter of 19 April 1917 'regarding the tactical employment of tanks': MUN 4/2791.

⁴ Thomas to Addison, 10 March 1917, cited in Stern, *Tanks*, pp. 125-6; Thomas, 'Note pour le service auto', 3 April 1917, Thomas Papers, 94/AP/17, Chars d'assaut, liasse 2.

⁵ *HMM*, 2/8, p. 57. The work devotes one sentence to the bureau.

⁶ 'Caterpillars Anglais', n.d., and Addison to Thomas, 25 May 1917, Thomas Papers, 94/AP/17, Chars d'assaut, liasse 2.

In certain areas of the 'Mechanical Warfare Department', they are in no hurry to see the inter-allied bureau set up, and ... the constitution of this bureau will be delayed for a long time so that M. de Chasseloup Laubat [one of the French representatives] will find himself faced with faits accomplis and arrangements made with the United States in conformity with British interests.

It even appears that the 'Mechanical Warfare Department' might seek to exercise some sort of guardianship over the Inter-Ally Bureau, and that influence might be brought to bear at the highest level here in order that Great Britain might play the role of 'courtier' between the United States and France, whereas our interests and those of the allies demand that it should be France that serves as the link between Great Britain and the United States.¹

Certainly the bureau's British and French members agreed neither about tactics nor equipment.² The French plans for closer collaboration, further from realization than ever, had exposed a degree of mutual mistrust that boded ill.

At the beginning of 1917, both Britain and France still had few tanks available: the British army had sixty, and the French 136 in service on 23 February, with seventy more stationed behind the lines and 953 more on order.³ By December, the Renault FT was being delivered; three hundred of the original-design Schneiders and St Chamonds were still in service; and more than nine hundred of the British Mark IV had been built.⁴ The figures reveal not only that closer co-operation might yet yield the significant benefit of speedier production, but also that the number of tanks in service was too small to allow for an exchange. The allies' battlefield experience would be distinct and separate in 1917, despite the command arrangements that placed Haig under Nivelle's direction until May.

In April, the British deployed tanks at Arras and the French on the Chemin des Dames, again with disappointing results. Arras was a preliminary to the offensive for which Haig had been placed under Nivelle's direction. After a three-week-long artillery barrage had softened up the ground, all sixty tanks were deployed, but they were the older Mark Is, IIs, and IIIs, which were vulnerable to German armour-piercing bullets as well as impeded by the soggy ground.⁵ They contributed little to the infantry's success on the first day, and the German defence in depth thereafter stymied the attack. In the subsidiary battle at Bullecourt, the late arrival of

¹ La Panouse to Thomas, 24 May 1917, Thomas Papers, 94/AP/17, Chars d'assaut, liasse 2.

² D. Wilson, *Treat 'Em Rough! The Birth of American Armor, 1917-20* (Novato, 1989), p. 10.

³ Thomas to pres., budget commission, 26 Feb. 1917 [Vincennes, Service historique de l'armée de terre, Records of the armaments ministry], 10N 52, file 'Tanks 21 Février 1917'.

⁴ French figures for 7 Dec. 1917 taken from *AFGG*, 6/1, p. 177; British production figure from *HMM*, 12/3, app. VI.

⁵ Fletcher, *Landships*, p. 24; Stern, *Tanks*, pp. 135-7.

the eleven tanks deployed and their poor mechanical performance led the Australians, whom they were supposed to lead across the Hindenburg Line, to mistrust them deeply thereafter.¹

Although the performance of the French tanks in battle echoed the British experience on the Somme, the overwhelming failure of Nivelle's offensive submerged the tank action. Two groups were employed on 16 April, one of forty-eight and the other of eighty tanks, in the attack on the German third and fourth lines. As the infantry failed to overrun the German first line, the tanks were exposed to the full range of German weaponry and many of them burst into flames as their petrol tanks were hit.² The incident, which led to rumours that tanks were death traps for their crews and of no use to infantry, contributed to the collective disobedience that broke out a few weeks later.³

The 5 Corps report for 16 April gives the flavour of what happened. Of the forty-eight tanks deployed, eight broke down before the battle began, and eight others returned more or less undamaged. Thirteen of their crews were killed or missing, presumed killed, with thirty-eight others wounded. The tanks' 'rapid destruction' was attributed not only to the Germans' possession of points of observation over the battlefield, but also to the tanks' vulnerability to artillery fire when immobilized, owing to their inability to cross trenches, and to their acting as magnets attracting artillery fire when infantry attempted to lay down materials that would enable them to cross.⁴ In a report to the chamber of deputies' army commission, dated 16 April, Ferry concluded that, even though the principle of the tank was good, the tactical use made of it was bad.⁵ A report by the chamber of deputies' budget commission went further: as the tanks were not up to their task mechanically, further research and development were required.⁶ Nevertheless, Breton defended the tanks before the senate army commission, on the grounds that they had not been deployed in a 'rational' way, and that steps were being taken to try to overcome the vulnerability of petrol tanks to catching fire.⁷ Estienne commented that the experience validated his requests for two thousand tanks armed with light machine-

1 C. Falls, *Military Operations France and Belgium, 1917* (London, 1940), i. 357-70.

2 GQG, 'Emploi des chars d'assaut à la bataille de l'Aisne', 30 June 1917, *AFGG*, 5/1, annex 1943. For a full account of the French tank battles of 1917, see Lt. Col. Perré, *Batailles et Combats des Chars Français: L'Année d'Apprentissage (1917)* (Paris, 1937).

