

Canadian Military History

Volume 27 | Issue 2

Article 16

11-12-2018

Clay-kickers of Flanders Fields: Canadian Tunnellers at Messines Ridge 1916-1917

Brian Pascas

Recommended Citation

Pascas, Brian (2018) "Clay-kickers of Flanders Fields: Canadian Tunnellers at Messines Ridge 1916-1917," *Canadian Military History*: Vol. 27 : Iss. 2 , Article 16.
Available at: <https://scholars.wlu.ca/cmh/vol27/iss2/16>

This Article is brought to you for free and open access by Scholars Commons @ Laurier. It has been accepted for inclusion in Canadian Military History by an authorized editor of Scholars Commons @ Laurier. For more information, please contact scholarscommons@wlu.ca.

Clay-kickers of Flanders Fields

Canadian Tunnellers at Messines Ridge 1916-1917

BRIAN PASCAS

Abstract: This article explores the Canadian tunnelling companies' military mining organisation and accomplishments in underground galleries during the Great War. This comprehensive study explains the crucial role played by the Canadian engineers, in conjunction with British and Australian engineers, in the successful detonation of nineteen deep mines at Messines Ridge, Belgium on 7 June 1917. The tunnellers' perseverance and skill were evident that morning when they slammed home plungers and threw switches igniting the largest planned explosion up to that time. However, daily hardships and dangers of underground warfare from the claustrophobic environment to the stress from the eavesdropping enemy led to disciplinary action including Field Punishment No. 1.

*Tunnellers all, we are "doin' our bits"
Deep down in the bowels of France;
In the darkness we flits—a-givin' Fritz fits,
And when WE blows—he's sure got to dance.¹*

ON JUNE 7TH, 1917, TOOK PLACE A BATTLE which on the morrow was hailed as a brilliant military achievement, ... the capture of the Messines ridge by General Plumer's Second Army was almost the only true siege-warfare attack made throughout a siege war."² B. H. Liddell Hart's summation of the operations at Messines-Wytschaete

¹ Edward Synton, *Tunnellers All*, (London: Grant Richards Ltd., 1918), 7.

² B.H. Liddell Hart, *History of the First World War*, (London: Papermac, 1992), 322.

Ridge marks it as a unique moment in the First World War. In a set-piece offensive, nine divisions from Britain, Ireland, Australia, and New Zealand assaulted German positions on the ridge immediately after nineteen mines exploded beneath the ridge at 3:10 a.m. The tunnelling companies that blew the mines are not given adequate recognition for this complete tactical victory, and are generally unidentified, especially in Great War secondary sources.

Canadians played an important role on that day as well. Canadian tunnelling companies detonated five mines and an analysis of their underground work in the 1916 and 1917 tunnelling operations attests to their solid contribution to the success of the Battle of Messines Ridge. Their toil—involving specialised equipment and explosives in a daily life-and-death struggle—exacted a price. Some tunnellers faced reprimands for failing to cope with the incessant strain, deadly skirmishes, and oppressive darkness. One ultimately deserted from the front line. But the costly success had been the culmination of many long years of preparation, training, and strategy for the Canadians and their allies on the battlefields of northwest Europe.

ORGANISATION

Mobile warfare's misnamed "Race to the Sea" with its outflanking attempts, ended on the Western Front in mid-October 1914 and changed the nature of the Great War. Oberstleutnant Otto Füsslein wrote, "When open warfare reached stalemate and the long front ... solidified ... techniques of siege warfare received a new lease of life. As the enemy could not be attacked on the surface, he was attacked from under the ground."³ Military mining's objective was to pulverise the enemy's tunnels, dugouts and trenches by burrowing through earth, clay, and chalk beneath No Man's Land. On 15 December 1914, British Major John Norton-Griffiths wrote to the War Office volunteering to raise a company of tunnellers. Norton-Griffiths then demonstrated clay-kicking techniques to Lord Kitchener later

³ Peter Barton, Peter Doyle and Johan Vandewalle, *Beneath Flanders Fields: The Tunnellers' War 1914-1918*, (Montreal & Kingston: McGill-Queen's University Press, 2004), 26.

that month.⁴ His offer was ignored until January 1915, when it was realized the Germans were engaging in a systematic mining offensive. In early February, Lord Kitchener demanded 10,000 tunnellers. On 13 February 1915 the Army Council sent Major Norton-Griffiths to report to Brig.-Gen. Fowke, Engineer-in-Chief at St. Omer, France, resulting in the War Office's approval on the 19th for the formation of nine tunnelling companies.⁵

In the summer of 1915, the Department of Militia and Defence of Canada also began organising tunnelling companies to aid the Royal Engineers (RE). Commencing in September 1915, miners were recruited in Canada for two such companies. Owing to the urgency of extensive mining operations, Commander-in-Chief Sir John French proposed a third Canadian tunnelling company (CTC) in November 1915, created from personnel already serving in the Canadian Corps.⁶ By the autumn of 1916, thirty-three tunnelling companies were operating on the Western Front: twenty-five British, three Australian (earwiggers), three Canadian (beavers), one New Zealander, and the Australian Electrical and Mechanical Mining and Boring Company (Alphabet Company)—approximately 30,000 men.⁷ These tunnelling companies' unseen labours—and not often acknowledged—would become critical to the victories at Vimy Ridge and Messines Ridge.

Major Robert P. Rodgers mobilised the 1st Tunnelling Company, Canadian Engineers (CE) in Pembroke, Ontario during the autumn of 1915, with miners recruited from New Brunswick, Nova Scotia, Quebec, and Ontario. They arrived in France on 16 February 1916.⁸ Major Cyril B. North became Officer Commanding (OC) in April 1916 and retained command until June 1918.⁹ Major Robert W. Coulthard mobilised the 2nd Tunnelling Company, CE in Calgary, Alberta during December 1915 and January 1916. Miners were recruited from

⁴ Tony Bridgland and Anne Morgan, *Tunnel-master & Arsonist of the Great War: The Norton-Griffiths Story*, (Barnsley, England: Leo Cooper, 2003), 116.

⁵ Barton et al., *Beneath Flanders Fields*, 59-60; Bridgland and Morgan, *Tunnel-master & Arsonist of the Great War*, 123.

⁶ Note from Sir John French, 30 November 1915, RG24, Volume 1440, Folder HQ593-7-13, Library and Archives Canada [hereafter LAC].

⁷ Phillip Robinson and Nigel Cave, *The Underground War: Vimy Ridge to Arras*, (Barnsley, England: Pen & Sword Military, 2011), 4.

⁸ Robert W. Coulthard, "Tunnellers at the Front," *Transactions of the Canadian Mining Institute XXII* (1919), 445.

⁹ List of Officers 1st CTC, RG150, Volume 451, LAC.

Alberta and British Columbia, arriving in France on 10 March 1916.¹⁰ Major Lawrence N.B. Bullock served as OC from the summer of 1916 until March 1917, Major Frederick A. Brewster until the end of 1917, and Major Alan B. Ritchie until July 1918.¹¹ The 1st and 2nd CTCs were disbanded in July 1918 and the tunnellers joined Canadian engineer battalions. Major Angus W. Davis mobilised the 3rd Tunnelling Company, CE at Ste. Marie-Cappel during November and December 1915, drawing men from mining sections of the 1st and 2nd Canadian Divisions.¹² Major Alan B. Ritchie became OC in the summer of 1917 until relinquishing command to Major Arthur Hibbert late in 1917. Major Hibbert commanded until the end of the war.¹³ The company strength was 339 officers and other ranks. With attached infantry, the total varied from 500 to 800. The company establishment was authorised on 15 January 1917 to be 569.¹⁴ Captain James R. Roaf mobilised the 4th Tunnelling Company, CE in March 1916 at Nanaimo, British Columbia, but on 24 August 1916, the Canadian Engineers Training Depot in Bramshott absorbed the understrength unit of 164 soldiers.

An army Controller of Mines at General Headquarters coordinated all mining activities in 1916, which were administered by corps and divisions.¹⁵ Nevertheless, the Canadian Corps controlled all promotions.¹⁶ Tunnelling companies were viewed as army troops, separated from their corps.¹⁷ Unlike their RE counterparts, Canadian tunnellers received no extra pay for their expertise.¹⁸

¹⁰ Coulthard, "Tunnellers at the Front," 445.

¹¹ List of Officers 2nd CTC, RG150, Volume 451, LAC.

¹² Coulthard, "Tunnellers at the Front," 445. The 6th Infantry Brigade contributed 78 mining personal.

¹³ List of Officers 3rd CTC, RG150, Volume 451, LAC.

¹⁴ RG9, III-D-1, Volume 4711, Folder 96, File 17, LAC. There were two establishments for RE companies.

¹⁵ In 1918, the 3rd CTC reported directly to Brig.-Gen. W. Bethune Lindsay, Chief Engineer at Corps HQ. See David W. Love, *A Nation In Making Volume 2: The Organization and Administration of the Canadian Military During the First World War*, (Ottawa: Service Publications, 2012), 272.

¹⁶ R.N. Harvey, Inspector of Mines, 3 March 1917, RG9, III-C-5, Volume 4434, Folder 21, File 11, LAC.

¹⁷ G.W.L. Nicholson, *Canadian Expeditionary Force 1914-1918*, (Ottawa: Queen's Printer, 1964), 501.

¹⁸ Some Canadian tunnellers believed, incorrectly, that they were entitled to an extra twenty-five cents per diem. British sapper's pay, depending on qualifications, could be more than a shilling a day. See RG24-c-6-b, Volume 1098, File DHS-5-9-10, LAC.

