

3. The Western Front

On return to Egypt after the Gallipoli campaign, the AIF underwent a major reorganisation prior to moving to join the British Expeditionary Force (BEF) on the Western Front. At this stage, ANZAC consisted of three divisions: the original 1st Division, the New Zealand and Australian Division, and the 2nd Division, which had taken part in the latter phases of the campaign. This force would now be doubled in size. Three new infantry divisions would be formed, the 3rd Division in Australia and the 4th and 5th in Egypt. The 1st, 2nd and 3rd Light Horse Brigades and New Zealand Mounted Rifles Brigade were consolidated to form an Anzac Mounted Division and the other New Zealand elements used to form a New Zealand Division. Another corps headquarters was raised and the two became I and II Anzac Corps, under the command of Lieutenant Generals Sir W.R. Birdwood and Sir A.J. Godley respectively. At this stage of the war, a corps normally consisted of three divisions.

To form the 4th and 5th Divisions, the original sixteen infantry battalions were split in two to create sixteen new battalions for four more brigades. All eight brigades were then brought up to strength with reinforcements from the depot in Cairo. The 4th Infantry Brigade (from the New Zealand and Australian Division) was assigned to the 4th Division and the 8th Infantry Brigade to the 5th Division. In this way, the infantry of the new divisions instantly became as experienced as that of the 1st Division. The most experienced division now became the 2nd Division, to which this reorganisation did not apply.¹

At the same time, the establishment of the divisions was altered to conform to the "New Armies" establishment of British divisions on the Western Front. This involved the creation of some new types of units. The largest of these were the pioneer battalions, one per division, organised along the same lines as infantry battalions. They were intended to carry out mundane construction tasks such as digging trenches and repairing roads, which did not require special engineering expertise or equipment. In practice, the Pioneer Battalions were often expected to perform the duties of engineer units. In a pinch, they could also be used as infantry and were, notably during the campaigns of 1918. To provide a kernel of tradesmen for each battalion, Birdwood intended to break up the Mining Corps, a special unit raised for underground warfare.² The Department of

¹ "Organisation of Fourth and Fifth Divisions", Australian Archives CRS B539 AIF264/1/176

² Cable, Governor General to Secretary of State for Colonies, 8 September 1915, Australian Archives CRS B539 AIF143/2/1

Defence refused permission for this and tradesmen were transferred from infantry units instead.³

Birdwood intended to make two departures from the New Armies establishment. The first was that the artillery would remain on the old establishment of three brigades each of three batteries of four 18 pounders, as in the 1st and 2nd Divisions. The British War Office did not agree with this and ordered full conformance with the New Armies establishment of three brigades of four batteries of four 18 pounders and a brigade of three batteries of 4.5 inch howitzers.⁴ This meant expanding the field artillery of the AIF from 18 batteries to 75. Priority was given to getting the 1st and 2nd Divisions ready, leaving the artillery of the 4th and 5th Divisions, composed mainly of former infantry and light horse reinforcements, dangerously inexperienced. Live shoots were conducted before leaving for France, all 18 pounder batteries firing 150 rounds and all howitzer batteries firing 120.⁵ Shortly after arriving on the Western Front, the artillery was reorganised, with the howitzer batteries being redistributed so that each division had three brigades of 12 guns and 4 howitzers and one with 12 guns only.

The second variation was for each division to have a regiment of light horse rather than a squadron. The immediate result was that the 11th and 12th Light Horse Regiments were reformed at Heliopolis,⁶ but in the end this change too was dropped and the 4th and 5th Divisions were each assigned a squadron of the 13th Light Horse Regiment instead. Shortly after I Anzac Corps arrived on the Western Front, the divisional light horse squadrons were consolidated to form a corps mounted regiment, the 1st Anzac Mounted Regiment, consisting of a squadron each from the 4th and 13th Light Horse Regiments and the New Zealand Otago Mounted Rifles. When II Anzac Corps was ordered to France, the opportunity was taken to reform the 13th Light Horse Regiment. The headquarters and machine gun sections were reformed at Tel El Kebir and accompanied the 5th Division to France.⁷ A 2nd Anzac Mounted Regiment was formed for II Anzac Corps, with B and D Squadrons of the 4th Light Horse Regiment. The cyclists too were consolidated to form the 1st and 2nd Anzac Cyclist Battalions. This change was made in anticipation of a breakthrough into open country, which would provide scope for the deployment of mounted troops.

³ Cable, GOC AIF to DOD 11 March 1916, Australian Archives CRS B539 AIF24/7/2

⁴ Cable, GOC AIF to DOD 6 March 1916, Australian Archives CRS B539 AIF24/7/2

⁵ "Extracts from GHQ MEF file no GS113. Australian and New Zealand Formations Egypt 1916", AWM45 31/3

⁶ BG DA&QMG ANZAC, 24 February 1917, AWM25 455/30

⁷ War Office to DOD, 15 May 1916, Australian Archives CRS B539 AIF264/1/233

Each infantry brigade now had a machine gun company, formed from the four battalion machine gun sections in the brigade. These were reequipped with 16 new Vickers machine guns. The Vickers was the British Navy's redesign of the Maxim and involved turning the toggle upside down and the lightening of various parts by judicious calculation of stresses and the substitution of lighter materials. Water-cooled, it weighed 18 kg, 40 per cent less than the Maxim, and could fire 450 to 550 rounds per minute. Vickers eventually managed to increase production to 1000 guns per week.⁸

The infantry battalions reformed their machine gun sections, which were in turn given four Lewis guns each. The Lewis gun was invented by an American, Samuel MacLean, and developed by two other Americans, O.M. Lissak and I. N. Lewis. It weighed 12.7 kg and had a cyclic rate of fire of 500-600 rounds per minute. It was ingeniously air cooled, using the gas blast to set up air currents and aluminium components to dissipate heat. Notably, it could be disassembled with the one item guaranteed to be available: a .303 cartridge. The British Army adopted the Lewis gun as an aircraft observers' gun in August 1914 and as a ground gun in November 1914. Some infantrymen were not entirely impressed with the new weapon. The 47 round drum magazine could be fired off in seconds and the 2 kg drums were awkward and, round for round, heavier than the Maxim's 250 round belts. The tactical implications of a lighter weapon would gradually become apparent. What was more important for the moment was that a Lewis gun could be made for one fifth of the time and materials of a Vickers by the Birmingham Small Arms Company, which increased production from 30 per week in 1914 to 2,000 per week in 1918, or by the Savage Arms Company in Utica, New York, which produced 400 per week in 1917 and 1,200 per week in October 1918.⁹

The use of jam tin bombs was discontinued and the diggers were informed that materials for constructing them would no longer be supplied. Henceforth, the Mills Grenade would be the standard grenade of the AIF.¹⁰ This weapon was invented by Belgian Captain Leon Roland and developed by a British Engineer, William Mills. The Mills grenade was egg shaped, about 10 cm long and 20 cm in circumference. Releasing a lever that holds a spring-loaded hammer in place inside activates the bomb. The hammer strikes a detonating cap, which sets off a fuse that, after a 5 second time interval, sets off the detonator. The rest of the inside is filled with ammonal and this explodes, shattering the chocolate bar shaped 5 mm steel casing. A ring pull pin is provided as a safety

⁸ Hogg, *The Machine Gun*, pp. 24-25; DeWar, George A. B., *The Great Munitions Feat, 1914-1918*, London, Constable and Company, 1921, p. 104

⁹ Hogg, *The Machine Gun*, pp. 26-27; DeWar, *The Great Munition Feat 1914-1918*, pp. 83, 193-194; Crowell, Benedict and Wilson, Robert Forrest, *The Armies of Industry*, Englewood, New Jersey, Yale University Press, 1921, pp. 204, 405

¹⁰ QMG I ANZAC, QMG Staff Circular No. 1, "SAA, Grenades and Trench Mortar Ammunition", 23 April 1916, AWM25 21/10

device. Pulling the pin does not activate the grenade; only releasing the lever does that. Most of the development effort went into improving the reliability and safety of the weapon, which caused large numbers of fatal accidents in its early days.¹¹ Australian soldiers had mixed experiences with small numbers of early models of the Mills in the latter part of the Gallipoli campaign, one digger taking his complaints direct to Birdwood and almost killing them both when the grenade duly exploded as designed.¹² By mid-1916 the weapon had become both more reliable and more easily manufactured. The diggers were fascinated by the weapon and frequently attempted to take it with them on leave. Some Gallipoli hands, accustomed to shortages, were apprehensive about the fact that bomb making materials would no longer be issued. Fears about availability proved groundless, the weekly supply of Mills bombs to the Western Front rising to 1.4 million during 1916.¹³

Trench Mortar Units (1916)¹⁴

	Officers	Other Ranks	Total
Light Trench Mortar Battery	4	46	50
Medium Trench Mortar Battery	2	23	25
Heavy Trench Mortar Battery	3	66	69

