Technological Adaptation in a Global Conflict: The British Army and Communications beyond the Western Front, 1914-1918

Brian N. Hall

Abstract

This article seeks to contribute to recent scholarly analysis of the British Army's military performance and its leadership's willingness and ability to adapt during the First World War by examining a maligned, though vital, aspect of its command and control system, communications. It offers a comparative assessment of the development and contribution of communications to British operations beyond the Western Front and concludes that the army was, on the whole, remarkably successful at adapting its communications system to suit the demands of fighting a modern, global conflict.

As the centenary of the First World War approaches, scholarly debate concerning the military performance of the British Army on the Western Front shows little sign of abating.[1] One strand of the historiography that has come under particular scrutiny in recent years is the "learning curve" hypothesis. Generally speaking, supporters of the "learning curve" have used the term as a means of describing the process by which the British Army's tactical and operational efficiency gradually improved during the course of the war. Challenging the long-held view that British generals were either "butchers and bunglers" or the victims of circumstances beyond their control, the notion of a "learning curve" suggests that commanders did learn important lessons with regards to the conduct of operations and subsequently implemented a variety of changes that resulted in improved battlefield performance, indicating a degree of institutional professionalism which previous historians had ignored.[2]

Although it is a view that has undoubtedly aided our understanding of how, and to what extent, the British Army responded to the transformation of war between 1914 and 1918, it would appear that the "learning curve" model has now run its

course. Besides questioning the accuracy of the term "curve" to describe the army's learning process and criticising the Anglo-centricity of the concept, prominent historians such as Hew Strachan and William Philpott have also begun urging British scholars of the First World War to look beyond the narrow confines of the Western Front and assess the conflict in its wider, global context.[3] Although the Western Front was the main focus of its effort, any assessment of the British Army's military performance during the war remains incomplete unless it takes into account the campaigns conducted in Africa, the Balkans and the Middle East.[4] Indeed, as David French has shown, during the interwar period the British General Staff sought to restructure and reorganise the army and rewrite its doctrine based not only on its experiences in France and Belgium but also from the lessons it had learnt from fighting in the extra-European theatres.[5]

This article will attempt to make a modest contribution to this re-evaluation of the British Army's military performance and its ability to adapt on a global scale during the First World War by focusing on a maligned, though vital, aspect of its command and control system, communications.[6] This is a particularly fitting subject to re-assess for two key reasons. First, it has the potential to provide fresh insights into the on-going debate concerning the role of communications and information resources in warfare in general. Over the last three decades, dramatic advances in communications and information processing technology have led a number of commentators to speculate that the armed forces of several Western states are in the midst of an information-based Revolution in Military Affairs (RMA).[7] Some historians have sought subsequently not only to uncover past examples of RMAs but also to assess the extent that these RMAs depended on their communications components.[8] As yet, however, there has been no detailed and systematic exploration

of the role of communications and information resources in the British Army during the First World War, the conflict which, according to some historians, spawned the most important RMA to date.[9]

The second key justification for re-examining this subject lies in the unique communications circumstances faced by all the armies during the war. As Gary Sheffield puts it: "The era of the First World War stands as the only period in history in which high commanders were mute."[10] The absence of suitable mobile, "real-time" communications imposed profound restrictions on the successful conduct of British operations on the Western Front. During the heat of battle, telephone and telegraph lines were destroyed by shellfire or accidently cut by cavalry and tanks; wireless sets were heavy, fragile and could only transmit information in Morse code; visual signalling via electric lamps, flags and heliograph was subject to interference from dust, smoke and poor weather conditions, as well as endangering the life of the signaller; and, message carriers, both human and non-human, were slow, vulnerable and unreliable. As the "Report of the Committee on the Lessons of the Great War" in October 1932 made clear, the breakdown of communications was often accountable for "the general air of uncertainty and absence of command" which characterized nearly all of the British Army's battles on the Western Front.[11]

However, recent research has suggested that, although communications lay at the heart of the difficulties of waging war on the Western Front, they also played an important part in overcoming the superiority of the defence and the stalemate of trench warfare. Despite not having been prepared in 1914 for the difficulties of modern, industrial warfare, the British Army's communications system did improve during the course of the war and made an important contribution to the successful combined-arms operations in the summer and autumn of 1918.[12] The case of

communications highlights one area of the British Army's willingness and ability to adapt successfully to the demands of modern war, seeking out new ideas, modifying existing practices and harnessing both the skills of its citizen soldiers and the full potential of the technologies at its disposal.[13]

But how does this ability to adapt on the Western Front compare with the British Army's communications experiences in the other, so-called "peripheral," theatres? This is a question that has so far gone unanswered by historians and there appear to be two possible explanations for this. First, the seemingly technical complexity of communications has acted as a serious deterrent to historians wishing to undertake such a project. Paddy Griffith, for instance, described Raymond Priestley's regimental history of the British Army's Signal Service on the Western Front as "positively the most impenetrable book ever written on the war."[14] Secondly, the difficulty of obtaining reliable sources, both primary and secondary, has also acted as a major disincentive. Only one of the most senior officers of the Signal Service left any personal papers, correspondence or diaries relating to their wartime experiences.[15] Furthermore, of the three secondary works that do contain some detailed information on communications in the subsidiary theatres, Priestley's *The Signal Service in the War 1914 to 1918 (Salonika)* and *The Signal Service in the War 1914 to 1918 (East Africa)* were never published,[16] while the official history of the Royal Corps of Signals, published in 1958, was written by a former signals officer, Major-General Reginald Nalder, who, unsurprisingly, paints a rather over-optimistic picture of the work of the Signal Service during the war.[17]

Despite these restrictions and the subsequent historiographical disregard for the subject, a comparative assessment of the way in which the British Army adapted its communications system to meet the demands imposed by the conditions that

existed in the various theatres in which it fought offers the real possibility of making more rounded and definitive judgements about the nature and development of British communications policy and practice during the First World War. In the process, it also sheds light on the British Army as an institution, particularly the extent to which the army displayed many of the characteristics of a "learning organization" – that is, "an organization which facilitates the learning of all its members and continuously transforms itself."[18] While mistakes and setbacks are "elemental features of development and learning," it is "the way in which organizations respond" to challenges and "the lessons that are learnt from the experience" that qualifies them for the title "learning organization."[19]

This article seeks to fill this intriguing gap in the literature by making extensive use of British, American, Canadian and Australian sources, particularly the GHQ, army, corps and divisional signal company war diaries held at the National Archives in London, which have so far remained largely untouched by First World War historians. In addition, to compensate for the deficiency of personal papers belonging to senior Signal Service officers, not only have the private papers belonging to junior officers, NCOs and other ranks of the Signal Service been consulted, but also the private papers of a number of senior officers who were not attached to the Signal Service have been examined in the search for information pertaining to communications. Together, these sources will help provide answers to two key questions: first, how, and to what extent, did British communication practices in the peripheral theatres differ from those on the Western Front?; and, second, how well did the British Army adapt its communications system to meet the diverse array of challenges it faced in each of these theatres? In attempting to place the British Army's communication experience during the First World War into some sort of

global comparative context, this article begins by briefly outlining the key features of the communication technologies and practices employed by the British Army on the Western Front. Five theatres of war will then be considered: Gallipoli; Mesopotamia; Egypt and Palestine; East Africa; and Macedonia. Examining each in turn, the article suggests that British communications practice during the war contained elements of both diversity and commonality, demonstrating that the army was, on the whole, remarkably successful at adapting its communications system to suit the demands of fighting a modern, global conflict.

Communications Technology and the Western Front

Before examining the communication practices of British forces in the extra-European theatres, it will first be necessary to provide a brief overview of the main communication technologies employed by the British Army during the war and how these shaped the nature of the communications system developed on the Western Front. According to *Field Service Regulations Part I: Operations (1909)*, it was of the utmost importance that there existed "a constant maintenance of communication between the various parts of an army." To this end, the efficiency of the army's communications system depended on the "careful coordination and economical employment of the several means of intercommunication available."[20] Besides utilising an array of message carriers, including runners, despatch riders, liaison officers and carrier pigeons, and employing a range of visual signalling methods, such as heliograph, semaphore and electric lamps,[21] the mainstay of the army's communications system on the Western Front revolved around three, more modern means of communication: telegraphy, telephony and wireless.

By the outbreak of the First World War the telegraph had firmly established itself as a standard method of communication within the British Army, particularly at the strategic and operational levels of command.[22] Throughout the war, the strategic telegraph network, from the War Office and the Central Telegraph Office in London to the headquarters of the lines of communication on the Channel Ports, consisted of two double-current duplex circuits. A high-speed Wheatstone automatic system, consisting of double-current simplex circuits, operated along the lines of communication to GHQ and army headquarters. Double-current simplex circuits connected army and corps headquarters, while single-current simplex and buzzer circuits were the standard methods of telegraphy from corps to divisions and divisions to brigades.[23]

The army utilised two types of line: "Airline" and "Cable." The former referred to bare wire fixed to poles, buildings or trees, while the latter consisted of gutta-percha or rubber-insulated wire laid along the ground.[24] Airline was the prominent feature of the telegraph and telephone system to the rear of divisional headquarters, beyond the range of enemy artillery fire. Lines forward of divisional headquarters were laid on short poles or stakes, along the sides or the bottom of trenches, or simply along the ground.[25] However, the closer to the frontline the more susceptible to faults and breakages from enemy shellfire these lines became, not to mention their vulnerability to enemy interception. Throughout the war, the British Army implemented numerous measures to combat these problems, including twisting the cable to reduce "leakage," duplicating the number of lines laid and burying them to ever-greater depths to protect them from shellfire.[26] By the summer of 1915, the standardised depth of lines forward of divisional headquarters was 2 feet 6 inches. By the end of the year this had been deepened to 5 feet and by the start of the Somme

offensive in July 1916, all lines up to battalion headquarters were laid to a depth of 6 feet.[27]

In contrast to the telegraph, upon the outbreak of the war British commanders had yet to fully appreciate the significant potential of the telephone.[28] With the onset of trench stalemate in late 1914, however, the telephone quickly became the army's principal means of communication. As a former brigade staff captain wrote after the war: "… a telephone wire was not only the outward sign of command, but the life-blood of its existence. A general without a telephone was to all practical purposes impotent – a lay figure dressed in uniform, deprived of eyes, arms and ears."[29] The original D. Mark I and Mark II portable buzzer telephones, however, were too few in number and not very popular. Although they could be used for speaking and sending messages by Morse code,[30] according to Colonel R.M. Powell, who commanded 2nd Division Signal Company in 1914:

> The hand telephone attachments were quite useless for any but short distances, and the only conversations between Division and Brigade consisted of "speaking over the key", i.e., the Staff Officer dictated his conversation to the telegraph operator, who sent it by vibrator in Morse – the receiving operator "translating" it to the Staff Officer at the other end; a very slow and unsatisfactory process.[31]

In late September 1914, British General Headquarters (GHQ) informed the War Office that the army 'urgently required' the supply of the new, more reliable and efficient D. Mark III telephone, which was a lot simpler to use and produced a better sound quality over longer distances.[32] While the D. Mark III subsequently became the standard portable buzzing telephone set in service during the war, the huge demand for telephonic communication also ensured the supply of specially designed magneto telephones and switchboards.[33] These magneto telephones were of two types: those of

"a semi-portable nature, providing first grade speaking and ringing facilities, and, at the same time, capable of ready transportation from point to point;" and those "designed for longer and more permanent connections established between the various headquarters, as well as for the scattered offices of the staff and administration officers."[34]

Although the telephone quickly became the army's most indispensable method of communication, its use was not without its drawbacks. Like the telegraph, its lines were extremely vulnerable to shellfire and to enemy interception. It was also ill-suited to the conditions of mobility and manoeuvre which characterised the operations of 1918. As Lieutenant-General Sir Ivor Maxse, GOC XVIII Corps, stated in May that year: "Officers must learn to discard the 'telephone habit' as soon as open warfare commences and concentrate on alternative methods of communication."[35] Furthermore, while there was practically no limit to the operational range of the telegraph, telephones in the early twentieth century suffered from the problem of attenuation.[36] As one signal officer noted after the war, "long distance telephony with the circuits then available was extremely capricious and in any case not suitable when secrecy was necessary."[37]

The static nature of the fighting on the Western Front resulted in the development of an equally static, though increasingly elaborate, telecommunications network. This served the needs of the army relatively well so long as trench stalemate prevailed. Once troops clambered out of their trenches and ventured out into "no-man's-land" and beyond, however, telephones and telegraph became a liability. The communication difficulties that plagued British operations throughout the war were graphically illustrated at the Battle of Neuve Chapelle in March 1915, the army's first major offensive under trench conditions.[38] As one post-action report observed,

although "the commander can ensure that the general plan of attack is sound and that the troops start the attack knowing their tasks and objectives and well provided with all essentials," once the battle has begun "control passes largely out of his hands except under exceptionally favourable circumstances."[39] Since it was almost not worth running out lines during the initial stages of an assault, "as they get cut before they can be of any practical use,"[40] British commanders began experimenting with an alternative and more flexible means of communication: wireless.