UNDERGROUND MINING OPERATIONS

Tunnelling operations were divided into offensive, defensive, and offensive-defensive mining methods. In some areas, both the defensive and deeper offensive galleries were in the same vertical plane. Listening posts were established in lateral galleries dug below No Man's Land parallel to the front line. Offensive tactics were applied for destroying the enemy's strong points or salient, assisting in surface attacks on the enemy's lines, destroying or minimising hostile underground offensives, combating hostile surface attacks, and disparaging the morale of the enemy's rank and file.¹⁹

Defensive operations were designed to destroy enemy mining. From a shaft in a communication trench near the front line, the gallery—a tunnel running towards the enemy line—would be driven where enemy mining was expected. A camouflet charge placed against the face of the tunnel would be blown to destroy an enemy gallery along with German *pionieres* (military engineers). This undercharged defensive mine was designed to wreck galleries without breaking the earth's surface, unlike the overcharged offensive mine, which broke the surface leaving a rimmed crater. In a second defensive technique a hand auger was used to bore a hole towards the enemy's gallery into which a torpedo was fired. This type of camouflet was typically an 8-foot-long pipe packed with about 100 lb (45 kg) of ammonal.²⁰

In offensive-defensive mining, offensive systems were converted into defensive positions and vice versa.²¹ Up until March 1917, the tunnelling companies' work was 45 percent offensive mining, 25 percent defensive mining, and 30 percent dugouts.²² Memorandum "SS 540" issued in November 1915 described the principles of mining schemes. These directives were translated from a German document.²³

The underlying strata of the Western Front can be divided into two regions. Ypresian clay extends north of Ypres to La Bassée Canal.

¹⁹ Coulthard, "Tunnellers at the Front," 448; RG9, III-C-5, Volume 4400, Folder 17, File 2, LAC.

²⁰ Alexander Barrie, *War Underground: The Tunnellers of the Great War*, (London: Tom Donovan Publishing Ltd., 1993), 227.

²¹ Coulthard, "Tunnellers at the Front," 449; Barrie, *War Underground*, 146.

²² James E. Edmonds, *Military Operations France and Belgium 1917 Volume II: 7th June - 10th November*, (The Imperial War Museum London and The Battery Press: Nashville, Tennessee, 1991), 39n.

²³ Instructions for Mine Warfare Tactics, RG9, III-C-5, Volume 4434, Folder 21, File 3, LAC.

From there south to the River Somme, the geology is chalk.²⁴ The Messines-Wytschaete Ridge (*Wijtschatebogen* to the German Army) formed a portion of the Ypres Salient's southern arc. The ridge is composed of clay strata (Ypresian clay and Paniselian clay) overlaid with sand strata—Kemmel sand with trapped water and other sand layers. Once excavated, the dry blue-grey Ypresian clay oxidises to a dull brown colour.²⁵

Piling was a method of sinking a vertical shaft into wet or sandy ground using circular steel shafts called tubbing, the lowest section having had a cutting edge.²⁶ Timbered shafts were utilised for dry conditions and all joints were sealed to prevent sand from seeping through. Deep shafts were sign-boarded as “deep wells.” After someone fell down one, the Inspector of Mines instructed that all disused shafts be covered up.²⁷ Galleries, mostly horizontal, had to be deep enough to pass under the enemy's defences. A standard gallery was 4 feet 3 inches high by 2 feet 3 inches wide. For efficient patrolling of a long offensive gallery, 5 feet by 2 feet 3 inches was recommended, decreasing to the standard size for the last 300 to 400 feet.²⁸ The walls, roof, and slightly inclined floors were timbered for added strength. Occasionally, steel girders reinforced the tunnels, especially where excessive clay pressure existed. The survey officer attempted a magnetic bearing to drive the gallery in the correct direction, but could not achieve it when enclosed with steel timbering.²⁹ Tunnellers also excavated and constructed deep dugouts and subways, such as the ones at Vimy Ridge, which allowed infantry safe passage and could be up to 6 feet 6 inches high by 3 feet 6 inches wide.³⁰

²⁴ *The Work of the Royal Engineers in the European War, 1914-19: Military Mining*, (Uckfield, UK: Naval & Military Press Ltd, 2004), 113. The frontispiece of Barrie's *War Underground* depicts the geological divide near Aubers Ridge.

²⁵ Barton et al., *Beneath Flanders Fields*, 76-7.

²⁶ The Berlin Tunnel at Hill 60, started in 1915, was a long inclined gallery through a wet and treacherous subsoil. After that all shafts were vertical. See R.N. Harvey, “Military Mining in the Great War,” *The Royal Engineers Journal* XLIII (December 1929), 545.

²⁷ Memorandum from R.N. Harvey 5 July 1917, RG9, III-C-5, Volume 4434, Folder 21, File 4, LAC.

²⁸ Clay Mining Shafts, RG9, III-C-5, Volume 4434, Folder 21, File 5, LAC.

²⁹ Anon, “Some Notes on Surveying for the Deep Offensive Mine Galleries in Front of the Messines-Wytschaete Ridge,” *Tunnellers Old Comrades Association Bulletin* 11 (1936), 2.

³⁰ Infantry subways, RG9, III-C-5, Volume 4429, Folder 4, File 15, LAC.

The Messines galleries' restrictive dimensions prevented swinging a pick. Instead, tunnellers used a special type of sharp cross-handled spade called a grafting tool. There were at least five different shaped blades.³¹ Clay-kickers leaned backwards on a cross-shaped piece of wood, some using sandbags to prop up their backs and heads. They then kicked the blade's shoulder or the lateral projection on either side of the shaft with the full force of their sandbag-wrapped boots. This was termed "working on the cross." Bayonets and entrenching tools were used in sandy ground. Blankets were hung at different places along the galleries to deaden noise. Flat rubber-tired trolleys on wooden rails screwed to the gallery floor conveyed hempen sandbags with dislodged clay (spoil) to the shaft where a hand-powered windlass hoisted eight bags of spoil slung on a pulley hook to the surface. Canadian tunnellers operated a geared windlass, which could haul up thirty to forty sacks per load. Infantry attached to the tunnelling company discarded the spoil in distant woods, railway cuttings, disused trenches, shell craters, dummy breastworks, and behind the parados. Trolleys transported timber on the trip back to the face. This tramping proved difficult over swelling floors, as the clay reacted to moisture introduced by the damp air. In the spring of 1917, the 1st CTC employed an electric Whitaker tunnelling machine at Lock Hospital on the Ypres-Comines Canal. But the engine would buck, stall, and only work part of the time.³²

Typically a twelve-man team of sappers, speaking in whispers, worked a six-hour shift. Four were assigned to kicking, timbering, and bagging; four trolley men to hauling or tramping the spoil to the shaft; two shaft men to hoisting the sandbags; and two to pumping out water.³³ A sandbag's hairy fibre occasionally clogged the water pump valves. Clay-kickers in the 1st CTC sat on the floor three feet from the face propped up by sandbags at their backs. They threw the excavated clay over their heads, hopefully without burying the ventilation hose. Five men working a six-hour shift could drive eight feet of gallery.³⁴ A tot of rum and a hot meal awaited the 2nd CTC

³¹ Types of Grafting Tools, RG9, III-C-5, Volume 4434, Folder 21, File 2, LAC.

³² War Diary [hereafter WD], 1st CTC, April and May 1917, LAC.

³³ Barton et al., *Beneath Flanders Fields*, 109; Coulthard, "Tunnellers at the Front," 452-3. Sapper was the lowest rank in the RE and CE.

³⁴ Robert R. Murray, "Tunnelling in the Ypres Salient," *Annual Journal of the United Services Institute of Nova Scotia* 2 (1929), 119.

tunnellers after their eight-hour shift.³⁵ Candles secured in bent iron holders with spikes provided light, acted as a timepiece and presaged a lack of oxygen when they burnt feebly or went out. Sometimes mining lamps were retained. Officers and senior non-commissioned officers (NCOs) carried electric torches when placing a charge and handling gunpowder, blastine, guncotton, gelignite, and instantaneous fuses.³⁶ Candles were not used once a mine was charged.

The atmosphere in a gallery was so foul that a lit match would merely glow red at the end. The air was damp and fetid—smelling of decaying wood and sandbags. Initially, windjammers provided ventilation using two-inch India rubber hose pipes attached to a noiseless five-foot blacksmith's bellows. Later, the Holman Air Pump and the Keith-Blackman Blower were available whereby armoured rubber hose carried air to the face.³⁷ Offensive galleries would have one or more sumps to collect water for pumping. Some floors had a gradient permitting water to flow back to the shaft's sump. Shafts with access ladders and air hoses also incorporated platforms at intervals with a fixed pump and barrel for water pumped from the bottom.³⁸

Counter-mining posed a constant threat. Contact with the enemy's timber was possible, or the floor could collapse into an enemy gallery. At any minute, a gallery in close proximity could be blown up. Escape from entombment in such a collapse was improbable. It was work as usual as long as enemy tapping could be discerned by a Canadian tunneller situated in a nearby "rabbit-hole" branch or gallery listening post. When tunnelling was finished and the mine was charged, artificial digging noises were often generated to fool their opponents.

Infantry squatting in a dugout could hear the tapping beneath them. Once, frogs croaking in a pond at a British brigade headquarters was thought to be the sound of an enemy boring machine.³⁹ In one dugout, a large rat's vibrating nose had been mistaken for the tip of a German mining drill. The wind blowing over an empty tin or rum

³⁵ Ernest Russell, "A Private Soldier's View on the Great War," MG30-E220, LAC.

³⁶ Correspondence with Phillip Robinson, 21 September 2016.