Another source of firepower available to the infantry on the Western Front was the trench mortar, which occupied a niche between bombs and artillery. On arrival on the Western Front, each infantry brigade of the 1st and 2nd Divisions was ordered to create two 25-man light trench mortar batteries, which were initially armed with four of the old 3.7 or 4 inch mortars. But a better weapon was at hand: the 3 inch Stokes mortar. Named for its inventor, British engineer F. William Stokes, the weapon consisted of a smooth bore barrel, round base plate and a bipod. To operate, one removed the safety pin and dropped the bomb down the muzzle. Because it was simple and cheap to make, it could be mass-produced by firms with little or no experience in munitions.¹⁵ It was capable of firing 6 rounds per minute or more, but BEF General Headquarters (GHQ) ordered that the rate of fire of the older mortars not be exceeded except under special circumstances so as to preserve this secret for as long as possible. The Stokes could be broken down and carried, but the barrel weighed 22 kg. Each division received a couple

¹¹ Hartcup, Guy, *The War of Invention: Scientific Developments 1914-1918*, London, Brassey's Defence Publishers, 1988, pp. 62-63

¹² Rowell, S. F., *Full Circle*, Carlton, Victoria, Melbourne University Press, 1974, p. 20

¹³ Edmonds, *Military Operations in France and Belgium 1916*, Volume I, London, HM Stationary Office, 1932, p. 124

¹⁴ "Establishments - Divisional Headquarters", AWM25 327/3

¹⁵ Hartcup, *The War of Invention*, pp. 64-67; Griffith, Paddy, *Battle Tactics of the Western Front: The British Army's Art of Attack 1916-18*, Cambridge, Massachusetts, Yale University Press, 1994, pp. 105, 115, 179

in April and by June the supply was sufficient to allow light trench mortar batteries to re-equip completely with the Stokes. At the same time, the two batteries were amalgamated to form a single eight gun light trench mortar battery.¹⁶

Characteristics of Trench Mortars (1916-18)¹⁷

Mortar	Bomb Weight (kg)	Charge Weight (kg)	Range (minimum) (metres)	Range (maximum) (metres)
3 inch Stokes	5	1.1	155	395
6 inch Newton	23	4.5	60	460
2 inch Vickers	23	5.7	90	524
9.45 inch "Flying Pig"	69	27.2	460	950

Each division also created three medium trench mortar batteries. These were manned by artillerymen (although the rank and file were transferred from the infantry), under the control of the Division Trench Mortar Officer (DTMO), who in turn reported to the Brigadier General, Royal Artillery (BGRA). Medium batteries were equipped with four 2 inch Vickers "Plum Pudding" or "Toffee Apple" spigot mortars. In June, each division also formed a heavy battery were equipped with four 9.45 inch mortars, known as "Flying Pigs" after the size of their round, which was roughly the size of a small pig.

I Anzac Corps, consisting of the 1st and 2nd Divisions and the New Zealand Division, moved into the line in April 1916, occupying the Armentieres sector just south of the border between France and Belgium. This sector was known as the "nursery" because both sides used it to train units new to the Western Front. The Anzacs travelled by ship from Alexandria to Marseilles, luckily avoiding loss to U-boats although one ship was torpedoed and sunk on the way back. From there they took the train to their railhead and trucks or buses to within a few miles of the front line, and made their way to the trenches on foot in groups too small to draw German artillery fire.

The 1st Division indented for 14,000 helmets immediately upon arrival in France and all troops in the front line area were issued with them, although several months would pass

¹⁶ GS I ANZAC, GS Circular No. 2, "Circular Memorandum and Notes on Trench Mortar Batteries - 1916", 16 April 1916, AWM25 973/2;

GS 2nd Division, "Instructions regarding the use of Light Trench Mortars", 25 May 1916, AWM25 973/4

¹⁷ Commandant of the Trench Mortar School, "Syllabus of Lectures to Senior Officers ", 1917, AWM25 973/48

before every Australian soldier had one.¹⁸ Helmets and armour had been standard military equipment since ancient times but had gone out of fashion during the early modern period. This is conventionally attributed to improvements in firearm technology but this is only partly true. The main reasons for the move away from armour were tactical: increasing the mobility of armies by reducing their weight.¹⁹ In 1915 the French army introduced the Adrien helmet which, despite its flaws, was credited with reducing casualties by between 2 and 5 per cent. The British followed suit the next year, adopting a design notable for its ease of manufacture, since it could be pressed cold out of a 720g sheet of manganese steel that could stop a bullet travelling at 250 metres per second. However, the helmet was heavy and uncomfortable because the leather and felt liner did not follow the shape of the head and it did not protect the back of the head or the neck. Some 70,000 tonnes of steel went into the manufacture of between 7 and 8 million of these helmets, which were adopted by all English speaking armies. Some 50,000 suits of body armour were also produced from manganese steel.²⁰ Body armour being heavy, its use was restricted to trench duties for relatively immobile jobs, such as snipers and observers.

When the 1st Division arrived, it was reunited with its mechanical transport. Back in September 1914, the Army had decided to supply mechanical transport for the 1st Division by activating the 8th Service Company in New South Wales as an ammunition sub-park and the 9th Service Company in Victoria as a supply column. These were the first ever mechanical transport units in the Australian Army. Some 135 trucks and 35 other vehicles were purchased and the two units departed Melbourne for Egypt on 22 December 1914.²¹ Unfortunately, vehicles over 5 tons were prohibited in Cairo as most bridges could not hold their weight, whereas the companies possessed vehicles weighing up to 7 tons. It was therefore arranged for them to proceed to England where they arrived on 15 February 1915.²² There they lived in tents on Salisbury Plain and hauled gravel for roads before being alerted for service in France in June 1915.²³ As spare parts for some of the vehicles they had brought from Australia were hard to obtain, they

¹⁸ Bean, C.E.W., *The Official History of Australia in the War of 1914-1918. Volume III: The AIF In France 1916*, Sydney, Angus and Robertson, 1929, p. 89

¹⁹ Dyer, *War*, p. 61

²⁰ DeWar, *The Great Munition Feat 1914-1918*, pp. 90-94; Crowell and Wilson, *The Armies of Industry*, pp. 285-289; "Steel Helmets", AWM45 40/3

²¹ DMTS AIF, "Motor Transport Board's Report", 18 May 1915, Australian Archives CRS B539 AIF378/2/552

²² Telegrams, War Office to GOC Egypt dated 29 December 1914, GOC Egypt to GOC ANZAC dated 1 January 1915, War Office to GOC Egypt dated 17 January 1915, AWM4 1/28/13 Microfilm Roll 783

²³ The truck drivers were not the first Australians to serve in France, although they were the first units of the AIF. An Australian Volunteer Hospital had been formed in England in August 1914 from Australian expatriates. All medical practitioners in the unit were Australians and although women were not allowed to serve as doctors, Australian nurses were gratefully accepted. The unit left for France in August 1914 and from October was based at Wimereux, where the 2nd General Hospital joined it in June 1916. In July 1916, the Australian Volunteer Hospital was absorbed into the British Army. See Ray, Pam, "A Photographic Record of an Australian Nursing Sister", *Journal of the Australian War Memorial* No. 18, July 1991, pp. 63-65

exchanged them for standard types on 10 June; 87 Peerless 3 ton trucks for the 8th Service Company and 46 Peerless 3 ton trucks and 14 Daimler 30 cwt trucks for the 9th Service Company.²⁴

Another group of Australians had arrived in France in advance of I Anzac. In June 1915, the 1st Siege Artillery Brigade was formed under the command of Lieutenant Colonel W. A. Coxen, the Australian Army's Director of Artillery, for service on the Western Front.²⁵ About half the men in the unit were permanent gunners of the Garrison Artillery.²⁶ The brigade departed Melbourne for England on 17 July 1915 and landed in France on 27 February 1916.²⁷ The delay in England was necessitated because heavy artillery pieces were in short supply. Eventually the 54th Siege Battery was equipped with 8 inch howitzers and the 55th Siege Battery with 9.2 inch howitzers. An emergency response to the need for more long range artillery, early model 8 inch howitzers were adaptations of naval guns. Later models were purpose built by Vickers and fired a 90.7 kg shell up to 9,600 metres. The largest artillery piece ever operated by the Australian Army, the 9.2 inch howitzer was also one of the most unusual. Weighing in at a hefty 16.5 tonnes, it could fire a 132 kg shell up to 12,740 metres. Its carriage bed consisted of two large rectangular box girders. To prevent the gun lifting, a box on the front of the carriage had to be filled with at least 9 tonnes of dirt. It was transported broken up into three loads, hauled by caterpillar tractors. A notable feature was the air recuperator, which later became standard on most guns.²⁸