Wireless technology was very much in its infancy in 1914. Like the early versions of computers and mobile telephones, wireless sets in the early twentieth century were large, heavy and unreliable.[41] With the transmission of human speech over radio waves (wireless telephony) at an early, experimental stage,[42] the wireless sets employed by the British Army during the war were "almost exclusively Morse-operated with crystals or magnetized tape-detection for receivers, and arc or spark-gap radiation for transmission,"[43] which meant that they were easily susceptible to damage, their operational range was limited and channel selectivity poor. Only a limited number of sets could be employed on a given frontage without risk of mutual interference and no portable, man-carried set existed for army purposes at the beginning of the war.[44]

Three main wireless sets were in use by the British Army in 1914: the motor lorry set, wagon set and pack set. Powered by a 1.5 kilowatt engine and comprising two 70-foot masts, the motor lorry set was carried within the confines of a lorry and had a range of approximately 100 miles. Wagon sets were also similarly powered, weighed over a ton and were equipped with an 80-foot mast, all drawn by four horses. Pack sets were lighter and thus more mobile, though four horses were still required to carry the transmitter, receiver, 0.5 kilowatt engine and two 30-foot masts. It took

between 15 and 20 minutes to set up and had a range of approximately 30 miles.[45] In light of their size, weight and technical shortcomings, only GHQ and the cavalry were furnished with wireless upon the outbreak of the war. GHQ possessed one motor lorry set and three wagon sets, while Cavalry Division headquarters was equipped with three wagon sets and each cavalry brigade provided with a standard pack set.[46]

However, these sets proved ill-suited both to the mobile operations which characterised the fighting in 1914 and to the trench conditions that prevailed from the winter of 1914-15 onwards.[47] In mid-1915, GHQ began looking at the possibility of developing lighter, portable wireless sets for use in the field. By the spring of 1917 the army had developed, and was employing, three types of wireless apparatus: the British Field (BF) trench set, the Loop set and the Wilson set. The BF trench set, first introduced in 1916, had a range of approximately 4,000 yards, possessed a conspicuous 12-foot aerial and required six men to carry it and all its paraphernalia. The Loop set, which entered service in 1917, was lighter and its aerial was much less conspicuous. However, its range was limited to between 2,000 and 3,000 yards and its band of operating frequencies was so narrow that mutual interference prevented the set from being employed on a large scale. Wilson sets were employed chiefly at army, corps and divisional headquarters to monitor brigade and battalion wireless traffic. Their communication range with the BF trench set ranged from four to ten miles.[48]

Although these sets added a great deal of flexibility to the British Army's communications system, they all operated according to the principles of spark telegraphy, which meant that in the hostile environment that lay beyond brigade headquarters they were very unselective, easily damaged and were highly prone to mutual interference and jamming.[49] To overcome these problems, from 1917 the army began employing continuous wave (CW) sets, which relied upon newly-developed

thermionic valves (or vacuum tube amplifiers) to generate shorter wavelengths, affording lighter wireless-telegraphy sets and a greater range of communication (6,000 yards) for much less power expenditure. Although the Germans never employed CW during the war, the limited number of sets available in the British Army in 1917-18 meant that CW wireless was restricted mainly to the artillery for counter-battery work.[50] However, it proved very successful, as a report by the Assistant Director of Signals (AD Signals), Canadian Corps, noted in August 1918: "… it had been proved that flash spotting by [CW] Wireless is not only possible, but that better results can be obtained than by the use of telephone."[51]

Thus, although Dennis Showalter is correct when he argues that by the summer of 1918 the British Army on the Western Front possessed "a tactical communication system that by then was generally adequate to coordinate the movements of semi mechanized armies in semi mobile operations,"[52] tenuous communications were still having a profound impact on its operations.[53] During the Battle of Epéhy on 18 September, for instance, the breakdown of telegraphic, telephonic and wireless communication meant that communications forward of divisional headquarters were completely reliant upon a slow service of runners. Consequently, "it was hours after events had happened at the front that they became known to divisional headquarters, and the direction of the battle lagged even more than ordinarily."[54] Nevertheless, the communications system employed in 1918 was certainly a lot more flexible, robust and sophisticated than it had been in 1914, a reflection in part of the willingness and ability of the British Army to adapt to the conditions of modern, industrialised warfare.

Gallipoli

Having outlined the chief characteristics of the communication technologies employed by the British Army on the Western Front, it is now possible to offer a comparative assessment of the communications systems developed by British forces elsewhere during the war. Arguably the most infamous British "sideshow" of the First World War was the ill-fated Gallipoli campaign of 1915, aimed at knocking Germany's ally, Turkey, out of the war.[55] Recent studies of the campaign lay blame for its failure on a combination of factors, including: a lack of sufficient manpower, material and political support; structural weaknesses in the British command system; Allied inexperience of fighting modern war; and, fierce Turkish resistance.[56] While poor communications have been cited by some historians as a contributory factor to the Allied defeat,[57] no in-depth examination of the British communications system during the Gallipoli campaign has been made.

Although there already existed a *Manual of Combined Naval and Military Operations*, the British Army and the Royal Navy had had little practical experience working together before the war.[58] As the Commander-in-Chief of the Mediterranean Expeditionary Force (MEF), General Sir Ian Hamilton, noted in his *Gallipoli Diary*, given "the amount of original thinking and improvisation demanded by a landing operation," the commander of the naval forces, Admiral John de Robeck, "is working under conditions just as unusual to him as mine are to me."[59] It was perhaps fortunate, therefore, that the man appointed as Director of Army Signals on Hamilton's staff, Lieutenant-Colonel Michael Bowman-Manifold, had not only attended the Royal Naval War College in 1908, but had also served as the commander of I Corps Signal Company on the Western Front in 1914.[60] With a firm understanding of both army and naval communication practices, Bowman-Manifold was instrumental in helping

formulate *Signal Organization for Combined Operations*, a pamphlet issued to all naval and army units taking part in the landings in order to establish a common set of methods between the two services.[61] It was agreed in general that the navy would be responsible for maintaining communications from ship-to-ship and between the ships and the landing beaches, while the army would take charge of all communications ashore.[62] Small naval signal parties were to establish visual communication between ships and the shore on each of the five landing beaches at Helles, code-named "S", "V", "W", "X" and "Y" respectively, and at Anzac Cove. A combined beach signal office would be opened on "W" Beach and at Anzac, where the navy would provide wireless and visual links to the ships offshore, and to which the army was to connect the various headquarters on land. The army would also establish wireless stations on the flanks of "V" Beach and at Anzac in order to direct naval gunfire, while army visual signallers were employed on board transport vessels to signal to the covering ships.[63]

Unfortunately, the appointment of Bowman-Manifold and the issuing of *Signal Organization for Combined Operations* could not make up for the general lack of practical experience in conducting amphibious operations and the absence of a joint organization to reconcile inter-service communication problems in the years preceding the war. Serious problems occurred during the initial landings on 25 April when the two services were required to link up and interact. For example, although it had been agreed that naval wireless procedure be adopted, severe delays occurred in the transmission of messages from shore-to-ship on account of army operators being unfamiliar with naval ciphering methods and operating frequencies.[64] As Hamilton recorded in his diary the following day: "Our naval and military signallers were at sixes and sevens… [W]e could not get in touch with the soldiers at all."[65] Adding to

these difficulties was the severe shortage of despatch boats to deliver messages from ship-to-ship, the breakdown of the Royal Naval Air Service's wireless transmitters used for spotting naval gunfire, and the inability of the army visual signallers aboard transports to get to grips with the naval system of hoists which was used for sending messages over distances beyond the operating ranges of Morse and semaphore.[66] Compounding all these problems, however, were the difficulties involved in connecting the various army headquarters ashore to the beach signal offices. Telephone lines were frequently cut by Turkish shellfire, while the large distances and the mass of ravines and gullies which characterized the Gallipoli coastline made it difficult for commanders to assess the situation on neighbouring beaches.[67] As Brigadier-General Cunliffe Owen, the ANZAC artillery commander, later reported, "units were much mixed up. No one really knew where anyone was."[68]

Whilst inexperience in maintaining communications in modern, amphibious operations and the limitations of early twentieth century communications technology both contributed to the breakdown of communications once the Allied troops at Gallipoli were ashore, the chronic shortage of signal equipment and trained personnel exacerbated the situation. During the opening three days of the campaign, GHQ, located on board H.M.T. *Arcadian*,[69] was without a signal company, and so had to improvise as best it could by borrowing four Marconi pack wireless detachments from the ANZAC Signal Company. When GHQ Signal Company did arrive on board H.M.T. *Scotian*, most of its stores were located on another ship, which meant that it was inoperative for some time. The headquarters of VIII Corps, commanded by Lieutenant-General Aylmer Hunter-Weston, was not established ashore until early June, but it too was without its signal company until July. Finally, it had been arranged that the stores, horses and transport of the corps and divisional signal

companies were to be left on the advanced base on the island of Lemnos until the initial landings had been successful and the troops had made significant progress inland. The disappointing outcome of the initial landings, however, meant that signal stores remained on Lemnos for the majority of the campaign.[70]

The shortage of signal stores and trained personnel resulted in some unusual practices and skilful acts of improvisation, highlighting the long-standing tradition of pragmatism inherent in the British Army.[71] In a letter to his wife, one signal officer complained of having to lay "weird lines, with poles hidden from shell-fire, uneven spans, some 400 yds. long! Everything dominated by the one idea that a line if safe from shell-fire need not be constructionally ideal."[72] Similarly, while in some units telephone receiver diaphragms had to be adapted from tobacco tin lids,[73] at the Battle of Gully Ravine on 28 June, each attacking infantryman of the 29th Division wore "a triangular piece of biscuit tin" on his back in order to reflect sunlight thus enabling the commanders in the rear to monitor their progress.[74] Watching from his command post, Hamilton described the attack "as if someone had quite suddenly flung a big handful of diamonds on to the landscape."[75]

With the onset of trench warfare the communications system at Gallipoli very quickly assumed the rigid characteristics of that employed on the Western Front.[76] Telephone and telegraph lines were duplicated and laid to link up the various headquarters ashore, while extensive use of submarine cables were made to connect the beach signal stations to each other, GHQ and the advanced base. On 29 April, the Eastern Telegraph Company's cable ship *Levant II* laid a line connecting "W" Beach to the cable station on the island of Tenedos, from which telegraphic communication to Egypt and the UK already existed. Between 1-2 May, lines were laid between the beach signal stations on Helles and Anzac, and further extended to GHQ onboard the