³⁷ Preliminary Tests with Mine Ventilators, RG9, III-C-5, Volume 4434, Folder 21, File 2, LAC. The Holman air pump was used in the Berlin Sap at Hill 60. See WD, 3rd CTC, 2 September 1916, LAC.

³⁸ Bernard C. Hall, *Round the World in Ninety Years*, (self-published, 1981), 60.

³⁹ W.G. Grieve and B. Newman, *Tunnellers: The Story of the Tunnelling Companies, Royal Engineers, during the World War*, (Uckfield, UK: Naval & Military Press), 47.

jar produced noises presumed to be mining. Coarse humour helped defuse nerve-wracking conditions.

One-seventy-seven Company ... appointed two elderly coal miners, Sappers Laughton and Bickley, as visiting listeners ... chosen mainly because their hearing was poor... To anxious infantrymen they would say, "Yes, we hear them. They're there all right. They seem to be fornicating." The hoped-for reply was an astonished, "What—the Germans?" to which Laughton and Bickley would say, "No—not the Germans—the rats."⁴⁰

Locating and destroying the enemy's tunnels before he discovered yours was absolutely vital.⁴¹ An inattentive sapper at a listening post was severely punished.⁴² In the early days of tunnelling, the unaided ear detected counter-mining. Listening sticks with a single vibrating earphone proved ineffectual. The flat, round French Army pattern water bottle was used. A rubber tube was inserted in the bottle's stopper and an ear piece attached to the other end. This device proved to be reliable, albeit with gained experience.⁴³ The Canadians in early 1916 used the French-designed 4-inch-diameter wooden disc geophone—slightly bigger than a puck—containing two mica discs filled with mercury. The geophone had a nipple to attach a stethoscope. Only one was needed to magnify sound. A trained listener could obtain the precise direction of the enemy's workings by taking a compass bearing once the sound levels from two geophones were equal in both ears. This listening device proved to be extremely sensitive to sound. The listener's own heart beat had to be eliminated from the calculations.⁴⁴ To the untrained listener, a bluebottle flying across the gallery sounded like a train rushing forward and then suddenly stopping.⁴⁵

⁴⁰ Barrie, *War Underground*, 82. At least three other versions of tunnel rat stories exist.

⁴¹ A.J. Kerry and W.A. McDill, *The History of the Corps of Royal Canadian Engineers, Vol. I 1749-1929*, (Ottawa: The Military Engineers Associations of Canada, 1962), 124.

⁴² Coulthard, "Tunnellers at the Front," 454.

⁴³ Grieve and Newman, *Tunnellers*, 48.

⁴⁴ Synton, *Tunnellers All*, 58.

⁴⁵ Hall, *Round the World in Ninety Years*, 67.

Electric seismo-microphones in listening posts and gassy galleries were linked up to a central listening station and were effective as long as shells and rats did not cut the wires.⁴⁶ Australian tunnellers at the Bluff would catch rats and tie little bells around their necks with string. The rats were then released in the direction of the German lines, scurrying speedily through the subterranean routes.⁴⁷

MINE EXPLOSIVES

At the beginning of the war black powder packed in 100-lb sacks and guncotton in slabs of a few pounds were used in mining operations. Other explosives included amatol, blastine, sabulite, ammonal, cheddite, and gelignite. Ammonal superseded gunpowder; it was easier to handle, safer since it could not be detonated by a bullet or flame and had three-and-a-half times the lifting power. It was composed of 65 percent ammonium nitrate, 15 percent TNT, 3 percent charcoal, 16 percent coarse aluminium, and 1 percent fine aluminium.⁴⁸ An ammonal charge was stored either in 50-lb tins or 25-lb to 40-lb rubberised canvas bags clamped with wood slats. Water-proof rubberised bags were necessary because ammonal was very deliquescent and liable to fail after 10 percent moisture or less if not powerfully detonated. A detonator was triggered electrically (exploder or dynamo), by fuse or by *cordeau détonant*. The detonator fired a primer, which in turn fired the charge. Fulminate mercury detonator tubes were inserted into the guncotton primers.⁴⁹ German miners used westphalite—one of the safest explosives to work with—placed in 20-kg metal boxes.⁵⁰

⁴⁶ In early 1916, the 3rd CTC used a German-made Siemens Halske electric sound detector. The American Western Electric sound detector was also used. The Germans operated the Edelmann apparatus, a switchboard for six microphones, and the Moritz listening station to intercept Allied telephone calls. See *The Microphone Applied to Listening in Mines*, RG9, III-C-1, Volume 4429, Folder 5, File 13, LAC; *Mining Operations at Hill 60*, RG24-C-6-e, Volume 1834, GAQ-8-42, LAC.

⁴⁷ Damien Finlayson, *Crumps and Camouflages: Australian Tunnelling Companies on the Western Front*, (NewPort, Australia: Big Sky Publishing, 2010), 164.

⁴⁸ Grieve and Newman, *Tunnellers*, 42; RG9, III-C-5, Volume 4434, Folder 21, File 2, LAC; Angus W. Davis, "Tunnelling Reminiscences," *Transactions of the Canadian Mining Institute* XXII (1919), 476.

⁴⁹ Correspondence with Phillip Robinson, 11 January 2017.

⁵⁰ L.B. Reynolds, "Mining in Chalk on Western Front," *Transactions of the Canadian Mining Institute* XXII (1919), 473.

A charge, such as a camouflet, intended to destroy an enemy gallery was tamped by placing sandbags behind the charge. Tamping prevented the explosion from flowing down the gallery instead of through the strata above the charge. The explosion released carbon monoxide (CO) gas, which remained bottled up and trapped in the gallery.⁵¹ Air spaces between piles of sandbags acted as pneumatic cushions, reducing the shock of the explosion. For example, 15 feet of tamping, a 10-foot air space, 10 feet of tamping, and another 10-foot air space sufficed for a 50-foot mine depth.⁵²

A blown camouflet could kill trapped tunnellers either by the explosion's concussion or the ensuing odourless chokedamp—the coal miner's term for CO.⁵³ Prolonged exposure produced breathlessness, headaches, and then vomiting and retching. A large amount of CO could cause unconsciousness in minutes.⁵⁴ For the assault on the Messines-Wytschaete Ridge, the infantry was advised that crater bottoms were dangerous owing to the possibility of the gas collecting there. Troops were to stay well up on the rims.⁵⁵ To counter CO effects, anti-gas breathing apparatus called Proto sets—in use at mine rescue stations at British coalfields—were utilised along with the Salvus breathing apparatus.⁵⁶

The 32-lb self-contained Proto set included two oxygen cylinders and a breathing bag containing caustic soda sticks—a carbon dioxide absorbent for exhaled air.⁵⁷ Wearing a Proto set, the average tunneller could work only fifteen or twenty minutes without a break, whereas a strong individual might work for thirty minutes. The air became too hot to work comfortably after thirty minutes. Two fully charged cylinders could last up to two hours of moderate work. The 17-lb one-cylinder Salvus could also last up to half an hour before the air became too hot. The contents were depleted more quickly with strenuous work.

⁵¹ The detonation of high explosives produced carbon monoxide. See *The Work of the Royal Engineers in the European War, 1914-19*, 60; *S.S. 534 Defence Against Gas*, March 1918, 6.

⁵² Grieve and Newman, *Tunnellers*, 43; Reynolds, "Mining in Chalk on Western Front," 472.

⁵³ Alexander Turner, *Messines 1917: The zenith of siege warfare*, (Oxford: Osprey Publishing, 2010), 26.

⁵⁴ Barrie, *War Underground*, 102; Barton et al., *Beneath Flanders Fields*, 126.

⁵⁵ Summary of Disposition of 3rd Tunnelling Company, Canadian Engineers During Operations, RG9, III-C-5, Volume 4434, Folder 21, File 12, LAC.

⁵⁶ Grieve and Newman, *Tunnellers*, 59.

⁵⁷ *The Work of the Royal Engineers in the European War, 1914-19*, 62.

Both Proto and Salvus apparatus were installed at life-saving stations along with Novita Pattern oxygen reviving sets. Every company had proto-men trained in the operation of breathing apparatus and in resuscitation techniques. Two proto-men were assigned to each trench where mines were set to be blown by Canadian tunnellers on 7 June 1917.⁵⁸ Tunnelling companies were reminded that box respirators did not afford protection against mine or explosive gases.⁵⁹ At 11 p.m. on 14 February 1917, a fire broke out in the 2nd CTC's dugout system. An officer—wearing a Salvus mouthpiece, noseclip, and goggles—was mistaken for a German by newly-arrived reinforcements who attempted to stick him with their bayonets.⁶⁰

If a mine's atmosphere was suspected of being dangerous, an officer or NCO wearing a Proto or Salvus set took caged mice or canaries along with his air-tight electric flash-lamp. Both mice and canaries have high metabolic rates and show symptoms of CO poisoning in only two minutes, whereas a person might not be affected for thirty minutes.⁶¹ A distressed canary would sway, take flight, and fall to the cage bottom. A canary's claws were regularly trimmed to ensure it could not grip its perch, but instead plunge downwards when overcome.⁶²

MESSINES RIDGE OPERATION

In May 1915, Norton-Griffiths believed a large-scale mining operation on the Messines-Wytschaete Ridge could blow the Germans off it. A diagram “of an arc like a large Capital C with three crosses for St. Eloi, Wytschaete and Messines in line to the right of it” illustrated his proposed plan.⁶³ Places on the arc included Hollandscheschuur, Petit Bois, Meadelstede Farm, Peckham Farm, Spanbroekmolen, Kruisstraat, Ontario Farm, and La Petite Douve Farm. The arc was

⁵⁸ Hall, *Round the World in Ninety Years*, 60; Robinson and Cave, *The Underground War*, 9; Summary of Disposition, RG9, III-C-5, Volume 4434, Folder 21, File 12, LAC.