Due to the low-lying nature of the ground around Armentieres, elaborate drainage was required. Extensive use was made of duckboards, 2 metre long ladder-like wooden footways consisting of two beams with boards nailed to them. These were often set upon pairs of "A frames", wooden frames shaped like an inverted letter "A". This allowed water to drain away beneath the duckboards. The parapets of the fire trenches were 3 to 4 metres wide and built high, so that much of the trench was above ground level. Beyond the parapet lay the wire entanglements, listening posts and No Man's Land. The Anzacs were disappointed with the condition and quality of the trenches but impressed with the cornucopia of trench stores like barbed wire, sandbags, timber, iron "cork screw" posts for hanging barbed wire on and thick corrugated iron sheets known as

24 "No. 8 Company AASC: Summary of Events in England and France 1915", AWM224 MSS219; Bean, III: *The AIF in France: 1916*, pp. 115-116

25 DOD order 3 June 1915, Australian Archives CRS B539 AIF24/4/59

26 Horner, *The Gunners*, pp. 81-82

27 "The Australian Siege Brigade in the Great War", AWM224 MSS686

28 Gower, *Guns of the Regiment*, pp. 54-55, 172-177

"elephant iron" for constructing shelters. Tramways had been constructed to bring stores forward and fresh water was piped direct to the trenches.²⁹

Special positions were provided for snipers. In Egypt, each battalion had formed a thirty-man scout platoon under the command of the battalion intelligence officer. These men were hand picked, the selection guideline calling for men who were country bred, intelligent and well educated, first class shots and of good physique. The whole platoon was equipped with telescope rifles. They were exempt from fatigues and carried out the sniping, observing and patrolling tasks, leaving the ordinary infantryman with little to do. The Australian soldier did not agree with this arrangement and all were soon on the lookout for targets. To cope with this, it was found necessary to construct additional loopholes and upgrade the existing ones. The German sniper, equipped with armour piercing bullets with a solid steel core for dealing with inadequately protected loopholes, was initially "top dog". Although the Australian sniper soon asserted himself, no supremacy of the kind achieved over the Turkish snipers at Anzac was ever attained.³⁰

At Anzac, patrolling had been largely the responsibility of the light horse and confined to the flanks and the area captured around Suvla in the August offensive but because No Man's land was much wider on the Western Front, there was more scope for patrolling. Patrols from both sides were active after dark, reconnoitring enemy positions and inspecting the condition of their own and the enemy's barbed wire. Initially the Germans had the advantage of local knowledge and small unit experience, and the Australian patrols were comparatively few and timid. As they became more experienced, however, the Australian scouts became more aggressive and began cutting off German patrols and attacking them. As with sniping, the digger was unwilling to leave the job to the specialists, six man detachments of the scout platoon. In an effort to capture a German prisoner in May the 6th Infantry Battalion had up to 100 men in No Man's Land nightly. As at Gallipoli, the Australian soldier preferred not to use flares or illumination at night. The Germans on the other hand made extensive use of flares and firing one was often their first reaction to sighting a patrol. Because the flare was moving it produced moving shadows, so if a patrol lay very still it could still escape detection. The Germans also made use of searchlights. If caught by one, a digger had little option but to play dead and hope for the best.³¹

²⁹ Bean, III: *The AIF in France: 1916*, pp. 69, 73, 97-99, 104, 128

³⁰ Bean, III: *The AIF in France: 1916*, pp. 119-121, 130-136; "Report on Sniping in Trench Warfare", AWM25 979/7

³¹ Bean, III: *The AIF in France: 1916*, pp. 97-99, 104, 119-121, 130-136

Each battalion formed a bombing platoon of 33 men from graduates of a short bombing course, under the command of an officer. In France, training courses were conducted on all manner of technologies and technics. Each company had an equal number of trained bombers, and increasingly these too were organised as a bombing platoon. Gradually the number of bombers was increased to 128 per battalion, or 8 per platoon.³² The Mills also came in a rifle grenade version. This consisted of a Mills on a rod which was inserted into the rifle barrel and fired with a blank cartridge. It became increasingly popular but initially only the bombers were trained to use it. On 14 June 1916, Australian bombers fired 30 rifle grenades in order to provoke German mine throwers into retaliating and thereby giving away their position.³³

Each battalion also had a Lewis gun platoon. On reaching the Western Front, the number of Lewis guns per battalion was gradually increased to six and then eight. Two Lewis guns were then assigned to each company and the former commander of the battalion machine gun section became the battalion Lewis Gun Officer (LGO), and responsible for the training of Lewis gunners and technical advice on their use to the battalion and company commanders. In July the allocation of Lewis guns was increased to twelve. Normally two would be assigned to each company and the remaining four held as a battalion reserve under the LGO.³⁴ Pioneer battalions remained on two Lewis Guns per company "in view of the difficulty experienced by Pioneer battalions in providing trained Lewis Gun detachments owing to the demands on their time". Cyclist Battalions also stayed on two guns per company.³⁵

The administration of the scouting, bombing and Lewis gun platoons was initially informal, with each company contributing a section that lived and took their meals with their company. Gradually, these platoons became permanent. This marked the emergence of the platoon as a tactical unit.³⁶

Unlike on Gallipoli, there was little contact between the miners and the infantry. Systematic destruction of frontline areas by trench mortars and artillery made mining from the front trenches impossible. Instead, long inclines were constructed to allow access to mine systems from the support lines and sometimes even further back and the frontline entrances were sealed up. On 3 August 1916, the Mining Corps was split up

³² GOC 1st Division, 14 August 1916, AWM26 51/25

³³ Bean, III: *The AIF in France: 1916*, p. 104, 210

³⁴ BGGs I Anzac Corps, "Organisation of Lewis Gun Detachments", 31 July 1916, AWM26 50/14; "Lectures (by Military Officers) Machine Guns including Lewis Guns", AWM25 385/4

³⁵ BGGs I Anzac Corps General Staff Circular No. 30, 10 November 1916. AWM26 114/25

³⁶ Rule, E.J., *Jacka's Mob*, Sydney, Angus & Robertson, 1933, p. 87-88

into three tunnelling companies, which worked different parts of the system.³⁷ The headquarters company was formed into the Australian Electrical and Mechanical Mining and Boring Company (AEMMBC). The first unit of its kind to serve on the Western Front and one of the most technologically advanced units there, its role was to keep the tunnel systems clear of water and to supply electricity for tools and lighting for the frontline area.³⁸ It did this with 220 and 440V generators. Even tramways and dugouts were supplied with electric lighting and the services of the "Alphabet Company", as it was colloquially known, were much in demand.³⁹ From its workshops in Hazebrouck, the company maintained all electrical pumps and generators in the British First and Second Army areas. The company also employed the Wombat boring machine that it had brought from Australia. A giant drill, this device was used for drilling horizontal bores for demolitions and ventilation.⁴⁰

The capability of artillery during the Gallipoli campaign had been severely limited by, amongst other things, shortage of ammunition. This was only partly due to the low priority accorded to the theatre; it also reflected a worldwide shortage. The need for High Explosive (HE) shell had been particularly underestimated because of the assumption that open warfare would prevail, in which shrapnel would be more important. Trench warfare involved far more use of artillery ammunition in general and HE in particular due to the requirement for destruction of trench systems and other field fortifications.

Little TNT had been manufactured in the UK before the war. The standard process of manufacture involved treatment of toluene (methyl benzene) with nitric acid and oleum (a solution of sulphur trioxide in sulphuric acid). The process was not easily scalable and the oleum was imported from Germany. A process for making TNT without oleum was devised by Professor W.R. Hodgkinson at the Woolwich Arsenal, where production began on 17 January 1915. By the end of the war 30 factories in the UK were producing 1,000 tonnes of TNT per week. TNT was poured into a shell in a molten state. As it contracts while it cools, the shell would be two thirds filled and then left to cool until a crust formed. The crust would then be broken and the shell would then be filled up, filling any cavities that had formed.

Amatol was an 80/20 mix of Ammonium Nitrate and TNT which was easier to handle than pure TNT and manufacture in Britain required just 1.5 tonnes of imported materials

³⁷ AIF Order No. 214

³⁸ Electrical wiring was insulated with cloth, and water proofed with shellac, a substance derived from the resinous secretions of beetles.

³⁹ E-in-C GHQ BEF 28 January 1917, AWM45 32/13

⁴⁰ McNicoll, *Making and Breaking*, pp. 180-183

per tonne produced as opposed to 7.5 tonnes per tonne of pure TNT. In testing it was found to be a satisfactory high explosive and it was adopted as the standard shell filling by the BEF in December 1916. Thus, a technological solution was employed on a strategic problem, the shortage of shipping caused by U-boat attacks.

Initially, shells were filled with cold Amatol that was pressed into the required density. This process was fraught with danger, both of explosion and of an unacceptable percentage of dud rounds. A new process was devised in which the shell was filled with hot but not molten Amatol, in which form it could easily and more safely be compressed. At first this was done by hand but an extruding machine was invented to automate the process, leaving behind a neat hole for the tetryl booster.⁴¹ In this case, technology was employed to overcome an industrial problem.