Arcadian anchored off "W" Beach. Due to the threat posed by German submarines however, the *Arcadian* was moved to Kephalos Bay on the island of Imbros where, on 31 May, GHQ was established ashore, remaining there for the rest of the campaign. Existing Turkish and Greek submarine cables were used to connect GHQ to Helles and to Lemnos which then put it in telegraphic communication with Alexandria and London. The system was finally completed in July when a direct cable was laid from GHQ to Anzac.[77]

In August, Hamilton launched another amphibious operation aimed at breaking the stalemate on the peninsula. The failure of the landings of the 10th and 11th Divisions of IX Corps at Suvla Bay on 6-7 August highlighted not only the weaknesses of the army's means of communication but also, more importantly, the structural inadequacies of the British command system.[78] Although much of the work was carried out in complete darkness, communications during the landings were established according to plan. Within four hours of the initial beach landings a submarine cable had been laid successfully between Imbros and the corps signal office at Nibrunesi Point in Suvla. Telephone lines were laid to connect this office to division and brigade headquarters, as well as to Anzac Cove, whilst wireless and visual communication was established with the covering ships.[79] In spite of these provisions, the commanders of GHQ, IX Corps, and the attacking divisions all complained, at one time or another, of being starved of adequate and timely information.[80] While the success of the operation undoubtedly required "an improvement in communications both for the receipt of information as to the situation and the issue of orders," the weakness of the communications system exacerbated a much more serious problem, namely the inadequate command arrangements.[81] Hamilton was "marooned upon an island" 20 miles away,[82] while the commander of

IX Corps, Lieutenant-General Sir Frederick Stopford, chose to direct the operation aboard the destroyer *Jonquil*, anchored off Suvla Bay, whose only means of communicating with the forces ashore was via the medium of semaphore. Given also that there were too few despatch boats available to enable Stopford's staff to make regular visits to the beaches, and that it took until the morning of 8 August for a direct telephone line to be laid, Stopford's decision to remain on board the *Jonquil* until the evening of 8 August almost certainly contributed to the failure of the operation.[83] In sum, the failure to capitalize on the initial success of the landings owed more to the structural and institutional weaknesses of the British command system than to the shortcomings of communications technology.[84]

Ironically, perhaps the most impressive and successful aspect of communications at Gallipoli occurred during the evacuation of the peninsula between December 1915 and January 1916. The maintenance of reliable communications with a minimum number of personnel, whist saving as much equipment as possible, was essential if the operation was to have any chance of succeeding. The principle of lower formation headquarters falling back to the headquarters of higher formations was adopted, much like that employed by retreating British units on the Western Front in the spring of 1918,[85] and although additional lines were laid on top of the existing telephone system in case of emergency, they were not needed in the end. Fortunately the Turks had neither valve amplifiers to tap into the British telephone system nor a sufficient number of aeroplanes to observe from the air the activity of their retreating enemy.[86] Nonetheless, this should not detract from what was an otherwise smooth and very efficient operation in which communications played an important role. As one report later testified: "The whole system of communications was maintained throughout without a hitch."[87]

Mesopotamia

Whereas the rigidity of the British communications system at Gallipoli bore striking similarity to that employed on the Western Front, the army's communication practice in Mesopotamia was, for the most part, markedly different. This can be attributed mainly to the geographic and climatic conditions of the country, but also to a less dense force-to-space ratio, which resulted in campaigns of greater mobility and manoeuvre. From a historiographical perspective, studies of the fighting in Mesopotamia tend to say little of real substance with regards to communications, preferring instead to focus on the logistical aspects of the campaign.[88] Those that do mention communications have done so mainly with reference to their use for signals intelligence (SIGINT) purposes.[89]

The most striking feature of the Mesopotamian campaign was the widespread use of wireless. From the outset British forces became dependent on wireless since it was very often the only means of communication that could adequately bridge the large distances between mobile units. The Marconi 1.5 kilowatt Wagon Set, powered by a 6 horsepower Douglas engine, for example, could send and receive messages over distances of between 150 and, on occasions, 350 miles.[90] Wireless was also a much more flexible method of communication than either telegraph or telephone. The latter methods not only impeded the freedom and mobility of a unit on the move but, as one signal officer observed, "the lines are some hundreds of miles long, and run through areas devoid of troops. So you can imagine the maintenance of the lines is not too easy."[91] Faults and interruptions on the lines were commonplace, some as a result of wilful damage by the native Arab population.[92] Finally, the popularity of wireless amongst commanders and their staff can be attributed to the absence of strict security

procedures during the first two years of the campaign, when all but the "most secret" messages could be transmitted without having to go through a lengthy and complicated encryption process. Yet even after tighter security measures were enforced in 1916, GHQ continued to impress on all commanders "the importance of keeping in closest touch by wireless throughout operations."[93]

Nevertheless, as one former wireless operator in the 6th Indian Division remarked after the war, wireless could at times be "a very hit and miss game."[94] Atmospheric disturbances, for instance, were a frequent problem in Mesopotamia, rendering the reading of some wireless messages very difficult for the receiving operator.[95] At Kut-al-Amara in April 1916, for instance, strong atmospherics hampered wireless communication between the commander of the besieged British garrison, Major-General Sir Charles Townshend, and the relief forces attempting to reach them.[96] The arrangements for transporting wireless sets on mule carts also caused problems. As the commander of the 34th Division Signal Company observed, "jolting over the desert in carts was hardly good for such instruments and the dust played havoc with it."[97] Establishing wireless communication was also a rather time-consuming affair. A standard Marconi Pack Set took an average of 15-20 minutes to erect and a further 15 minutes to dismantle.[98] When Lieutenant-General Sir Stanley Maude demanded regular updates from the cavalry during the advance on Baghdad in 1917, their wireless sets had to be set up every hour, severely impeding mobility.[99] This was still a common complaint of the cavalry during the advance on Mosul in October 1918.[100]

Therefore, every effort was made to ensure that units had access to a reliable and efficient telecommunications network. Initially, this proved rather difficult since "there were no obvious points of access to the landlines used by the Turkish 6th

Army."[101] Gradually, however, as British forces advanced further inland extensive use was made of the civilian telegraph lines that linked the main towns and cities – Basra, Amara, Baghdad, Naziriya and Ahwaz – to one another. For the most part, these lines were owned and worked by the Indian Government Telegraph Department whose staff comprised about one-third army operators and two-thirds civilians.[102] In late 1916 however, the staff were absorbed into a newly formed Lines of Communication Signal Company, and a separate military route, consisting in part of abandoned Turkish lines and apparatus, was built from Basra to Baghdad.[103] At the tactical level, telephone cables were laid between division and brigade headquarters when the distances between them were not too great. These were also extended down to battalion headquarters during static periods, though visual signalling via heliograph was the preferred method of communication between the lower formations whilst on the move.[104]

Besides the aforementioned difficulties experienced in maintaining the civilian telegraph and telephone system, lines laid at the tactical level suffered from the same vulnerabilities as those on the Western Front. For example, during the attack on Nasiriya in July 1915, telephonic communication was rendered extremely difficult as a result of the lines being constantly cut by enemy shellfire.[105] On the whole, however, such occurrences were more infrequent than, and certainly not as acute as, those experienced by the armies on the Western Front. This owed as much to the less intense nature of the Mesopotamian campaign as it did to the general dearth of concentrated Turkish artillery fire. As one signal officer noted in a letter to his wife in September 1916, even when the Turks did "heave over a few spare shells, we view their efforts rather with pained surprise than with any passionate resentment."[106] During a successful attack carried out by the 21st Brigade (7th Indian Division) on

Turkish positions around Mushahida, 20 miles north of Baghdad, on 14 March 1917, for instance, although "the Brigade Signalling Officer and many of his men were killed," the telephone lines of the Black Watch Regiment held-up well and "intermittent communication was kept up throughout the battle between the battalion, the covering batteries, and the Brigade Commander."[107]

Yet the mobile nature of the war in Mesopotamia presented its own unique set of communication dilemmas. Attempts to relieve the besieged British forces at Kut-al-Amara between January and April 1916, for example, failed partly on account of the lack of coordination between the relief forces, which was itself the result of the breakdown of telephonic communication between brigades and division headquarters. As the war diary of 13th Division testifies: "… telephone comms. to Bdes. broke down owing to cable parties not being able to keep up with Bde. HQrs. which moved very quickly."[108] Forward of brigade headquarters, the dearth of timely and accurate information was often attributed to the reliance placed upon runners and mounted orderlies who, more often than not, were either killed before they arrived at their destination or carried messages containing information that was out of date and of little use by the time it reached its intended recipient.[109] In these circumstances some senior officers felt they had no other option but to exercise command much closer the front line than they had hitherto been accustomed to. Although this overcame the problems brought about by the limitations of the means of communication available, as Townshend discovered at the battle of Ctesiphon in November 1915, it also had the negative effect of distorting the commander's decision-making ability, forcing him to lose sight of the bigger picture.[110]

Finally, an arguably even greater problem was the inadequate supply of men and equipment, particularly during the first half of the campaign. Communication

became almost entirely lost when both the 16th and 17th Infantry Brigades ran out of telephone line during the Battle of Kut in late September 1915, while the relief forces at Kut in December suffered from chronic shortages of adequate telephone cable and apparatus.[111] It was not until late 1916 that a Signal Depot in Mesopotamia was established. Thereafter the supply of stores improved, though the Signal Service continued to struggle with rather modest resources until the end of the war.[112] Indeed, as the history of the Royal Corps of Signals notes, the low priority status afforded the theatre by the British government meant that the provision of personnel and equipment in divisional and brigade signal units in Mesopotamia by the autumn of 1918 "had not expanded comparatively with those on the Western Front."[113]

Egypt and Palestine

As in Mesopotamia, the nature of British military operations in Egypt and Palestine was dictated by a similar combination of factors, including wide frontages, open desert flanks, long lines of communication, adverse climate and terrain, and a relatively light concentration of enemy artillery. In these circumstances the fighting was more or less fluid, particularly from 1917 when General Sir Edmund Allenby assumed command of the Egyptian Expeditionary Force (EEF) and the campaign pursued the much more aggressive objective of driving the Turks out of Palestine.[114] Although British strategy, intelligence and use of chemical weapons in Egypt and Palestine have been the subjects of recent scholarly enquiry, communications has received rather short shrift.[115] In many respects, the communication practices of British forces in Egypt and Palestine shared many of the characteristics of those employed in Mesopotamia, though there were some notable differences.