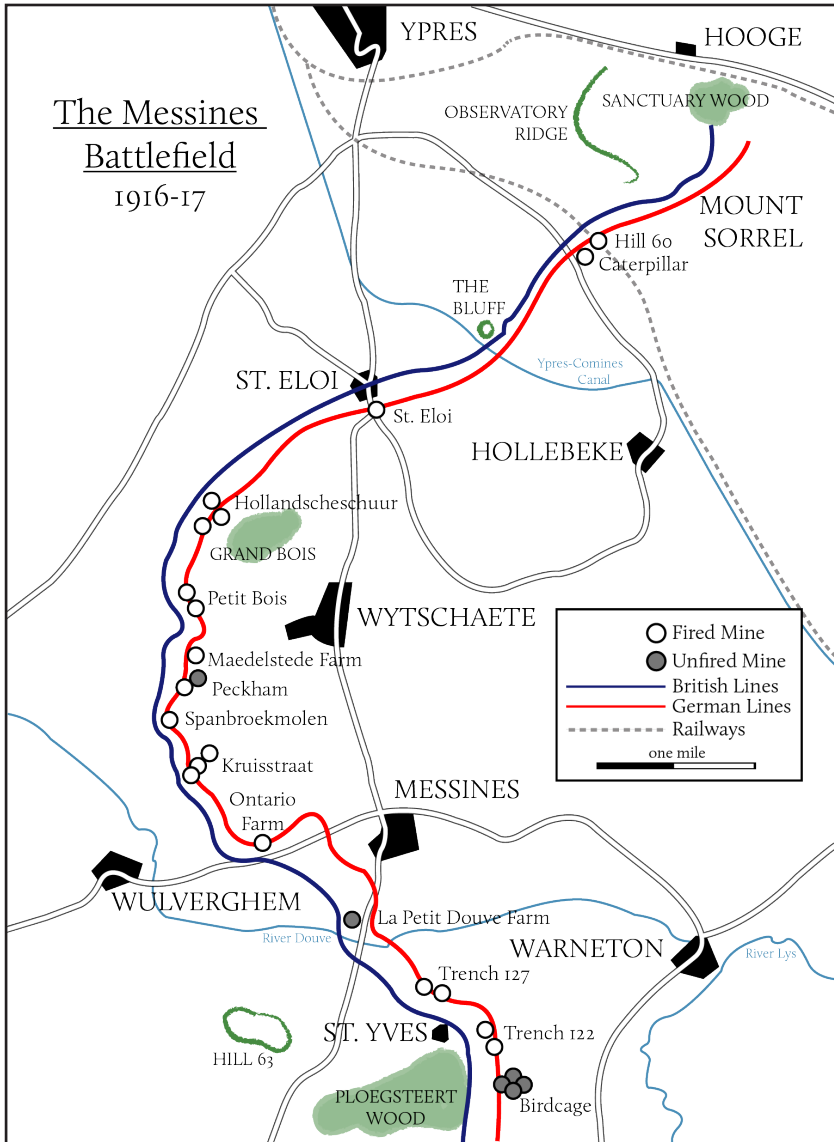
⁵⁹ *S.S. 534 Defence Against Gas*, March 1918, 25.

⁶⁰ Report of Fire on Mount Sorrell [*sic*], RG24-C-6-e, Volume 1834, GAQ-8-44, LAC. Eleven men died although the unofficial report claimed forty-eight had perished.

⁶¹ *The Work of the Royal Engineers in the European War, 1914-19*, 67.

⁶² Simon Jones, *Underground Warfare 1914-1918*, (Barnsley, England: Pen & Sword Military, 2010), 182; Barton et al., *Beneath Flanders Fields*, 131.

⁶³ Barrie, *War Underground*, 89.



later expanded north to Hill 60 and south to Ploegsteert Wood. Early in 1916, British Commander-in-Chief Sir Douglas Haig believed that the capture of the ridge was a prerequisite to clearing the enemy from the high ground east of Ypres and freeing the Belgian coast. At a conference in May 1917, Haig split the operation into two phases,

having the Northern Operation occur some weeks after the capture of the Messines-Wytschaete Ridge.⁶⁴

Eventually twenty-five Messines mines were charged, although one mine was lost to nature and one to enemy countermining. The chamber at “A” gallery under Peckham Farm near Wytschaete was charged with 87,000 lb (39,462 kg) of mostly ammonal in June 1916. “C” gallery with 20,000 lb (9,071 kg) of explosive stacked in several chambers was abandoned when the gallery collapsed after the electric pumps broke down. By August 1916, a 50,000 lb (22,679 kg) charge had been placed in La Petite Douve Farm’s main drive. But enemy voices were detected so a small camouflet was blown, killing nine *pionnières* in an adjacent gallery. The Germans retaliated by blowing a 6,000 lb (2,721 kg) camouflet, which killed four British tunnellers and shattered the main gallery beyond repair—the charge was abandoned.⁶⁵

The sector east of Ploegsteert Wood between St. Yves and Le Gheer had been nicknamed the Birdcage, attributed to the heavy barbed wire fortifications the British had installed after losing trenches there to German assaults in November 1914.⁶⁶ Three shafts, M₁, M₃, and M₄, were sunk near a dugout at Trench 121. Three charges were placed off shaft M₁ and a fourth charge off shaft M₃, all under the Birdcage. This cluster of four mines—with a combined charge of 112,000 lb (50,802 kg)—was completed by spring 1916. (See Appendix, Table 1) However, General Plumer thought that the Birdcage mines were not close enough to the attack zone to have the intended impact.⁶⁷ On 24 May 1917, the 3rd Australian Divisional headquarters issued an order not to blow the Birdcage mines. Consequently, the mines were held in reserve and the galleries were reinforced with struts to withstand the shock from the adjacent mines.⁶⁸ On 7 June 1917, nineteen charged mines were detonated. (See Appendix, Table 2)

⁶⁴ Nicholson, *Canadian Expeditionary Force*, 301.

⁶⁵ Phillip Robinson, “The Abandoned Messines Mines,” 2-6; Grieve and Newman, *Tunnellers*, 226-7, 233-4; Jones, *Underground Warfare 1914-1918*, 151, 154.

⁶⁶ Tony Spagnoly and Ted Smith, *Cameos of the Western Front: Salient Points Five Ypres Sector 1914-1918*, (Barnsley, England: Pen & Sword Military, 2009), 27-30.

⁶⁷ Ian Passingham, *Pillars of Fire: The Battle of Messines Ridge June 1917*, (Gloucestershire, UK: Spellmount, 2012), 68.

⁶⁸ RG9, III-C-5, Volume 4434, Folder 21, File 12, LAC; WD, 3rd CTC, 27 May 1917, LAC.

CANADIAN TUNNELLERS AT MESSINES RIDGE

In March 1916, the 1st CTC replaced the 182nd Tunnelling Company, RE at Armentières. In early May, two sections moved to the St. Eloi front where the 172nd Tunnelling Company, RE had blown six mines on 27 March. By the end of May 1916, the two remaining sections of Canadians were prepared to take over the work at the Bluff—a large 30-foot-high mound of spoil—midway between St. Eloi and Hill 60. At the beginning of June, a new steel shaft was started at the Bluff to combat the enemy's complete system of galleries. In July, a gallery was driven out from the shaft at a depth of 90 feet. On the evening of 25 July, a German mine destroyed about 150 feet of tunnel, the explosion forming a crater.⁶⁹ By September, two defensive galleries at the Bluff and the Ravine were underway, driven approximately 1,300 feet and 500 feet respectively by year's end.

The 1st CTC tunnellers worked in short shifts—one hour working and one hour listening for enemy activity. The listeners equipped themselves with sawed-off rifles. On 11 December, a camouflet of four charges totalling 10,070 lb (4,568 kg) was blown opposite the Bluff, leading to the capture of 700 feet of intact enemy gallery.⁷⁰ At the end of January 1917, after the 2nd Australian Tunnelling Company relieved the 1st CTC's two sections at the Bluff, the Canadians moved to Lock Hospital on the other side of the canal. They sank two shafts 130 feet down and drove a gallery 600 feet.

At St. Eloi a new shaft called Queen Victoria was started on 17 August 1916 and completed by 5 September. The gallery's explosives chamber was under 5 feet of Campinian (Alluvial) sand, 20 feet of Sandy clay, 23 feet of damp Paniselian clay, and 77 feet of Ypresian blue clay. About 1700 cubic yards of spoil were hauled away in 75,000 sandbags. On 21 May 1917, the tunnellers finished loading the explosives.

The 1st CTC had laid the biggest charge of the war—95,300 lb (43,227 kg) of ammonal and 300 lb (136 kg) of gelignite packed into 1,912 50-lb tins—in a chamber 1,340 feet from the shaft along a

⁶⁹ Mining Operations at the Bluff, May-December 1916, RG9, III-C-5, Volume 4427, Folder 1, File 15, LAC.

⁷⁰ RG9, III-C-1, Volume 3962, Folder 24, File 4, LAC.