While the primary ingredients of Cordite - nitroglycerine, nitrocellulose and vaseline - were readily available in the UK, the same could not be said for acetone, the solvent needed for gelatinising the mixture. Acetone was imported from the United States and was also vital for making the dope used to treat the fabric of aircraft wings. To economise on acetone, a new process was devised which used alcohol, produced by distilleries, as a solvent. As a result, Scotch whisky became scarce in the UK. Here, technology was employed to solve an economic problem. In Australia, the economic situation was different and old processes continued, an acetone factory being established on the Brisbane River to produce it from waste molasses. By June 1918 it was being exported to ammunition factories in India.⁴²

Throughout 1915 and 1916, existing factories were expanded and new ones constructed on an unprecedented scale. There was a growing army of munitions workers: 2,871,000 in the UK alone in 1918, of whom over 6,000 were Australian war workers sent to assist British industry. Some 200 Australian war workers served in France. The full effects, however, would not be felt until 1917. In the meantime, ammunition was being hoarded for the upcoming offensive on the Western Front and was therefore rationed to 3 rounds per gun per day.⁴³

In the event of a German attack, however, company commanders could request artillery support. Artillery arrangements on the Western Front were more orthodox than at Anzac, with each battery assigned to defend a particular sector. The company

⁴¹ Crowell and Wilson, *The Armies of Industry*, pp. 170-172, 184-186; Hartcup, *The War of Invention*, pp. 45-49

⁴² Crowell and Wilson, *The Armies of Industry*, pp. 340-342; Hartcup, *The War of Invention*, pp. 50-52; Scott, XI: *Australia During the War*, pp. 260-261

⁴³ DeWar, *The Great Munition Feat 1914-1918*, p. 14; Scott, XI: *Australia During the War*, pp. 265-276; Bean, III: *The AIF in France: 1916*, p. 123

commander need only send the message "SOS" and the number of his trench and the artillery would respond with a pre-registered barrage on the enemy trench and other key positions. Response time was reported to division headquarters. By day, artillery observers and flying corps aircraft closely watched the front. At night, the artillery could also be summoned by firing the SOS rocket, a firework made of grey paper with a stick at one end, which burst in a prearranged colour. One problem with this signalling mechanism was that the SOS rocket always seemed to get wet and would not fire half the time. Later a version was provided that was similar to a rifle grenade, and operated in the same way except that it was fired perpendicularly. Another problem was that the Germans often accidentally or deliberately sent up fireworks of the same colour. The Germans solved this problem with a more elaborate firework that changed colours in sequence. I Anzac Corps would not be equipped with a similar technology until January 1917.⁴⁴

Conditions on the Western Front did not favour visual signalling. The terrain was flat, the weather frequently misty or rainy, and the battlefield often smoky. Dry cell battery powered electric lamps and flashlights were utilised. Large sheets known as Popham Panels were used for communication with aircraft, which would immediately return to an airstrip from which the message could be relayed to the appropriate destination. Smoke was also used to signal aircraft at times. Audible signalling was used for some purposes. Klaxon horns and gongs were used to warn of a gas attack and whistles were used extensively by raiders as a signal to return to the trenches.⁴⁵

Carrier pigeons were widely used on the Western Front. I Anzac Corps established its own pigeon lofts and a carrier pigeon station was attached to each brigade. Special lightweight message forms were provided but in a pinch anything that could fit into the container attached to the pigeon's leg would do. The advantage of this form of communication was that diagrams and maps could be sent as well as written messages. Pigeons could only be used by day, in reasonably calm weather and - for security reasons - when there was no strong westerly wind blowing. Predators, shellfire and gas were all hazards but pigeons delivered 95 per cent of their messages successfully. At Mouquet Farm, a request for heavy artillery support sent by pigeon was received by the pigeon loft, telephoned to the batteries and acted upon within twenty minutes of the pigeon being released.⁴⁶

⁴⁴ Bean, III: *The AIF in France: 1916*, pp. 107-108, 217, 250, 326; Rule, *Jacka's Mob*, p. 206-207; BGGs I Anzac Corps, "SOS Signals", 3 January 1917, AWM26 114/28

⁴⁵ Bean, III: *The AIF in France: 1916*, pp. 108, 250, 636

⁴⁶ Bean, III: *The AIF in France: 1916*, pp. 90, 749; Barker, *Signals*, pp. 67-68; Crowell and Wilson, *The Armies of Industry*, pp. 584-586

Sometimes the only other way that messages could be sent was by runner. This was work for heroes:

Yet when, during these barrages, the battalion staff called for a runner, the next messenger on the list would come forward and, receiving his message, climb the dugout stairs and issue in the face of the storm. Fifteen or twenty minutes later, emerging from between the shell bursts which shovelled in the trenches, he might, if he lived, tumble exhausted, strained almost to speechlessness, down the stairs of some headquarters to deliver his message, and then curl himself up in the corner like a dog until he was called upon to return with another communication.⁴⁷

The most important means of communication was by cable. The requirement for signal wire, or more precisely cable, electric D1 and D3 single, was enormous, exceeding all expectations. The technology was convenient and allowed direct conversation between a commander and subordinate units. However, there were problems with maintenance, especially the vulnerability of the lines to shellfire, with reliability, particularly when inexperienced personnel were involved, and with security. The last was particularly serious since it was found that the line could act as a giant antenna and the enemy could listen in. One solution to this was devised by a British officer, Major A. C. Fuller. Since the alternating current sent out by telephones was so easy to detect, Fuller devised a means of using a weak direct current instead. Known as the Fullerphone, it could be used on the same lines as telephones. The only problem was that there were never enough of them. Some 15,000 sets were eventually supplied to the British and US Armies but for the moment they were still in short supply.⁴⁸ Roughly from divisional headquarters back, telegraph poles were used to carry the cable. Forward of this, the cables were buried five feet underground. On a typical night's work, each man would dig 3 metres of trench, and later refill it after the cable had been laid by the signal engineers. By the end of June 1916, the 1st Division alone had dug 29 kilometres of trench. Ladder like layouts were used to increase survivability to shelling.⁴⁹

A feature of the Western Front at this time was trench raids. The first of these had been carried out on the night of 9/10 November 1914 by Indian troops, the 1st and 2nd Battalions of the 39th Garhwal Rifles. The idea gradually spread to other armies. Trench raids were carried out for a multiplicity of purposes: identification of enemy units, distracting the enemy's attention away from other sectors, training new troops, building up offensive spirit, inflicting loss on the enemy, and damaging enemy morale. Only the identification and training reasons seem convincing today, but by May 1916 BEF GHQ

⁴⁷ Bean, III: *The AIF in France: 1916*, p. 729

⁴⁸ Barker, Theo, *Signals. A History of the Royal Australian Corps of Signals 1788 - 1947*, Canberra, Corps Committee of the Royal Australian Engineers, 1987, pp. 70-71; Hartcup, *The War of Invention*, pp. 78-79

⁴⁹ Bean, III: *The AIF in France: 1916*, p. 129

was requiring a certain number of raids be carried out in each sector as part of a deliberate policy.⁵⁰

A trench raid was an elaborate affair. The Canadians were regarded as the experts so two Canadian officers were sent to assist in training the Australians. Raiding parties were composed of volunteers, often from two or more units, and each man was assigned a particular role. Replicas of the enemy trenches were constructed from aerial photographs and the raiders rehearsed the assault by day and by night until they could carry it out in silence in the dark. The raiders wore special clothing with badges and other distinguishing marks removed so as not to provide the enemy with identification if they were killed or captured. White armbands were worn to enable the raiders to distinguish themselves from the enemy once the shooting started. Until then, they were covered with black cloth. Faces and hands were blackened. Bayonets were painted black and the raiders wore sand shoes, dyed black. Instead of rifles, many soldiers carried grenades, revolvers or "life preservers" - lumps of four by two with a steel bolt through one end. Whistles and flares were used to signal the moment of withdrawal and tapes were laid to guide the raiders back. A trench raid could be "quiet", entry to the enemy trenches being made in silence, relying on the element of surprise or "noisy", following an artillery barrage. In both cases, an artillery barrage covered the withdrawal. The Australians preferred the silent method, although the first raid was noisy. Even in a noisy raid, the Australian bombardment was shorter than that used by the Germans.⁵¹

The first raids on the Anzac front were carried out by the Germans on 5 and 30 May 1916. In both instances, Australian casualties were 131 men while German losses were light, 19 in the first raid and 8 in the second. Both raids followed the same pattern of an annihilating bombardment followed by a German entry into the Australian trenches, protected from neighbouring units by a box barrage. Overcrowding the trenches had caused the excessive casualties. For this, Birdwood and his chief of staff, Brigadier General C.B.B. White, were responsible. They had ordered the trenches held on the scale of Gallipoli but the Turks did not have the same artillery resources as the Germans. Considerable embarrassment was caused in the first raid in that the Germans not only captured two of the new still-secret Stokes mortars but by the fact that the British Second Army Headquarters found out about it from the German daily communiqué.