For instance, as in Mesopotamia, wireless proved to be of much greater relative value in Egypt and Palestine than it did on the Western Front. A much more favourable force-to-space ratio and the general absence of both prolonged trench stalemate and concentrated artillery barrages presented circumstances which were much more conducive for the successful employment of wireless. At the operational level, a chain of wireless stations was established during 1916, linking up the principal headquarters in the Sinai and along the Suez Canal with GHQ in Cairo and the Signal Depot at Alexandria.[116] Tactically, by 1918 all attacking division and brigade headquarters were ordered to establish wireless communication with each other as soon as possible, "even if telephone lines are working satisfactorily."[117] Wireless was also used by the RAF to help direct artillery fire during the last months of the war.[118] The most effective use of wireless was made by the cavalry and the Desert Mounted Corps during the advance towards Damascus and Aleppo in September and October 1918, when line communication was difficult to establish.[119]

However, the infantry in Egypt and Palestine did not employ wireless for communication purposes to the same extent as their counterparts in Mesopotamia. There are three main explanations for this: first, strict security procedures were vigorously enforced from the outset of the campaign. No messages were to be transmitted or accepted in "clear" due to the fear of enemy interception.[120] To some extent this fear was of British making. From 1917, Turkish telegraph and telephone lines were systematically destroyed in order to force the army to use wireless more extensively, which the British could then intercept.[121] Although this gave the British Army access to "a remarkable amount of information," it also heightened concerns that British wireless messages could be read by the Turks;[122] second, the adverse climate and geography of Egypt and Palestine resulted in a much higher incidence of

wireless atmospherics and static disturbances than in Mesopotamia.[123] Again, this persuaded many commanders to rely on alternative methods of communication; and third, by reason of the relatively light concentration of Turkish artillery fire, most forward telephone lines laid by the infantry suffered only minor damage during the heat of battle.[124] During the Battle of Sharon in September 1918 for example, although BF Trench Sets had been issued to the 162nd and 163rd Brigades of 54th Division, "owing to cables holding up no necessity arose for the use of wireless."[125]

Thus, in Egypt and Palestine a much greater emphasis was placed upon telephone and telegraph as the principal means of communication from GHQ down to brigade headquarters. As a report by 60th Division Signal Company following the Third Battle of Gaza in November 1917 made clear, "communications, instead of being an aid to operations, have become an absolute necessity; the Staffs being most exacting with regards to communications, not only expecting facilities similar to those of trench warfare, but depending on them."[126] At the operational level, GHQ in Cairo relied primarily on civil lines to connect it to the principal headquarters along the Suez Canal. Following the defeat of Turkish forces at Rumani in August 1916, however, a permanent telephone trunk line was constructed through the Sinai along the same route as the railway and water pipeline, eventually reaching Rafah near the Palestinian border in early 1917. After the fall of Gaza in November 1917 the trunk line was extended with each successive advance until, in the autumn of 1918, a system was in place that connected the principal centres of Gaza, Jerusalem, Jaffa, Tul Keram and Haifa.[127] Though laying cable across the desert was a fatiguing affair, most Airline Sections could erect line at a rate of over four miles per day.[128] To speed up the process, however, every effort was made to utilize abandoned Turkish poles

and lines, with specific instructions issued to all troops not to purposely damage or cut them down.[129]

At the tactical level, telephone formed the principal means of communication between division, brigade and battalion headquarters. Although the lines were usually laid along the ground, they were sometimes laid on short poles or stakes and, on occasions, even buried.[130] However, unlike on the Western Front, the main reason for the latter methods was not so much to protect the cables from the effects of enemy shellfire but rather from the damage done by the movement of friendly troops, cavalry, guns and transport.[131] The mobile nature of operations in Palestine also posed another dilemma for cable communication, one that British commanders on the Western Front did not have to contend with until the last months of the war.[132] As the commander of 10th Division Signal Company, Major M.E. Webb, noted in August 1918: "With fast moving troops, telephone communication is obviously impossible while the HQrs. are actually moving, unless they stop and thereby hold up the progress of the operations, or delay themselves."[133] The rapidity with which formations moved also made it difficult for cable detachments to reel up cable fast enough for it to be re-laid and re-used.[134] Despite an increase in the establishment of cable from 1917, the Signal Service in Palestine continued to struggle with similar personnel and material shortages experienced in the other "peripheral" theatres. As a memorandum issued by the Director of Army Signals in early February 1917 made clear: "The necessity for rigid economy in all technical material must be brought to the notice of all ranks, and constantly borne in mind."[135] This, combined with the heavy demand for telephonic communication, often resulted in serious congestion on forward telephone lines at critical moments during the heat of battle.[136]

To alleviate some of these problems, from early 1918 commanders were urged to make greater use of an array of alternative methods of communication.[137] Visual signalling was regarded as a valuable means of communication forward of brigade headquarters since it was ideally suited to the geographical and meteorological attributes of the region. Using flags and heliograph during the day and electric lamps at night, visual signalling was chiefly employed during the initial stages of an advance, when headquarters were on the move and telephone lines were in the process of being laid.[138] In addition to visual signalling, 300 carrier pigeons were made available to British forces from the autumn of 1917. The birds were flown mainly from brigade and battalion headquarters to portable lofts at division headquarters, and proved to be of some value. During the Third Battle of Gaza, for instance, over 180 pigeon messages were received at various headquarters during the course of operations, including that pertaining to the capture of Tel-el-Saba to the south of Beersheba.[139] Finally, extensive use was made of runners and liaison officers at the tactical level and motorcycle despatch riders along the lines of communication. Although an efficient runner relay system and despatch rider letter service gradually emerged, the principal drawback to such methods in the heat of battle, as one report noted, was that: "The time taken for runners and mounted despatch riders to locate the various HQ when they were continually moving causes messages to be so delayed that by the time they arrive at their destination the whole situation may have changed."[140]

In light of the difficulties involved in maintaining effective communications at the tactical level, both brigade and battalion commanders increasingly felt obligated to leave their respective headquarters and attempt to conduct operations closer to the firing line. In one infamous example cited in the official history, Brigadier-General

J.B. Pollock-McCall, GOC 155th Infantry Brigade, personally organised and then led the attack of the 1/4th and 1/5th King's Own Scottish Borderers on El Mughar Ridge on 13 November 1917. Although the attack was a resounding success, Pollock-McCall was fortunate to emerge unscathed after his helmet was pierced by a Turkish bullet. Such behaviour would have been considered unbecoming of a brigade commander in the trench conditions of the Western Front.[141]

East Africa

The predominant factors influencing both the nature of the fighting and British communication practice in East Africa were strikingly similar to those in the Middle East. Communications were clearly vital to British interests since one of the main objectives of British strategy from the outset of the war in Africa was the destruction of Germany's colonial wireless stations. While this aspect of communications has been well-documented by historians, coverage of the operational and tactical facets of British communications practice in East Africa has been more patchy.[142] This is somewhat surprising given both the peculiar conditions under which communications had to be provided and maintained, and the affect that communications had on shaping the nature of the fighting.

Perhaps the most unique feature of British communications in East Africa was the heterogeneous composition of the signal units. Three divisional signal companies had been formed by 1916, two consisting of a mixture of British, Indian and African personnel, while the third was of South African origin.[143] In addition to these were the GHQ and Lines of Communication signal companies, also composed "of men of different nationalities – of different training – speaking different languages, with equipment of varying patterns thrown together without any coordinated training to

carry out an important operation in unknown country."[144] A report by a British signal officer regarding the state of a group of Nigerian signallers in early 1917, for instance, complained that the postal service men had "practically no knowledge of ordinary signals work," that the signallers were slow at visual and "know nothing of telephone work," and that the clerks were "lazy, objectionable and inefficient." With regards to the linesmen, the officer remarked sarcastically: "I find an ordinary porter with two days practice is more use."[145] This lack of common training and adequate experience made the task of establishing a reliable and efficient communications system much more difficult than in the other theatres. For example, in accounting for the fact that no wireless messages had been transmitted from the South African Mounted Brigade to GHQ during operations on 20-21 March 1916, the Deputy Director of Army Signals, Lieutenant-Colonel Henry Hawtrey, blamed the lack of timely information on the brigade's signal officer, Captain F.E. Jackson, since "he is a visual signaller and therefore does not make sufficient use of a technical side of the service at his disposal."[146]

The dearth of highly skilled and experienced signallers was compounded by the enormous casualty rates caused by diseases such as dysentery and malaria. Throughout the East African campaign the ratio of non-battle casualties to battle casualties was roughly 30 to 1.[147] By the end of 1916, 82 per cent of the signallers in South African units were declared "unfit" for duty, while the motorcycle despatch rider service was 40 per cent below establishment as a result of sickness and disease.[148] As well as being hugely understaffed the Signal Service also suffered from acute shortages of stores and equipment, particularly during the first half of the war. Not only was the provision of telephones, long distance signalling lamps and the necessary spare parts for motorcycles extremely poor but, as Hawtrey noted in July

1916, even the telephone and telegraph cable provided to the Signal Service in East Africa had been "condemned about six years ago in India as unfit for use."[149] It should be noted, however, that these problems were not unique since the German forces under Colonel Paul von Lettow-Vorbeck were forced to plunder Belgian and Portuguese cable and improvise lines and insulators from barbed wire, beer bottles and bamboo.[150]

In spite of such deprivations the signal units in East Africa managed to provide a service which was of paramount importance to the successful conduct of operations. The only pre-existing system of communication available at the outset of the war were the telegraph lines built alongside the principal railways from Mombasa to Lake Victoria via Nairobi, and from Tanga to Mount Kilimanjaro in British East Africa. The only railway in German East Africa ran from east to west from Dar-es-Salaam to Ujiji on Lake Tanganyika.[151] Since none of these lines ran in the general direction of the British advance, a significant amount of time and effort was invested in extending and maintaining the telegraph system for military purposes. By July 1916, 1,700 miles of new permanent and semi-permanent airline routes had been built. However, these long lines were extremely vulnerable to the natural hazards of the country. Besides the problems caused by tropical storms and bush fires, in certain areas airline had to be raised at least 25 feet off the ground in order to avoid being damaged by roaming giraffes. As such, the lines were frequently out of service and constantly having to be repaired. Therefore a chain of visual stations, operating over distances of between 30 and 70 miles, was established to provide an emergency means of communication when the lines were faulty.[152]

By far the greatest challenge facing signal units in East Africa, however, was the provision and maintenance of communication between the widely dispersed

mobile columns and between the advancing columns and their respective bases. As one officer noted after the war: "The meaning of the 'fog of war' only becomes properly appreciated when you find yourself turned loose in the bush with a detachment of perhaps a hundred men… Everything goes according to plan until you have proceeded for perhaps a quarter of a mile, and then you begin to wonder what has happened and what has become of everybody."[153] Indeed, the difficulty of maintaining adequate communications exacerbated the inability of British and Allied forces to close-in on, and decisively engage, Lettow-Vorbeck's forces in a large-scale pitched battle for much of the war. According to Brigadier-General Charles Fendall, Assistant Adjutant-General of the East African Force (1916-18): "It was important that every column used in converging movements should be strong enough to hold its own until given time for other forces in that area to get up and join in the fight."[154] However, as Lettow-Vorbeck observed in his memoirs, "it was quite impossible for the enemy, in spite of the unremitting labours of his wireless service, to obtain a clear picture of the situation as a whole and to keep his subordinate leaders informed in time of all the changes of the situation."[155] With poor communications making it difficult for the pursuing British and Allied forces to co-ordinate their movements and bring effective concentrated force to bear on the enemy, fighting often resolved into "a series of local operations" which were "independent of each other," such as at Mkalamo on 9 June 1916 or at Namirrue on 23 July 1918, where on both occasions Lettow-Vorbeck's forces were allowed to extricate themselves relatively unscathed.[156]

In spite of the difficulties associated with laying lines in mobile operations, and notwithstanding the damage done to lines by bush fires, tropical storms, troop movement and "ant ravages," the telephone quickly became the primary means of tactical communication.[157] As one officer testified after the war:

> Telephone communication is practically indispensible in modern bush fighting. It not only permits of linking up headquarters with units and detachments, but also lays a trail for them which proves invaluable when sending messengers, food, stretchers or ammunition… Fighting in the bush is practically synonymous with fighting in the dark, and the telephone is not only a necessity but a great moral asset, as it takes the place of eyes.[158]

Nevertheless, the telephone's limitations in mobile bush operations ensured that an array of alternative means of communication were always on stand-by. Visual signalling, using heliographs and flags during the day and signalling lamps at night, was widely utilized, as were runners and mounted or motorcycle despatch riders. With regards to the latter, however, the thick bush country and lack of suitable roads resulted in a very high incidence of mechanical breakdowns, for which there was a very limited supply of spare parts and oil.[159]

Given the principal drawbacks of the above methods, the large geographical spread of the forces and the fluidity of operations, British commanders in East Africa, like their counterparts in the Middle East, very quickly came to appreciate the value afforded by wireless. As Hawtrey informed Captain Jackson in March 1916, wireless should "always accompany a mounted detached force taking guns."[160] However, the equatorial climate resulted in poor wireless atmospherics, while the thick bush country often reduced the range of a standard Marconi wagon set from 150 to 25 miles and a pack set from 80 miles to just 12.[161] The sets were also regularly on the move, being erected and dismantled on a daily basis, and often carried in loads by the native porters.[162] Wear and tear was therefore a major problem, with sets requiring regular "extensive overhaul and repair."[163] For all the difficulties involved in its use, however, wireless was widely employed during the last two years of the war in East

Africa, providing an invaluable means of communication in the most trying of circumstances.