3 French bulletin d'information no. 52, 29 Aug. 1918, CAB 45/161.

4 Tenth Army, 5 Corps, 'Compte rendu sur l'emploi des chars d'assaut, le 16 avril 1917', 24 April 1917, *AFGG*, 5/1, annex 1661.

5 A. Ferry, 'Rapport sur l'Offensive Générale du 16 Avril 1917', 16 May 1917, in Ferry, *La Guerre vue d'en haut et d'en bas* (Paris, 1920), pp. 256-7.

6 'Extrait d'un Rapport de M. M. Klotz et Ch. Dumont à la suite d'une Mission sur le Front de l'Aisne du 6 au 8 Mai 1917', 19 May 1917, Thomas Papers, 94/AP/16, Chars d'assaut.

7 Extract from senate army commission hearing, cited in Mortier, *Chars d'assaut*, pp. 44-6.

guns, four hundred with medium-heavy, and one hundred with heavy guns.¹

Haig, once free from Nivelles's direction, deployed tanks again in Flanders. The Mark IV had begun arriving in France in May and, by 27 October, 824 had been delivered.² At Messines – the overture to Passchendaele – on 7 June, Haig deployed seventy-six of them, along with older Mark Is and IIs now converted to supply vehicles to keep the fighting tanks furnished with petrol and ammunition.

Although these events show that the British were trying to learn from their experience, their tanks played an insignificant role in the battle. The mining of the enemy positions, improved artillery bombardment, and protection of the infantry by accurate creeping barrages led to the capture of Messines ridge.³ Tanks were deployed again during the main battle which began on 31 July. As it was already well known that heavily shelled ground, waterlogged terrain, and thick woods (or the remains of them) were inimical to tanks, their failure to achieve anything at Passchendaele was unremarkable.

What was remarkable, however, was the success at Cambrai in November. Out of a total number of 476 machines, the three tank brigades deployed 342 fighting tanks, with forty-one more in reserve in case of breakdown. The rest were fitted as supply, wireless, or towing tanks.⁴ The tanks were not responsible for the initial success, however, despite being deployed for the first time in large numbers in the way their designers and promoters wished. The effect of a surprise attack launched without preliminary bombardment owing to new artillery methods, against tired German troops withdrawn from Passchendaele, won the day. Once the Germans recovered, they retook almost all of the ground they had lost. But important lessons were learned at Cambrai which led to the Mark V, a longer version, the Mark V*, and a more powerfully engined version, the Mark V**.

Meanwhile, the French had deployed their tanks again in the so-called *batailles de redressement* when Nivelles's successor as commander-in-chief, General Philippe Pétain, tried out his armies after nursing them back to offensive health. At Verdun, on 20 August 1917, the battle was mainly an artillery affair; but on 23 October, at La Malmaison on the Chemin des

1 Estienne's comments typed at end of the GQG report on the attack of 16 April 1917, 16N 2120, file 2.

2 'Tank Supply, 1917-18', MUN 4/775.

3 For a recent account of the battle, see R. Prior and T. Wilson, *Passchendaele: The Untold Story* (New Haven, 1996), ch. 5.

4 J. F. C. Fuller, *Tanks in the Great War, 1914-18* (London, 1920), pp. 146-7. Harris gives slightly different figures: 378 fighting tanks, with fifty-four in reserve and fifty-four supply tanks: *Men, Ideas, and Tanks*, p. 123.

Dames, where Nivelle had broken the spirit of the French infantry in April, the French knocked the Germans off the ridge. Of the sixty-three tanks deployed, however, twenty-seven did not make it past the French first line; fifteen broke down on the German first line; and only twenty-one played a useful role. Notwithstanding the figures, Pétain judged the deployment of the tanks a success which had restored the troops' confidence in them.¹

The developments in tank design were all that was achieved in 1917. Little had been won by the tanks' deployment in battle, although they had demonstrated their potential worth. Nor had any progress been made in co-ordinating tactics and design between the two armies. When Fuller suggested joint Anglo-French action at St Quentin in August, he got nowhere; according to Harris, Elles 'did not think an Anglo-French operation would appeal to GHQ and does not appear to have passed this proposal on'.² While Elles was probably right – Haig had had enough of 'joint' actions – the response clearly reveals the lack of inter-allied co-operation.

One development in 1917 would affect tank design and production: the United States entered the war as an associated power. Provided the allies could find the ships, the materials to build any number of tanks would be forthcoming, together with the Liberty aero-engine to power them. An abundant supply of raw materials, together with a design of tank that resolved many of the problems encountered thus far, meant that production-line techniques might at last be employed if the allies would co-operate.

The entry of the United States, however, might also have drawbacks. The French had already accused the British of dragging their feet over the Inter-Ally Bureau and of wanting to act as 'courtier' between France and the United States. Churchill, minister for munitions since July 1917, removed Stern, who was at odds with the war office, from his post as head of the mechanical warfare supply department and sent him to Paris in October to 'secure the co-operation of the US and British Governments with a view to increasing the output of tanks in 1918'. Churchill told him 'to study the possibility of finding a factory in France in which tanks of a less recent design than that now in use can be converted into improved types ... [and the] possibility of furthering the assembling and even the construction of tanks in France for the Allies'. The British had never been willing to co-operate so closely with the French.³

Thus, by the end of 1917, the British and French were no closer to developing a mutually beneficial relationship for the production and deployment of tanks. Indeed, in some ways matters had worsened. The

¹ G. Pedroncini, *Pétain: Général en Chef* (Paris, 1974), pp. 103, 105-7.