⁵⁰ Bean, III: *The AIF in France: 1916*, pp. 257-259, 284-287; Gudmundsson, Bruce I., *Stormtroop Tactics*, New York, Praeger, 1989, p. 80; Griffith, *Battle Tactics of the Western Front*, pp. 60-61; Rawling, *Surviving Trench Warfare*, pp. 47-48

⁵¹ Bean, III: *The AIF in France: 1916*, pp. 203, 212, 245, 248; Griffith, *Battle Tactics of the Western Front*, pp. 61-62

Defensive tactics were revised and commanders were instructed to retire to the flank and to counterattack vigorously when the barrage lifted and the Germans advanced. This proved impossible because the German box barrage prevented any withdrawal to the flanks and did not lift when they advanced but only after they had retired. Thus, no counterattack was possible. The only solution was to reduce the size of the garrison. More disturbing was that the artillery's response was confused by German pyrotechnics, slow, dispersed over too wide an area, failed to suppress the German artillery and caused no German casualties. Like the infantry, it was slow to modify its tactics to the new circumstances, in this case the abundance of ammunition.

Australian raids began on 6 June. In the lead up to the Somme operation, I Anzac Corps was ordered to stage a raid every night from 25 June. Most raids involved 60-70 men but the later raids in the series used entire companies. Enemy trench lines were occupied but rarely for more than 30 minutes. Enemy losses were usually much higher than those of the raiders but the increased activity on the Armentieres front saw Australian casualties climb from 282 in April to 874 in May and 1,228 in June. The Australian artillery allowance was trebled. Many important tactical lessons were learned, particularly concerning the coordination of all arms. Some items used in the early trench raids, such as the sandshoes and knobkerries, were found to be impractical and discarded. As time went by, the enemy became more wary and raids became more difficult but the AIF was well on the way to developing its own techniques. The final raid in the series was conducted by the 4th Brigade of the incoming 4th Division on the night of 2/3 July.⁵²

Some 160 Allied divisions faced about 120 German divisions on the Western Front. The ability to concentrate troops in such enormous numbers depended on a modern industrial transportation infrastructure. Of the British Expeditionary Force's daily requirements, only a few items - mainly coal, timber, bricks, gravel and stone - were procured locally. Everything else had to be shipped in. Australia supplied the AIF's requirements for clothing, footwear and saddlery. Other war supplies sent from Australia to Europe included beef, lamb, rabbit, pork, butter, condensed milk, canned and dried fruits, wool, wheat, tallow and metals. As the war went on and the shipping situation became critical, Britain was forced to cut imports from Australia drastically. By 1918, AIF reinforcements were disembarking in Italy and taking the train from there to save shipping.⁵³

⁵² Butler, A.G., *The Australian Army Medical Services in the War of 1914-1918. Volume II: The Western Front*, Melbourne, Australian War Memorial, 1940, p. 864; Bean, III: *The AIF in France: 1916*, pp. 259-287, 305

⁵³ Scott, XI: *Australia During the War*, pp. 523-545

Six French ports operated by the British handled 96 per cent of the BEF's requirements: Dunkirk, Calais, Dieppe, Boulogne, Rouen and Le Havre, where the AIF's depot units of supply were located. From the ports, supplies moved by rail or barge to regulating points where they were sorted before being forwarded. The supply system might be described as "semiautomatic". Certain supplies for which demand was invariant, such as fodder and rations, were sent daily without requisition in division sized "packs" consisting of two railway trucks of bread, two of groceries, one of meat, four of hay, five of oats and one of petrol, a total of 15 trucks. Each pack was earmarked for a particular division and would be delivered to its railhead. Supplies for which there was variable demand, such as reinforcements, remounts, ammunition and engineering stores, had to be indented, and were sent by the railway truckload. A typical train would consist of 40 trucks: two packs and 10 other trucks. Each division drew its supplies from a single railhead, although it might share it with other divisions.⁵⁴

Mechanical transport was used for hauling supplies from the railheads to the refilling points, whence the supplies were hauled away by horse transport. Due to the narrow roads through French towns, circular one way traffic routes were preferred. Where there was little enemy air or artillery activity against the lines of communication, forward railheads were used where the railhead was also the refilling point, which reduced handling and wear and tear on both trucks and roads. Control of transport tended to drift to higher levels to provide flexibility and economy. The mechanical transport was reassigned to corps control and the brigade ammunition columns were consolidated with the divisional ammunition columns to economise on horses, whose fodder required scarce shipping space. The resulting division ammunition column had 1,040 horses. The French and Canadians had made a start on construction of tramways to connect forward dumps with refilling points, but this method was still under-utilised by the British Army in mid 1916.⁵⁵

The war on the Western Front had settled into a stalemate with the Germans on the defensive while seeking a decision against Russia. Allied leaders agreed on a major offensive on the Western Front in 1916. The Australians were originally intended to spearhead the British attack but the month's delay imposed by the reorganisation in Egypt had led to their replacement by British troops. A 40 km sector of the front between the Somme and Ancre Rivers was chosen as the site for the offensive because it was where the British front joined the French, enabling the two allies to attack side by side. Ground in this sector had no strategic value as the Germans could afford to

⁵⁴ Henniker, *Transportation on the Western Front 1914-1918*, London, HM Stationary Office, 1937, pp. 103-104, 187, 232

⁵⁵ Henniker, *Transportation on the Western Front*, pp. 149-156

withdraw should a breakthrough occur; destruction of enemy forces was far more important than the capture of any locality. The area was far from an ideal place for a major offensive. The water supply was inadequate and the capacity of the two railway lines that approached the front fell below the estimated requirements. No tramways existed, policy being at the time to put resources into improving and extending the railways. Of course, supplies could be hauled by truck from Arras or Amiens but the area was rural, the main roads not suitable for heavy traffic and stone for road repair was omitted to save rail capacity.⁵⁶

Huge numbers of troops coupled with the increased frontage that could be covered with modern weapons meant that both sides had more than enough men to cover the entire Western Front from the North Sea to the Swiss border, so there were no gaps or open flanks. Envelopment was therefore impossible; any assault had to be a frontal one. What the British Army desperately needed was tactics for dealing with this situation. Two general approaches to the problem were developed using the *Field Service Regulations* as a philosophical framework.

Reading through the *Field Service Regulations* some British officers concluded that the Western Front was a gigantic siege. For this, the regulations prescribed "a series of independent frontal assaults on a well defined and limited frontage".⁵⁷ A couple of hours before dark was suggested as the best time for an assault. The storming parties would consist of infantry with fixed bayonets and hand grenades accompanied by carrying parties and engineers. As soon as a position was captured, the attackers would entrench and construct field fortifications with sandbags.⁵⁸ The *Field Service Regulations* warned that "a bombardment should rarely precede the delivery of the assault except when the course of the previous operations has been such that a bombardment will not serve as a warning to the enemy" and suggested dusk as the best time for an attack.⁵⁹

The other meme held that the offensive was a battle. For this the *Field Service Regulations* had some interesting advice:

To concentrate superior power at the decisive point, a portion of the force must be held in readiness to deliver the decisive attack, while the remainder is employed to develop the attack and to wear down the enemy's power of resistance.⁶⁰

⁵⁶ Edmonds, *Military Operations in France and Belgium 1916*, Volume I, pp. 270-278

⁵⁷ *Field Service Regulations*, p. 146

⁵⁸ *Field Service Regulations*, pp. 147-8

⁵⁹ *Field Service Regulations*, p. 147

⁶⁰ *Field Service Regulations*, p. 112

When it came to wearing down the enemy,

The general principle is that the enemy must be engaged in sufficient strength to pin him to his ground, and to wear down his power of resistance while the force allotted to the decisive attack must be as strong as possible. The higher the fighting qualities of the enemy are estimated, the more closely he must be engaged. ⁶¹

For a general strategy, the Field Service Regulations recommended envelopment, on its great morale effect.⁶² In general, this was the favoured meme, but the two were not entirely incompatible.

British efforts at developing offensive tactics had not been very successful thus far. The main shift in thinking since 1914 was therefore that while the battle was still seen as beginning with a struggle for superiority of fire and ending with a bayonet assault, now it was entirely up to the artillery to achieve that superiority of fire. At Neuve Chapelle in March 1915, a short but intense artillery bombardment had allowed a British advance of 1,000 metres on a 2,000 metre front at a cost of 12,000 casualties.⁶³ Lieutenant General Sir H.S. Rawlinson commented that,

The lessons we have learned at Neuve Chapelle are... that it is always possible by careful preparation and adequate artillery support by heavy howitzers to pierce the enemy's line provided that his wire entanglements can be cut by the fire of our field guns, and it can always be so cut if it is visible and not protected by earthworks.⁶⁴

The lesson drawn from this battle by the Germans was somewhat different: the need for shellproof defences in depth. Improved defences showed their value in subsequent offensives in 1915 but the shell shortage led to failures being blamed on inadequate artillery preparation.