Macedonia

In stark contrast to the British Army's operations in the Middle East and East Africa, the nature of the fighting in Macedonia was almost identical to the trench stalemate endured on the Western Front and Gallipoli peninsula. Between October 1915 and September 1918 the Allied forces in Macedonia were locked in what the Germans referred to as "the biggest internment camp in Europe."[164] The communication practices of the Signal Service, therefore, followed a very similar pattern to those in France and Belgium. However, as in the other subsidiary theatres, British signal units in Macedonia suffered from chronic shortages of both men and resources in a country with inhospitable climate and terrain. Despite these handicaps the Signal Service developed a healthy interest in innovation and experimentation which gradually resulted in the establishment of a semi-reliable and efficient communications system.

From the initial Allied landing at Salonika in October 1915 one of the biggest obstacles hindering British communication practice was the rather hostile attitude adopted by the neutral Greek government.[165] The local authorities in and around Salonika refused to give the Allies permission to use the existing civil telecommunication network. This made the work of the signal units much more arduous since they were forced to dip into their already limited supply of cable and lay it through the streets at night so as not to antagonize the local population. After much arguing, the Greek authorities reluctantly gave the British the go-ahead to suspend cable on the telegraph lines that ran alongside the Salonika-Sarigol-Doiran

railway – a distance of some 45 miles. This was completed at the end of November 1915 and used to good effect during the withdrawal from Serbia in December. Up until the same time, strategic communication with both London and Alexandria had to be made through the Eastern Telegraph Company, via the operators in the civil post office. This rather laborious process came to an end on 20 December when, on the orders of the Director of Army Signals, Egypt, Brigadier-General Bowman-Manifold, a submarine cable was laid between Salonika and the island of Mudros, thereby making the Allied forces in Salonika independent of the civilian system.[166]

When the Allies formally took control of the civil telegraph offices and telephone exchanges in June 1916 the shortage of signal stores and personnel had reached an acute stage. The building of a Signal Park two months previously had resulted in only minor increases to stocks.[167] Galvanised iron wire, telegraph poles and bobbin insulators had to be purchased locally while magneto telephone exchanges had to be improvised from electric light plugs and sockets, and "buzzer" switchboards improvised from bullets and cartridge cases.[168] With regards to personnel, the Director of Army Signals, Major Alexander Grubb, noted in January 1917 that, although there was ample unskilled labour available, "the number of permanent linemen is not at present large enough to make really quick process… It is hoped that as the work goes on, more men will rapidly become trained and a much faster rate of progress will be maintained."[169] The situation did gradually improve. Between January 1916 and December 1917, British forces in Salonika were supplied with 12,300 miles of cable, 1,090 magneto telephones and 1,450 "buzzer" telephones. However, it was not enough to meet the insatiable needs of the army. On 5 January 1918, Grubb issued a circular memorandum calling for the "urgent necessity for economy in the expenditure of Signal Service stores." Although he hoped that the

situation would improve, three months later, with the Allies reeling from the German spring offensives on the Western Front, Grubb had to accept that "under present circumstances we can only expect the barest necessities in the way of stores."[170]

Compounding the troubles of the Signal Service in Macedonia were the natural hazards presented by the country. The regional infrastructure was very under-developed. Roads, in particular, were virtually non-existent, with supplies having to be hauled across a combination of swamps, streams and mountainous terrain.[171] This presented enormous difficulties for despatch riders and mounted orderlies whose task was made even more difficult during periods of bad weather. In November 1916, for instance, heavy rains made the condition of the road between GHQ and XII Corps headquarters so bad that arrangements had to be made to take messages via aeroplane.[172] As in East Africa, too, sickness and disease took a heavy toll on the army. Between July and August 1916, 295 troops and NCOs of the Army Signal Company, approximately 55 per cent of its total strength, were admitted to hospital suffering from the effects of malaria and sand fly fever.[173] This seriously depleted the number of men available for work, stretching the resources of the signal units to almost breaking point.

The static nature of the fighting in Macedonia meant that the British communications system shared many of the characteristics of that employed on the Western Front. The most obvious feature was the development of an extensive telephone and telegraph network. During the winter of 1915/16 the first consignments of much needed cable and suitable poles to construct permanent airline routes to the headquarters of XII and XVI Corps arrived. As Major Geoffrey Rawson, AD Signals XII Corps, related after the war, these were badly needed since the civil lines that were hitherto being used by the army "were not of great service as they were of poor

construction, the poles in many cases being rotten and the few wires heavy and slack."[174] However, from April 1916 the interposition of French and Italian divisions between the two British corps complicated signal arrangements, increasing the distance from Salonika to the headquarters of XII Corps and XVI Corps to 23 and 50 miles respectively.[175] The complex and over-elaborate line system that subsequently emerged caused great difficulties for maintenance. It was perhaps fortunate therefore that on 18 August 1917 a fire broke out in Salonika, burning most of the telephone cables in the town. This provided the opportunity to replace the lines to the corps headquarters with a much simpler system. By the beginning of October 1917, the Army and Lines of Communication signal companies presided over 375 miles of permanent line route, carrying 2,800 miles of wire.[176]

The communications system forward of corps headquarters bore an even closer resemblance to that on the Western Front, where the burying of telephone lines had been standard practice since 1915. This was particularly the case on XII Corps front where the fiercest fighting took place. Initially, the rocky terrain and lack of topsoil made the burying of telephone lines extremely difficult. Most lines were either poled or laid along the ground, yet this made them vulnerable to shellfire, troop movement and, in the summer, damage from grass fires.[177] The vulnerability of the unburied cables of the 26th and 27th Divisions during the Battle of Doiran in the spring of 1917, for instance, was duly noted and in February 1918 work began on the construction of a 1,000 yard cable trench to protect the system of artillery communications in 22nd Division.[178] Although it took six months to complete on account of having to cut through almost solid rock, it played an important role in the final Allied assaults against the retreating Bulgarian forces in September 1918.[179]

Given the difficulties involved in establishing line-based communications, and in light of the fact that British forces from November 1916 held a 90 mile sector of the frontline, it would be reasonable to assume that wireless played a prominent role in the army's communications system. However, apart from its use for the early warning anti-aircraft system developed in 1916-17, the full potential of wireless was not exploited by British forces in Macedonia. This was largely on account of the limited number of wireless sets and trained operators available. Consequently, wireless was regarded as a secondary means of communication, just as it was on the Western Front until 1918, when the transition from static to more mobile warfare exposed the limitations of line-based communications in such operations.[180] This point was illustrated in February 1918 when the airline routes between GHQ and corps headquarters were badly damaged by a severe snow storm. Wireless became the principal means of communication during the three month period the lines were being repaired. Once the line system was fully restored, however, wireless dropped out of use completely.[181]

Conclusion

In 1919, an official account of the actions of the EEF under General Allenby observed: "… while the Signal Service is functioning as a whole, the parts are constantly being altered and improved, and the smooth working of the machine must go on owing to elasticity of the organization and the adaptability of individual members."[182] Although it relates specifically to the British military operations conducted in Egypt and Palestine, the report's conclusion could equally be applied to any of the theatres in which the British Army fought during the First World War. This article has sought to place the British communications experience on the Western

Front with an additional, wider context by examining the army's communications practices in the other, so-called "peripheral," theatres and asking two significant questions: first, how, and to what extent, did British communications practice in the "peripheral" theatres differ from that on the Western Front?; and, second, how well did the British Army adapt its communications system to meet the diverse array of challenges it faced in each of these theatres?

With regards to the first question, it is clear that where trench warfare was the dominant characteristic of the fighting, such as at Gallipoli and in Macedonia, British communications practice bore a very close resemblance to that on the Western Front. The static nature of the operations in each of these theatres resulted in the construction and maintenance of an equally static communications system, in which telephonic and telegraphic communication were the predominant means of conveying information. In Mesopotamia, Egypt and Palestine, and East Africa, however, the less dense force-to-space ratios, long lines of communication and a relatively lighter concentration of enemy artillery resulted in campaigns of greater mobility and manoeuvre, which in turn necessitated the use of more flexible means of communication. Wireless, in particular, proved to be of much greater relative value in the Middle East and East Africa because the natural conditions which prevailed in these theatres were much more conducive to its widespread and successful employment than at Gallipoli, in Macedonia and, until 1918, on the Western Front.

Indeed, to answer the second question posed in this piece, the case of wireless serves as a good illustration of how successfully the British Army was able to adapt its communications system to suit the diverse array of challenges it faced during the First World War. Based solely upon an examination of the British Army's use of wireless on the Western Front, one recent study has argued that it was the "significant

institutional bias" of the British high command against wireless communication that prevented it being employed both earlier and to its fullest extent.[183] Such a conclusion not only underestimates the scientific and technical limitations of the wireless sets of the era for their successful employment on the Western Front but, more specifically, fails to take into account the British Army's global communications experience. As this study has demonstrated, officers from this same, supposedly rigid, institution were able to employ wireless to great effect in Mesopotamia, Egypt and Palestine, and East Africa. The fact that they were able to do so provides further compelling evidence of an institution both willing and able to adapt its communications system to meet the challenges of fighting a modern industrial conflict on a global scale.

However, while there were notable differences between the communications practices employed on the Western Front and in the extra-European theatres, there was also a great deal of commonality. That is to say that the signal units in each subsidiary theatre conformed to the same set of general principles adhered to by the Signal Service on the Western Front. These principles were officially laid down in *SS. 148. Forward Inter-Communication in Battle*, the army's first authoritative communications manual published in March 1917.[184] Based on the lessons learnt from the experiences of fighting on the Western Front in 1916, *SS. 148* represented British communications doctrine in all but name. Copies of the manual and references to it, however, can be found littered throughout the war diaries of signal companies in every theatre of operations during the war, with the obvious exception of Gallipoli. Thus, the evidence presented in this article demonstrates that the British Army did not develop its communication practices in one theatre to the exclusion of developments elsewhere. There was clear cross-fertilization of best communication methods and practices amongst British forces fighting around the globe. In many respects,

therefore, the case of communications reveals the extent to which the British Army underwent a process of "intra-organizational learning," one of the key attributes of a "learning organization."[185]

Nevertheless, although all British Army signal units from March 1917 were effectively "singing from the same hymn sheet," they proved talented in adapting these principles to better suit the conditions of the various theatres in which they were fighting. Indeed, British officers in all theatres found that the most flexible and efficient communications system was one that utilised a combination of telegraph, telephone, wireless, visual signalling and despatch riders, although the order in which these methods were ranked in terms of priority varied according to local and regional circumstances.[186] Very often, as Theo Farrell has recently argued, it is this "tinkering" of techniques, technologies and procedures to improve operational performance "that aids victory in battle and contributes to success in war."[187] Overall, therefore, a comparative assessment of British communications practice during the First World War provides further evidence to support the argument that the pragmatic nature of the British Army and its leadership provided it with a degree of latitude and flexibility that, ultimately, enabled it to adapt successfully to the demands of fighting a modern, industrialised war on a global scale.[188]

[1] See for example: J.P. Harris, *Douglas Haig and the First World War* (Cambridge: Cambridge University Press, 2008); Paul Harris and Sanders Marble, "The 'Step-by-Step' Approach: British Military Thought and Operational Method on the Western Front, 1915-1917," *War in History* 15 (2008): 17-42; Jonathan Boff, "Combined Arms during the Hundred Days Campaign, August-November 1918," *War in History* 17 (2010): 459-78; Gary Sheffield, *The Chief: Douglas Haig and the British Army* (London: Aurum Press, 2011); Jonathan Boff, *Winning and Losing on the Western Front: The British Third Army and the Defeat of Germany in 1918* (Cambridge: Cambridge University Press, 2012); and, Jim Beach, "Issued by the General Staff: Doctrine Writing at British GHQ, 1917-1918," *War in History* 19 (2012): 464-91.