² Harris, *Men, Ideas, and Tanks*, p. 103.

³ *HMM*, 12/3, p. 57; Stern, *Tanks*, pp. 175-81.

French, who needed a heavy tank – Cambrai had proved that – lacked the industrial capability or the raw materials to build heavy tanks of their own. The changed relationship between France, the Entente's leading military power in 1914, and Britain, the leading economic power, was shown in Britain's ability to ignore the French in tank production. Britain was becoming the Entente's leading military power.

Closer co-operation between the two was nonetheless vital. The Entente's fortunes were at a low ebb, owing to the failure of their offensives on the western front, Russia's defection, the Italians' disaster at Caporetto, and the loss of shipping caused by German submarines. Even though the United States was even less prepared for war in 1917 than Britain had been in 1914, the British were willing to co-operate with the Americans because the United States possessed the resources Britain needed and France could not provide.

* * *

By the time Stern took up his new appointment in Paris early in November 1917, the US commander-in-chief, General J. J. Pershing, had already ordered two of his ordnance officers, Major J. A. Drain and Major H. W. Alden, to confer with the British and French before making a plan to build American tanks for the US tank corps. Although the allies had deployed so few tanks, Cambrai had convinced the US army of their value in lowering the human cost of battle. Drain and Alden recommended the production of heavy tanks in the United States and, after Captain George S. Patton Jr. of the US Cavalry, who visited French tank units, praised the Renault tank, of light tanks as well. Following discussions among the three allied armies, a proposal was approved in September 1917 for an American force of 375 heavy and 1,500 light tanks.¹

Drain and Alden found that the British and French armies were ignoring one another while developing their tanks on account of their disagreement about tactics and design. The British, despite preferring the heavy tank, were developing a lighter model. The 'whippet' tank had already been constructed experimentally, and Cambrai had proved the need for a lighter, more manoeuvrable vehicle; it became the Medium Mark A. The French, on the other hand, despite being convinced of the value of their lighter Renault tank, were experimenting with a heavier vehicle.² After Drain and Alden chose the Renault as the best light tank available, France

¹ 'Report on the development of the Tank Corps', in *United States Army in the World War, 1917-19* (Washington, 1948): XV: *Reports of Commander-in-Chief, AEF, Staff Sections, and Services*. See also Wilson, *Treat 'Em Rough!*, ch. 1. Patton's report of 12 Dec. 1917 on his experiences is discussed in *Patton Papers, 1885-1940*, ed. M. Blumenson (Boston, 1972-4), i. 448-57.

² See B. Crowell and R. Forrest Wilson, *The Armies of Industry: Our Nation's Manufacture of Munitions for a World in Arms, 1917-18* (1921, facsimile repr. 1974), i. 193-9.

agreed to reveal the company's secret plans, and to supply a model to act as a template, to enable forty-four hundred of the tanks to be built in the United States. Renault asked for two thousand finished tanks in return.¹ Difficulties stemming from the need to convert Renault's metric measurements and from the inability of US firms to supply similar armour-plating delayed the completion of the tanks until October 1918. Sixty-four left the factory before the Armistice, but the first two arrived in France only on 20 November, followed by another eight before the end of the year.²

For heavy tanks, an Anglo-American design was developed – the Mark VIII, or Liberty tank – which placed a US engine inside a body based on the earlier British models. A factory in France was scheduled to produce three hundred tanks a month at joint expense, rising to twelve hundred, at a cost per tank of £5,000: the target for 1918 was fifteen hundred. The United States was to supply the engines, Britain the steel plates and the armament, though the United States was to supply Britain with the same quantity of steel in compensation. The first six hundred tanks were allocated to the US government, and any others shared between the British and Americans after the French had bought as many as it wanted.³

To the Americans, the Anglo-American agreement signed in London on 22 January 1918 by the US ambassador, W. H. Page, and the foreign secretary, Arthur Balfour, had the force of a treaty obligation: it was a more powerful instrument than any that bound Britain to France. It was signed only nine months after the United States entered the war. The French were left out because the Americans believed that, not being interested in building a heavy tank, they had 'decided to take no active part'.⁴ In London, the chief of the imperial general staff, General Sir Henry Wilson, noted that the 'French are making their own separate tanks and have not joined with us'.⁵ Nonetheless, the French, in true Third World fashion, were to provide a site for the factory and construction workers from among their colonial subjects. This was hardly in the spirit of 'presenting to the US the joint agreed proposals of the Allies, in whose decision the accord of England and France should play a dominating part', as Churchill had written on 17 September to Thomas's successor as minister of munitions, Louis Loucheur.⁶

¹ Wilson, *Treat 'Em Rough!*, p. 11.

² Crowell and Wilson, *Armies of Industry*, p. 96; 'Report on the development of the Tank Corps', pp. 222-3.

³ 'Agreement between the British and US Government for the Production of Tanks', 22 Jan. 1918, in 'Report on the development of the Tank Corps', pp. 223-5.

⁴ J. J. Pershing, *My Experiences in the World War* (London, 1931), p. 212.

⁵ Wilson diary, 3 Dec. 1917, London, Imperial War Museum, Sir Henry Wilson Papers.

⁶ Churchill to Loucheur, 17 Sept. 1917, in M. Gilbert, *Winston S. Churchill: IV: 1917-22, Companion*, pt. 1 (London, 1977), 163.