The British concentrated 164 battalions against an estimated 32 German battalions, a 5:1 superiority which conventional wisdom held would ensure success. As at Gallipoli, superiority of numbers proved meaningless in the face of the capabilities of modern weapons. The attacking infantry were not wanting in courage or enthusiasm, but such human factors were to little avail so long as they lacked appropriate technologies and tactics.⁶⁵ In just one day's fighting the British Army lost 60,000 men but it was not so much the enormous casualty list that disturbed the British commanders as the lack of

⁶¹ *Field Service Regulations*, pp. 113-114. Emphasis original.

⁶² *Field Service Regulations*, p. 112

⁶³ Prior, Robin and Wilson, Trevor, *Command on the Western Front*, Oxford, Blackwell Publishers, 1992, pp. 68-69

⁶⁴ Letter, Rawlinson to Kitchener, 15 March 1915, Prior and Wilson, *Command on the Western Front*, p. 77

⁶⁵ Prior and Wilson, *Command on the Western Front*, p. 323

commensurate results.⁶⁶ The AIF was originally supposed to spearhead the attack but the reorganisation in Egypt had forced a change of plans.⁶⁷ Now it had just three weeks to come up with some answers.

One formation would not even get that. The 5th Division, the last to arrive on the Western Front, having relieved the 4th Division only on 11 July, and the British 61st Division, recently arrived from England, were placed under the command of the British XI Corps and ordered to attack on either side of a concreted complex known as the Sugar Loaf on a 4000 metre front south of Armentieres. Here the width of No Man's Land ranged between 100 metres on the left flank to 400 metres on the right, near the Sugar Loaf. Once the bombardment lifted the Germans could emerge from their dugouts, set up their machine guns and engage the attacking infantry unless they had already reached the trenches, so they advanced in four waves, intending to approach to within 200 metres of the Sugar Loaf five minutes beforehand and then to rush it when the moment it lifted.⁶⁸

Artillery at Fromelles⁶⁹

Guns	Number of Guns	Rounds available	kgs per round	Total kgs
18 pounder	210	200,000	8.39	1,677,950
4.5 inch howitzer	48	15,000	15.87	238,087
60 pounder	36	4,440	27.21	120,812
6 inch howitzer	20	180	45.35	8,163
9.2 inch howitzer	8	30	131.52	3,945
TOTAL	322	219,650		2,048,958

The bombardment was completely inadequate, so instead of covering in their bunkers the German machine gunners were able to fire through the barrage. The diggers encountered fierce artillery fire even before the attack began. Except around the Sugar Loaf, they still succeeded in overrunning the German front line and pushed on to their objective, which proved to be non-existent due to poor British staff work. It is hard to recover from an error like this one. Some units fell back to the old German front line. Others set up in drains and filled their sandbags with mud. Throughout the night the

⁶⁶ Bean, III: *The AIF in France: 1916*, p. 242

⁶⁷ "Employment of ANZAC in Somme Offensive 1916", AWM45 31/5

⁶⁸ Bean, III: *The AIF in France: 1916*, pp. 334-341

⁶⁹ Bean, III: *The AIF in France: 1916*, p. 337; Griffith, *Battle Tactics of the Western Front*, p. 136

Germans counterattacked, pushing along their old trench line and cutting off the Australians. By daylight, the last diggers had been forced to return.

There were six real reasons for the failure: (1) a well trained and well led German division, (2) incompetent leadership and staff work by the British XI Corps and, to a lesser extent, 5th Division, that, amongst other things, set an objective that turned out to be non-existent, (3) an ineffective barrage that failed to suppress the German machine guns, (4) German observation of the battlefield from Aubers ridge, aided by a start time before dark, that probably would have rendered ground captured untenable in any case, (5) ineffective counter battery fire and (6) a shortage of ammunition and grenades.

The Battle of Fromelles cost the 5th Division 1,917 dead, 470 captured and 3,146 wounded, a total of 5,533 casualties. Tragically, as at the Nek at Gallipoli, the bravery and resolution of the diggers and junior leaders of the AIF only served to run up an even higher casualty list. Lieutenant General Sir R.C.B. Haking, commander of the British XI Corps, blamed the failure on inadequate infantry training and felt that this had done the division "a great deal of good".⁷⁰ In this he was still subject to the meme, enshrined in prewar doctrine, that human factors were paramount.

In this case, this meme was no doubt aided by cognitive dissonance, Haking's willingness to place the blame on his men rather than admit to being an incompetent general, but it is worth considering how this meme came to exercise such a hold on the British regular army, who after all, were generally supportive of technological innovation. The reason is that if technology, and therefore tactics, is constant, as it is in the short term, then the human dimension still provides scope for improvement, and this became the main role of regular army officers. From here, it was but a short distance to the meme that the human dimension was the more important one.

On arrival in the Somme sector, the 1st Division came under the direct command of the British Reserve Army, under General Sir H. de la P. Gough. Up to this point it had been preparing for semi-open warfare, exploiting a breakthrough made by the British.⁷¹ Gough gave it the job of taking the fortified town of Pozieres, a key position that had already been attacked three times without success by the British Army. Repeating attacks battering ram style was a feature of this campaign. Although I Anzac Corps consisted of three divisions, the 1st, 2nd and 4th, only part of one would be in the line at a time during this campaign. This tended to render corps a superfluous level of command and Gough frequently bypassed it. He gave the 1st Division's commander,

⁷⁰ Bean, III: *The AIF in France: 1916*, pp. 442-447

⁷¹ Notes on 1st Division conference, 13 July 1916, AWM26 51/24

Major General H. B. Walker, the option of attacking from the southeast or southwest. Either option would leave a flank exposed, but after reconnoitring the ground Walker realised that on the southeast approach the Pozieres Heights would shield his right flank so this was therefore selected, although it meant a more difficult assembly.⁷²

Australian commanders and staffs pumped their British counterparts for ideas and pored over memoranda circulated by GHQ and Reserve Army.⁷³ Tactics were modified, and practiced in the fields and downs of the billeting areas.⁷⁴ To prevent another Fromelles, the barrage was strengthened and the infantry were enjoined to creep as close to the enemy line as the barrage would permit; 100 metres or less. This would enable them to reach the German deep dugouts before the occupants could emerge. To reduce enemy observation, the attack would be delivered at 12:30am in moonless darkness. Instead of moving forward in big lifts, the barrage would shift on to an objective close enough in front to provide continuous cover. By the end of the campaign this technic would be further refined by the British Army into the "creeping barrage", in which the barrage moved forward by short increments at regular intervals.

The infantry would still attack in waves but now each wave would have its own objective which it would capture and consolidate - a process known as "leap frogging" because the next wave would pass over the one before. The first objective would be the German trenches in front of Pozieres; the second, a new trench just on the outskirts of town; the third, the main road through the town itself. Engineers, pioneers, trench mortars and Vickers guns would follow the assault waves closely and the Lewis guns would travel with them. Special "jumping off" trenches were dug by the 1st Pioneer Battalion in order to reduce the distance the infantry would have to attack over to 200 metres, the lack of which was considered one reason for failure at the Sugar Loaf.⁷⁵

Consolidation involved refitting an enemy position, moving sandbags from the parapets to the parapet and cutting loopholes and fire steps. Letting the remaining Germans know their position had been captured was called "mopping up". The British had discovered that simply tossing a couple of bombs into a dugout would not necessarily take care of the inhabitants.⁷⁶ A technological fix was applied in the form of a new weapon, the phosphorus No. 27 grenade or "P bomb". A tin canister filled with Red Phosphorus, the

⁷² Bean, III: *The AIF in France: 1916*, pp. 468-470

⁷³ BGGGS I Anzac Corps, 17 July 1916, AWM26 50/12; GS 1st Division GS Memorandum No. 54, 14 July 1916, AWM26 51/24. Officers of the British 7th and 19th Divisions were the 1st Division's primary sources of information.