1,640-foot-long gallery.⁷¹ Wiring, bracing, and tamping were finished on 25 May at St. Eloi. Thirty feet of sandbags sealed the chamber with 150 feet of sandbags along the gallery. Eleven series of 30 feet of sandbags with 10-foot air spaces plus two 5-foot seals, for a total length of 600 feet, completed the tamping.⁷² The leads from the three exploders had been tested with very low amperage by noon on 6 June. The Canadian gallery had succeeded in bypassing the German's elaborate defensive galleries.⁷³

While the 1st CTC concentrated on offensive mining, the 2nd CTC was engaged in defensive work: dugouts at the Bluff and mining at Mount Sorrel, Tor Top (Hill 62), Armagh Wood, Observatory Ridge, and the Lille Gate from the spring of 1916 until the Battle of Messines. A defensive lateral system with many listening posts and a 1,700-foot defensive gallery near Trench 49, facing Mount Sorrel, were constructed. On the morning of 2 June 1916, the Germans bombarded Mount Sorrel, Armagh Wood, and Sanctuary Wood for nearly four-and-a-half hours. The 4th CMR's Lt.-Col. John F.H. Ussher took shelter with some of his men, along with about fifty tunnellers, in a 60-foot-long shallow tunnel with one exit at the Tube—a 15-foot-deep shelter trench—and a second at the O'Grady Walk communication trench. Both exits collapsed. XIII Corps (Württemberg) assault troops captured the Canadians as they emerged after two hours of digging. More tunnellers were captured in shallow defensive galleries south of the Tube in front of Trenches 48 and 49 as well as at the 49-foot-long gallery near Clonmel Copse, northeast of these trenches. Of the ninety-five tunneller casualties, sixty-five were captured, twenty-two were killed or died from wounds, and eight were wounded.⁷⁴ The 1st Canadian Division recaptured the sector on 13 June.

The 3rd CTC went into the line near Wulverghem in January 1916. They replaced the 182nd Tunnelling Company, RE at Kruisstraat Cabaret mine on the 16th. The shaft was extended another 26 feet to

⁷¹ Details of charge and electric exploding apparatus, RG9, III-C-5, Volume 4427, Folder 2, File 1, LAC.

⁷² Tamping at Queen Victoria, RG9, III-C-5, Volume 4427, Folder 2, File 1, LAC; Grieve and Newman, *Tunnellers*, 214-6.

⁷³ WD, 1st CTC, March 1916 to June 1917, LAC; Jones, *Underground Warfare*, 147.

⁷⁴ J. Castell Hopkins, *Canada at War: A Record of Heroism and Achievement 1914-1918*, (Toronto: The Canadian Annual Review Limited, 1919), 145-7; Daily Orders, RG150, Volume 256, 1, LAC; Lt.-Col. Ussher, MG30-E376, LAC; WD, 2nd CTC, June 1916 Appendix B, LAC; Report on Operations June 1st-4th, 1916, RG9, III-C-3, Volume 4162, Folder 9, File 5, LAC.

a depth of 66 feet. On the 20th, the 250th Tunnelling Company, RE handed over Spanbroekmolen with a 90-foot-long main gallery. The Canadians had driven more than 800 feet of gallery in both locations by the end of March, when they handed the work to the 175th Tunnelling Company, RE. The 3rd CTC started a tubbed shaft (Q1) for the La Petite Douve Farm mine in Trench 134 north of the River Douve in March 1916. The 171st Tunnelling Company, RE replaced them and eventually drove a gallery to La Petite Douve Farm.

Early in April, the 3rd CTC moved to Hill 60, taking over the Berlin Tunnel complex from the 175th Tunnelling Company, RE. Hill 60 was one of the most dangerous mining operations with countermines exploding almost every week.⁷⁵ Mines were at three levels: shallow (about 20 feet), middle for defensive mining, and deep for offensive mining. Acetylene lamps were used instead of candles in the damp environment along with electric mine lamps to save air. Two main offensive inclined galleries were forked off the Berlin Tunnel—"A" for Hill 60, 90 feet deep into Paniselian clay, and "B" for the Caterpillar spoil heap at 100 feet deep. By 1 August, 45,700 lb (20,729 kg) of ammonal and 7,800 lb (3,538 kg) of guncotton had been loaded at Hill 60's three charge chambers. Then the Berlin Tunnel flooded in September. The Canadian tunnellers installed a centrifugal pump to drain the water. Sixty men worked full time on hand pumps to control the water inflows from the sand.⁷⁶ "D" gallery was begun in August to protect the mines. Fifteen hundred tightly sealed tins of ammonal (70,000 lb/31,751 kg) were packed, detonators placed between the tins, and 630 feet of tamping, the same as Hill 60, were completed at the Caterpillar's six charge chambers at the end of a 1,380-foot-long gallery on 18 October.⁷⁷ Before they left Hill 60, work began on the Berlin Shaft, which was needed to replace the old timbered inclined shaft.

The exhausted tunnellers, many with sepsis, needed a rest from the mining, repeated counterblows, and dangerous living conditions

⁷⁵ Roger Clarke, "History of Mining at Hill 60," MG30-E155, LAC.

⁷⁶ Finlayson, *Crumps and Camouflets*, 135.

⁷⁷ Four-gallon petrol tins were utilised for wet chambers at Hill 60, the Caterpillar and Kruisstraat No. 3. See Franky Bostyn, "Zero Hour: Historical Note on the British Underground War in Flanders, 1915-1917," in *Fields of Battle: Terrain in Military History*, ed. by P. Doyle and M. R. Bennett, (Dordrecht, Netherlands: Kluwer Academic Publishers, 2002), 226, 235n.

on the hill.⁷⁸ On 8 November, the 3rd CTC left Hill 60 and moved south to Ploegsteert Wood, exchanging headquarters with the 1st Australian Tunnelling Company. The Australian official historian Charles Bean documented “... ‘very fine counter-mining work carried out under very difficult conditions’ by the Canadians. ... after seven months of extraordinarily gallant and clever mining, [at Hill 60] ...”⁷⁹ The charges from Trenches 122 and 127—located northeast of Ploegsteert Wood—had been completed by June 1916. A new incline was dug by the Canadians for Trench 122. In addition to cleanup, pumping, and repairs in Trenches 121, 122, and 123 new offensive work began immediately at Trench 131 to excavate Seaforth Farm to a depth of 120 feet. A new steel shaft was started for Trench 127. The Russian saps at Trench 123 were braced with timber to resist the blows from Trenches 122 and 127.⁸⁰ Typically, these saps were shallow underground galleries, which could be converted into trenches by breaking open the ceiling.

Lieut. George H. Dickson and Lieut. (later captain) Bernard C. Hall, along with fourteen other ranks (OR) were responsible for blowing the two mines originating from Trench 122—Ultimo and Factory Farm, a fortified strongpoint. Dickson developed the flu and had been exposed to gas. Therefore, Sergeant Leonard T. Beer took his place at the exploder’s handle for Ultimo. Lieut. George H. Hambly and six OR were tasked with pulling down the horizontal braces in the Russian saps at Trench 123 and to break through to the surface. Lieut. Harold C. Garner, Lieut. John J. Hanna, and ten OR were responsible for blowing the two mines at Trench 127. Proto-men were also assigned to the mined galleries.⁸¹ Trench 122’s charges were the final ones to be wired owing to last minute orders on 6 June to extend the leads from the bottom of the 70-foot shaft up to the trench. Fifteen OR were assigned to Trench 121, with its four charged mines, at Birdcage.

⁷⁸ According to Hall, “Jaundice, boils and tetanus were rife.” See Barton et al., *Beneath Flanders Fields*, 168.

⁷⁹ C.E.W. Bean, *The Australian Imperial Force in France 1917*, Volume IV, 13th Edition, (Sydney: Angus and Robertson Limited, 1943), 951.

⁸⁰ WD, 3rd CTC, January 1916 – June 1917, LAC; Jones, *Underground Warfare*, 145-152; Grieve and Newman, *Tunnellers*, 211, 227-236; Report of the Work of the Canadian Tunnelling Companies in the Second Army, RG9, III-D-1, Volume 4709, Folder 94, File 5, LAC.

⁸¹ Summary of Disposition of 3rd Tunnelling Company CE during Operations, RG9, III-C-5, Volume 4434, Folder 21, File 12, LAC.

ZERO-HOUR AND AFTERMATH

It was essential that the nineteen mines be fired at zero-hour, at which time the artillery barrage would open fire and the infantry begin to advance. Infantry brigades were informed that if a mine had not been blown by ten seconds after zero, the mine would not be blown at all. One important reason for blowing all mines at zero was to prevent the Germans from occupying a crater before the assaulting infantry could capture the ground.⁸² The objective of the II Anzac Corps—the 25th Division, the New Zealand Division, the 3rd, and 4th Australian Divisions—was the southern shoulder of the ridge, which included Messines, the Douve Valley, and the St. Yves area.⁸³ Standard time was received at II Anzac Corps Headquarters by wireless from the Eiffel Tower. This time was then telegraphed to divisions, artillery, and the RFC. Lower units were prohibited from receiving the time by telephone; coded messages were sent by runners.⁸⁴

Hall and Dickson, assigned to blowing the mines at Trench 122, were to synchronise their watches with the Infantry officer commanding the assembled troops, who would attack over the areas impacted by the mines.⁸⁵ Garner and Hanna did the same for Trench 127. Captain Harry R. Urie was informed about zero-hour at 12:50 p.m. on 6 June. Hall, in his autobiography, records that on that day, Urie handed him a watch with zero-hour for Trench 122 set at 3:10 a.m., plus a correction factor of thirteen seconds because the watch was fast.

However, the mines did not detonate simultaneously. The New Zealand official history states, “Within a few seconds of the proper time the mines were sprung from Factory Farm, [Trench 122] ... and at Anton’s Farm Road, [Trench 127] ...” The Australian official history records a seven-second premature firing, which briefly panicked some of the Australian soldiers who mistook it for an

⁸² The Germans had beaten the British to the crater at Hawthorn Ridge on 1 July 1916.