[2] Notable studies in this genre include: Paddy Griffith, *Battle Tactics of the Western Front: The British Army's Art of Attack 1916-18* (New Haven: Yale University Press, 1994); Paddy Griffith, ed., *British Fighting Methods in the Great War* (London: Frank Cass, 1996); J.P. Harris with Niall Barr, *Amiens to the Armistice: The BEF in the One Hundred Days' Campaign, 8 August-11 November 1918* (London: Brassey's, 1998); Gary Sheffield, *Forgotten Victory: The First World War – Myths and Realities* (London: Headline, 2001); Simon Robbins, *British Generalship on the Western Front, 1914-18: Defeat into Victory* (London: Frank Cass, 2004); Gary Sheffield and Dan Todman, eds., *Command and Control on the Western Front: The British Army's Experience 1914-18* (Staplehurst: Spellmount, 2004); and, Andy Simpson, *Directing Operations: British Corps Command on the Western Front 1914-18* (Stroud: Spellmount, 2006).

[3] Hew Strachan, "Back to the Trenches: Why Can't British Historians be Less Insular about the First World War?," *The Times Literary Supplement*, 5 November 2008; William Philpott, "Beyond the 'Learning Curve': The British Army's Military Transformation in the First World War," accessed 20 February 2013, http://www.rusi.org/analysis/commentary/ref:C4AF97CF94AC8B/.

[4] Hew Strachan, *The First World War: Vol. 1: To Arms* (Oxford: Oxford University Press, 2003), xvi; Ian F.W. Beckett, ed., *1917: Beyond the Western Front* (Leiden and Boston: Brill, 2009); Hew Strachan, "The First World War as a Global War," *First World War Studies* 1 (2010): 3-14.

[5] David French, "Doctrine and Organization in the British Army, 1919-1932," *The Historical Journal* 44 (2001): 497-515.

[6] The only published works that focus exclusively on British communications on the Western Front are: R.E. Priestley, *Work of the Royal Engineers in the European War, 1914-19: The Signal Service (France)* (Chatham: W. & J. Mackay, 1921); and, Mike Bullock and Laurence A. Lyons, *Missed Signals on the Western Front: How the Slow Adoption of Wireless Restricted British Strategy and Operations in World War I* (Jefferson, North Carolina: McFarland & Company, Inc., 2010). The latter, however, relies so much on the former for its source material that it offers very little in the way of fresh information.

[7] Jeremy Shapiro, "Information and War: Is it a Revolution?," in *Strategic Appraisal: The Changing Role of Information in Warfare*, eds., Zalmay M. Khalilzad and John P. White (Washington, D.C.: RAND Corporation, 1999), 113-53. See also the collection of articles in *The Journal of Strategic Studies* 33 (August 2010), Special Issue: The Information Technology Revolution in Military Affairs.

[8] Emily O. Goldman, ed., *Information and Revolutions in Military Affairs* (London: Routledge, 2005).

[9] Jonathan Bailey, *The First World War and the Birth of the Modern Style of Warfare*, Occasional Papers 22 (Camberley: Strategic and Combat Studies Institute, 1996); Jonathan B.A. Bailey, "The First World War and the Birth of Modern Warfare," in *The Dynamics of Military Revolution 1300-2050*, eds., MacGregor Knox and Williamson Murray (Cambridge: Cambridge University Press, 2001), 132-53; and, Colin S. Gray, *Strategy for Chaos: Revolutions in Military Affairs and the Evidence of History* (London: Routledge, 2004), 170-221.

[10] Sheffield, *Forgotten Victory*, 120.

[11] "Report of the Committee on the Lessons of the Great War (The Kirke Report)," October 1932, WO 32/3116, The National Archives (TNA), London.

[12] Brian N. Hall, "The British Expeditionary Force and Communications on the Western Front, 1914-1918" (Ph.D. diss., University of Salford, 2009).

[13] For an examination of the problems that military organisations confront when attempting to adapt in war, see Williamson Murray, *Military Adaptation in War: With Fear of Change* (Cambridge: Cambridge University Press, 2011).

[14] Griffith, *Battle Tactics*, 266.

[15] This was Brigadier-General Arthur Hildebrand, Deputy Director of Signals, Second Army, whose personal diary of the 1914 campaign on the Western Front was published as: "Second Army Signals, 1914: From the Personal Diary of Brigadier-General A.B.R. Hildebrand," *The Royal Signals Quarterly Journal* VI (July 1938): 129-41.

[16] R.E. Priestley, *The Signal Service in the War 1914 to 1918 (East Africa)*, n.d., and *The Signal Service in the War 1914 to 1918 (Salonika)*, n.d., both unpublished, are available for consultation at the archive of the Royal Signals Museum, Blandford, UK.

[17] Major-General R.F.H. Nalder, *The Royal Corps of Signals: A History of its Antecedents and Development* (London: Royal Signals Institution, 1958).

[18] Michael Muller-Camen, Richard Croucher and Susan Leigh, *Human Resource Management: A Case Study Approach* (London: Chartered Institute of Personnel and Development, 2008), 457.

[19] Margaret Dale, "Learning Organisations," in *Managing Learning*, eds. Christopher Mabey and Paul Iles (London: Cengage Learning EMEA, 1994), 22.

[20] *Field Service Regulations Part I: Operations (1909) (Reprinted, with Amendments October 1914)* (London: General Staff, War Office), 22, 39.

[21] Hall, "The British Expeditionary Force and Communications," 104-11.

[22] On the history and development of the electric telegraph, see: Irving Fang, *A History of Mass Communication: Six Information Revolutions* (Oxford: Focal Press, 1997), 77-82; Tom Standage, *The Victorian Internet* (London: Weidenfeld and Nicholson, 1998); and, Laszlo Solymar, *Getting the Message: A History of Communications* (Oxford: Oxford University Press, 1999), 51-88.

[23] In a simplex circuit, telegraphic messages could flow in only one direction at a time, whereas duplex allowed communication in both directions simultaneously. The high-speed Wheatstone automatic apparatus, named after its inventor Sir Charles Wheatstone, allowed for a much faster and intensive system of telegraphy than by simple manual operation. See Major W.A.J. O'Meara, "The Various Systems of Multiplex Telegraphy," *The Royal Engineers Journal* 14 (1911): 353-64; and, Nalder, *The Royal Corps of Signals*, 94.

[24] Captain R.C. Hammond, "Communication in the Field," *The Royal Engineers Journal* 7 (1908): 140.

[25] Nalder, *The Royal Corps of Signals*, 102.

[26] "Lecture No. 30. Observations at the British Front," Officers' School – First Course, Monday, January 7th, 1918 to Saturday, February 2nd, 1918, RG120, Entry 404, Box #2, National Archives and Records Administration (NARA), College Park, MD.

[27] Hall, "The British Expeditionary Force and Communications," 169, 181-2.

[28] For the reasons why, see Brian N. Hall, "The 'Life-Blood' of Command? The British Army, Communications and the Telephone, 1877-1914," *War & Society* 27 (2008): 43-65.

[29] Wyn Griffith, *Up to Mametz* (first published 1931; new ed., London: Severn House, 1981), 185.

[30] For which purpose a key was provided. See *Instruction in Army Telegraphy and Telephony: Vol. 1 – Instruments* (London: HMSO, 1914), 166-8.

[31] Colonel R.M. Powell, "Divisional Signals in 1914," *The Royal Signals Quarterly Journal* 7 (1940): 340.

[32] GHQ to War Office, 30 September 1914, WO 33/713, TNA.

[33] Magneto telephones incorporated a small hand generator to supply the current used to contact the switchboard operator. John William Henry Boon, Interview (1986), 009476/1, Department of Sound Records, Imperial War Museum (IWM), London.

[34] T.F. Purves, "Trench Telephones," *The Post Office Electrical Engineers' Journal* 8 (1915-16): 95.

[35] "Lessons From the Recent Operations of the XVIII Corps," 16 May 1918, Notes on British Operations, April-October 1918, WO 158/406, TNA.

[36] John Bray, *The Communications Miracle: The Telecommunication Pioneers from Morse to the Information Superhighway* (London: Plenum Press, 1995), 5.

[37] "A Signaller in France 1914-1918," 27, Captain J.C. Craven Papers, 92.1 CRAVEN, Royal Engineers Museum Archive (REMA), Gillingham, Kent.

[38] Robin Prior and Trevor Wilson, *Command on the Western Front: The Military Career of Sir Henry Rawlinson, 1914-18* (Oxford: Blackwell, 1992), 44-73.

[39] 'Report on the Operations of the IVth Army Corps from 10th to 15th March, 1915', undated, WO 158/374, TNA.

[40] "Notes on Communications During Recent Operations," 15 August 1916, X Corps Signal Company War Diary, WO 95/875, TNA.

[41] Ian Poole, *Newnes Guide to Radio and Communications Technology* (Oxford: Newnes, 2003); Bray, *The Communications Miracle*, 67; Solymar, *Getting the Message*, 130.

[42] Peter J. Hugill, *Global Communications Since 1844: Geopolitics and Technology* (Baltimore and London: The John Hopkins University Press, 1999), 141-54.

[43] Dean Juniper, "The First World War and Radio Development," *Journal of the Royal United Services Institute* 148 (2003): 84.

[44] For additional context on the development of wireless within the British Army both before and during the First World War, see Brian N. Hall, "The British Army and Wireless Communication, 1896-1918," *War in History* 19 (2012): 290-321.

[45] "Wireless Memories Round About the First World War" (1958), 6, Raymond Priestley Papers, GS 1303, Liddle Collection, Brotherton Library, University of Leeds (LCL).

[46] Colonel R.S. Curtis, "The Work of Signal Units in War," *The Royal Engineers Journal* XVIII (1913): 273-4; "Report of Conference on Personnel and Training of Wireless Units. 1914," 15 June 1914, 3, WO 33/3076, TNA.

[47] Hall, "The British Army and Wireless Communication:" 301-2

[48] *SS. 148. Forward Inter-Communication in Battle* (March 1917), 22; *Signal Service (France). Technical Instructions No. 1. W/T Sets, Forward, Spark, 20 Watts, B., Front and Rear ("Loop" Set)* (May 1917); Brigadier H.E. Hopthrow, "The Use of Wireless Telegraphy by the Royal Engineers in the 1914-18 War," *The Royal Engineers Historical Society, Occasional Paper No. 2* (May 1983): 10.

[49] Captain B.F.J. Schonland, "W/T. R.E.: An Account of the Work and Development of Field Wireless Sets with the Armies in France," *The Wireless World* 7 (1919): 178.

[50] Bray, *Communications Miracle*, 67; Solymar, *Getting the Message*, 153; Nalder, *The Royal Corps of Signals*, 123; Schonland, "W/T. R.E.:" 396-7.

[51] "Operations. Amiens (Report on Wireless Communications) 8-8-18 to 22-8-18. Cdn. Corps Heavy Artillery," 29 August 1918, Vol. 3923, Folder 10, File 6, RG9-III-C-1, Library and Archives Canada (LAC), Ottawa.

[52] Dennis E. Showalter, "Mass Warfare and the Impact of Technology," in *Great War, Total War: Combat and Mobilization on the Western Front, 1914-1918*, eds., Roger Chickering and Stig Förster

(Cambridge: Cambridge University Press, 2000), 86.

[53] Hall, "The British Expeditionary Force and Communications," 309.

[54] Brigadier-General Sir J.E. Edmonds, *Military Operations, France and Belgium, 1918*, Vol. IV (London: HMSO, 1947), 478.

[55] For the British official history, see Brigadier-General C.F. Aspinall-Oglander, *Military Operations, Gallipoli*, 2 Vols. (London: Heinemann, 1929 and 1932).