It was not true that the French were uninterested in heavy tanks. The value they placed on tanks of all sorts is seen by the fact that the new premier and war minister in November 1917, Georges Clemenceau, took back responsibility for tank development from the ministry of munitions at the beginning of 1918.¹ The French had been developing a heavy tank of their own, experimenting, in 1917, with a vehicle as heavy as sixty-two tons and, in February 1918, the war ministry placed an order for three hundred.² After meeting Stern on 4 November, Loucheur asked Pétain whether the army preferred to cease production of the French twenty-ton tank in favour of the new, heavier British thirty-ton model.³ Estienne answered the question of whether heavy tanks were necessary for 1919 with an unequivocal 'absolutely' and after the German spring offensive, Foch, now supreme allied commander, told Loucheur that he must meet the shortage, with British tanks if necessary, as Britain was producing more than it needed.⁴ The French wished to deploy heavy tanks: they merely lacked the raw materials with which to produce their own and looked to their allies to make good the deficiency. The three hundred French heavy tanks ordered were not built, precisely because of a lack of raw materials and manpower: as the British and Americans would discover, the skilled labour needed was with the armies, not available in the munitions works.⁵

The construction of the allied tank factory at Neuville-Pailloux, outside Châteauroux, descended to the level of farce. The production target for 1918 was set at fifteen hundred, although Churchill aimed much higher: ten thousand tanks of which Châteauroux was expected to produce just over half.⁶ The performance fell far short. When the search for a site began in December 1917, no ready-made factory was available, and sites at Bordeaux and Roanne (where a new French state arsenal was under construction) were rejected owing to their inadequate rail connections; the Châteauroux site was bounded by the main Paris-Limoges-Toulouse railway. Permission for the factory was given on 26 February; the railway sidings were ready by 2 April; and the foundations were 'almost set out' by the end of April. The delay was caused by local French officials who had to give

¹ Ramspacher, *Estienne*, p. 52. See also, S. D. Carls, *Louis Loucheur and the Shaping of Modern France, 1916-31* (Baton Rouge, 1993), pp. 55-8.

² Ramspacher, *Estienne*, p. 53.

³ Churchill to Loucheur, 31 Oct. 1917, and Loucheur to Pétain, 9 Nov. 1917, *Organisation et Matériel*, 16N 2120. The former letter is also reproduced in Stern, *Tanks*, pp. 186-7, whence the translation has been taken.

⁴ 'Exécution de la notification 31.786 du 28 janvier 1918 au Général Commandant l'AS', n.d.; Foch to Loucheur, EM Allié no. 1613/C, 24 June 1918, 16N 2120.

⁵ Ramspacher, *Estienne*, p. 53.

⁶ Minutes of the Tank Co-ordinating Committee, 7 Jan. 1918, MUN 4/5160. Emphasis added. On the disparity between targets and output, see Prior, *Churchill's 'World Crisis'*, pp. 246-8.

permission for huts to accommodate the labourers who numbered 1,071 by the end of May. After visiting the site on 9 June, Loucheur reported to Clemenceau that there was no control, no sanitation, and waste of labour: the 'only building which looks permanent is the YMCA canteen'. After the British and American commissioners took control on the 17th, their French liaison officer lacked the authority to obtain the timber, lorries, and other supplies that were ordered and promised, but never arrived.

The French government claimed that the site was so disorganized that it would never produce tanks: 'further large quantities of labour would be wasted.' But the British and Americans rejected Loucheur's offer at a meeting in London on 3 July to take over the unfinished factory and sent out a new works manager. At a meeting on the 15th, the American commissioner said that given two thousand American labourers and top priority, the factory might be ready by the time the engines arrived from the United States. The British commissioner added that production would not begin before January 1919, with the first tanks rolling off the line in March.¹

After the French made a second offer to take over the factory, an investigation in August led to the appointment of a new firm of construction managers and, in October, a visiting 'board of experts' examined the 'contemplated arrangements' for assembly. In November, of course, the Armistice was signed. In the words of the *History of the Ministry of Munitions*, the 'scheme for joint production had not materialised before hostilities ceased'.² Thus ended 'one of the most far-sighted and enterprising bits of industrial co-operation of the whole war'.³ Far-sighted it may have been; effective it was not.

French industry was already in difficulties trying to build the arsenal at Roanne. Ferry, who complained of administrative delay, asked why permission to begin construction was only given at the end of February, two months after the selection of the site.⁴ A French war ministry report on the factory of 10 June noted the shortage of labour: the manpower barrel had been scraped almost clean. It judged the British and black American railway worker to be 'good', but the French and Portuguese workers to be 'mediocre' and the colonial Indo-Chinese workers ineffective. The report claimed that too many officials had ill-defined powers: a boss was needed, with full powers, to make sure the deadline was met.⁵ Nor did the Liberty

¹ 'Factory at Châteauroux', MUN 4/4979.

² *HMM*, 12/3, p. 70.

³ Harris, *Men, Ideas, and Tanks*, p. 136.

⁴ For Roanne, see J. F. Godfrey, *Capitalism at War: Industrial Policy and Bureaucracy in France, 1914-18* (Leamington Spa, 1987), pp. 257-88; Ferry, 'Rapport sur l'AS', C 7502.