⁸³ Passingham, *Pillars of Fire*, 108-9.

⁸⁴ 3rd Australian Division, 3 June 1917, RG9, III-C-5, Volume 4434, Folder 21, File 12, LAC; Synchronisation of Watches “B,” 6 June 1917, RG9, III-C-5, Volume 4434, Folder 21, File 12, LAC.

⁸⁵ Trench 122, RG9, III-C-5, Volume 4434, Folder 12, File 12, LAC.

enemy mine.⁸⁶ At St. Eloi, three exploder handles were pushed down after Capt. Stuart Thorne gave the word “go.” Hall in Trench 122 is quoted as saying, “had to count those thirteen seconds after 3.10. ... When the watch came round I said ‘DOWN!’ ...”⁸⁷ There is no mention of a seven second slip-up and no admission of premature timing in Hall’s autobiography. Was Hall’s synchronised watch from Urie inaccurate or unreliable, or had Hall—perhaps through misty gasmask eyepieces—pressed the T-bar plunger too soon?

The British official history documents a nineteen-second interval between the first and last mine explosions.⁸⁸ An extract from Major R.S.G. Stokes’ war diary records, “At about 03-9.30 Peckham was fired; 20 seconds later, Spanbroekmolen, and 2 seconds later, Kruistraat [*sic*].”⁸⁹ Brig.-Gen. R.N. Harvey witnessed the explosions from a dugout at Mont Kemmel and recorded thirty seconds as the time from the first to last mine explosions. The Australian official historian claimed a period of twenty seconds.⁹⁰ The two Petit Bois mines were allegedly blown twelve seconds late, causing a number of 49th Brigade troops to be blown off their feet. Jones described the same outcome when Spanbroekmolen was purportedly fired fifteen seconds late.⁹¹ If true, this late firing blatantly ignored the decree prohibiting blowing mines no more than ten seconds after zero-hour.

The official nineteen second interval is plausible assuming the first mine was fired seven seconds early and the last mine fired twelve seconds late. Eyewitness accounts vary in the timing they report. Lieut. Bryan Frayling, an RE tunnelling officer, observed the explosions while in the open, near the forward observation points for generals and war correspondents at Mont Kemmel. He was about two miles west of the Spanbroekmolen mine, near the midpoint of the arc of mines. Frayling believed he witnessed all nineteen explosions, but found it impossible to check his watch’s second hand while registering the separate explosions. Spanbroekmolen blew, followed immediately

⁸⁶ Hugh Stewart, *The New Zealand Division 1916-1919: A Popular History Based on Official Records*, (Auckland, NZ: Whitcombe and Tombs, 1921), 185; Bean, *The Australian Imperial Force in France 1917*, 593.

⁸⁷ Barton et al., *Beneath Flanders Fields*, 188.

⁸⁸ Edmonds, *Military Operations France and Belgium 1917 Volume II*, 59n.

⁸⁹ Barton et al., *Beneath Flanders Fields*, 188.

⁹⁰ *The Work of the Royal Engineers in the European War, 1914-19*, 40-1; R.N. Harvey, “British Military Mining, 1915-1917,” *The Military Engineer* XXIII No. 132 (1931), 515; Bean, *The Australian Imperial Force in France 1917*, 593.

⁹¹ Edmonds, *Military Operations France and Belgium 1917 Volume II*, 58-9.

by the Kruisstraat mines. Ten or twelve mines to the north and south went up while he was watching the closest eruptions. A fellow officer confirmed the last of the mines to go up was Ontario Farm.⁹²

Major Stokes, in a support line, claimed that fumes screened the visual spectacles from all but the nearest mines. Consequently, it is impossible to ascertain the precise time frame of mine explosions on 7 June 1917. A period of about thirty seconds is possible. Eyewitnesses may have been distracted and confused by the sounds and shock of battle pandemonium: massive mines detonating, secondary explosions and minor after-flashes from the main eruptions, and the thunderous artillery barrage.

The nine infantry divisions did not suffer major casualties from the staggered mine eruptions. The artillery's drum-fire from 2,266 guns and howitzers and 700 machine guns opened a barrage along the 17,000 yard (15.5 km) front on the Messines-Wytschaete Ridge, already earthquaking from the force of 933,200 lb (423,293 kg) of explosives.⁹³ That was the signal for the seventy-six Mark IV tanks and the first waves of 80,000 troops to storm, conquer, and occupy the ridge. Some infantrymen lost their sense of direction in the miasma or collapsed from the repercussion of the blasts and others strayed from their units while detouring around the tortured landscape of gas-filled craters and shell holes.

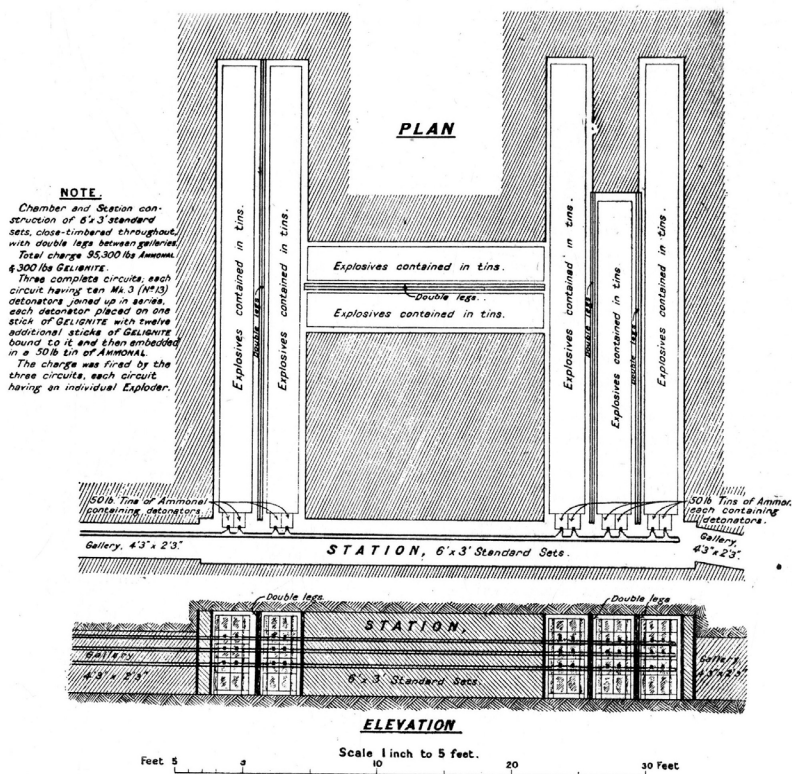
At zero-hour the men were lying out in the assembly trenches extending into No Man's Land. No one had been allowed to penetrate the 200-yard danger zone in front of the mines. Sapper Jack Martin was posted to the 122nd Brigade, 41st (Imperial) Division near St. Eloi on the night of 6 June 1917. "For several minutes the earth rocked to and fro oscillating quite twelve inches. ... It was stupendous beyond the imagination." Fusilier Paul Schumacher, 12th Company Fusilier Regiment 33 writes, "Then suddenly there was an enormous flash, just where we had come from, to the right by St Eloi and to the left at Messines. Blood-red flames shot up into the sky and a dull crack

⁹² Bryan Frayling, "Tunnellers," *The Royal Engineers Journal* 102 (1988), 173-4. He was interviewed in 1964.

⁹³ In May, the Canadian Corps transferred heavy batteries, siege batteries, and field artillery to the Second Army operations at Messines. See Douglas E. Delaney, "Introduction," in *Capturing Hill 70: Canada's Forgotten Battle of the First World War*, ed. by Douglas E. Delaney and Serge Marc Durflinger, (Vancouver: UBC Press, 2016), 11; WD, Canadian Corps GS, May 1917, Appendix 1/4, RG9, III-D-3, Volume 4812, Reel T-7176, LAC.

CHAMBER OF ST. ELOI MINE

BLOWN JUNE 7th, 1917.



Royal Engineers plan diagram of a mine at St. Eloi. [*The Work of the Royal Engineers in the European War, 1914-19: Military Mining* (Chatham: Institute of Royal Engineers, 1922)]

and boom penetrated the roar of the guns. The earth heaved and rocked as though it was trying to tear itself apart.”⁹⁴ Private Norman Gladden of the 11th Northumberland Fusiliers, 23rd (Imperial) Division was near Hill 60. “The ground began to rock. My body was carried up and down as though by the waves of the sea. In front the earth opened and a large black mass mounted on pillars of fire to the

⁹⁴ Jack Martin, *Sapper Martin: The Secret Great War Diary of Jack Martin*, ed. by Richard van Emden, (London: Blumsbury Publishing, 2009), 71; Jack Sheldon, *The German Army at Passchendaele*, (Barnsley, England: Pen & Sword Military, 2007), 16.

sky, where it seemed to remain suspended for some seconds while the awful red glow lit up the surrounding desolation.” Reserve Leutnant Freiherr Kreß von Kressenstein, 2nd Company Infantry Regiment 413 had been lying down for a short rest. “A massive earthquake, coupled with a thunderous noise from underground, brought me back to my feet. On Hill 60/59 a huge pillar of fire, a good hundred metres high, had shot into the sky.”⁹⁵ Lieut. A. G. May led his machine gun team into battle from a position opposite Wytschaete. “Not far in advance of our front parapet I saw a couple of our lads who had gone completely goofy, perhaps from the concussion. It was pitiful, one of them welcomed me like a long lost friend and asked me to give him his baby.”⁹⁶

The Messines-Wytschaete Ridge was obliterated. Almost 700 Germans had been killed at the Hill 60 and Caterpillar craters. Enemy dead were later found, standing, in crushed trenches. Concussion had killed others. “The effect on the [204th German Division at Hill 60] troops was overpowering and crushing ... the trenches were now the graves of our infantry.”⁹⁷ Another 400 were dead at St. Eloi. A shockwave had killed German officers near Spanbroekmolen. Veteran German soldiers staggered drunkenly, some crawled on hands and knees. Near Ontario Farm, half of two Bavarian battalions were wiped out. The mine blasts had annihilated whole companies. Massive concrete dugouts tossed skywards now entombed twenty to thirty German corpses.⁹⁸ Between 1-10 June, 7,548 front-line German soldiers went missing—some completely buried and others vapourised by intense heat—as a result of the mines and the crushing artillery.⁹⁹

British war correspondent Philip Gibbs witnessed the eruptions from his observation point at Mont Kemmel. His despatch to the *Daily Sketch* and *Daily Chronicle* reported “By my side to-day, [11 June] as I looked down into this pit of hell, [St. Eloi] stood a man who had worked for a year in the making of it—an Australian officer of engineers.” Two days earlier, Gibbs had informed his readers that British, Australian, and New Zealander tunnellers had carried out the

⁹⁵ Norman Gladden, *Ypres 1917: A Personal Account*, (Abingdon, England: Purnell Book Services Limited, 1967), 61; Sheldon, *The German Army at Passchendaele*, 26.