⁷⁴ Bean, III: *The AIF in France: 1916*, pp. 453-454

⁷⁵ GS 2nd Division, "Tactical Notes", 19 July 1916, AWM26 56/2; GS 1st Division Order No. 31, 21 July 1916

⁷⁶ Griffith, *Battle Tactics of the Western Front*, pp. 113-114; Edmonds, *Military Operations in France and Belgium 1916*, Volume I, p. 291

P bomb scattered burning phosphorus in a circle 4 to 10 metres in diameter and burned strongly for 3 to 4 minutes. It could be used for signalling or creating smoke screens.⁷⁷ Each man was given a P bomb and two Mills bombs.⁷⁸

The attack near Pozieres on 23 July was the AIF's first truly successful attack since Lone Pine. All objectives were attained and consolidated and the inevitable German counterattack was beaten off. Small parties of diggers began "prospecting" in Pozieres - searching the town for Germans and souvenirs. Lewis guns were turned on German snipers. Cellars were attacked with phosphorus grenades and a steady stream of prisoners was brought out. The German artillery withheld its fire because it was unsure of where the German and Australian positions were but they were fairly accurately reported by the Royal Flying Corps (RFC) and Gough, suspecting that Pozieres had been abandoned, it being hard to spot Germans in the rubble from the air, ordered patrols to seize the remainder of the town. Diggers who had been shot at from the town all day regarded this as a bit of an insult, but the order was complied with. A ten man patrol attacked a German concrete pillbox called Gibraltar just south of the town and captured 26 men and 3 machine guns. By dawn most of Pozieres had been occupied.⁷⁹

The Commander in Chief of the BEF, General Sir Douglas Haig, decided to continue the Australian offensive at Pozieres but not as part of any general attack. Piecemeal attacks would be made in the hope of engaging and wearing down the enemy. This allowed the enemy guns to concentrate on the Australians. At this time I Anzac Corps Heavy Artillery⁸⁰ consisted of a Heavy Artillery Group with four batteries (the 54th, 55th and two British batteries) equipped with 8 inch, 9.2 inch and 6 inch howitzers, and one with four British 60 pounder batteries which were used mainly for counterbattery fire. This allocation was inadequate to deal with the heavy concentration of German guns in this sector and the infantry suffered terribly from the incessant enemy shelling.

The 2nd Division replaced the 1st and its commander, Major General J. G. Legge, was ordered to take the Pozieres heights, the not so high ground north of the town. Before this happened, his 5th Infantry Brigade bought into a twelve hour bomb fight started by the British troops on their flank attempting to capture a German trench by bombing. British and Australian bombers threw some 15,000 bombs and almost all the brigade's regimental bombers became casualties. In bomb fighting the Germans had the advantage

⁷⁷ HQ British Third Army, "Smoke Production by Infantry", 10 April 1917, AWM25 97/5

⁷⁸ Bean, III: *The AIF in France: 1916*, p. 493

⁷⁹ Bean, III: *The AIF in France: 1916*, pp. 514-516, 532-535

⁸⁰ I Anzac Corps Heavy Artillery had been formed on 4 April 1916. It was a headquarters for controlling heavy artillery assigned to the corps, and was subordinate to I Anzac Corps Artillery. It was commanded throughout the war by a British Royal Garrison Artillery officer, Brigadier General L. D. Fraser.

because their "egg" bombs could be thrown further than the Mills while their "stick" grenades were more devastating at short range.⁸¹ The sheer inefficiency of bombing as a tactic for capturing a trench when the enemy had anything approaching equal numbers was amply demonstrated. The I Anzac Corps staff recommended that a British "egg" grenade be adopted but none ever was.⁸²

The 2nd Division's attack on the night of 28 July 1916 was a failure.⁸³ Much of the German wire was uncut, jumping off trenches had not been dug and German artillery was turned on the infantry while they were crossing No Man's Land. I Anzac Corps ordered a repeat of the attack the next night but fortunately this was postponed. Legge introduced a new practice, a series of conferences in which the details of the attack were discussed among those involved. An elaborate artillery program was worked out involving working over the German trenches, wire cutting and heavy bombardments that looked like attacks.⁸⁴ Patrols checked the condition of the enemy wire to determine that it had been sufficiently cut.⁸⁵ Digging the jumping off trenches proved extremely hard on the infantry, engineers and pioneers as the barrages caused German retaliation that inflicted casualties and damaged the works. Many at the front believed that the jumping off trenches that the corps chief of staff, Brigadier General C. B. B. White, insisted be dug were unnecessary and could be replaced by a simple tape line on which the infantry could line up without letting the enemy know an attack was impending. This technic was adopted for all subsequent operations. Legge was able to get the job done by persuading corps artillery to cut back.⁸⁶ On the night of 4 August the attack was delivered and was successful.⁸⁷

After this the 4th Division swept north over the rise to the outskirts of Mouquet Farm, where the wheels fell off the Australian war machine. Over the next weeks each division would return for a second tour of Pozieres, but little progress was made in the course of seven attacks on very narrow 2 or 3 battalion fronts in a salient that only became more pronounced. Because of the terrible bombardment which gradually obliterated the trench systems, buried the infantry and caused enormous casualties, efforts were made to hold the forward area as lightly as possible, relying on the firepower of the Lewis guns to make up for numbers. Birdwood experimented with the use of much lighter forces in the attack as well, while beefing up the artillery support, in the hope of reducing infantry

81 Bean, III: *The AIF in France: 1916*, pp. 607-613

82 BGGs I Anzac Corps to British Fourth Army 21 November 1916, AWM26 114/25

83 GSO1 2nd Division, 29 July 1916, AWM26 56/5

84 GOC 2nd Division, "Preparations for the attack of 4/5 August", 14 August 1916, AWM26 56/5

85 GS 2nd Division "Extracts from Patrol Reports 31 July/ 1 August", 2 August 1916, AWM26 56/5

86 GOC 2nd Division, 6 August 1916, AWM26 50/15

87 GOC 2nd Division, "Preparations for the attack of 4/5 August", 14 August 1916, AWM26 56/5

casualties.⁸⁸ This failed because the infantry were unable to overwhelm the objective as they had done during the capture of Pozieres, and came under attack from Germans who had not been mopped up.⁸⁹

The tactic was making a virtue of a necessity because many battalions had taken very heavy losses in their first tour of Pozieres and not only had they been unable to absorb sufficient reinforcements in time to restore them to full strength, but orders were issued that not more than 20 officers per battalion should accompany infantry units in an attack and 15 per cent of NCOs should also be left behind in order to form a "nucleus" from which the battalion could be rebuilt after the battle.⁹⁰ The leaving of a number of officers behind with the transport had already been practiced by the 1st Division in the first assault on Pozieres,⁹¹ but from now this would be doctrine throughout the BEF. As a consequence, a battalion that was 25 per cent under strength would have only about 240 men available for the actual assault.⁹²

One promising new technic in these operations was the machine gun barrage, a technic learned from the British at Armentieres. From 4 August onwards, the machine gun barrage was a standard part of every action. During the attack on 21 August, the 3rd Machine Gun Company had all of its fourteen guns firing over the heads of the infantry, expending some 36,500 rounds in three hours and 14,500 more during the night.⁹³ In this they were taking advantage of the tremendous stamina of the Vickers gun. How effective the machine gun barrage was is open to question. During a counterattack on 6 August, the 7th Machine Gun Company reported that the enemy was moving through the barrage and their fire had to be beefed up with field artillery.⁹⁴

The Somme battles cost Australia dearly. In just seven weeks of fighting, the AIF had more casualties than in the entire seven month Gallipoli campaign. For this terrible cost, a few hundred metres of ground had been captured and losses had been inflicted on the enemy that were less than, but comparable to, those of the Australians. The story was the same across the whole BEF. Total losses on the Somme came to about 410,000 in return for 180,000 German casualties - an average of 2.3 BEF soldiers per German.⁹⁵

⁸⁸ BGGs I Anzac Corps, 10 August 1916, AWM26 56/6

⁸⁹ Bean, III: *The AIF in France: 1916*, pp. 803-805

⁹⁰ GS 1st Division, 14 August 1916, AWM26 51/25

⁹¹ GS 1st Division, GS Memorandum No. 54, 14 July 1916, AWM26 51/24. This memorandum noted that this was the practice of certain British units.

⁹² GOC 1st Division, 14 August 1916, AWM26 51/25

⁹³ "Brief Report on Indirect Machine Gun Fire - 3rd Machine Gun Company 4/8/1916", AWM25 385/8

⁹⁴ Bean, III: *The AIF in France: 1916*, pp. 713, 797

⁹⁵ Bean, III: *The AIF in France: 1916*, pp. 862-863, 944-945

AIF Casualties in the Somme Campaign
19 July 1916 - 5 September 1916⁹⁶

Division	Dead	Wounded	Captured	Total
1st Division	2,364	6,147	70	8,581
2nd Division	2,340	5,825	152	8,317
4th Division	2,025	5,002	167	7,194
5th Division	1,917	3,146	470	5,533
Corps Troops	12	35	0	47
TOTAL	8,658	20,155	859	29,672

(Note: Dead includes killed in action, died of wounds and died of gas.)