⁵ Ministère de la Guerre, Direction de l'Artillerie, 'Note sur la Situation de l'Usine Interalliée de Châteauroux', 10 June 1918, 16N 2130, file 8: Constructions Anglaises et Américaines en France.

aero-engine arrive on time. In February 1918, the US war department notified the army that the first two hundred engines would not arrive until May; in April, the best estimate was 365 by the end of August; in June, the earliest delivery had slipped to one hundred engines by 1 October.¹ Monthly production figures did not exceed fifteen hundred until June 1918 and only reached three thousand plus in October – and of engines designated for aircraft as well as for tanks.²

The only serious attempt the allies made to combine their resources was a failure: it came too late. After making no attempt to co-ordinate design, production, tactics, or deployment with the French, the British made too ambitious a plan with the Americans. The debate over whether mechanical means to win the war should take precedence over the discredited tactic of relying on inadequately supported infantry was overtaken by the crises that resulted from the German offensive on 21 March. After that, for the tank, resources never met requirements. As men were combed out from the factories and sent to the front, production levels fell accordingly.

The project's failure created a further problem. Despite the fact that the factory never produced a single tank (or perhaps because of it), the coalition squabbled over the unhatched chickens. The French high commissioner in Washington, André Tardieu, protested in March against the allotment of the first six hundred tanks to the United States.³ The chamber of deputies' army commission also questioned France's share of the tanks. Its report of 10 May 1918, adopted unanimously, suggested that, as there was no separate US front, all the tanks produced should be assigned to amalgamated French-British-American divisions⁴ – a proposition hardly likely to appeal to either Pershing or Haig.

The supreme war council's Inter-Allied Tank Committee, which wished to increase the numbers of tank forces, also reallocated the factory's nominal production of fifteen hundred. At the committee's first meeting, on 6 and 7 May 1918, Estienne stated that the French 'felt very sore' about the way the United States and Britain had decided the allocation. At the second meeting a month later, the committee, prompted by Loucheur, changed it: the first twelve hundred tanks would now go alternately to the Americans first, and the French second, in lots of seventy-five. The remaining three hundred would also be allocated to the French, giving them nine hundred in all.⁵

¹ Wilson, *Treat 'Em Rough!*, p. 78.

² See the graph in Crowell and Wilson, *Armies of Industry*, p. 380, who do not mention that the aero-engines were also used for tanks.

³ Tel., Tardieu to [GQG?], 30 March 1918, 16N 2130, file 6.

⁴ Ferry, 'Rapport sur l'AS', C7502.

⁵ Procès-verbaux of the three mtgs. of the first session of the Versailles Inter-Allied Tank Committee,

When Loucheur and Churchill met on 6 June at Versailles, they discussed the factory 'at some length'. Churchill stated that 'whilst he was perfectly agreeable to concur in this [revised] allocation, yet ... Great Britain had expended a considerable amount of money and a large amount of material.' So, if France was allocated the entire output save that going to the United States, it must supply Britain with fifteen hundred Renault tanks in return. Although Loucheur agreed in principle, he was 'very doubtful' how soon he could deliver them: Churchill asked for them at the time the tanks from Châteauroux were delivered.¹ Ironically, the British took up the idea of an exchange just as production levels fell away, owing to the manpower crisis.

Although such agreements were nugatory, as the factory was not yet built, the French still sought to exchange their lighter tank for the heavier British one. In May, Loucheur suggested an exchange of five hundred Renaults for one hundred Mark Vs. The war office, happy to keep the option open, asked Loucheur to send ten Renaults to Tank Corps HQ for trials, even though he could not say when he might be able to deliver the other 490. He was even unsure whether France could supply all of the tanks it had promised to the Americans.²

When Loucheur disingenuously confirmed the exchange to Churchill at the end of June, he did so in the aftermath of General Charles Mangin's successful use of the speedier and more manoeuvrable French tank in a counter-attack that halted the German offensive on the river Oise. Deploying more than one hundred tanks over suitable terrain, the French had both made good progress and inflicted a heavy blow on the enemy, despite heavy casualties to both tanks and crews and to the tanks' leaving behind their accompanying infantry. Loucheur claimed, optimistically given the lack of labour, to be aiming for a completion rate of twelve hundred light tanks a month, though only 234 had been produced in March.³ What he lacked in addition to labour was steel. He asked Churchill to increase Britain's supply of armour-plating to nine thousand tons per month, or half of France's needs for such a program, and in case the British might jib, reminded him that France was arming the US troops as well as its own.⁴

6-7 May 1918, p. 9; agenda, second session of the Versailles Inter-Allied Tank Committee, 5 June 1918, CAB 25/121; 'Meeting held on 6th June', 6 June 1918, MUN 4/2807; Clemenceau to Loucheur, 6 July 1918, 16N 2120.

¹ 'Meeting held on 6th June', MUN 4/2807.

² Sec., WO, to sec., MM, 13 May 1918, MUN 4/2807.

³ 'Fabrication du Mois de Mars (Analyse des états décennaires du Ministère de l'Armement)', 22 April 1918, in *AFGG*, 6/1, annex 1862.

⁴ Loucheur to Churchill, 29 June 1918 [King's College London, Liddell Hart Centre for Military Archives], Stern Papers, O/8/56.