⁹⁶ Malcolm Brown, *The Imperial War Museum Book of the Western Front*, (London: Sidgwick & Jackson, 1993), 173.

⁹⁷ Jones, *Underground Warfare 1914-1918*, 160.

⁹⁸ Hall, *Round the World in Ninety Years*, 65.

⁹⁹ Turner, *Messines 1917*, 55.

Messines mining.¹⁰⁰ Lieut. Edward McCammon, who served in the 1st CTC, sent a three-page typewritten letter to Lord Beaverbrook complaining that Gibbs had not mentioned that Canadian tunnellers had performed the mining at St. Eloi.¹⁰¹ Gibbs may have assumed there were no Canadian tunnellers since the Canadian Corps had not fought at Messines. McCammon—a Canadian journalist before enlisting—may have had an ulterior motive for writing Beaverbrook who was in charge of the Canadian War Records Office.

The Birdcage mines, which had been held in reserve, were inspected by Hall for any Factory Farm damage. He climbed down to the bottom of one shaft, probably M4 at Trench 121, where he tested the leads and workings, finding them satisfactory. Major H.R. Dixon writes “For the rest of that year and well into 1918, we were in correspondence with the Belgium [*sic*] Government over the question of the removal of these mines.”¹⁰² But the German spring offensive of 1918 recaptured the lost ground, leaving the four Birdcage mines with 112,000 lb (50,802 kg) of explosive untouched.

On the morning after the Messines explosions the twelve [German] geologists and, it is believed, Lieut.-Colonel Füsslein [Commander of the Tunnellers], were lined up in the [Lille] Museum, a German general arrived, cursed them freely for failing to warn him of the mining possibilities on the British side, and ordered those under 40 to join regiments at the front, and those over 40 to go back to their wives.¹⁰³

PSYCHOLOGICAL IMPACTS OF UNDERGROUND WARFARE

The psychological trauma experienced by the German defenders overshadowed the mine casualties. “What is clear is that the physical destruction wrought by the mines was of secondary importance to the profound and widespread effect on German cohesion.”¹⁰⁴ General

¹⁰⁰ Philip Gibbs, *From Bapaume To Passchendaele 1917*, (Toronto: William Biggs, 1918), 174, 166.

¹⁰¹ McCammon Letter, 20 June 1917, RG9, III-D-1, Volume 4709, Folder 94, File 5, LAC.

¹⁰² Robinson, “The Abandoned Messines Mines,” 8.

¹⁰³ Anon, “The Messines Ridge Mines, 7th June, 1917, German Accounts,” *The Royal Engineers Journal* LIV (September 1940), 353.

¹⁰⁴ Turner, *Messines 1917*, 55.

Ludendorff conceded defeat due to the exceptionally powerful mines, acknowledging the overwhelming impact of shell shock on the surviving Messines Ridge defenders.¹⁰⁵ “The fact that, unintentionally, the explosions were not all simultaneous ... had a cumulative effect on the German garrison, and their panic was further increased by the ... ventriloquial character of great explosions. The demoralizing effect did, in fact, far exceed expectations ...”¹⁰⁶ There was nowhere to run and hide. Advancing British troops encountered the enemy cowering. In a stupefied state, many surrendered without resistance. One Australian battalion found the local German garrison “entirely unstrung.”¹⁰⁷

Many tunnellers, drained and cantankerous from the life-threatening mining environment, flouted military discipline. Others despaired—tormented by their harrowing experiences—as their courage drained away. The 3rd CTC suffered severely from the strain of the trying conditions. More than ninety Field Punishment No. 1 sentences were handed out in 1916 to sappers and privates in the 3rd CTC.¹⁰⁸

Sapper Joseph Bromley, regimental number 53547, disobeyed Army regulations in England and in the field. He forfeited one day’s pay for being absent without leave in August 1915. For being drunk on active service, he was sentenced to twenty-eight days Field Punishment No. 1 in December 1915.¹⁰⁹ On 28 November 1916, he was put under open arrest, according to Captain Urie, after he “... got too familiar with the [stolen] jug containing the rum issue in the dugouts at the mine at Trench 123.”¹¹⁰ The war diary records that sometime between 8 and 9 p.m. on 28 November, twenty-one-year-old Bromley deserted and went over to the enemy. The Daily Orders for 31 December acknowledged Bromley’s desertion by logging: Absent without leave 28/11/16. (Auth: ... 8/12/16).¹¹¹ Bromley certainly possessed considerable information. But had he spilled the beans to

¹⁰⁵ See General Eric Ludendorff, *My War Memories 1914-1918 Vol. II*, (London: Hutchison & Co, 1919), 428-9.

¹⁰⁶ Edmonds, *Military Operations France and Belgium 1917 Volume II*, 55.

¹⁰⁷ Bean, *The Australian Imperial Force in France 1917*, 593.

¹⁰⁸ 3rd CTC Daily Orders Part II, RG150, Volumes 256 and 257, LAC.

¹⁰⁹ Joseph Bromley, service file, RG150, Accession 1992-93/166, Box 1096-1, LAC.

¹¹⁰ Barton et al., *Beneath Flanders Fields*, 182.

¹¹¹ Ashley Ekins argues that desertion is one of the “chronic symptoms of disintegration.” See Ashley Ekins, “Fighting to exhaustion: Morale, discipline and combat effectiveness in the armies of 1918,” in *1918 Year of Victory: The end of the Great War and the shaping of history*, ed. by Ashley Ekins, (Auckland: Exisle, 2010), 111.

the enemy? Did they act on it?¹¹² The war diary for 20 December records that the enemy had concentrated shelling on trenches 122 and 123 after Bromley had deserted. Urie recounted that the Germans launched a raid after saturating the area with shelling, inflicting infantry casualties.¹¹³

Upon returning to Canada, he was admitted to hospital where he claimed to have been wounded by a bomb and taken prisoner at Armentières on 28 November 1916.¹¹⁴ He had been hospitalised with wounds to his right hand and leg from a grenade according to his German POW file.¹¹⁵ He was approved for a war service gratuity even though soldiers were not to be paid if they had contributed to their own captivity by cowardice or neglect. Therefore, he was either not interviewed or not rigorously interrogated during the twenty-four-hour repatriation process at the reception centre in Ripon.¹¹⁶ Bromley moved to Detroit upon demobilisation. He was awarded the Victory Medal and the British War Medal. The latter was returned in July 1921. Bromley died August 1962 in Windsor Ontario and his widow received a pension.¹¹⁷

Private (later lieutenant) John Westacott of the 19th Canadian Battalion was attached for temporary duty to the 2nd CTC on 9 May 1916. His service file—corroborated by the 3rd CTC's war diary—records that he was temporarily assigned to the 3rd CTC at Hill 60 from 8 June to 21 June.¹¹⁸ However, according to Barrie's *War Underground*, Westacott fought the enemy underground on 13 June at Mount Sorrel, blowing camouflets and killing Germans. But these exploits are not recorded in the 2nd CTC's war diary, and its June 1916 "Casualties By Day-France and Belgium" sheet reveals

¹¹² German intelligence officers never looked upon deserters favourably. They most likely regarded the prisoner with suspicion and distaste. See Aaron Pegram, "The Most Valuable Sources of News," *Stand To!* 106 (2016), 29.

¹¹³ Barton et al., *Beneath Flanders Fields*, 182; Barrie, *War Underground*, 244. The raid occurred on 23 December.

¹¹⁴ Joseph Bromley, service file, LAC.

¹¹⁵ Red Cross Archives, <http://grandeguerre.icrc.org/en/List/4889879/698/11126>, last accessed 17 January 2017.

¹¹⁶ Desmond Morton, *Silent Battle: Canadian Prisoners of War in Germany 1914-1919*, (Toronto: Lester Publishing Limited, 1992), 137. Bromley would have been entitled to a \$420 gratuity.

¹¹⁷ A deceased ex-prisoner of war's family was entitled to a pension if the soldier had not been taken prisoner through neglect or misconduct. See Appendix 1 to Chapter XX, RG9, III-B-1-33, Volume 2921, P-248-33, LAC.

¹¹⁸ John Westacott, service file RG150, Accession 1992-93/166, Box 10244-8, LAC.

no casualties incurred between the 11th and 20th. In fact, the main body of the 2nd CTC had been temporarily attached to the 1st and 3rd CTCs on 8 June at St. Eloi, the Bluff and Hill 60.