[56] Nigel Steel and Peter Hart, *Defeat at Gallipoli* (London: Macmillan, 1994); John Lee, *A Soldier's Life: General Sir Ian Hamilton 1853-1947* (London: Macmillan, 2000); Edward J. Erickson, "Strength Against Weakness: Ottoman Military Effectiveness at Gallipoli, 1915," *Journal of Military History* 65 (2001): 981-1011; Tim Travers, *Gallipoli 1915* (London: Tempus, 2004); Robin Prior, *Gallipoli: The End of the Myth* (New Haven: Yale University Press, 2009).

[57] Most notably in Eliot Cohen and John Gooch, *Military Misfortunes: The Anatomy of Failure in War* (London: Vintage Books, 1990), 159-60.

[58] *Manual of Combined Naval and Military Operations* (London: HMSO, 1913), General Sir Ian Hamilton Papers, 7/4/2, Liddell Hart Centre for Military Archives, King's College, London (LHCMA). On the inability of the British Army and Royal Navy to resolve problems relating to integrated planning and unified command before the war, see Jim Beach, "The British Army, the Royal Navy, and the 'Big Work' of Sir George Aston, 1904-1914," *Journal of Strategic Studies* 29 (2006): 145-68.

[59] General Sir Ian Hamilton, *Gallipoli Diary*, Vol. 1 (London: Edward Arnold, 1920), 118, 127.

[60] Following the Gallipoli campaign, Bowman-Manifold served the remainder of the war as Director of Army Signals, Egyptian Expeditionary Force (EEF). See Hall, "The British Expeditionary Force and Communications," 364.

[61] *Signal Organization for Combined Operations* (1915), Director of Army Signals War Diary, WO 95/4268, TNA.

[62] "Orders for Naval Signal Parties Landed with Military," 12 April 1915, "G.H.Q./R.A., 2. Directions Concerning 'Observation Officers' for Observing Fire of H.M. Ships in Combined Operations," 14 April 1915, Hamilton Papers, 7/4/18-19, LHCMA.

[63] "Operation Order No. 1. Appendix III: Instructions for Inter-Communication," 17 April 1915, "29th Division Operation Order No. 1," 20 April 1915, Australia and New Zealand Army Corps War Diary, 1/25/1, Australian War Memorial (AWM).

[64] Director of Army Signals War Diary, 25 April 1915, WO 95/4268, TNA.

[65] Hamilton, *Gallipoli Diary*, 146.

[66] Nalder, *The Royal Corps of Signals*, 158.

[67] See "Lessons of the Great War Committee. Military Operations – Gallipoli – Vols. I and II. Report by Lieutenant-General W.M. Kirke," May 1932, General Sir Walter Kirke Papers, 4/11, LHCMA.

[68] "Landing of Australian and New Zealand Army at Gabe Tepe in Gallipoli Peninsula," n.d., General Cunliffe Owen Papers, CAB 45/246, TNA.

[69] General Hamilton remained separate from his GHQ staff on board H.M.S. *Queen Elizabeth*. See Travers, *Gallipoli 1915*, 302-6.

[70] "Signals – Gallipoli (Furnished by Major H.C.B. Wemyss, DSO., MC., R.Signals)," n.d., 2, CAB 45/230, TNA; New Zealand and Australian Division Signal Company War Diary, 30 April 1915, 22/15A/1, AWM.

[71] French, "Doctrine and Organization:" 514.

[72] "A Series of Letters from Lieut. P.W. Turner, R.E. Signal Service: 5 December 1915," *The Post Office Electrical Engineers' Journal* XI (1918-19): 45.

[73] "Signals – Gallipoli," 5, CAB 45/230, TNA.

[74] "My Narrative of the Great German War, Vol. 1," (1919), 81, Lieutenant-General Sir Beauvoir de Lisle Papers, 3/1, LHCMA.

[75] Hamilton, *Gallipoli Diary*, 345.

[76] On the significant parallels that existed between the Gallipoli and the Western Front theatres, see Travers, *Gallipoli*, 310-11.

[77] "Signals – Gallipoli," 4-5, CAB 45/230, TNA.

[78] Cohen and Gooch, *Military Misfortunes*, 163; Travers, *Gallipoli*, 310-11.

[79] "Signals – Gallipoli," 6; "Narrative of Signal Work (GHQ & 9th Corps) for Operations 6th-7th August, 1915," Director of Army Signals War Diary, WO 95/4268, TNA.

[80] Director of Army Signals War Diary, 6-9 August 1915, WO 95/4268; 10 Division War Diary, 6 August 1915, WO 95/4294; Arthur E. Beecroft (11th Division Signal Company) to General Aspinall-Oglander, 9 February 1931, CAB 45/241, TNA.

[81] "Lessons of the Great War Committee," Kirke Papers, 4/11, LHCMA.

[82] Hamilton, *Gallipoli Diary*, Vol. 2, 58.

[83] Nalder, *The Royal Corps of Signals*, 161.

[84] Tim Travers has labelled this British command practice as "HQitis." See Travers, *Gallipoli*, 172. See also: Cohen and Gooch, *Military Misfortunes*, 163; and, Prior, *Gallipoli*, 245.

[85] 24 March 1918, "Private Diary of Major-General C.E. Pereira, Vol. III, 1917 & 1918," 2 Division War Diary, WO 95/1289, TNA; Lieutenant-Colonel J.S. Yule, "Signals with Carey's Force: An Episode of the March Retreat, 1918," *The Royal Signals Quarterly Journal* V (July 1937): 158.

[86] "Signals – Gallipoli," 8-9, CAB 45/230, TNA.

[87] "Report by Major Bidder R.E. Officer i/c Signals 9th Corps on the Signal Arrangements for the Evacuation of SUVLA," 11 July 1916, CAB 45/225, TNA.

[88] See, for example, Kaushik Roy, "From Defeat to Victory: Logistics of the Campaign in Mesopotamia 1914-1918," *First World War Studies* 1 (2010): 35-55.

[89] For the British official history, see Brigadier-General F.J. Moberly, *The Campaign in Mesopotamia 1914-1918*, 3 Vols. (London: HMSO, 1923-25). Though it mentions communications sparingly, the best modern account of the campaign is Charles Townshend, *When God Made Hell: The British Invasion of Mesopotamia and the Creation of Iraq 1914-1921* (London: Faber and Faber, 2010). For signals intelligence, see: Peter Morris, "Intelligence and its Interpretation: Mesopotamia 1914-1916," in *Intelligence and International Relations 1900-1945*, eds., Christopher Andrew and Jeremy Noakes (Exeter: University of Exeter Press, 1987), 77-102; and, Richard Popplewell, "British Intelligence in Mesopotamia 1914-16," *Intelligence and National Security* 5 (April 1990): 139-72.

[90] Nalder, *The Royal Corps of Signals*, 191-3.

[91] "A Series of Letters from Lieut. P.W. Turner – 11 November 1916," 51.

[92] "Statement of Military Signals and Telegraphs on the 30th July 1915," Director of Signals War Diary, WO 95/4984, TNA.

[93] "0/624, with Reference to Operation Order No. 2," 7 January 1917, GHQ Mesopotamia War Diary, WO 95/4966, TNA.

[94] E.S. Humphries Interview with Peter Liddle, April 1972, E.S. Humphries Papers, MES 050, LCL.

[95] Moberly, *The Campaign in Mesopotamia*, Vol. 1, 113-14.

[96] Moberly, *The Campaign in Mesopotamia*, Vol. 2, 442.

[97] Captain H.S. Cardew, cited in Townshend, *When God Made Hell*, 157.

[98] "Wireless Memories Round About the First World War" (1958), 6, Raymond Priestley Papers, GS 1303, LCL.

[99] R.H. Dewing, "Some Aspects of Maude's Campaign in Mesopotamia. No. 2. Cavalry," *The Army Quarterly* XIV (April 1927): 73-5.

[100] "Report of No. 7 Wireless Station Attached 7th CAVALRY BRIGADE Period 1st October to 29th November 1918 during Operations on MOSUL;" "Report on No. 8 Wireless Station from 1st October 1918 to 18th January 1919," 1st Australian Wireless Signal Squadron War Diary, 22/16/12, AWM.

[101] Popplewell, "British Intelligence," 147.

[102] "A Series of Letters from Lieut. P.W. Turner – 15 June 1916," 49.

[103] Lieutenant-Colonel Leslie Queripel (Director of Army Signals and Telegraphs) to his wife (Sybil), 16 March 1917, Colonel L.H. Queripel Papers, 1/1, LHCMA.

[104] Nalder, *The Royal Corps of Signals*, 191.

[105] Moberly, *The Campaign in Mesopotamia*, Vol. 1, 291.

[106] "A Series of Letters by Lieut. P.W. Turner – 7 September 1916," 50.

[107] Captain H.J. Blampied, *With a Highland Regiment in Mesopotamia 1916-1917, by One of its Officers* (Bombay: The Times Press, 1918), 78-9. See also Lieutenant-Colonel A.H. Burne, D.S.O, *Mesopotamia: The Last Phase* (London: Gale and Polden Ltd., 1938), 11-14.

[108] 13 Division Signal Company War Diary, 5 April 1916, WO 95/5152, TNA.

[109] Andrew Syk, "Command in the Indian Expeditionary Force D: Mesopotamia, 1915-16," in *The Indian Army in the Two World Wars*, ed. Kaushik Roy (Boston: Brill Academic, 2011), 94-5.

[110] Nikolas Gardner, "Charles Townshend's Advance on Baghdad: The British Offensive in Mesopotamia, September-November 1915," *War in History* 20 (2013): 192-3.

[111] Moberly, *The Campaign in Mesopotamia*, Vol. 1, 325; Moberly, *The Campaign in Mesopotamia*, Vol. 2, 206; Townshend, *When God Made Hell*, 127.

[112] For an appraisal of the work carried out by the Signal Service, see "General Headquarters. Mesopotamian Expeditionary Force. Despatch on Operations from 28th August 1916, to 31st March 1917," 10 April 1917, Queripel Papers, 1/1, LHCMA.

[113] Nalder, *The Royal Corps of Signals*, 200.

[114] For the British official history, see Captain Cyril Falls, *Military Operations. Egypt and Palestine*, 2 Vols. (London: HMSO, 1922 and 1930).

[115] Matthew Hughes, *Allenby and British Strategy in the Middle East 1917-1919* (London: Frank Cass, 1999); Yigal Sheffy, *British Military Intelligence in the Palestine Campaign 1914-1918* (London: Frank Cass, 1998); Yigal Sheffy, "Chemical Warfare and the Palestine Campaign, 1916-1918," *Journal of Military History* 73 (2009): 803-44.

[116] "Notes on the Signal Communications of the Force," 27 December 1916, Western Force Signal Company War Diary, WO 95/4443, TNA.

[117] "10th Division Signal Communications," 16 September 1918, 10 Division Signal Company War Diary, WO 95/4574, TNA.

[118] "Plans and Orders for Operations Resulting in Capture of Tul Keram. September 19th 1918. Secret Instruction No. 3. Co-operation with R.A.F.," 14 September 1918, General Sir John Shea Papers, 4/4, LHCMA.

[119] "Desert Mounted Corps. Communications," 12 September 1918, Desert Mounted Corps War Diary, 1/62/6, AWM.

[120] "Major-General A. Lynden-Bell (CGS, Egyptian Expeditionary Force) to Western Frontier Force," 3 May 1916, Director of Signals War Diary, WO 95/4387; "54th Divisional Instruction No. 4. Communications," 11 September 1918, 54 Division Signal Company War Diary, WO 95/4645, TNA.

[121] Lieutenant-Colonel The Hon. R.M.P. Preston D.S.O., *The Desert Mounted Corps: An Account of the Cavalry Operations in Palestine and Syria 1917-1918* (Boston and New York: Houghton Mifflin Company, 1921), 57.

[122] Yigal Sheffy, "Institutionalised Deception and Perception Reinforcement: Allenby's Campaigns in Palestine," *Intelligence and National Security* 5 (April 1990): 202; Sheffy, *British Military Intelligence*, 255.