On the not-unreasonable assumption that Britain would supply the steel – during the first six months of 1918 the mechanical warfare department took up only 61 per cent of its steel allocation¹ – Loucheur was confident that he could deliver the tanks for the exchange. A difficulty then arose about what France would accept in return. Loucheur had asked in December 1917 for ‘200 tanks of the latest model’ (a request Churchill had turned down),² and Estienne told the Inter-Allied Tank Committee in May that GQG wished to deploy only one model of heavy tank, preferably the Mark VIII, rather than ‘be burdened with a multitude of different types’.³ Loucheur had suggested the exchange of Renaults for Mark Vs at a time when the Mark VIII was merely a design. Nevertheless, Clemenceau himself asked Loucheur before the committee’s July meeting to explain how the different types of tank were to be shared among the coalition. Although the British were turning out four types of heavy tank in numbers that ‘considerably exceeded’ their needs, Clemenceau understood that one-third of them were both underpowered and underprotected. Even if the Mark V**’s engine was powerful enough, its armour was insufficient. France, in accepting Britain’s surplus, must not allow Britain to palm it off with redundant models.⁴

Clemenceau was right to be suspicious because Stern has been blamed for ordering too many Mark IVs, which were still being produced in 1918, along with the original Mark V.⁵ ‘In the interests of the Allies generally’, however, the war office decided in October to supply the Mark VIII and to allow the French to attend the trials to reassure them that ‘they are not being asked to take an inferior article.’⁶

The French army was as suspicious as the government. Estienne had declined the four hundred Mark IVs that Churchill’s under-secretary, J. E. B. Seely, the head of the ministry’s tank board, offered him in July. Churchill had asked Seely to dispose of any machines the Tank Corps did not want by offering them to the French army or storing them close to the front.⁷ As Estienne lacked surplus manpower, he did not wish to reassign crews unless he placed them in an improved vehicle, namely the Mark V** or, better still, the Mark VIII. Seely explained that owing to the labour troubles in Britain, output of all types of Mark V had fallen behind. Given

¹ Childs, *Peripheral Weapon*, p. 86.

² Churchill to Loucheur, 30 Dec. 1917, in Gilbert, *Churchill Companion*, p. 223.

³ Sec., WO, to sec., MM, 13 May 1918, MUN 4/2807; ‘Procès-verbaux of the Versailles Inter-Allied Tank Committee’, CAB 25/121.

⁴ Clemenceau to Loucheur, 6 July 1918, 16N 2120.

⁵ Fletcher, *Landships*, pp. 21–2; Childs, *Peripheral Weapon*, p. 42.

⁶ Tank Board agenda and minutes, 17 Oct. 1918, WO 158/867.

⁷ Seely to Churchill, 23 July 1918 [Nuffield College, Oxford], Mottistone Papers, 23/23. See also, Childs, *Peripheral Weapon*, pp. 43–4.

that the only tank victory, at Cambrai, had been won by Mark IVs, he did not understand why the Americans as well as the French were reluctant to accept them.¹ As Churchill told Loucheur: 'In the emergency it is a great mistake to treat as valueless the Mark IV tanks of which about seventy are already surplus. These tanks won the battle of Cambrai and on any ground except the Flanders winter mud are effective weapons.'² One is forced to wonder why three types of Mark V, a Mark VII, and the Mark VIII had been developed, and why seventy Mark IVs were surplus, if it was such an effective weapon.

That the British kept the best for themselves was natural, but not necessarily effective in coalition warfare. Wilson was aggrieved when Seely promised three hundred Mark V**s to Foch: they should be kept for the British army and the French given any Mark Vs that Britain could spare. Churchill saw no likelihood of an exchange on account of the fall in production; nor would he give up control of allocation when Britain was producing by far the greater number.³ Pershing was disappointed when the British rescinded a promise of 24 July to supply him with 'some' heavy tanks when the French supplied five battalions of light tanks. His comment that he had failed 'to obtain a more equitable allotment of the heavy type', reveals his feeling that the British were being selfish.⁴

The war office's tank board recognized the possibility of conflict between British and allied interests: 'if they were to feed out of the same plate some definite arrangements should be come to.'⁵ Accordingly, some tanks were supplied to the French army in September, along with spare parts, although the army council made no promise to carry out repairs. The loan of the special railway wagons needed for transporting tanks was also promised, provided they were returned immediately.⁶ The lack of railway wagons of every sort was becoming critical: the volume of the British official history dealing with transport gives a clear picture of the problems involved in moving large numbers of tanks about the devastated battlefield, owing to the need for special railway wagons to cope with their weight and the difficulty of loading and unloading them.⁷ Once movement was restored to the battlefield as the Germans were driven back, the lighter Renault had the advantage of being transported by lorry.

¹ Memo, 14 July 1918, Stern Papers, O/11/22.

² Churchill to Loucheur, 15 July 1918, in Gilbert, *Churchill Companion*, p. 347.

³ Harington to Churchill, 16 July 1918, and Churchill to Harington, 17 July 1918, in *ibid.*, pp. 351-2; Seely to Churchill, 10 Sept. 1918, Mottistone Papers, 23/29-30.

⁴ Pershing, *Experiences*, p. 557.

⁵ Tank Board agenda and minutes, First Tank Board documents, 17 Aug. 1918, WO 158/867.

⁶ Trans. of letter, WO to Du Cane [with Foch], 6 Sept. 1918, 16N 2130.

⁷ A. M. Henniker, *Transportation on the Western Front, 1914-18* (London, 1937), pp. 305-13. See also, Childs, *Peripheral Weapon*, pp. 108-15.

As late as 21 October, three weeks before the Armistice, the allocation of the tanks expected vainly from the factory at Châteauroux was still causing problems. Stern records that in reply to an enquiry from Edward R. Stettinius, head of US purchasing in Europe, 'as to who should have the first tanks produced, Mr Churchill informed the meeting that owing to a misunderstanding the American representative had agreed to let the French have the first 600 tanks produced.'¹ Perhaps it is as well that no Mark VIII Liberty ever left the factory; in fact, only one was ever produced, by the British Locomotive Company in October 1918. The squabble over who took how many in what order would have been an unedifying spectacle.