Westacott was granted a commission on 21 June and was taken on strength that day by the 2nd CTC. The Daily Orders for 28 September 1916 state that Lieut. J. Westacott was invalided (sick) on 15 September. Several medical boards reported he suffered from severe influenza after falling ill on 26 August, and he was hospitalised in England on 15 September for a week. However, in *War Underground*, Barrie relates the ongoing feats of Westacott combatting the invading Germans underground once more at Mount Sorrel on 15 and 16 September 1916, where sixty of the eighty-man tunnelling shift allegedly became casualties—including Westacott. But there is no record of this brutal battle in the 2nd CTC's war diary and these casualties are not chronicled in the Daily Orders. Trenches and tunnels at Mount Sorrel were not attacked during the night of 15 September. Moreover, only nine battle casualties had been recorded for the entire month of September.¹¹⁹ Westacott had reconstructed two fictitious underground battles in June and September 1916. He suffered a complete breakdown after the war.¹²⁰ Sadly, the “natural penchant for mendacity” among some veterans rendered their accounts unreliable.¹²¹

CONCLUSION

The accomplishments of the 1st, 2nd, and 3rd CTC companies in 1916 and 1917 were solid contributions to the success of the Battle of Messines Ridge. The 1st and 3rd CTCs laboured at twelve locations. Mines were blown at seven: St. Eloi, Kruisstraat, Spanbroekmolen, Hill 60, the Caterpillar, Trench 122, and Trench 127. The Canadian tunnellers laid, charged, wired, and tamped the St. Eloi, Hill 60, and the Caterpillar mines. They toiled on defensive, abandoned, unfinished or unfired tunnels at five sites: the Bluff, Trench 123,

¹¹⁹ Casualties by Days—France and Belgium: September 1916, RG150, Volume 494, LAC. Inexplicably, the eight casualties inflicted by a minenwerfer on 16 September are not recorded here.

¹²⁰ Barton et al., *Beneath Flanders Fields*, 289.

¹²¹ Russel G. Hann, “Introduction,” *The Great War and Canadian Society: An Oral History*, ed. by Daphne Read, (Toronto: New Hogtown Press, 1978), 28.

Trench 121 (Birdcage), Seaforth, and La Petite Douve Farm. They fired five mines totalling 241,600 lb (109,588 kg) of explosive at St. Eloi, Trench 122, and Trench 127. St. Eloi was the only blown mine of considerable depth in Ypresian clay—a much tougher substance to penetrate than Paniselian clay.

At least forty-nine mines had been suggested and more than twenty-five mines had been completed or were in progress by 7 June 1917.¹²² For example, tunnelling in the 720-foot gallery at Seaforth Farm off Trench 131 was abandoned on 11 May 1917 after time ran out.¹²³ Nevertheless, twenty-five mines were charged: nineteen were blown, four were prepared but not fired, and two were lost.¹²⁴

On 17 July 1955, Birdcage Mine No. 3 exploded during a thunderstorm. An armoured firing cable connecting Shaft M₄ to Mine No. 3, via Shaft M₁, had been maintained decades before by the 3rd CTC.¹²⁵ If the cable “... came close to the surface, the buildup of static in a thunderstorm, or a lightning strike could induce sufficient current to initiate the detonators.”¹²⁶ The detonators, primers, and 26,000 lb (11,793 kg) of ammonal in waterproof rubberised bags in the flooded tunnel had remained in remarkably good condition. Fortunately no one suffered in the blast, but the “... milk yield of several dozen dairy cows took a sharp downward turn.”¹²⁷

The owners of La Petite Douve Farm, the Mahieu family, rebuilt it after the war and renamed it La Basse Cour. La Petite Douve mine—with its 50,000 lb (22,679 kg) charge—lies 70 feet beneath a barn, next to the farmhouse. “It doesn’t stop me sleeping at night,” said M. Mahieu, 60, living at the farm with his wife and daughter when interviewed by a British journalist.¹²⁸ A farm has also been built over the abandoned Peckham mine with its 20,000 lb (9,071 kg) charge. Today, five Messines mines containing 156,000 lb (70,760 kg) of explosives lie dormant beneath the battlefield. The number of

¹²² Barton et al, *Beneath Flanders Fields*, 166.

¹²³ WD, 3rd CTC, 11 May 1917, LAC.

¹²⁴ Nineteen mines were fired on 1 July 1916 at the Somme, but eleven were very small. See Edmonds, *Military Operations France and Belgium 1917 Volume II*, 38n.

¹²⁵ Trench 121 Map, RG9, III-C-5, Volume 4435, Folder 23, File 5, LAC.

¹²⁶ Robinson, “The Abandoned Messines Mines,” 9.

¹²⁷ Barton et al., *Beneath Flanders Fields*, 199.

¹²⁸ Neil Tweedie, “Farmer who is sitting on a bomb,” *The Telegraph*, 12 January 2004.

abandoned smaller mines and camouflets cannot be ascertained. Can any of these mines be detonated today? Opinion is divided.

The German multi-zone defence-in-depth scheme of 1917 and their 1918 spring offensive, plus the return to open warfare of the last hundred days ended the vast time-consuming underground work, such as the nine-and-a-half month siege operation at St. Eloi. In 1918, tunnelling companies concentrated on defensive work including dugouts, pillboxes, and trenches. After the Hindenburg Line was breached, the 3rd CTC repaired roads, cleared mines, and graded tracks on captured ground.

June 1917 had marked the culmination of the tunnellers siege-warfare art. Messines Ridge was the last large-scale mining offensive of the war. Later that month, Field Marshal Haig conveyed his congratulations to the tunnellers: “I consider that the splendid work of these Tunnelling Companies carried out under the most trying conditions has played a very large part in the success of the recent operations.”¹²⁹

APPENDIX

Mine	Shaft	Depth (ft/m)	Charge (lb/kg)
No. 1	M1	60/18	34,000/15,422
No. 2	M1	60/18	32,000/14,514
No. 3	M1	65/20	26,000/11,793
No. 4	M3	60/18	20,000/9,072

Table 1. The Birdcage mines.

Note: All charges were ammonal in 50-lb tins. Each charge had eighteen detonators in three series of six each.¹³⁰

¹²⁹ WD, 3rd CTC, June 1917, 15, LAC.

¹³⁰ Trench 121, RG9, III-C-5, Volume 4431, Folder 21, File 1, LAC; Plan of trenches, WD, 3rd CTC, April 1917, 31, LAC.

Mine Name	Charge (lb/kg)	Depth of Charge (ft/m)	Method of Firing
Hill 60 "A"	53,500/24,267	90/27	Power
Caterpillar "B"	70,000/31,751	100/30	Power
St. Eloi	95,600/43,363	125/38	Exploder
Hollandscheschuur No. 1	34,200/15,512	60/18	Exploder
Hollandscheschuur No. 2	14,900/6,758	55/17	Exploder
Hollandscheschuur No. 3	17,500/7,937	55/17	Exploder
Petit Bois No. 1 Right	30,000/13,607	70/21	Power
Petit Bois No. 2 Left	30,000/13,607	57/17	Power
Maedelstede Farm	94,000/42,637	100/30	Power
Peckham	87,000/39,462	70/21	Exploder
Spanbroekmolen	91,000/41,276	88/27	Power
Kruisstraat No. 1 and No. 4	49,500/22,452	57/17	Power
Kruisstraat No. 2	30,000/13,607	62/19	Power
Kruisstraat No. 3	30,000/13,607	50/15	Power
Ontario Farm	60,000/27,215	103/31	Exploder
Trench 127 No. 7 Left	36,000/16,329	75/23	Exploder
Trench 127 No. 8 Right	50,000/22,679	76/23	Exploder
Trench 122 No. 5 Left	20,000/9,071	60/18	Exploder
Trench 122 No. 6 Right	40,000/18,143	75/23	Exploder

Table 2. The nineteen Messines Ridge mines blown on 7 June 1917¹³¹

Note: "Power" indicates an external dynamo detonated the mine, in which a double-pole knife switch was thrown connecting the current from the dynamo to the switchboard's multiple circuits to

¹³¹ *The Work of the Royal Engineers in the European War, 1914-19*, Summary of Offensive Mines, 7.6.17 Plate XVIII. Some of the weights and depths differ with those in the Second Army Offensive Mines Table A, 7 June 1917 chart e.g. Trench 122 No. 5 is 36,000 lb (16,329 kg). See RG9, III-C-5, Volume 4427, Folder 2, File 1, LAC.

the detonators. Each circuit had a backup exploder. Plunging the exploder's T-bar handle rotated a highly-g geared internal dynamo, which generated an electrical charge down the wires connected to the two knobs on the exploder box setting off an electrical detonator to fire a primer. All charges contained ammonal. Some mines also included blastine, guncotton or gelignite.



ABOUT THE AUTHOR

Brian Pascas, professional engineer, is an independent researcher focussed on the Great War's Western Front. He has had the privilege of interviewing WWI veterans at the Canadian War Museum. He has been a member of the Western Front Association for twenty years. His historical fiction novel, *Mud, Blood and Rum: A Year in the Trenches with the 42nd Battalion* was published in 2009.

I am much indebted to Lt.-Col. Phillip Robinson RE (ret). With his kind permission I have referenced his published article "*The Abandoned Messines Mines?*". Phillip also provided a copy of *The Tunellers Old Comrades Association Bulletin* as well as extracts from *Work of the Royal Engineers in the European War*. Through our many correspondences, I have attained a better understanding of the Proto apparatus, exploders, fuses, detonators, primers, and explosives employed at Messines Ridge.