In order to understand what went wrong, we need to start right back at the factories in Britain and North America, which did not reach full production in 1916. This made itself felt particularly in the matter of guns. In the first nine months of 1916, 7,908 guns were supposed to have been delivered, but only 4,314 actually reached the troops during the whole of 1916. In attempts to meet their quotas, the manufacturers put completion of new guns ahead of shipping spare parts. The 18 pounder had a hydraulic buffer to absorb recoil and keep the gun in one place on its platform but used springs to return the gun mass into position. However the heat caused by constant firing resulted in the hydraulic oil losing its effectiveness and in turn placed excessive stresses on the springs, which soon lost their resiliency. The guns then had to be run back into firing position by hand. Replacement springs became impossible to get. The result was guns deadlined for want of parts. Frantically, the Ordnance Corps attempted to improvise them.⁹⁷

The planners had hoped for practically unlimited numbers of shells and the requested numbers were delivered for all but the larger calibres. But there were severe problems with quality control. Hairline cracks in 9.2 inch howitzer shells caused explosions in the bore or muzzle. The 4.5 inch howitzers had similar problems owing to defective charges and fuzes. Loose copper driving bands on the 18 pounders caused erratic shooting.⁹⁸ Drop shorts became so common that gun pits were constructed with sandbagged rearward cover to protect them from their own shells.⁹⁹ On 20 July, the 1st Infantry Brigade complained that their own artillery had shelled them six times that day.¹⁰⁰ Other

⁹⁶ Butler II: *The Western Front*, pp. 48, 73

⁹⁷ Edmonds, *Military Operations in France and Belgium 1916*, Volume I, pp. 121-123; Horner, *The Gunners*, p. 129; Gower, *Guns of the Regiment*, pp. 44, 58

⁹⁸ Edmonds, *Military Operations in France and Belgium 1916*, Volume I, pp. 123-124

⁹⁹ Horner, *The Gunners*, p. 132

¹⁰⁰ 1st Infantry Brigade, wire sent 3:50pm, AWM26 51/28

weapons with serious manufacturing defects included Mills bombs, P grenades and Stokes mortar rounds.¹⁰¹

The overall effect of faulty weapons and ammunition was a requirement for still more ammunition when it was already being fired off faster than it could be delivered. From the beginning of the Somme bombardment on 24 June until 23 July, 148,000 tons of ammunition had been fired but only 101,771 tons were landed, the difference being made up by depleting stockpiles. In August the British government appointed Sir Eric Geddes, an industrialist with extensive experience in railways and shipping,¹⁰² to investigate the situation. He discovered that the maximum port discharge in a week was 138,987 tons against projected requirements for 248,327 tons to sustain an offensive. Vigorous measures were proposed to increase capacity and decrease turn around time. As the U-boat offensive began to bite, the British could no longer afford to have shipping idle awaiting discharge. On 22 September, Haig appointed Geddes as his Director General of Transport (DGT) at BEF GHQ, responsible for all forms of transportation. Cross channel ferries were used to shift bulky cargoes like railway locomotives and rolling stock. Wharves were cleared and stores moved out of transit sheds to inland dumps to free up quay space. The ports had 92 French cranes. To increase capacity, 29 British cranes were installed by December 1916. By December 1918, 215 British cranes were in action and the number of metres of quay space per crane had fallen from 62 to 28. Work practices were overhauled. The net result was an average weekly discharge of 224,000 tons by May 1917.¹⁰³

Had the ports been able to deliver the required tonnage, the railway system would probably have collapsed. There were chronic shortages of both locomotives and rolling stock. Repair facilities were inadequate and were extended. Maintenance on the lines had been neglected and was starting to put them out of commission. Estimates of requirements ran to 112,000 tons of construction materials. By the end of 1916, 62 British locomotives had been imported; this had grown to 753 a year later and 1,205 by the end of 1918, by which time 54,000 wagons had been imported.¹⁰⁴ The railway system was improved and extended in 1917, with 1270 kilometres of new track being laid in 1917. Geddes realised that part of the answer was to exploit alternative means of transport, and the capacity of the inland waterways was increased from 76,000 to 110,000 tons per week. Light railways were developed to move supplies forward from

¹⁰¹ Edmonds, *Military Operations in France and Belgium 1916*, Volume I, pp. 123-124

¹⁰² Grieves, Keith, *Sir Eric Geddes: Business and government in war and peace*, Manchester, Manchester University Press, 1989, pp. 1-9

¹⁰³ Edmonds, *Military Operations in France and Belgium 1916*, Volume I, pp. 121-122; Henniker, *Transportation on the Western Front*, pp. 185, 233-238

¹⁰⁴ Henniker, *Transportation on the Western Front*, pp. 251-262

the railheads and relieve pressure on the roads and by May 1917, 80 kilometres of light rail track were being laid every week.¹⁰⁵

The road transportation situation was also very bad. The road metal in the Somme region was eight centimetres thick on a foundation of chalk and if the surface was broken, water could turn it into a morass. Minor roads were unsealed tracks and road bridges needed work. In all, making the road system fit for intensive round the clock military usage was found to be beyond the labour and resources available in 1916, and as a result thousands of Indian, Chinese and Egyptian labourers would be brought in during 1917.¹⁰⁶

The logistical planners regarded it as fortunate in many ways that no major advance occurred. The only bright spot was that the French and British flying corps had suppressed the enemy's air patrols and the rear areas, except for certain crossroads that the Germans shelled blind, were generally safe.¹⁰⁷ Most German air raids occurred at night. A taste of what could happen occurred at Audruicq on the night of 20 July 1916 when an air raid set an ammunition dump alight and explosions continued for 48 hours. The dump was completely destroyed and the nearby Nord main railway line was cut.¹⁰⁸

Thus, logistical difficulties prevented Haig from maintaining a broad front offensive. Instead, a series of narrow front operations was carried out, which were estimated to cost 40 per cent more casualties than those undertaken on a broad front to achieve the same results. Using the AIF in this manner was particularly wasteful because it contained a high proportion of experienced troops.

Shortages of new weapons such as Lewis guns, rifle grenades, tanks and heavy artillery pieces slowed the development of new tactics built around them. During the Somme fighting, both infantry and artillery tactics were still primitive, with high casualties once again the result. Casualties in the Somme campaign fell almost entirely on units forward of brigade, particularly the infantry, who accounted for 93 per cent of casualties, mainly caused by shellfire from unsuppressed German artillery. Excessive casualties among the engineers were the result of sending them forward with the infantry in attacks as per the *Field Service Regulations*,¹⁰⁹ where they were subject to artillery fire, became separated

¹⁰⁵ Grievies, *Sir Eric Geddes: Business and government in war and peace*, pp. 33-34

¹⁰⁶ Edmonds, *Military Operations in France and Belgium 1916*, Volume I, p. 278

¹⁰⁷ Bean, III: *The AIF in France: 1916*, p. 482

¹⁰⁸ Henniker, *Transportation on the Western Front*, pp. 314-315

¹⁰⁹ *Field Service Regulations*, pp. 147-8

and generally performed no useful engineering work. It was gradually realised that engineers were better utilised on the line of communications.

Casualties in the Somme Campaign

First tours of divisions

19 July 1916 - 15 August 1916¹¹⁰

Division	Infantry	Engineers	Pioneers	Artillery	Total
1st Division	4,937 (93%)	113	180	30	5,285
2nd Division	6,361 (92%)	167	203	72	6,846
4th Division	4,236 (91%)	57	224	79	4,649
TOTAL	15,534 (92%)	337	607	181	16,780

British generals continued to issue orders for positions to be captured "at all costs", as per the *Field Service Regulations*,¹¹¹ and in one case,

through some process of mind extremely difficult to understand, the British Fourth Army ordered an attack to be repeated even though four efforts had failed and no vital objective was to be gained.¹¹²

To someone using a mechanistic model of tactics, a mode of thinking that is itself a product of technology, it would come as no surprise, and indeed might even be reassuring that,

It is doubtful if there exists in the records of the AIF one instance in which, after one attacking party had been signally defeated, a second, sent after it, succeeded without some radical change having been effected in the plan or conditions.¹¹³

However, the process of mind can be understood in the light of the meme which emphasised the primacy of the human factor, as enshrined in the *Field Service Regulations*. Under this meme, repeating the attempt is quite understandable. In the new technological environment, mechanistic memes had a marked competitive advantage.

The notion that more clever generalship could have saved Australian lives on the Somme is whimsical because win, lose or draw, divisions were kept at it until they were exhausted, costing men that Australia and the Empire would soon need badly. What better generalship would have yielded was results more in line with the expense. As an attrition battle, the Somme was uneconomical, because it expended men at twice the rate of the enemy, though nowhere did the *Field Service Regulations* say anything about

¹¹⁰ Bean, III: *The AIF in France: 1916*, pp. 593, 724, 770

¹¹¹ *Field Service Regulations*, p. 116

¹¹² Bean, III: *The AIF in France: 1916*, p. 917

¹¹³ Bean, II: *The Story of Anzac*, p. 631

keeping losses down below the enemy's. As a breakthrough battle it was a failure, for no such breakthrough occurred. Surprisingly, the tacticians had devoted little thought to the problems of open warfare and, no less than the logisticians, were quite unprepared for it. Although the outlook for 1917 was bleak, the new technologies being deployed gave hope of new tactics and techniques and the possibility of an improved situation.