Despite the Anglo-American agreement to produce an allied tank, not only was no allied tank produced, but disagreements about allocations marred working relations. Although exchange was agreed in principle in 1918, too few tanks were available and the French declined to take obsolete British tanks in return for their newer, lighter model which had proved itself on the battlefield. Moreover, the Inter-Allied Tank Committee led to little harmony. Rather, there was 'much embarrassment' over the factory at Châteauroux which, as Churchill wrote to his wife, 'was in a fair way to become an international scandal'. Nonetheless, in September 1918, Churchill turned down Loucheur's proposal for an inter-allied tank production committee because there was 'no formal basis' for it. He fobbed off the French by giving Stern permission to 'inter-communicate and consult'.²

Training, on the other hand, was one area in which the allies made an effort. Stern wrote to the secretary for war, Viscount Milner, on 18 April 1918, enclosing a paper on tanks: 'I have been asked to build up an American camp for instruction at Châteauroux. Surely there should be a British and French camp there also, one central training ground for this International Force and one school of discussion and tactics, so that tactics, spares, equipment, workshops, and transport should all be standardized for this force which would consist of American, British, and French battalions of tanks.' He made the same point to Churchill, explaining that three years' experience had 'convinced' him that there should be 'one Central Military School and training ground for an Inter-Allied Heavy Tank Army at Châteauroux'. The advantages would be savings in rail transport, repairs, and reserves, both of men and spare parts, which could be pooled. Why distribute similar tanks to British, French, and American

¹ 'Anglo-American conferences', mtg., 21 Oct. 1918, MUN 4/4979.

² Churchill to his wife, 17[?] Aug. 1918, in Gilbert, *Churchill Companion*, p. 136; Churchill to Seely, 14 Sept. 1918, in minutes, tank board mtg., 26 Sept. 1918, WO 158/867; Seely to Churchill, 19 Sept. 1918, Mottistone Papers, 23/29-30.

units who would then 'train separately on different plans in different places with different tactics and methods, and with different railway facilities and repair shops?' As they would have to fight together, they should train together.¹ The French, of course, agreed. Loucheur was 'in full sympathy'; and as Pétain and Foch were 'in complete agreement' that tanks were 'infantry and were absolutely essential in large numbers', Pétain asked Stern to persuade the war office to approve the scheme. He hoped that Haig might be persuaded to agree.²

Although the war office rejected Stern's ideas, Estienne shared them. He, too, was trying to co-ordinate allied training. On 24 April 1918, he proposed an allied tank training school to the Inter-Allied Tank Committee. After it passed a resolution in favour, an inter-allied tactical school was founded at Fontainebleau under Estienne's command.³ The British general staff had been thinking along the same lines. A report for the supreme war council on 'Tanks and Mechanical Warfare' of 14 May stated unequivocally that a successful tank offensive could only follow from combining resources: 'training must be inter-nationalised.'⁴

The allies even co-operated to an extent in the field. One of the benefits of the appointment of a supreme commander on the western front was that he could deploy units from national armies alongside one another when a speciality was called for. The Inter-Allied Tank Committee had agreed in principle in May that 'the heavy tanks of one nation may be put in with the infantry of an ally when an attack is to be made.'⁵ Since the Americans had no tanks of their own, they 'borrowed' both British and French tanks and fought many of their engagements alongside French tank units. Similarly, the tank units of the French First Army fought with the British during the Hundred Days.

One of these joint actions, the battle of Moreuil, on 23 July 1918, led to the award of the Croix de Guerre to the British 9 Tank Battalion that had fought with the French 3 Division ('La Grenadière'). The divisional badge of the French unit, the 'grenade', forms part of the British unit's badge to this day; it was the 'only occasion during the war in which our tanks, in any numbers, operated with the French Army'.⁶ A vivid eyewitness account of the action is extant showing English-speaking French volunteers travelling on the fan-casings at the back of the tanks while signalling to the

1 Stern to Milner, 18 April 1918, Stern Papers, O/11/2, Stern to Churchill, 26 April 1918, *ibid.*, O/11/4.

2 Stern, 'Diary from April to May 1918', Stern Papers, O/11/13.

3 Stern, *Tanks*, pp. 216-17; 'procès-verbaux of the Versailles Inter-Allied Tank Committee', CAB 25/121.

4 Lt. Col. C. N. Buzzard, 'Tanks and Mechanical Warfare', 14 May 1918, SWC paper no. 208, CAB 25/121.

5 'Procès-verbaux of the Versailles Inter-Allied Tank Committee', CAB 25/121.

6 Fuller, *Tanks in the Great War*, p. 207.

following infantry. They were most enthusiastic, waving the tricolour for victory – sometimes too enthusiastic, as several were killed or wounded.¹

The opportunities for joint action in the field were limited by the shortage of tanks. A recent account of the final victorious Hundred Days concludes that the Tank Corps was tested ‘practically to destruction’.² Despite the success of the battle of Amiens that began on 8 September, when over five hundred were deployed, the tanks suffered enormously from enemy fire and from mechanical failure. Perhaps the picture might have been different had the allies learned to co-operate earlier. Then even a modest step – the British not wasting scarce resources on the whippet while the French ceased to pine for their own heavy tank – might have led to larger numbers of tanks being available for the final battles. The squabble over allocations might have been attenuated, if not avoided.