[123] "Report on Wireless Test between a Wagon Wireless Station and a Pack Wireless Station, Carried out between May 30th and June 9th, 1916," Western Force Signal Company War Diary, WO 95/4443, TNA.

[124] "Report on Signal Communications – 3rd Battle of Gaza," 24 November 1917, 54 Division Signal Company War Diary, WO 95/4645, TNA.

[125] "Operations on 18th, 19th and 20th September, 1918," 26 September 1918, 54 Division Signal Company War Diary, WO 95/4645, TNA.

[126] "Notes on Signal Communications in Recent Operations of the 60th Division," 17 November 1917, 60 Division Signal Company War Diary, WO 95/4664, TNA. It should be noted that 60th Division had spent July-October 1916 in the Arras sector on the Western Front.

[127] Nalder, *The Royal Corps of Signals*, 177-85.

[128] "General Notes on Communications Between September 19th and 24th," 30 September 1918, XX Corps Signal Company War Diary, WO 95/4487, TNA.

[129] "Minutes of the Commander-in-Chief's Conference, 17th September, 1917," GHQ Egyptian Expeditionary Force War Diary, WO 95/4368, TNA.

[130] On the poling of lines, see "Summary of Some Notes on Operations," 2 October 1917, General Sir William Bartholomew Papers, 1/3/2, LHCMA. For cable burying, see "Buried Cable Scheme," 12 September 1917, 75 Division Signal Company War Diary, WO 95/4685, TNA.

[131] "Director of Army Signals, Egyptian Expeditionary Force, Circular Memorandum No. 32," 5 May 1917, Director of Army Signals War Diary, WO 95/4387; "Report on Signal Communications During Operations Before Gaza, March 26th and 27th 1917," 11 April 1917, GHQ Signal Company War Diary, WO 95/4408, TNA.

[132] See Hall, "The British Expeditionary Force and Communications," Ch. 6.

[133] "Major M.E. Webb to G.O.C. 10th Division," 14 August 1918, 10 Division Signal Company War Diary, WO 95/4574, TNA.

[134] "Notes on the Fighting in Palestine Issued to 60th Div. Experience Gained in the Recent Fighting," 14 February 1918, Shea Papers, 4/3, LHCMA.

[135] "Director of Army Signals, Egyptian Expeditionary Force, Circular Memorandum No. 26," 6 February 1917, Director of Army Signals War Diary, WO 95/4387, TNA.

[136] "Report on Signal Communications During Operations Before Gaza, March 26th and 27th 1917," 11 April 1917, GHQ Signal Company War Diary, WO 95/4408, TNA.

[137] See, for example, "52nd Divisional (GS) Circular Memorandum No. 53," 7 January 1918, 52 Division War Diary, WO 95/4598, TNA. I am grateful to Dr Chris Forrest for drawing my attention to this memorandum.

[138] "Special Instructions – Signal Communications," 9 April 1917, Major-General Guy Dawnay Papers, 69/21/2, Department of Documents, IWM; "Special Instructions for Visual Signallers and Telephonists in Egypt," 7 March 1917, Director of Army Signals War Diary, WO 95/4387; "54th Division. Visual Scheme," 11 January 1918, 54 Division Signal Company War Diary, WO 95/4645, TNA.

[139] "Notes on Pigeon Service," 29 March 1918, GHQ Signal Company War Diary, WO 95/4408, TNA.

[140] "Notes on Signal Communications in Recent Operations of the 60th Division," 17 November 1917, 60 Division Signal Company War Diary, WO 95/4664, TNA.

[141] Falls, *Military Operations, Egypt and Palestine*, Vol. 2, 169; John Bourne, "British Generals in the First World War," in *Leadership and Command: The Anglo-American Experience Since 1861*, ed., G.D. Sheffield (London: Brassey's, 2002), 93-116.

[142] Ross Anderson, "The Battle of Tanga, 2-5 November 1914," *War in History* 8 (2001): 294-322; Hew Strachan, *The First World War in Africa* (Oxford: Oxford University Press, 2004); Ross Anderson, *The Forgotten Front: The East African Campaign 1914-1918* (Stroud: Tempus, 2004); Edward Paice, *Tip & Run: The Untold Tragedy of the Great War in Africa* (London: Weidenfeld and Nicolson, 2007).

[143] Nalder, *The Royal Corps of Signals*, 206.

[144] Brigadier-General J.J. Collyer (Chief-of-Staff to General Jan Smuts), quoted in Strachan, *The First World War in Africa*, 136.

[145] "Report on Nigerian Brigade Signallers by Capt. Williams, Nigerian Brigade Signalling Officer," 17 February 1917, Deputy Director of Army Signals War Diary, WO 95/5303, TNA.

[146] "Letter from DDAS to GSO," 27 March 1916, Deputy Director of Army Signals War Diary, WO 95/5303, TNA.

[147] Phillip Parotti, "War in the Tropics: East Africa and Burma," in *The Great World War 1914-45, Vol. 1: Lightning Strikes Twice*, eds. John Bourne, Peter Liddle and Ian Whitehead (London: HarperCollins, 2000), 168.

[148] "General Notes for November 1916," Deputy Director of Army Signals War Diary, WO 95/5303, TNA.

[149] "Report on Army Signal Service, 1st July 1916," Deputy Director of Army Signals War Diary, WO 95/5304, TNA.

[150] Strachan, *The First World War in Africa*, 125.

[151] Nalder, *The Royal Corps of Signals*, 202.

[152] "Report on Army Signal Service, 1st July 1916," Deputy Director of Army Signals War Diary, WO 95/5304, TNA.

[153] W. Whittall, *With Botha and Smuts in Africa* (London: Cassell and Company, 1917), 183.

[154] Brigadier-General C.P. Fendall, *The East African Force 1915-1919* (London: H. F. & C. Witherby, 1921), 116.

[155] General von Lettow-Vorbeck, *My Reminiscences of East Africa* (London: Hurst and Blackett, Ltd., 1920), 284.

[156] Ibid., 82, 284-5; Brigadier-General S.H. Sheppard, "Some Notes on Tactics in the East African Campaign," *The Journal of the United Service Institution of India* XLVIII (April 1919): 142-3.

[157] "Statement of Line Faults During the Month of February 1916," Deputy Director of Army Signals War Diary, WO 95/5303, TNA.

[158] Brigadier-General R.T. Ridgway, "With No. 2 Column. German East Africa, 1917," *The Army Quarterly* V (October 1922): 25.

[159] "Report on Communications at Action of Salaita Hill on 12.2.16," 2 East African Division Signal Company War Diary, WO 95/5344, TNA.

[160] "Memorandum from D.D.A.S. to B.S.O. 1st South African Mounted Brigade," 26 March 1916, Deputy Director of Signals War Diary, WO 95/5303, TNA.

[161] East Africa Wireless Signal Company War Diary, 27-28 August 1917, WO 95/5316, TNA; Major W. Rathbone Diary, 4 November 1915, P.181, IWM.

[162] Frank L. Musto (King's African Rifles), Interview (1984), 008288/1-2, Department of Sound Records, IWM.

[163] "Letter from O.C. Wireless Signal Company to Deputy Dir. Army Signals, Dar-es-Salaam," 18 January 1918, East Africa Wireless Signal Company War Diary, WO 95/95/5316, TNA.

[164] For the British official history, see Captain Cyril Falls, *Military Operations. Macedonia*, 2 Vols. (London: HMSO, 1933 and 1935). The best modern account of the campaign is Alan Wakefield and Simon Moody, *Under the Devil's Eye: Britain's Forgotten Army at Salonika 1915-1918* (Stroud: Sutton Publishing, 2004).

[165] For a concise overview of Allied-Greek relations during the war, see R.J. Crampton, "The Balkans, 1914-1918," in *The Oxford Illustrated History of the First World War*, ed. Hew Strachan (Oxford: Oxford University Press, 1998), 68-76.

[166] "Signals in Salonika, 1915-1918 by Brigadier G.G. Rawson," May 1937, 2-5, CAB 45/2, TNA.

[167] Nalder, *The Royal Corps of Signals*, 170.

[168] "Signals in Salonika, 1915-1918 by Brigadier G.G. Rawson," May 1937, 6, CAB 45/2, TNA.

[169] "January 1917 General Remarks," Director of Army Signals War Diary, WO 95/4783, TNA.

[170] "January 1918 General Remarks;" "Director of Army Signals. Circular Memorandum No. 22," 5 January 1918; "Notes for Conference to be Held in the D.A.S. Office at 11.30 am on Friday 12th April 1918," 11 April 1918, Director of Army Signals War Diary, WO 95/4984, TNA.

[171] "Signals in Salonika, 1915-1918 by Brigadier G.G. Rawson," May 1937, 3, CAB 45/2, TNA.

[172] "November 1916 General Remarks," Director of Army Signals War Diary, WO 95/4783, TNA.

[173] "August 1916 General Remarks," Director of Army Signals War Diary, WO 95/4783, TNA.

[174] "Signals in Salonika, 1915-1918 by Brigadier G.G. Rawson," May 1937, 8, CAB 45/2, TNA.

[175] Nalder, *The Royal Corps of Signals*, 169.

[176] "Notes on the Work of the G.H.Q. and L. of C. Signal Companies During September 1917," 3 October 1917, Director of Army Signals War Diary, WO 95/4783, TNA.

[177] Captain C.C.S. White, "An Unofficial History of the Signal Service with the British Salonika Force, 1915-18," *The Royal Engineers Journal* XL (December 1926): 652-53.

[178] Wakefield and Moody, *Under the Devil's Eye*, 97.

[179] "Signals in Salonika, 1915-1918 by Brigadier G.G. Rawson," May 1937, 13-15, CAB 45/2, TNA.

[180] Hall, "The British Expeditionary Force and Communications," Ch. 6.

[181] White, "An Unofficial History," 656; Director of Army Signals War Diary, 16-21 February 1918, WO 95/4984; "Signals in Salonika, 1915-1918 by Brigadier G.G. Rawson," May 1937, 15, CAB 45/2, TNA.

[182] *A Brief Record of the Advance of the Egyptian Expeditionary Force under the Command of General Sir Edmund H.H. Allenby, July 1917 to October 1918, Compiled from Official Sources* (London: HMSO, 1919), 86.

[183] Bullock and Lyons, *Missed Signals on the Western Front*, 192-4.

[184] *SS. 148. Forward Inter-Communication in Battle* (March 1917). In light of further experience, the manual was modified slightly and re-issued as *SS. 191. Intercommunication in the Field* (November 1917). See Hall, "The British Expeditionary Force and Communications," 223-6. For more detail on the British Army's training manuals, see Griffith, *Battle Tactics of the Western Front*, 179-86; and, Beach, "Issued by the General Staff."

[185] Mark Easterby-Smith, John Burgoyne and Luis Araujo, eds., *Organizational Learning and Learning Organizations: Developments in Theory and Practice* (London: SAGE, 1999). On the specific issue of

intra-organizational learning and the problems involved in internal-knowledge transfer, see Gabriel Szulanski, *Sticky Knowledge: Barriers to Knowing in the Firm* (London: SAGE, 2003).

[186] Despite the addition of wireless telephony, British commanders during the Second World War also found that the best communications system was one that utilized a combination of lines, wireless and despatch riders. See Simon Godfrey, "Command and Communications in the British Army in Europe and North Africa c.1919-1945," (Ph.D. diss., University College London, 2009), 337-8.

[187] Theo Farrell, "Improving in War: Military Adaptation and the British in Helmand Province, Afghanistan, 2006-2009," *The Journal of Strategic Studies* 33 (2010): 568.

[188] On the role played by the inherently pragmatic nature of the British officer corps to the successful conduct of operations on the Western Front, see Ian Malcolm Brown, *British Logistics on the Western Front 1914-1919* (Westport, CT.: Praeger, 1998), 231-40.