* * *

The tank progressed from its independent genesis in Britain and France, through disappointing performance for the British on the Somme in 1916 and for the French on the Chemin des Dames in 1917, to general acceptance of the weapon’s potential after the battle of Cambrai in November 1917. Co-operation proved a non-starter. The French hoped that their lighter tanks might operate alongside the heavier British vehicles in the way light and heavy artillery worked together. When the French understood that their models were not as effective nor could they produce them quickly enough, they developed a lighter model and offered to exchange. The British ignored the offer: Lloyd George’s offer of co-operation was merely a means of reining in Haig. Discussions in 1917 reached no agreement over design or tactics.

The emphasis changed in 1918. The Inter-Allied Tank Committee decided on a technological solution to the problem of how to win the war. The Anglo-American agreement for production of the Liberty tank was followed by the success of the massed Renault tanks in the counter-offensives in June and July that led to the Armistice, which showed that a more manoeuvrable and easily transported tank had a role to play in the open warfare that now became possible. Although the British finally accepted

¹ *Tanks and Trenches: First Hand Accounts of Tank Warfare in the First World War*, ed. D. Fletcher (Stroud, 1994), pp. 133–6. See also the brief accounts in D. G. Browne, *The Tank in Action* (Edinburgh, 1920), pp. 350–2; C. and A. Williams-Ellis, *The Tank Corps* (London, 1919), pp. 185–90; R. E. Jones, G. H. Rarey, and R. J. Icks, *The Fighting Tanks: From 1916 to 1933* (Old Greenwich, 1933, repr. 1969), pp. 33–4; Stern, *Tanks*, p. 226; B. H. Liddell Hart, *The Tanks: The History of the Royal Tank Regiment and Its Predecessors Heavy Branch Machine-Gun Corps Tank Corps and Royal Tank Corps, 1914–45: I: 1914–39* (London, 1959), 174. The British official history relegates the action to a footnote: J. E. Edmonds, *Military Operations: France and Belgium, 1918* (London, repr. of 1939 ed.), iii. 317–18.

² J. P. Harris with N. Barr, *Amiens to the Armistice: The BEF in the Hundred Days’ Campaign, 8 August–11 November 1918* (London, 1998), p. 297.

the principle of exchange, France's resentment over the Anglo-American agreement, together with the shortage of tanks and the failure of the factory at Châteauroux, led to suspicion and distrust rather than co-operation. Co-ordinated action between units in the field proved possible, but joint production led to disputes about allocation; and the Armistice was signed before tanks appeared in sufficiently large numbers to make a significant contribution to the allied victory.

The idea of the building of complementary types of tank, quickly adopted by the French, did not appeal to the British, despite their eventual shortage of manpower. As late as 21 January 1918, for example, the British representative on the Inter-Allied Tank Committee, General Sir John Capper, in a paper entitled 'Proposals for Use of Tanks in the Campaign of 1919', acknowledged the need for both heavy and light tanks, but made no mention of using Renault machines.¹ Loucheur's suggestions that France and Italy should make light tanks, while Britain and the United States made heavies, were ignored.² The British may have assumed that, if the war went on into 1919, they could produce enough medium tanks to obviate the need to use French models. David Childs wonders whether 'stubborn independence' was the reason. That, however, implies a conscious, or at least half-conscious, decision. Quite simply, neither the British high command nor the civilians at the ministry of munitions saw that an opportunity existed. To apply T. H. E. Travers's dichotomy, the problem was more 'mental' than 'mechanical'.³

France's motives are easy to discern. Huge numbers of casualties in 1914 and 1915 made a technological solution to the stalemate imperative. Loss of mineral resources left France dependent on British coal, steel, and shipping. Yet France was not completely handicapped; no use was made of France's pre-war armaments production infrastructure, for example. Moreover, after the middle of 1918, when the Renault had proved its worth, France not only possessed a useful tank for barter but had also created twenty-six tank battalions between 1 January and 5 November 1918.⁴

Britain's motives in not seeking to co-operate are less easy to discern. Cabinet memoranda on munitions versus manpower ignore the French tank. For Britain, self-sufficiency was taken for granted, the legacy of

¹ Supreme war council, circulated papers, CAB 25/121.

² A longer version of the minutes of the mtgs. is to be found in the papers of Sir Charles Ellis, MUN 4/738.

³ Childs, *Peripheral Weapon*, p. 169 n. 34; T. Travers, 'Could the Tanks of 1918 Have Been War-Winners for the British Expeditionary Force?', *Journal of Contemporary History*, xxvii (1992), 389-405. Childs comes down firmly on the 'mechanical' side of the debate (*Peripheral Weapon*, p. 194).

⁴ See 'Dates d'Arrivée des Unités d'AS aux Armées', n.d., 16N 2120, file 4. See also 'Strength and Establishment of the Artillerie d'Assaut from 1st January to the 31st October, 1918', in Stern, *Tanks*, p. 276.

centuries of rivalry and of splendid isolation, until force of circumstance imposed a change. One only has to read French's and Haig's diaries to find plentiful evidence of contempt for France's military competence. Lloyd George always doubted that the Anglo-French alliance would outlive the war, so why co-operate, if no long-term advantage accrued?

Whatever the difficulty of putting aside differences in the face of a common threat, the history of the tank bears witness to the shifts in the balance of power within the coalition. The British were able to develop their tanks independently because they took over the military leadership of the coalition from France. As soon as they needed the help of the United States, seen in the decision to build the Liberty tank, the Anglo-French balance shifted back again. As British casualties mounted and the survivors found themselves with 'their backs to the wall', the French tank came into its own at the start of the final victorious campaign. The fluctuations attest to the allies' interdependence. France could no more have defeated Germany alone than Britain could have survived the first two years of war alone while building up its armies and munitions factories.

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